ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

SEPTEMBER • 35¢

Exclusive!

BUILD THIS 2-WAY UNDERGROUND RADIO

(it works in water, too!)

ALL NEW!

New Features

New CB Column

New SWL Column

A New Look!

A New Value!

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- Our Second War With Japan
- How to Keep Up on SWL Schedules
- The New Art of Radar Astronomy
- How to Buy Hi-Fi Records

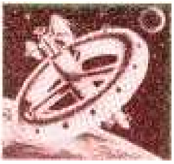
PROJECTS:

- Soup Up Your CB Antenna
- Build an Ion Generator
- WWV Converter for BC Band

FIRST CONTEST WINNER!

Home Study School of its Kind
...ning in Industrial ELECTRONICS

PRINCIPLES
PRACTICES
MAINTENANCE



For over 15 years NRI has been training men without previous experience for success in Radio-Television Servicing and Communications. Now, expanded uses of Electronics in industry, business and defense are increasing the demand for Electronic Technicians. Four to seven Technicians are needed for every engineer. To meet this demand NRI announces a complete, comprehensive course in ELECTRONICS—Principles, Practices, Maintenance.

This training stresses basic fundamentals because so many Electronic devices are built around identical Electronic principles. It is for beginners, or for Technicians who wish to expand their knowledge.

This is the Electronic Age. Electronic Equipment is already being used to count, weigh, control flow of liquids, solids, gases. Control exposure in photography, detect fumes, or fire. Inspect at remote points. Supervise traffic. Survey land areas and ocean contours. Search for oil, miles beneath the surface. Measure radiation and control power levels in atomic installations. Control air traffic. Translate one language into another. The MILITARY applications of Electronics . . . particularly in space rockets and missiles, tracking devices, etc. . . . probably equal all of the uses above. Electronic equipment is used to machine parts through complex cycles. It is used in business to process data, control inventory, prepare payrolls, post, calculate, and in medicine for electro-diagnosis, measure body characteristics, electro-surgery.

JOB COUNSELORS RECOMMEND

Right today a career in Electronics offers unlimited opportunity. Job Counselors know the pay is high, jobs interesting, advancement opportunities great. They advise ambitious, aggressive men who want higher pay now and a better future: "For an interesting career, get into Electronics."

LEARN MORE TO EARN MORE

Simply waiting and wishing for a better job won't get you ahead. You have to decide you want to succeed and *you must act*. NRI can provide the training you need at home in spare time. No need to go away to school. You don't need a high school diploma or previous Electronic experience. You work and train with components and circuits you will meet throughout your Electronics career. You get especially developed training kits for practical experience that make Electronics easier to learn.

NRI TRAINING PREPARES YOU FOR GOOD JOBS LIKE THESE

- Electronic Technician
- Assistant Engineer
- Designer
- Laboratory Technician
- Plant Parts Inspector
- Civil Service Specialist
- Laboratory Technician
- Service Technician
- Cameraman
- Computer Technician
- Field Technician
- Radio Operator
- Transmitter Engineer
- Aircraft Technician

Prepare NOW

FOR THE HIGHER REWARDS ELECTRONICS OFFERS THE QUALIFIED TECHNICIAN

A Message from
J. Morrison Smith
President
National Radio Institute

"Many men seem to have the idea that only engineers – with college degrees – are needed and are able to succeed in Electronics. Nothing is further from the truth. Authorities point out that: for every *one* engineer required, Electronics needs *four* to *seven* technicians. This NRI course trains you to become an Electronic Technician and opportunities are almost beyond belief."

Oldest and Largest School

Helping men to succeed by Home Study training is our *only* business. FREE 64-page Catalog gives facts about careers, shows what you learn, tells about NRI's courses in Industrial Electronics, Radio-Television Servicing and Radio-TV Communications.

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Complete Portable Communications for Everyone

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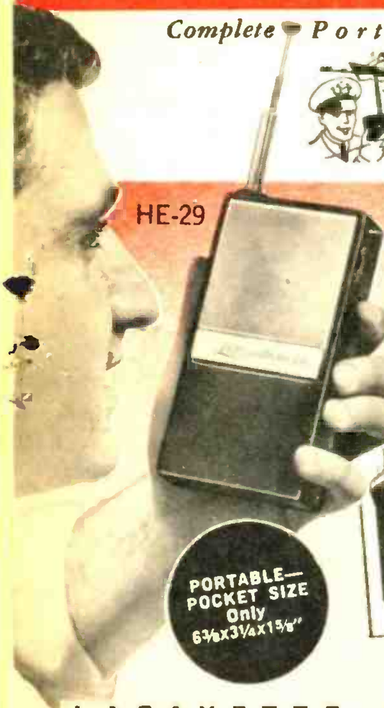

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- Complete with Matched Crystals for Channel 9

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- Complete with Transmitting Crystal for Channel 9

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September, 1961 | A Fawcett Publication | Vol. 4, No. 7

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ELECTRONICS ILLUSTRATED is published bi-monthly by Fawcett Publications, Inc., Fawcett Place, Greenwich, Conn. W. H. Fawcett, Jr., President; Gordon Fawcett, Secretary and Treasurer; Roger Fawcett, General Manager; Roscoe K. Fawcett, Circulation Director; Donald P. Hanson, Assistant General Manager.
EDITORIAL AND ADVERTISING OFFICES: 67 West 44th Street, New York 36, N. Y.
ADDRESS ALL MAIL: Subscriptions, change of address, Form 3579 to Subscription Dept., Fawcett Bldg., Greenwich, Conn.; and all editorial and advertising to Fawcett Publications, Inc., 67 W. 44th St., New York 36, N. Y.
Second-class postage paid at Greenwich, Conn., and at additional mailing offices.
Subscription price $4.00 for 12 issues in the U. S. and possessions and Canada. All other countries $6.00 for 12 issues. Foreign subscriptions and sales should be remitted by International Money Order in U. S. funds payable at Greenwich, Conn.

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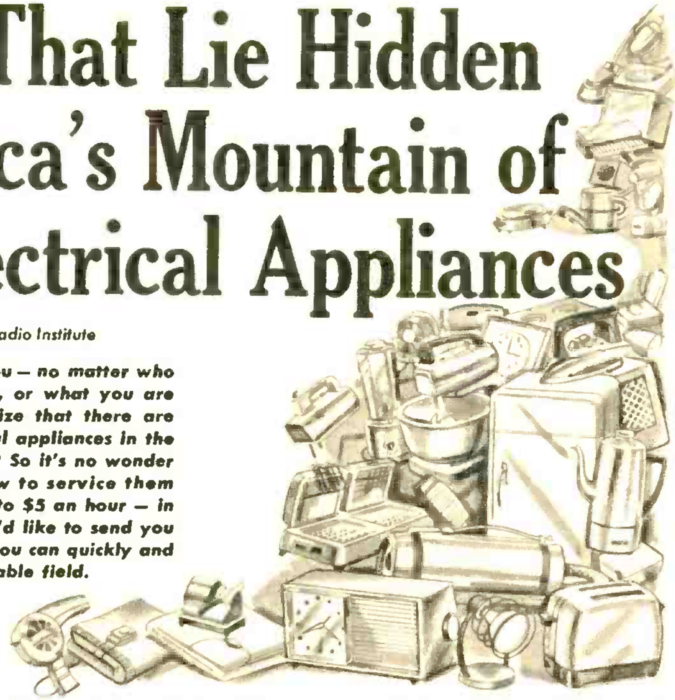
Profits That Lie Hidden in America's Mountain of Broken Electrical Appliances



By J. M. Smith *President, National Radio Institute*

And I mean profits for you — no matter who you are, where you live, or what you are doing now. Do you realize that there are over 400 million electrical appliances in the homes of America today? So it's no wonder that men who know how to service them properly are making $3 to $5 an hour — in spare time or full time! I'd like to send you a Free Book telling how you can quickly and easily get into this profitable field.

THE COMING OF THE AUTO created a multi-million dollar service industry, the auto repair business. Now the same thing is happening in the electrical appliance field. But with this important difference: anybody with a few simple tools can get started in appliance repair work. No big investment or expensive equipment is needed.

The appliance repair business is booming — because the *sale* of appliances is booming. One thing naturally follows the other. In addition to the 400,000,000 appliances *already* sold, this year alone will see sales of 76 million *new* appliances. For example, 4,750,000 new coffee makers, almost 2,000,000 new room air conditioners, 1,425,000 new clothes dryers. A nice steady income awaits the man who can service appliances like these. And I want to tell you why that man can be *you* — even if you don't know a volt from an ampere now.

A Few Examples of What I Mean

Now here's a report from Earl Reid, of Thompson, Ohio: "In one month I took in approximately $648 of which $510 was clear. I work only part time." And, to take a big jump out to California, here's one from J. G. Stinson, of Long Beach: "I have opened up a small repair shop. At present I am operating the shop on a spare time basis — but the way business is growing it will be a very short time before I will devote my full time to it."

Don't worry about how little you may now know about repair work. What John D. Pettis, of Bradley, Illinois wrote to me is this: "I had practically no knowledge of any kind of repair work. Now I am busy almost all my spare time and my day off — and have more and more repair work coming in all along. I have my shop in my basement."

We Tell You Everything You Need to Know

If you'd like to get started in this fascinating, profitable, rapidly growing field — let us give you the home training you need. Here's an excellent opportunity to build up "a business of your own" without big investment — open up an appliance repair shop, become independent. Or you may prefer to keep your present job, turn your spare time into extra money.

You can handle this work anywhere — in a corner of your basement or garage, even on your kitchen table. No technical experience, or higher education is necessary. We'll train you at home, in your spare time, using methods proven successful for over 45 years. We start from scratch — *tell* you in plain English, and *show* you in clear pictures — everything you need to know. And, you will be glad to know, your training will cost you less than 20¢ a day.

FREE BOOK *and Sample Lesson*

I think that our 24-page Free Book will open your eyes to a whole world of new opportunities and how you can "cash in" on America's "Electrical Appliance Boom."

I'll also send you a Free Sample Lesson. It shows how simple and clearly illustrated our instruction is — how it can quickly prepare you for a profitable future in this big field. Just mail coupon, letter, or postcard to me: *Mr. J. M. Smith. President, National Radio Institute, Dept. KJ1, Washington 16, D.C.* (No obligation, of course — and no salesman will call on you.)

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

P for Papa, S for Sierra

In your April 1961 Ham Shack you presented phonetic alphabets in use by various organizations. I should like to point out that the military alphabet you showed is slightly out of date. On 1 March 1956 the military services jointly published a new phonetic alphabet.

Capt. Bob Peterson, USMC
Camp Pendleton, Calif.

The NATO phonetic alphabet came in use . . . in 1956.

SP/5 L. Frank Berloth
Ft. Richardson, Alaska

Thanks, fellows. See the Ham Shack in this issue.

I think your man in the shack (Ham Shack) got his signals a little crossed on phonetic alphabets (he gave several of them and forgot the latest) but the most interesting thing to me is that battle between Roger and Romeo for the R position. You could make a funny cartoon of those two characters battling it out. Get the message?

Robert Chandler
Los Angeles, Calif.

Roger. See below.

And still going

Tom Kneitel's "They Went Thataway" letter in your Feedback column (May '61 EI) gives recent changes in frequencies used by the Civil Air Patrol, which is interesting and valuable information, but he should have stopped right there. People interested in joining the CAP, he went on, should write to a Washington address. The CAP's national headquarters is no longer there, however. It has now been moved someplace down in the Southwest. I'm not sure just where, but when last seen they were going thataway.

Bill Washington
Brooklyn, N. Y.

The national headquarters of the Civil Air Patrol is located at Ellington Air Force Base, Tex., which is near Houston.

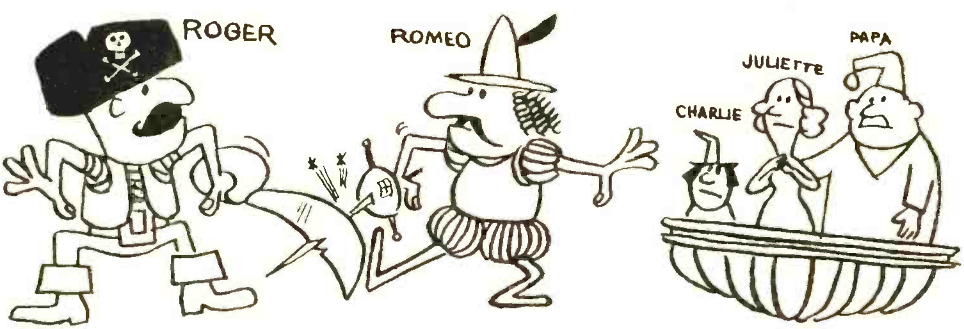
Einar H. Morterud, W5FPB
Operator, Station Pueblo 21
Albuquerque Composite Squadron
Albuquerque, N. M.

Looking for Trouble

In your April Feedback column one Paul Shomer complains that he can get nothing but TV sound on EI's one-transistor FM radio. I want the same trouble. How can I get it—with just any FM tuner?

L. C. McGowan
Fenton, Mo.

No. To get TV audio you have to have a receiver that will tune its two bands—accidentally or not. The bands are 54-88 and 118-216 mc.



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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, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, 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.

SERVICING LESSONS

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

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

FROM OUR MAIL BAG

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

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

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Tale of the Hoffman Uni-Tunnel Diode—Or, How Low Can You Get? is the title of a new handbook designed to help engineers learn about the uni-tunnel diode manufactured by Hoffman. Electrical and physical parameters of the device, testing criteria and typical circuit applications combined with amusing cartoons make this an interesting booklet. Free from Hoffman, 1001 N. Arden Dr., El Monte, Calif.

Further Studies in Space-Age Psychology, a somber title for a light-hearted book, is available from Audio Devices, 444 Madison Ave., New York, N. Y. In its second booklet of cartoons, Audio Devices has succeeded in giving those in the computer and telemetry fields a good laugh. Free on request.

Infrared Comfort Heating is the subject of an eight-page bulletin by the Fostoria Corp., 1200 N. Main St., Fostoria, Ohio. Ask for Bulletin CH-100.

The transmissions of stations WWV and WWVH are described in a booklet available from the U. S. Government Printing Office. 10¢. When ordering specify NBS Publication No. 236. GPO's address is Washington 25, D. C.

A new edition of **Shure's hi-fi component brochure** is being offered by that company on request. Write to Shure, 222 Hartrey Ave., Evanston, Ill.

Dry type transformers are described in the Atlantic Transformer Company's catalog. Wiring diagrams, prices and specs make up the booklet. Available on request from Atlantic Transformer, 8330 Hegerman St., Philadelphia, Pa.

Wehle's Catalog No. 72, containing 220 pages of radio, TV, kit and test equipment listings has been made available free at Wehle distributors.

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Radio & TV Receiver TROUBLESHOOTING AND REPAIR and CIRCUITRY AND OPERATION bring you complete, how-to-do-it training in professional service procedures on TV and Radio Receivers; Hi-Fi; Record Players, Communications Equipment, etc. No other service training at anywhere near the price can match it!

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(1) Don't confuse Ghirardi's 822-page Radio & TV TROUBLESHOOTING AND REPAIR with ordinary service manuals! Step by step, this giant manual explains practically *any* job on *any* Radio or Television Receiver you are ever likely to be called on to repair! Also covers record players, 3-way portables, communications receivers, etc. Helps you locate troubles in a jiffy—then fix them accurately. For beginners, this book with its 417 illustrations is a complete course in professional service methods. For experienced technicians, it is ideal for developing better troubleshooting procedures or finding quick answers to puzzling problems. Price $10.00. Money-back guarantee. See Money-Saving offer!

Radio & Television CIRCUITRY AND OPERATION

(2) You can repair ANY television, radio or other electronic equipment a great deal easier and better once you really understand their circuits, how they work and how to service them. That's exactly the training Ghirardi's 669-page Radio & TV CIRCUITRY & OPERATION handbook with its 417 illustrations brings you. Helps you understand modern circuits fully. Shows what troubles to look for in each type and how to eliminate useless testing. Throughout, this big book brings you above-average training that takes the guesswork out of troubleshooting and fits you for better jobs. $9.00 separately. See coupon for combination offer.

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...electronics in the news

Ribbon Styles . . . Flat plastic ribbons are taking the place of conventional round wires and cables in missiles and other vehicles where space is at a premium (no pun intended). The conductors in this case are metal strips imbedded in the plastic. In addition to taking less space, the ribbon cable is easier to use in making connections, can be bent and twisted without damage and weighs about half as much as its round counterpart.

—o—

PS on MHD . . . Magnetohydrodynamics, a $64 name for a new system for generating electric power, has encouraged its developers by producing 205 kilowatts of power (20 times more than it was able to produce previously) in an experimental run with a giant new generator. The principle behind MHD (see THE MHD REVOLUTION, April '61 EI) is one of heating, compressing and burning air, oxygen and coal to produce a high-temperature (5000° F), electrically-conductive gas. The gas, when passed through a magnetic field in the generator, creates DC power which is tapped off by electrodes. The power is then converted to AC.

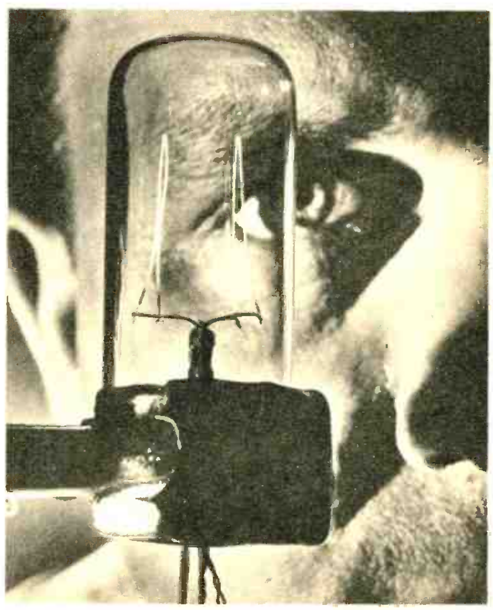
If MHD continues progressing at its present rate, it will have a far-reaching effect in the power industry. You never can tell . . . ten years from now the electricity that powers your electric razor may start off as hot air.

—o—

Cool, Man, Cool . . . Longer life and better performance are the claims made for a new *dark heater* type receiving tube introduced by RCA. The dark heater term comes from a gray insulation sprayed on the heater element (see photo). The insulation permits the tube to operate at lower temperatures and the heater never reaches the usual white-hot state. Normal heater temperatures are 2,200° F and up but the new tube operates below 1,800° F.

The reduced heat, it is said, cuts a tube's operating stresses by 25 per cent.

The tube at first is to be used in home entertainment instruments and then in industrial and military application.

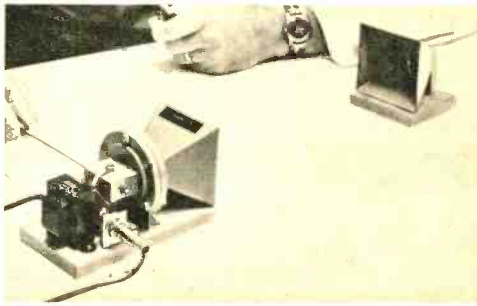


—o—

High Frequency, Low Power . . . Hams looking for more distance with less

. . .News

power might get an idea from this simple breadboard transmitter. The heart of the rig is a type 7486 "cavity" tube (which is shorter than a straight pin) putting out about 30 milliwatts of power on a frequency of 7300 megacycles. The horn is a directional an-



tenna, which beams signals to a similar horn attached to the receiver. The range so far achieved with this flea power unit is 50 feet but that's only the beginning. General Electric, the developers, are *not* offering schematics.

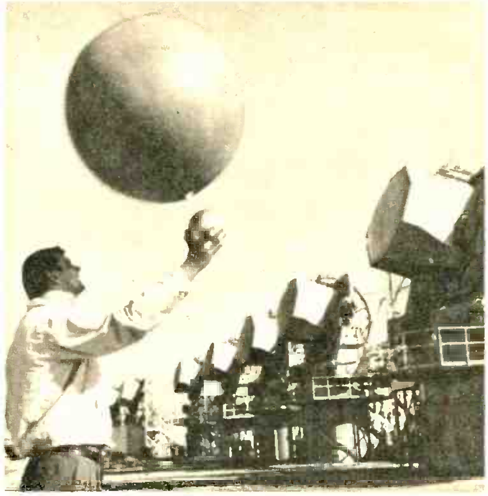
—o—

Ship Ahoy! . . . A midget radar screen that looks like Captain Kidd's spyglass is being put on the market for fliers and boat owners. It overcomes the discouraging disadvantages of size and weight—to say nothing of cost—of conventional radars. Inside the scope is a high-resolution cathode ray tube a little more than a half-inch in diameter, and in front of it is a magnifying eyepiece that enlarges the image ten times. Detail is good because the scanning system

uses 900 lines (compared with 525 for television). The complete viewing unit is only 8½ inches long, weighs 20 ounces and is hand-held. The radar receiver itself can be stowed anywhere in the plane or boat. When it becomes commercially available, the "Private Eye" will sell for about $150.

—o—

Tiny Taskmaster . . . How do you test the performance of a multi-million dollar missile tracking system without sending up a missile that cost a couple of million bucks itself? Sperry Gyroscope engineers have come up with the answer: test targets that cost less than a dollar apiece. The target is a grapefruit-size lightweight aluminum sphere carried up by a big, red balloon. The photo shows a technician releasing one of the stand-in missiles at MacArthur Field, N. Y., in front of a battery of imposing radar trackers that lock in on the tiny ball and keep it electronically in sight until the balloon bursts.



—o—

Nothing Wasted! . . . Meat packers used to say they used all of a pig except the squeal. Space scientists are apparently using the same approach, for the possibility of employing the ionized exhaust trails from rocket and jet engines

. . . News

as radio antennas is being explored. Barry Mindes of the ITT Federal Laboratories, Nutley, N. J., points out that these ionized gases are good conductors of electricity and have potential as transmitting and receiving antennas. Because the exhaust trails are long, they would be especially useful for low- and medium-frequency communications which at present are impractical in space vehicles because of the required antenna length. An obvious advantage of the ionized-gas antennas is that they add nothing to the weight of a spaceship.

—o—

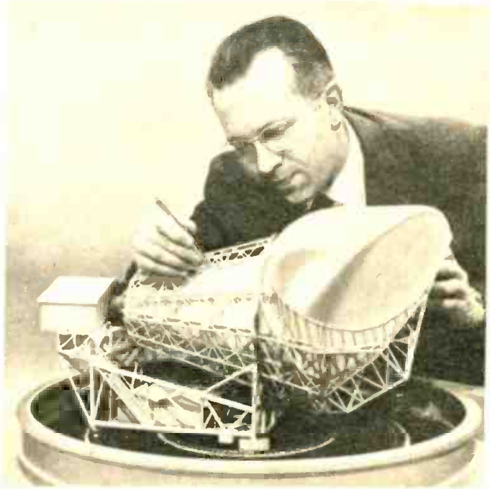
Dollars and Sense . . . Who said machines can't think? Here's one that converts dollar bills into dimes, nickels and quarters. Furthermore, according to its builders, it rejects phony money,

foreign currency and genuine U. S. bills of denominations higher than $1. Made by the Automatic Canteen Co., Rockford, Ill., the device is being installed primarily to make change for customers of vending machines.

To detect genuine bills, changers usually compare photoelectric scan signals with a standard signal.

...News

More on Tele-Satellites . . . AT&T is continuing its plans and work for a satellite communications system that would relay telephone calls from North America to Europe, or vice versa. The

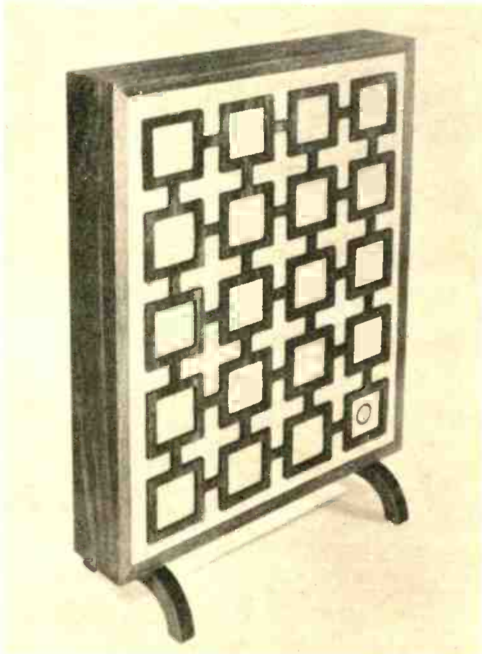


final design of the transmit-receive antenna to be used in the project is shown in model form in the photograph. Dimensions of the giant horn are to be 894 feet in height, 177 feet in length. It would be sheltered by a giant air-supported radome as high as a 13-story building, which would make it easily the biggest windbag on the continent. The first antenna and four others like it are to be constructed on a site in Maine. Besides relaying telephone calls across the Atlantic, the satellite system could carry all the other forms of communication, including television. When it's working, we will be able to receive live television programs directly from Europe, and Europe in turn will enjoy the benefits of our TV programs directly, although one might be led to wonder whether they have not suffered enough already, what with two world wars and sundry other troubles.

AT&T is working only on this end of the link. A European country or countries will have to build a similar transmit-receive station across the Atlantic to complete the system.

Electronic Marketplace

THIN HI-FI . . . The Sonoteer, Rek-O-Kut's newest speaker design, should appeal to those hi-fi buffs who have limited speaker space. Five flat speakers are housed in a cabinet only 4 inches



deep, 21 inches wide and 25 inches high. The Sonoteer's sound pattern is omnidirectional, making it suitable for stereo. About $80 from Rek-O-Kut, Inc., Corona, N. Y.

—o—

Echoes to Order . . . Want to make your hi-fi system sound a little different from your neighbor's? Add a CBS model 3-1-C reverberation unit. The echo effect produced is fully controllable to match the acoustics of the room and the nature of the music being reproduced.

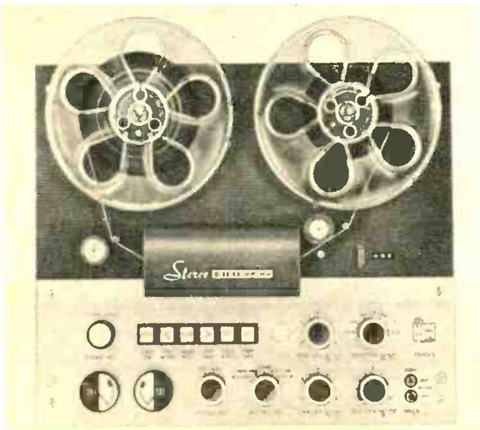
Marketplace

Only a control amplifier is required to add the 3-1-C to an existing music system.

For complete information write for bulletin E-438 from CBS Electronics, Information Services, 100 Endicott St., Danvers, Mass.

—o—

Stereo Recorder . . . EICO has announced a new stereo/mono 4-track tape recorder that is available in wired or semi-kit form. It features push-button controls, with the record and playback buttons interlocked to avoid accidental erasures; 7½ and 3¾ ips speeds, and a transistorized playback amplifier. $395 for the wired unit and $290 for the semi-kit. EICO, 33-00 Northern Blvd., Long Island City, N. Y.



—o—

Gibberish on the Air . . . Party-line eavesdroppers, industrial spies and just plain snoopers were dealt a low blow last fall when Delcon Corp. brought out a portable telephone scrambler called a Security Telephone. But conversations via two-way radio and radiotelephone were still wide open to anyone who wanted to listen in for fun or profit. Now Delcon has chinked up that gap with a portable scrambler handset that plugs into any standard FM mobile radio at fixed or mobile stations. The operator can broadcast in either scrambled or

Marketplace

clear speech by moving a selector switch.

The operation is simple. The transmitting handset electronically scrambles any signal and the matching receiver simply decodes the scramble, restoring the signal to its original pat-

tern. The scramblers are set up at the factory with one of several electronic codes. Two or more scramblers can be used together as long as they have the same code.

The portable Scrambler costs $249. Delcon Corp., 943 Industrial Ave., Palo Alto, Calif.

—o—

Mobile Power Supply . . . Designed for use in cars, boats, planes, trucks, buses, etc., the W612A all-transistor power supply will appeal especially to hams having old-style mechanical vibrators or rotary converters that need replacement. It boosts a 12-volt source to a maximum of 500 volts at 300 milliamperes with a battery drain of only 17 amperes.

Being very well heat-sinked, the unit can be installed in the engine compartment and can withstand temperatures up to about 250°F. $55.

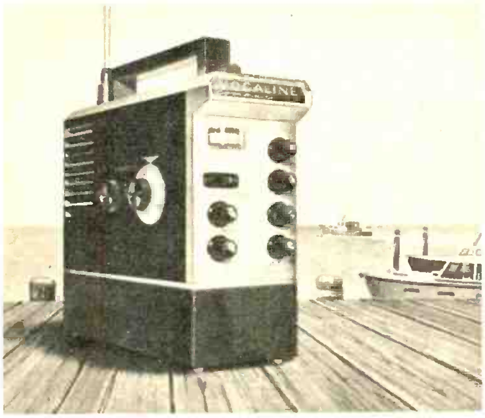
Minneapolis-Honeywell, Minneapolis, Minn.

—o—

CB-AM Portable . . . Vocaline has started to market a shoulder-strap type Citizens Band transceiver which includes a broadcast-band receiver. The 1-watt set has a four-channel selector switch and can tune all 22 channels, and

Marketplace

features a squelch circuit, antenna tuning (with meter), whip antenna, rechargeable dry cells. Battery drain is 30 ma on receive, 500 ma on transmit.



The transceiver can use either its own whip antenna or a base-station setup. It has 18 transistors and five diodes, weighs 11½ pounds with batteries and measures 9 inches high, 4 inches wide and 11 inches long. Price is $250.

Vocaline Co. of America, Old Saybrook, Conn.

—o—

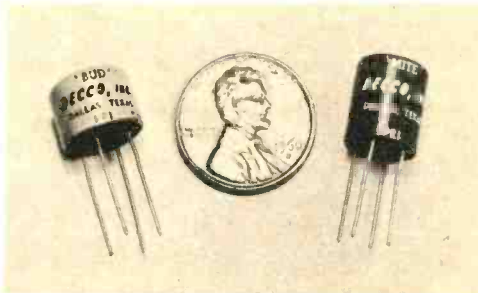
Strobotape . . . You can stop wondering whether your tape recorder is running at the right speed when you check it with the Robins TK-5 Strobotape Kit. The kit consists of a small neon light that blinks 120 times a second and five lengths of non-magnetic leader tape imprinted with vertical lines for the different speeds. Operation is simple. $2 from Robins Industries Corp., Flushing, N. Y.

—o—

New Nine-Pinners . . . RCA is developing a line of nine-pin, all-glass tubes to serve functions presently performed by the familiar octals. Called Novars, the new tubes have heavier leads and wider pin spacing than previous all-glass miniature types and are, therefore, able to withstand higher operating voltages and temperatures. The first models are intended for TV receivers. RCA, Harrison, N. J.

Marketplace

Getting Still Smaller . . . Miniaturization of components for transistor equipment is being pushed almost to the vanishing point. As examples, here are two audio-frequency transformers flanking a penny for comparison of size.



The Bud on the left is only $\frac{5}{16}$-inch high and slightly more in diameter, the Mite is ⅜-inch in diameter and about ½-inch high. Both are designed for printed-circuit mounting. Chokes as well as transformers, in a wide variety of characteristics, are available. Decco, Inc., 2025 Farrington, Dallas, Tex.

—o—

Bias Supply . . . The Align-O-Pak, an instrument used for aligning and/or troubleshooting TV receivers and test instruments, has been put on the test instrument market by Sencor. The unit

can be used as a single or dual 0-20 volt DC supply, depending on what is needed. Each individual power supply can be adjusted to a different voltage. Model BE113 is priced at about $13. Sencore, Addison, Ill.

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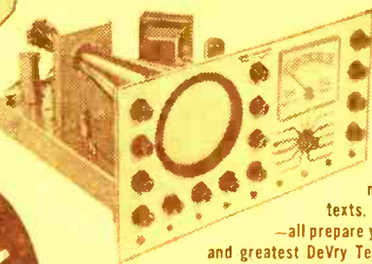

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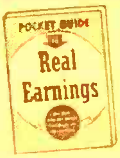

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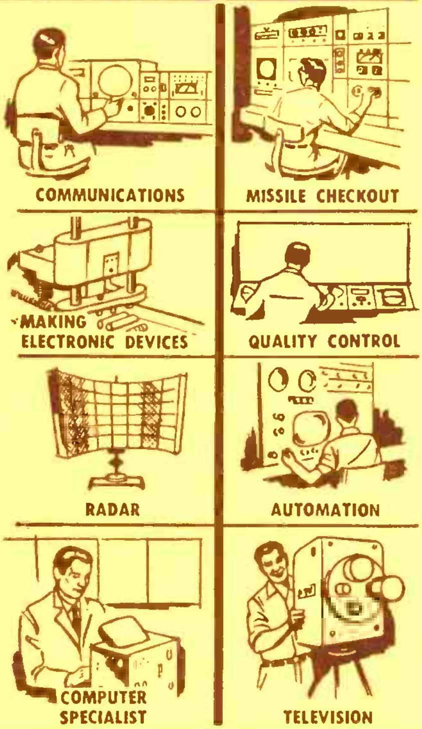

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WHAT SOME DeVRY TECH GRADUATES ARE DOING

Edward Hahn, Illinois, was a laborer. Now he is an Electronic Project Engineer with the Martin Company, a large producer of missiles.

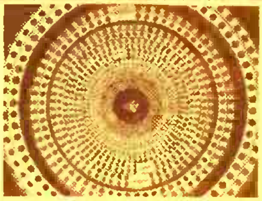
Dale L. Gawthorpe, Illinois, left a clerk's job to take the DeVry program. He is now enjoying his work with automatic pilot equipment at Sperry Phoenix Company.

Charles Morishita, Oregon, worked as a farmer before taking DeVry's training. Now he builds and tests equipment at Lockheed's Space and Missile Division.

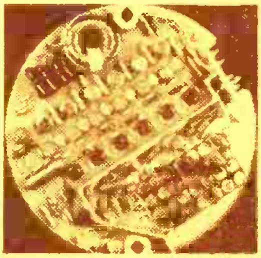
Gerald R. Borner, Washington, has found his DeVry training a valuable aid on his job as Radar Technician In Boeing Airplane Company's Aero Space Division.

DeVry Tech President Visits Missile Base

DeVry's president, Mr. T. J. Lafeber, accorded a special invitation to inspect a famous missile facility, was deeply impressed with the role of Electronics in the national defense.



A RARE VIEW! This inside view of a ballistic missile is seldom seen by a civilian. It's a sight that greatly impressed Mr. Lafeber.



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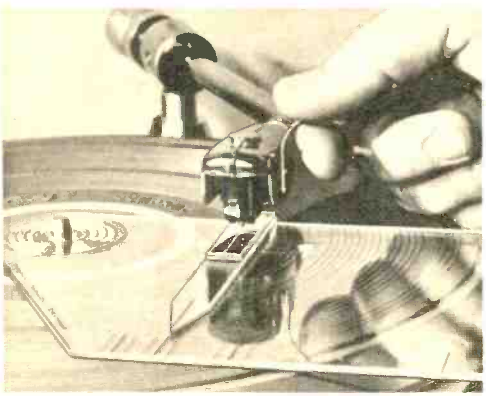
Marketplace

Mike With Two Ears . . . A microphone utilizing two dynamic elements has been announced by Lafayette. The PA-263, because of its new approach to stereo recording is said to eliminate the need for two mikes at a recording session.

Lafayette claims a frequency response of 50 to 15,000 cps that is essentially flat from 80 to 10,000 cps. Impedance is 50,000 ohms. Lafayette Radio, 165-08 Liberty Ave., Jamaica, N. Y.

—o—

Stereo Stylusmaster . . . is a new device for assuring that your stylus is tracking properly and is not worn or chipped. Prestige Products, 13647 Burbank Blvd., Van Nuys, Calif. $5.25.



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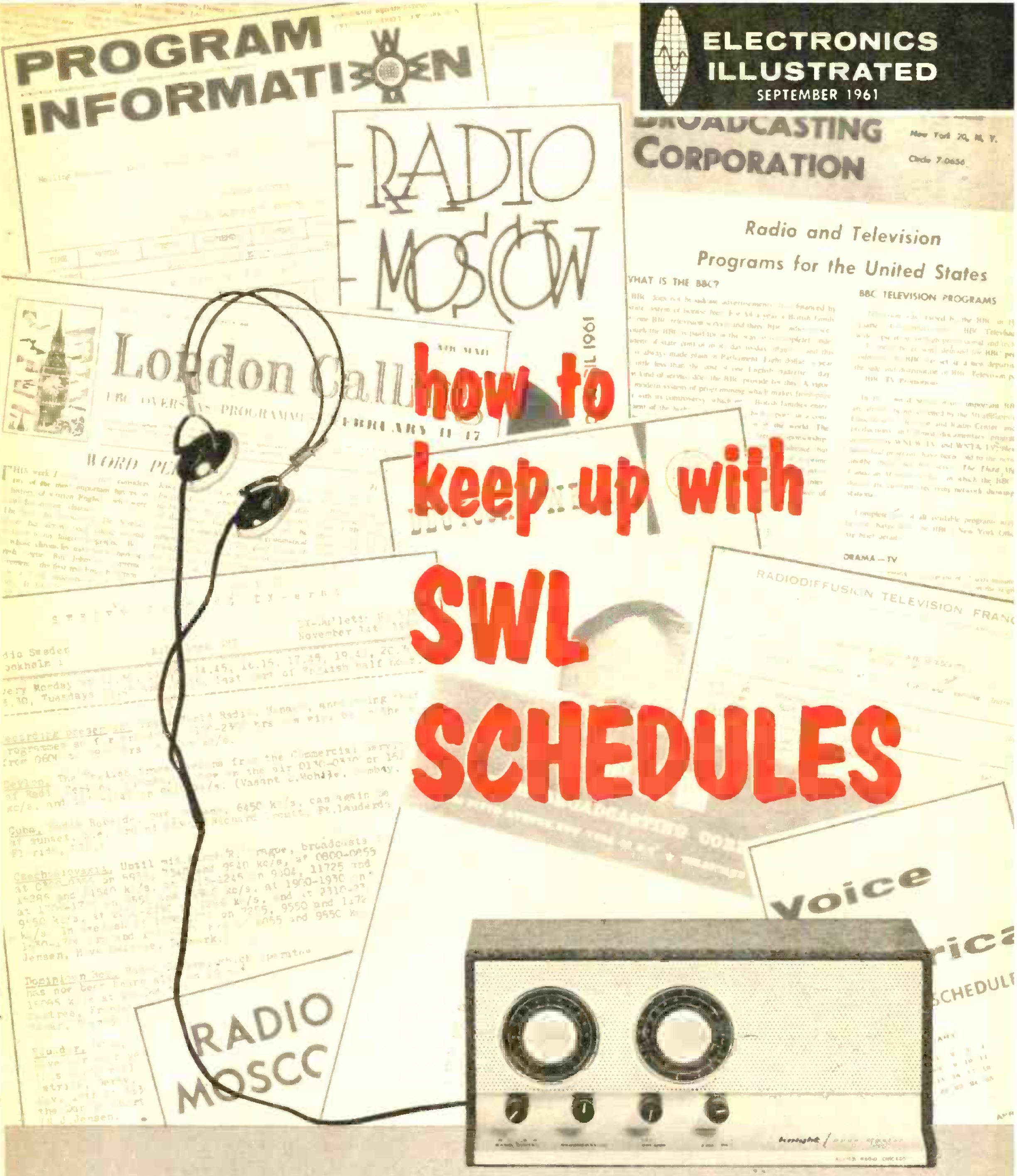
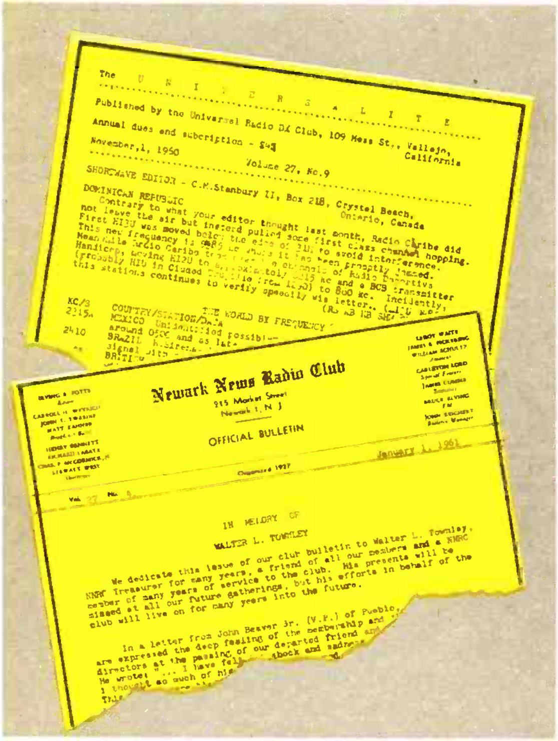


how to keep up with SWL SCHEDULES

How can an SWLer keep track of what's going on when there are so many stations? A veteran listener gives you the answer.

By Tom Kneitel, 2W1965

THE Short-Wave Listener and DXer has better equipment today than ever before, and there are more stations and programs to choose from, too. The picture looks pretty rosy at first glance, but there is a dark side to it. A sensitive and selective receiver, coupled with the hundreds of strong short-wave stations now on the air, can lead to confusion and



Radio club publications such as these give a DXer much useful information at small cost.

frustration for any listener.

Look at it this way. If you have a set that can bring in only a few stations you have no problem. You can keep up with their changing frequencies and schedules. It's when you have a good receiving station that the trouble begins. Today there are about 3,000 short-wave broadcasting stations, triple the number there were in 1948, and several thousand amateur stations also ride the airwaves.

Since short-wave broadcasters are constantly shifting frequencies and programs, it is a major job to keep track of even the ones that interest you most. Here is how to simplify the job.

First of all, you must realize that lists of stations and programs, available commercially and also free of charge, have their own limitations. By the time they are in print some of their information is out of date. This is nobody's fault. The publisher simply has to get his information several weeks or months in advance and stations may change their schedules almost by the hour.

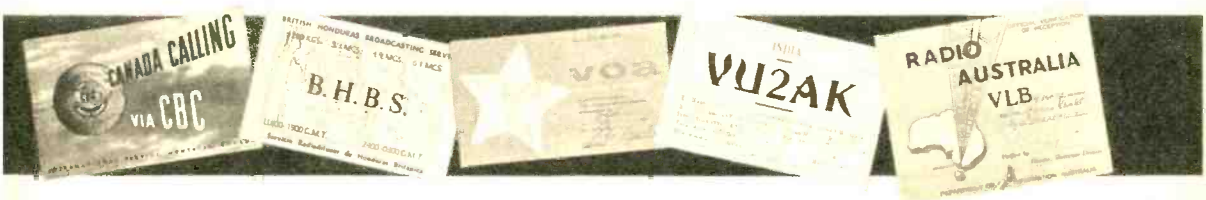
However, many short-wave stations have special programs and reports for the DXer, broadcast usually on a weekly basis. The programs not only discuss the station's own schedules and frequencies, but also talk about new stations being heard in Europe, America and other areas, tell of schedules and frequencies of other stations and round out the picture with tips and technical advice. The information invariably is up to date, some of it having been collected only hours before.

On the opposite page is a list of the most important special programs for the DXer.

The announcers on DX programs usually are veteran listeners themselves, such as Horst Krieger of Germany's Deutsche Welle, Graham Hutchins of Radio Australia, Arne Skoog of Radio Sweden, Russell Henderson of the Swiss Broadcasting Corp. and the Voice of Denmark's O. Lund Johansen. The Voice of America's DX program is hosted by famous TV newsman Bill Leonard, W2SKE, and is produced by Gene Kern, W2BAK.

Station WRUL, outlet for the Worldwide Broadcasting System, with headquarters in New York, plans to add several more DX programs to their present schedule. These will most likely be aired each Saturday.

A number of non-profit radio clubs issue monthly DX bulletins containing information sent in by members throughout the [*Continued on page* 100]



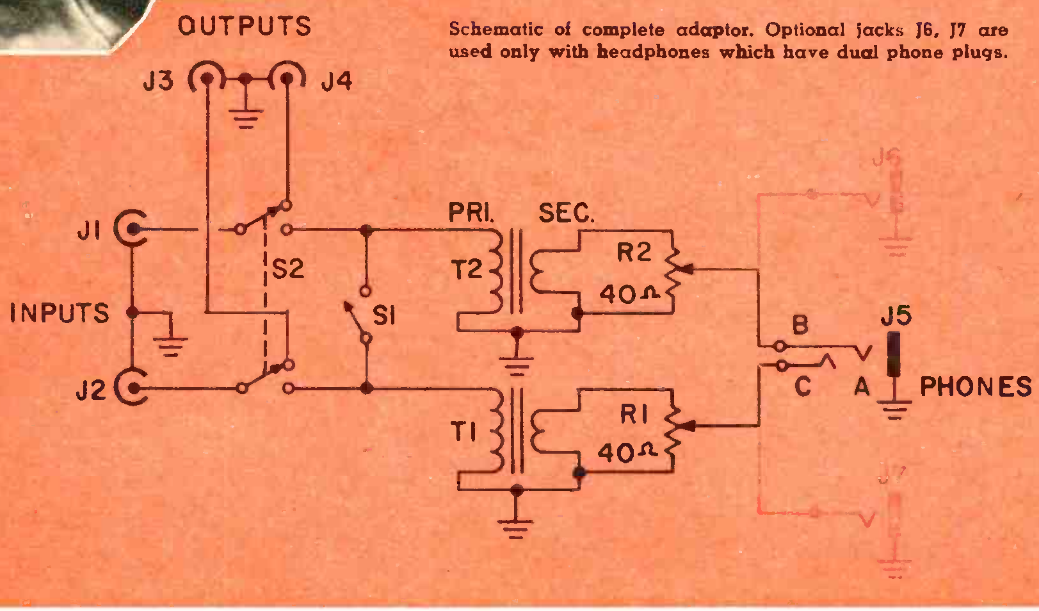
SPECIAL PROGRAMS FOR SHORT-WAVE LISTENERS & DXers

Day of Week	During Month	Time (EST)	Station	Location	Frequency (kc)
SUNDAY	every	8:00 A.M.	Radio Australia	Melbourne, Australia	11810
	every	10:14 A.M.	Radio Australia	Melbourne, Australia	11810
	2nd & 3rd	6:50 P.M.	Radio Moscow	Moscow, U.S.S.R.	7150, 7210, 7390, 9570, 9610, 9620, 9660, 9690, 9720
	3rd & 5th	8:15 P.M.	Radio Japan	Tokyo, Japan	15135, 17725, 21520
	2nd & 3rd	9:50 P.M.	Radio Moscow	Moscow, U.S.S.R.	7150, 7210, 7390, 9570, 9610, 9620, 9660, 9690, 9720
MONDAY	every	9:20 A.M.	Radio Sweden	Stockholm, Sweden	17840
	2nd	8:15 P.M.	Deutsche Welle	Cologne, W. Germany	9640, 11795
	every	9:05 P.M.	Radio Sweden	Stockholm, Sweden	9725
	every	10:35 P.M.	Radio Sweden	Stockholm, Sweden	9725
	2nd	11:15 P.M.	Deutsche Welle	Cologne, W. Germany	9640, 11795
TUESDAY	every	8:45 P.M.	Radio Netherlands	Hilversum, Netherlands	9590, 11950
	every	9:00 P.M.	Voice of Denmark	Copenhagen, Denmark	9520
	every	10:30 P.M.	Voice of Denmark	Copenhagen, Denmark	9520
	every	11:30 P.M.	Voice Evangelique	Cap Hatien, Haiti	11770
WEDNESDAY	1st	3:15 A.M.	New Zealand Calling	Wellington, N.Z.	6080, 9540
	1st	5:30 A.M.	New Zealand Calling	Wellington, N.Z.	6080, 9540
	every	7:15 A.M.	BBC	London, England	15070, 15110, 17870, 21470, 21710, 25720
THURSDAY	1st & 3rd	12 MID.	This Is Prague	Prague, Czechoslovakia	9665, 11840
	every	10:20 A.M.	Voice of Denmark	Copenhagen, Denmark	15165
	every	12:30 P.M.	BBC	London, England	15070, 15110, 15140, 17870
	1st & 3rd	7:00 P.M.	This Is Prague	Prague, Czechoslovakia	9550, 11745, 11840
	every	8:15 P.M.	BBC	London, England	6110, 9510, 9825, 11820, 11860, 12040
FRIDAY	1st & 3rd	3:30 A.M.	This Is Prague	Prague, Czechoslovakia	9550, 11745
	every	8:45 A.M.	Voice of America	(various locations)	6040, 6145, 9515, 9625, 11770, 15130, 15235, 17710, 17770, 21610, 21740 (partial list)
	every	10:20 A.M.	Switzerland Calling	Berne, Switzerland	17785, 21675
	every	11:20 A.M.	Switzerland Calling	Berne, Switzerland	15315, 21605
	every	2:20 P.M.	Switzerland Calling	Berne, Switzerland	7210, 9545
	1st	8:00 P.M.	Bulgaria Calling	Sofia, Bulgaria	9700
	every	9:05 P.M.	Switzerland Calling	Berne, Switzerland	6165, 9535, 11865
	1st & 3rd	10:00 P.M.	This Is Prague	Prague, Czechoslovakia	9550, 11745
	1st	11:00 P.M.	Bulgaria Calling	Sofia, Bulgaria	9700
	every	11:50 P.M.	Switzerland Calling	Berne, Switzerland	6165, 9535, 11865
SATURDAY	3rd & 5th	1:00 A.M.	Radio Japan	Tokyo, Japan	9525, 11800, 15235, 17825
	3rd & 5th	3:05 A.M.	Radio Japan	Tokyo, Japan	15135, 17725, 21610
	3rd & 5th	5:15 A.M.	Radio Japan	Tokyo, Japan	11855, 15235
	1st & 3rd	6:30 A.M.	Finnish Broadcasting Co.	Helsinki, Finland	11960, 15190, 17800
	1st & 3rd	11:00 A.M.	Finnish Broadcasting Co.	Helsinki, Finland	11960, 15190, 17800
	3rd & 5th	1:25 P.M.	Radio Japan	Tokyo, Japan	9525, 11800, 15135
	3rd	2:45 P.M.	WRUL	Boston, Mass.	11790, 15380, 17750
	3rd	6:15 P.M.	WRUL	Boston, Mass.	11830, 17845

STEREO HEADPHONE ADAPTOR

Don't waste watts! Here's an inexpensive device that allows you to connect any of the new low-impedance headphones directly to the output jacks of your stereo preamp or AM-FM stereo tuner!

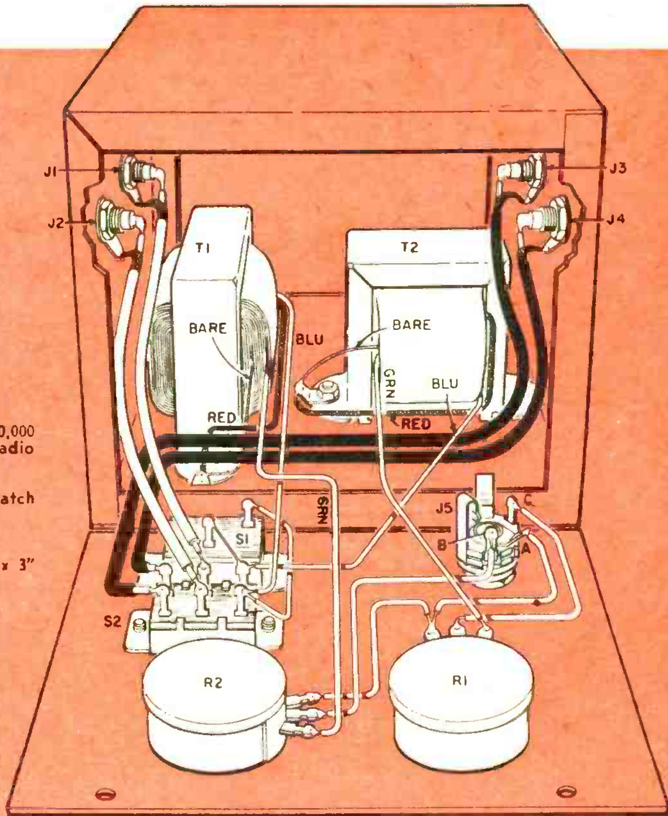
By Harry Kolbe



Schematic of complete adaptor. Optional jacks J6, J7 are used only with headphones which have dual phone plugs.

PARTS LIST

R1,R2—40-ohm wirewound potentiometer
T1,T2—output transformer—Primary: 7,000-10,000 ohms, Secondary: 3-8 ohms (Lafayette Radio TR-69 or the equiv.)
J1-4—single-hole mounting phono jack
J5—3-conductor, open circuit phone jack (to match headphone plug)
S1—SPST slide or toggle switch
S2—DPDT slide or toggle switch
1—aluminum utility cabinet approx. 4" x 5" x 3"
J6,J7—See text



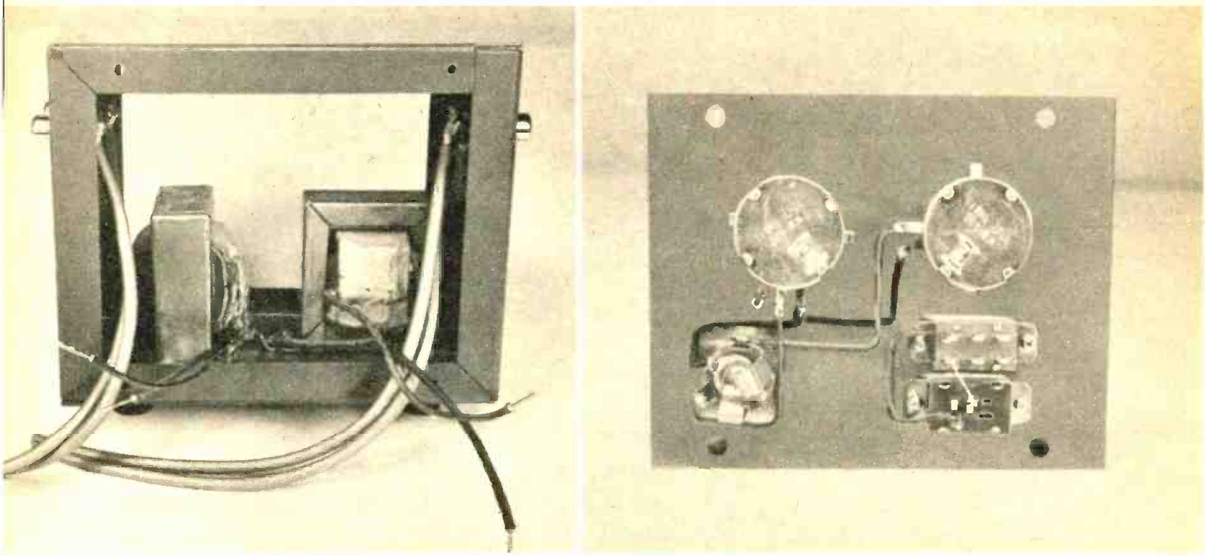
Unit with its front panel dropped to show the internal wiring. Transformers are installed toward rear and in position shown.

ALTHOUGH the new 8-ohm stereo headphones are ideal for solo hi-fi listening, they present problems. In the first place, it's a nuisance to have to disconnect the speaker leads from the amplifiers and replace them with the headphone leads. And secondly, it seems wasteful to use two high-powered amplifiers to drive a pair of headphones which require only a fraction of a watt for ear-splitting volume.

EI's impedance-matching switch box solves both these problems in one fell swoop. A *Phones-Amp.* switch (S2) provides instant choice of phone or speaker listening, and the impedance matching feature permits the direct connection of 8-ohm headphones to the preamp or tuner instead of to the amplifier's 8-ohm output terminals.

The box contains two output transformers, T1 and T2, which serve as the impedance matching devices. The units specified in the parts list can be purchased for only 39c each. Potentiometers R1 and R2 across the secondaries of T1 and T2 are large enough not to load down the headphones and yet allow compete control over the level of the signal fed to each ear.

Phones-Amp. switch S2 receives the stereo signals from the preamp or tuner via J1 and J2. In the *Phones* position, S2 feeds the signals to the primaries of T1 and T2, while in the *Amp.* position, the signal is routed directly to the inputs of the amplifiers via J3 and J4. For



Adaptor is constructed in two separate assemblies, front panel and cabinet, which are later interconnected.

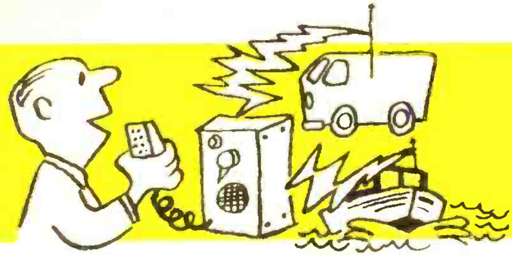
standard mono reception, *Stereo-Mono* switch, S1 parallels J1 and J2 so a signal appearing at either jack is fed to both earphones.

Construction

The wiring and assembling of the adaptor box is evident from the pictorial. For ease of construction, the front panel on which the two switches, pots and J5 are mounted should be assembled and wired first. The cabinet containing the two transformers and the four phono jacks is then assembled. Note that the jacks are the new single-hole mounting type that do not have a fiber mounting plate. The shielded wires have their shield leads connected to the ground lugs of the jacks and their hot leads connected normally. No ground connection is made to the shielding at the end of the leads connected to S2. Make sure that you allow enough shielded lead to enable the front panel to lie flat as shown in the pictorial.

Transformers (T1, T2) are mounted at right angles to each other and as far to the rear of the case as possible to allow sufficient clearance for the front panel components. A ground lug is installed under a mounting tab of each transformer and the red and bare leads are soldered to the lugs. (Some transformers may have *two* bare secondary leads instead of one bare and one green lead.) Make sure to scrape the enamel off the bare lead before soldering or a bad joint may result.

When FM stereo multiplex programs start coming through, the headphone adaptor will work equally well connected to the outputs of your multiplex adaptor. Most MX adaptor units have cathode-follower outputs and hence can drive the headphones through the adaptor box.

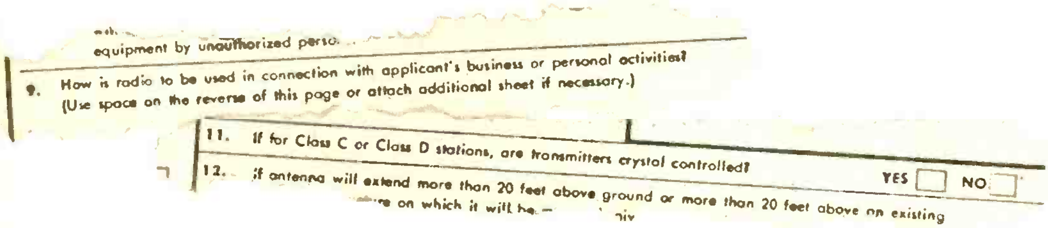


CB CORNER

Citizens Band News and Comments

by Len Buckwalter, 1W5733

AVOID LICENSE BOUNCE . . . Filling out the form for a CB license is simple, but a huge percentage of the applications received by the FCC are bounced back as defective. This can double the waiting time for your call letters and station license.



equipment by unauthorized perso...

9. How is radio to be used in connection with applicant's business or personal activities? (Use space on the reverse of this page or attach additional sheet if necessary.)

11. If for Class C or Class D stations, are transmitters crystal controlled? YES ☐ NO ☐

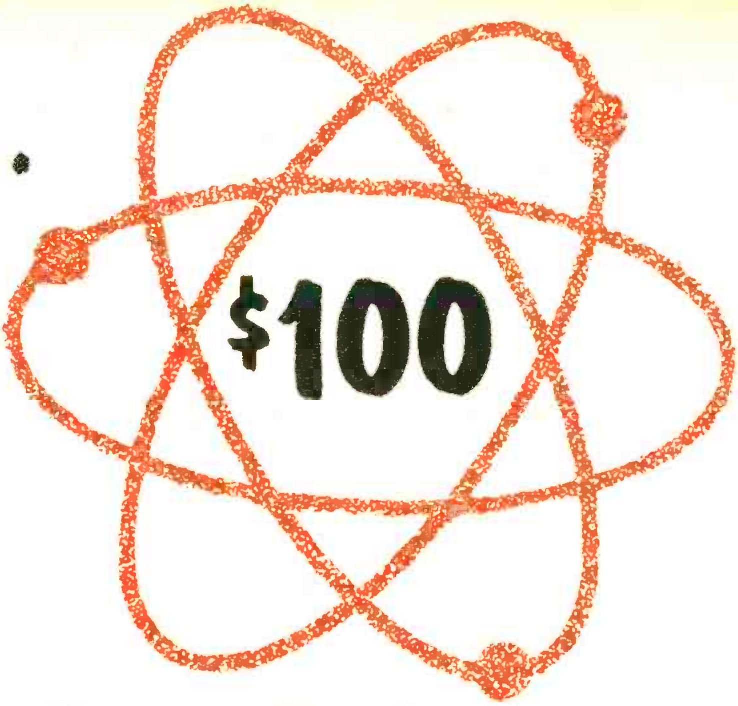
12. If antenna will extend more than 20 feet above ground or more than 20 feet above an existing ...re on which it will be...

By far the stickiest wicket is Item 9, "How is radio to be used in connection with the applicant's business or personal activities?" (see illustration). Two answers definitely are out: The words "business" or "personal." They are much too vague. Also, any entry that suggests that CB radio will serve as an end in itself—hobby interest, experimentation or for pleasurable conversation—is contrary to the rules and invites a fast return.

The acceptable answer is a brief but specific phrase on how CB radio is going to serve you. The band is open to hundreds of uses where a definite communication need exists: all the way from routing delivery trucks to running a sports event. It includes all kinds of activities where two-way radio is a boon: between home and auto, on a small boat or carried on a hunting trip. If you cannot think of a concrete application, amateur radio, rather than the CB band, is probably for you. The Citizens Band (like the telephone) is considered by [*Continued on page* 101]

LEN BUCKWALTER, who with this issue begins a regular column devoted to Citizens Band radio, is a veteran engineer-writer in the electronics and radio field. He has served as engineer and chief engineer of three commercial radio stations and formerly was a design engineer specializing in radio-frequency and audio equipment. Len holds an arm-length list of licenses. In addition to his CB ticket, he has Advanced Class amateur, First Class Commercial Radiotelephone and Radiotelegraph licenses. He thus is able to delve deeply into the circuitry and components of CB equipment to test and evaluate it. Len is now a full-time free-lance writer with an extensive personal laboratory at his home in Norwalk, Conn. A 1951 graduate of New York University, he is married and the father of a daughter. His column will be devoted to all aspects of Citizens Band operations, covering equipment, regulations, licensing, procedure, etc.

WIN...



$100 in EI's Easy Cash Contest

It's educational!
It's fun!
And here's how you do it...

WHAT is electricity? In our last issue we announced a contest with cash prizes of $100 for the best answers to that question. On the facing page appears the first winning answer. Its author has been awarded EI's first $100 prize.

Now it's your turn to win! As we said previously, this is not a one-time contest but a continuing competition. A winning entry will be published in every issue. Write out your answer to our question and mail it in now!

All entries received before press time will be considered for cash prize No. 2, announced in our next issue. However, to avoid confusion thereafter we are setting time limits. To be eligible for cash prize No. 3, your entry must be received on or before September 1, 1961.

How do you define electricity? So far, no one has been able to formulate one comprehensive theory that is universally accepted. Some theories speak of a flow of electrons, others simply call electricity a quantity of nature. A recent treatise related electricity to Einstein's theory of relativity. In formulating your answer to our question you may draw on any source material desired but your answer must be in your own words.

Mail entries to: EI Electricity Contest, 67 W. 44th St., New York 36, N. Y.

Rules: Entries will be judged on aptness of thought, clarity of expression and originality. Entries must be typewritten and double-spaced and may be no longer than two pages of 8½ x 11-inch paper. Ideally, a definition should be short. Print your name and address on your envelope and the first page of your answer. One entry per envelope. EI's Editors are the judges. Entries will not be acknowledged or returned.

Prizes: $100 will be paid the writer of the best definition. One winning definition will be published in each issue of EI. In case of ties, duplicate prizes will be awarded. Other entries of merit also may be published and will be paid for at the rate of $10 each.

Here it is!

FIRST WINNING ENTRY IN EI's EASY CASH CONTEST

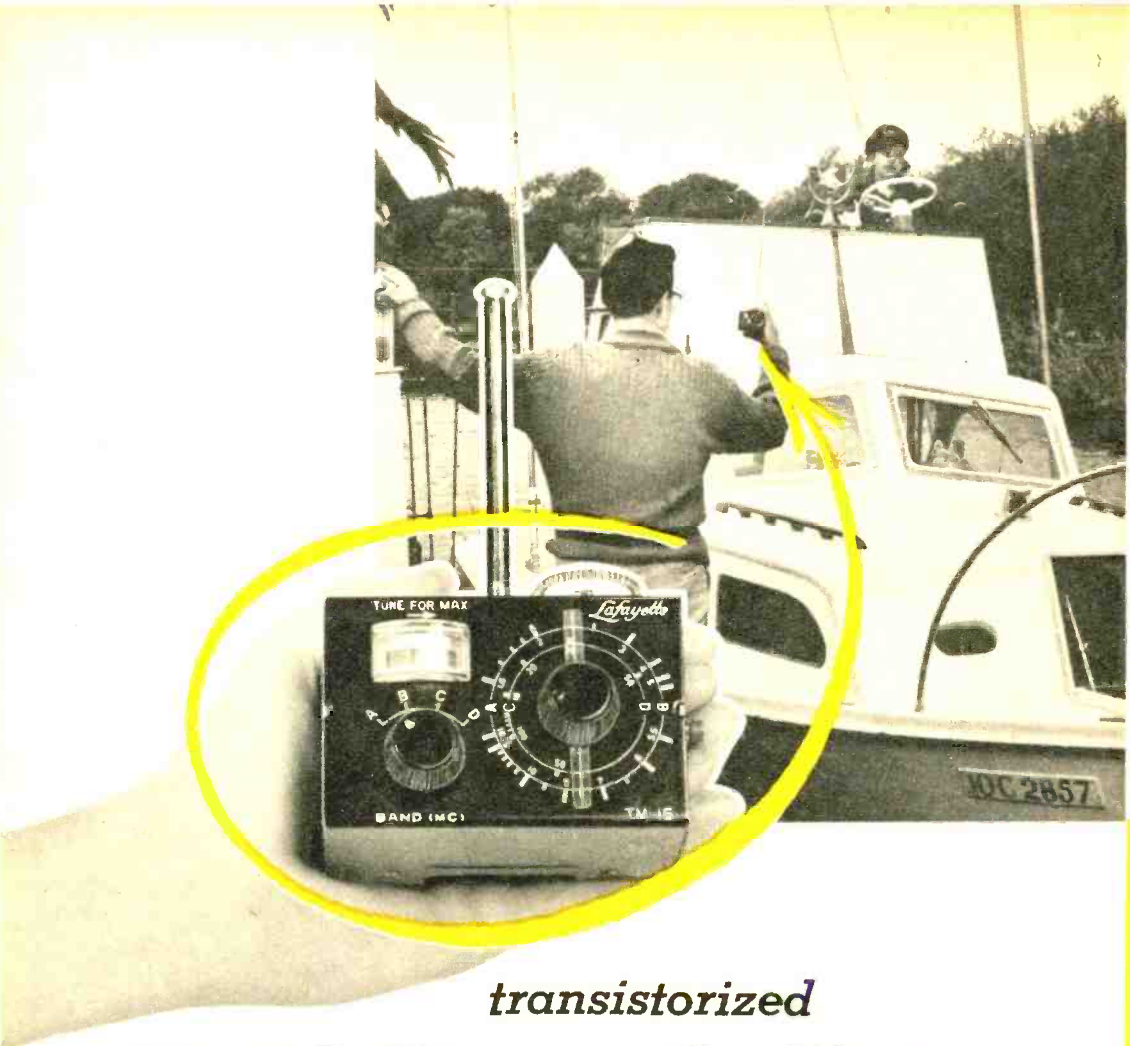
William Steinbrook
5834 Ralston Avenue
Indianapolis 20, Ind.

WHAT IS ELECTRICITY?

Electricity is matter in its smallest known state, and matter in its smallest state is one electron. Thus, one electron is electricity.

The seperation of an electron from the proton (or nucleus) around which it orbits establishes an unnatural condition which must and will be corrected--either instantly, tomorrow or after millenniums. The time does not matter. When the correction does take place we have a flow of electric current.

Man has learned how to establish this unnatural condition, how to control the time of correction and how to use the energy that is available when the electron re-enters its orbit.



transistorized

Field Strength Meter

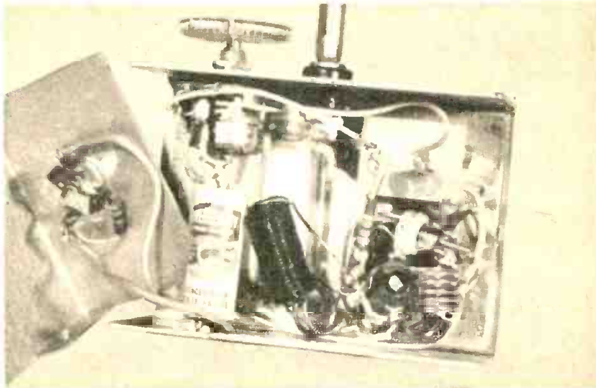
For checking the output of your amateur or CB transmitter

By Harvey Pollack

BY ADDING an inexpensive transistor and a few other components, you can soup-up the Lafayette TM-15 FS meter to a super-sensitive instrument capable of reading frequency and field strengths at great distances from the transmitting antenna of your ham rig, CB transmitter, or remote-control antenna.

Meter indication is proportional to the signal strength of the RF field and the calibrated tuning scale indicates the signal frequency within ±10%.

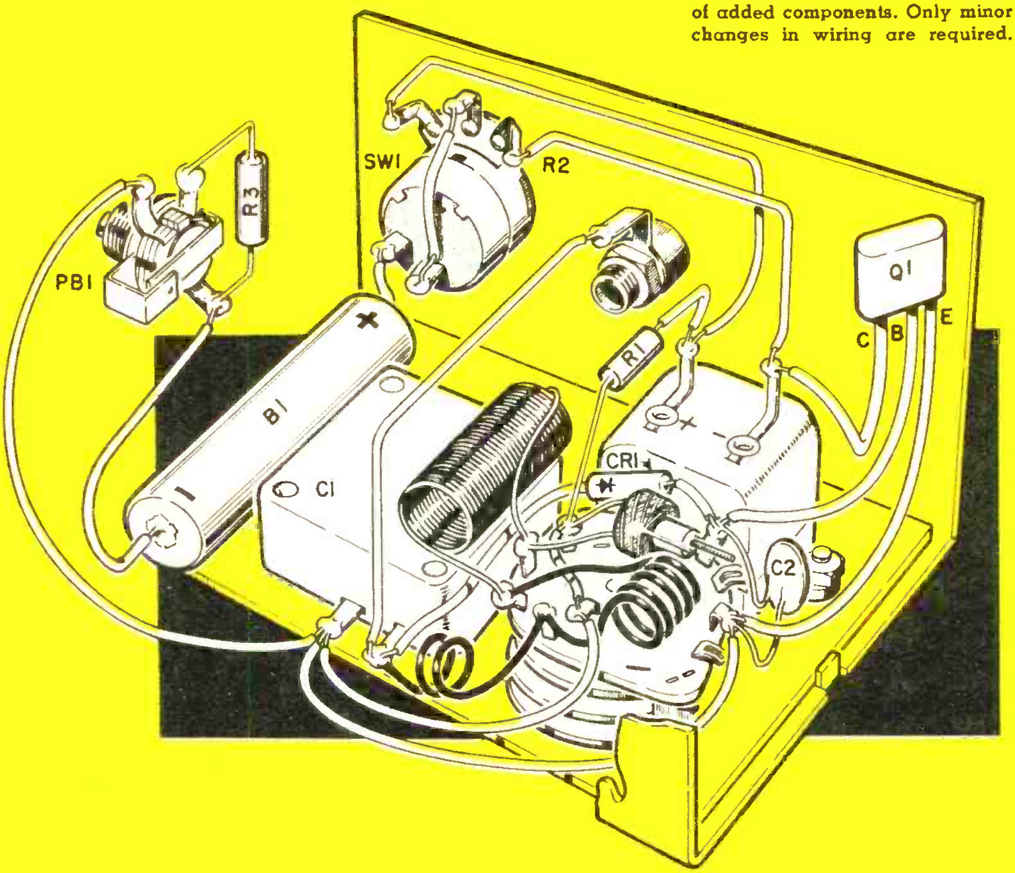
A transistor amplifier connected in a bridge configuration permits adjusting for zero-signal leakage current of the transistor. To avoid overloading the meter during bridge balance adjustment, miniature pushbutton PB1 puts a 5000-ohm resistor (R3) in series with the meter. When released, the button cuts out R3 providing maximum meter sensitivity. The finished instrument is so sensitive that it gave a 10% scale indication on a 3-watt mobile Citizen's Band transceiver located about 1½ city blocks away! (An unmodified TM-15 had to be brought about 10 feet from the transmitting antenna before any deflection was observed.) This high sensitivity is quite an advantage, for if reliable tuning of beam antennas is to be realized, a meter must be at least 20 beam elements away—further if possible. In fact, *any* kind of antenna adjustment should be made with the indicator as far away as space and sensitivity permit.



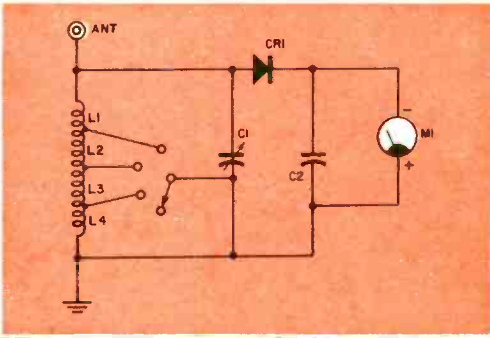
Construction

There is more than enough room inside the tiny case to install the additional parts. Note that the band switch is a two-pole, four-position type and that only one of the two poles and four of the possible eight circuit lugs are used. The unused terminals can be put to work as tie-points. The base lead of the 2N213 transistor goes to one lug, and the emitter goes to another. B1 should be a No. 904 or similar size cell as the AA size cell is too large to be fitted in the field-strength meter's already overcrowded cabinet. Don't force a larger cell in place, or you will set up capacities that will detune the coils.

Be certain that the mounting holes for R2 and PB1 are located properly so that the pot and switch clear the back of the tuning capacitor. It's a good idea to run



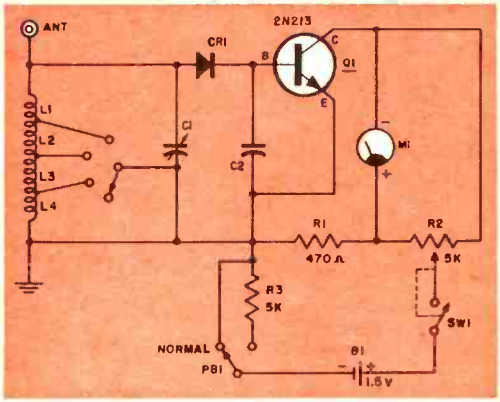
Modified unit showing location of added components. Only minor changes in wiring are required.



Before (left) and after (below) views indicate changes to be made. Tuning circuit is left undisturbed so as not to upset original frequency calibration on front panel.

PARTS LIST

TM-15 RF Field Strength Meter (Lafayette Electronics) Additional Parts required:
Q1—2N213 transistor
B1—1.5 volt dry cell, Eveready type #912 or #904
R1—470 ohms, ½ watt
R3—5000 ohms, ½ watt
R2,SW1—miniature 5000-ohm potentiometer with switch, slotted shaft and knob. (Lafayette VC-48 with KN-23 knob or equiv.)
PB1—Miniature SPDT pushbutton



all wires to a given tie-point *before* soldering the transistor lead in place; then a quick spot solder job on the globule of solder already on the tie-point limits the heat that will be applied to the transistor. Avoid moving the coils since this may change their spacing and make the frequency reading inaccurate. Keep your soldering tip away from the plastic cases of both the variable capacitor (C1) and the meter as they may melt. Wire in the battery *last* and be sure on-off switch SW1 is in the OFF position before making final connections.

Testing

Depress pushbutton PB1 and rotate the knob of zero balance control R2 until SW1 clicks on. The meter should read about half scale with no input signal. Now rotate the knob *slowly* clockwise until you notice the meter needle begin to drop. Release PB1 and the meter needle should then deflect all the way to the right. Continue to rotate R2's knob clockwise until the meter reads at or near zero. This adjustment is critical, requires a sensitive touch and patience, and may have to be repeated. As the transistor warms up, the needle will tend to climb but this can be offset with R2. Meter equilibrium should be reached in a few minutes and the instrument is ready for use. After readings have been taken, *always* depress PB1 while rotating SW1 to the OFF position. This protects the meter from overload when the bridge is unbalanced.

Operation

When using the instrument in a field of unknown strength, start with the antenna of the TM-15 removed and keep the instrument reasonably far from the antenna. If no reading is obtained, remain at the same distance and insert the *collapsed* antenna into its jack. To obtain greater sensitivity, extend the telescoping antenna as needed. If you should find it necessary to use the field strength meter close to the transmitter, work with the pushbutton depressed to keep R3 in the circuit and prevent meter damage.

EXCLUSIVE!

You can build your own underground wireless communications system with the . . .

TERRAQUAPHONE

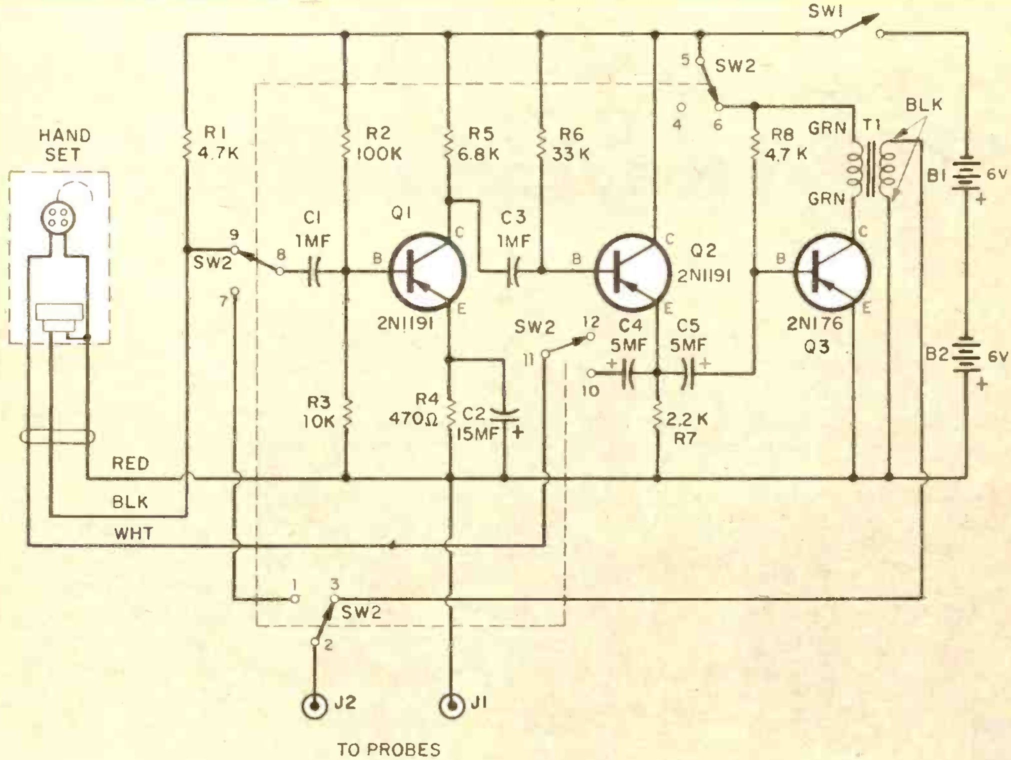
By Fred Maynard
Motorola Semiconductor Products

HUNTERS, campers, anglers, and other outdoor types may possess closets full of expensive equipment; but there is one item they're all likely to lack. That is a means of communication when in the field.

Unless a sportsman is also a ham or a Citizens Band licensee, he is cut off from the world when his hunting party splits or his fishing party spreads out. Whether he wants to tell his companions, "Hey come on over; they're biting here," or wants to summon help, he has no way to transmit his message.

EI's Terraquaphone answers this need for communications in the field. It also has other applications as an emergency signaling device, and hobbyists will find it an interesting experimental apparatus.

As the name Terraquaphone (earth-water phone) im-



Transistor amplifier is heart of Terraquaphone. Talk-Receive switch (SW2) is shown in Talk (depressed) position. In Receive position, power transistor Q3 is switched out and current drain is only 10 ma.

> **PARTS LIST**
>
> This list includes all components necessary for one Terraquaphone station. For two stations double the quantities.
>
> **Resistors:** ½ watt, 10%
> R1, R8—4700 ohms
> R2—100,000 ohms
> R3—10,000 ohms
> R4—470 ohms
> R5—6800 ohms
> R6—33,000 ohms
> R7—2200 ohms
>
> **Capacitors:** 15 volt or higher rating
> C1, C3—1 mf, paper or disc ceramic
> C2—15 mf, electrolytic
> C4, C5—5 mf, electrolytic
> T1—Any 6.3V filament transformer (used as output transformer)
> SW1—SPST toggle switch
> SW2—4-pole, 2-position spring return lever switch (Centralab No. 1457)
> B1, B2—Two 6V lantern batteries in series, 8 size D flashlight cells, or car storage battery
> J1, J2—Insulated banana jacks
> Q1, Q2—2N1191 or 2N650
> Q3—2N176 or 2N669
> Probes—2 each of the following ½"x18" copper, steel or aluminum rods—pointed. Flexible wire, banana plugs, battery clamps
> Sockets—2 standard transistor sockets, 1 Motorola M-15 mounting kit
> See-Zak Chassis Parts 4-R38 sides, 2-P88 panels
> Handset—includes carbon microphone and 35-100 ohm dynamic earphone. May be purchased as separate items. Handset illustrated available from Olson Electronics, stock No. PH-37 @ $2.35 postage paid

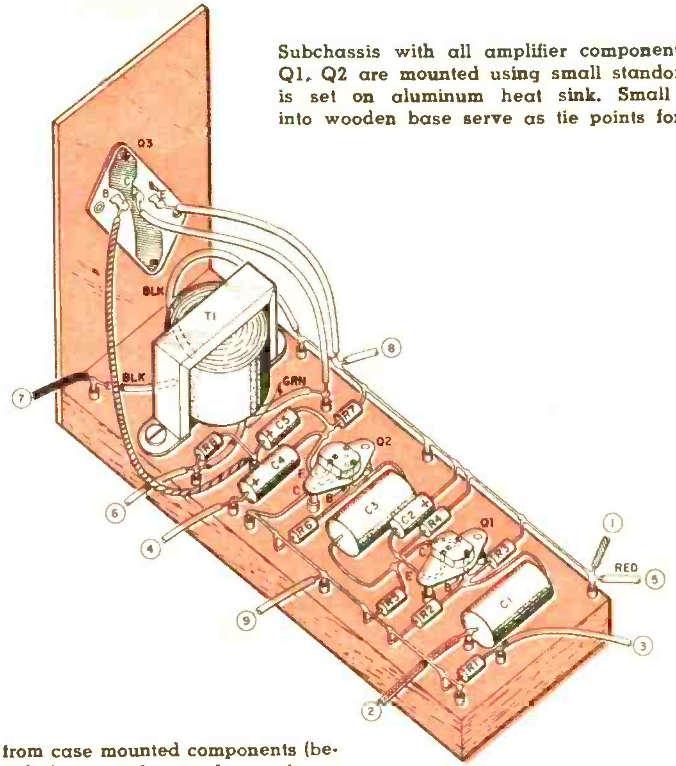
plies, the instrument transmits voice communications through earth or water. It is an underground wireless telephone or "radio."

An Old Idea

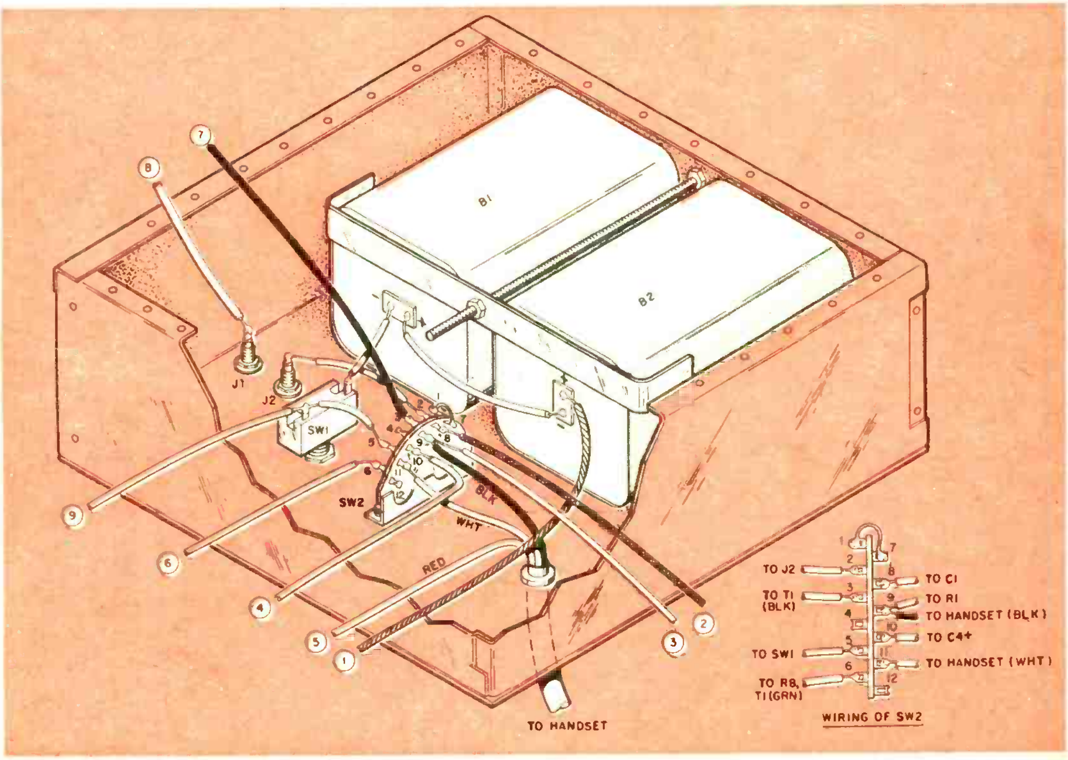
The idea of communicating via earth currents can be traced back to the year 1885 when an American, Nathan B. Stubblefield, achieved wireless communication using telephone equipment and ground stakes. Many now credit Stubblefield with the invention of radio (see AMERICA'S OWN MARCONI, July '61 EI) but what he actually invented probably was the underground wireless telephone.

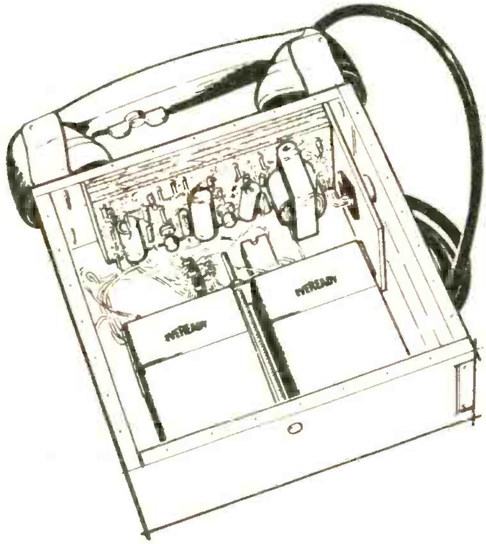
There's a considerable difference between underground radio and underground wireless telephone although the terms often are used interchangeably. In underground radio, an RF signal is radiated into the earth. A portion of it

Subchassis with all amplifier components. Sockets of Q1, Q2 are mounted using small standoffs, Q3 socket is set on aluminum heat sink. Small nails driven into wooden base serve as tie points for components.



Numbered leads from case mounted components (below) connect to leads from subchassis shown above.





Subchassis is fitted in cabinet as above. Avoid shorting out the wiring, components or tie points.

reaches the surface and is propagated along the interface between earth and air. A range of more than 100 miles is possible if sufficient power is applied.

Audio Transmission

Underground wireless telephone is something else again. No RF is employed. Instead, *audio* signals are pumped into the earth and travel through soil and water in all directions. The earth then becomes a giant *sheet resistance* and conducts the audio signal just as would a sheet of metal foil (although offering much more resistance). Receiving probes put down almost anywhere in this sheet pick up the signal.

The Terraquaphone's range depends on many variables. They include the homogenity of land or water in terms of resistance, moisture content (a Terraquaphone test in Arizona where the soil is quite dry achieved only 600 feet), absence of rocks (insulators), and the amount of dissolved salts in a body of water.

The Secret is Spacing

Since the sheet resistance concept is probably new to most EI readers, a word of explanation is in order. The two probes stuck into the ground will measure a certain resistance between them, as we mentioned before. The total resistance is actually composed of the resistance directly between the two probes shunted by an infinite number of other resistances, growing larger and larger as the resistance paths between the probes become more circuitous. Since the signal fed into the earth is developed across these resistances, it is necessary to place the pickup probes so they include as much signal path between them as possible. In general, the two sets of probes should be parallel to each other. The spacing of each pair is determined by the distance between the two Terraquaphones. The farther apart they are, the greater the range. Other things being equal, usable two-way communications usually is possible over a distance 30 to 50 times the probe spacing. A spacing of 30 feet then would mean a 1,500-foot range.

If probe spacing, sheet resistivity and orientation remain the same, signal strength diminishes as the square of the distance. Thus, doubling the distance between two Terraquaphones cuts signal strength to one-fourth its original level.

Since it is impossible to know exactly what sort of conductivity there is in any specific area, a certain amount of experimentation is required to achieve optimum results.

For a boat installation, the Terraquaphone's probes should be mounted on the bow and stern of the craft. Two boats wishing to communicate should be parallel to each other, with beam facing beam.

FCC APPROVED!

STEREO FM — STEREO FM

What the decision means to you.

NOW that the Federal Communications Commission has signaled its approval of a system for broadcasting stereo via multiplex FM, the last real obstacle to high-quality stereo on the air has disappeared.

Prior to the FCC decision, stereo broadcasts were few and usually poor. The procedure of the stations which did venture into stereo was to transmit one channel via FM and the other on AM. The AM channel was of limited fidelity and the splitting of stereo channels meant that anyone who was not listening on both AM and FM heard only half a program.

Now, with both stereo channels transmitted on FM, the only practical fidelity limit is the quality of a listener's equipment. For those who own or plan to buy a stereo tape recorder, the vistas are almost limitless, with the prospect of top-quality stereo tapes and discs transmitted free for the taping from local stations. And, since stereo promises another lift to the already rising fortunes of FM, listeners who now live beyond the range of the nearest FM station may find one springing up within earshot.

What kind of new equipment do you need for multiplex stereo listening? There are the usual stereo necessities, of course—a dual-channel amplifier and two speaker systems. In addition, you will need an adaptor for your present FM tuner. The adaptor's job will be to unscramble one transmission which carries both stereo channels as a complex modulation pattern. Audio engineers are still decoding and digesting the FCC requirements for the new transmission system, but here is a brief run-down on how it works.

FM stations will transmit a primary signal which carries a sum combination of both stereo channels (left plus right). This will permit balanced monophonic reception on any present-day FM tuner or receiver. But the main signal will be accompanied by a 38-kilocycle subcarrier which is suppressed and *amplitude modulated* by the difference signal of the stereo channels (left minus right). The sidebands of the suppressed subcarrier, which lie in the 23-53 kc range, will *frequency modulate* the main signal. This means that the AM involved on the subcarrier will play a small (though important) role and that the overall system will be all-FM, with its virtues intact.

The use of a suppressed subcarrier is a complex but efficient technique which has already seen use on telephone lines for transmitting multiple messages and, of course, suppressed subcarriers are old hat to single sideband hams.

Veteran audiophiles will recall that several multiplex systems competed for the FCC's favor over the past three years and that the Crosby system appeared to be the best of them for hi-fi broadcasting. Why, then, did it lose out to the system outlined above? The FCC credited both Zenith and General Electric for this one (and the two firms immediately began sniping at each other over who actually originated the idea).

In terms of frequency response, stereo separation and distortion, the Zenith-GE system came out on top in the FCC's field trials. And, although the Crosby system was better in signal-to-noise ratio for stereo reception, the GE-Zenith system showed a superior S/N ratio for combined monophonic reception. This means a listener in a fringe area, who has trouble receiving any kind of multiplex stereo, will still get a

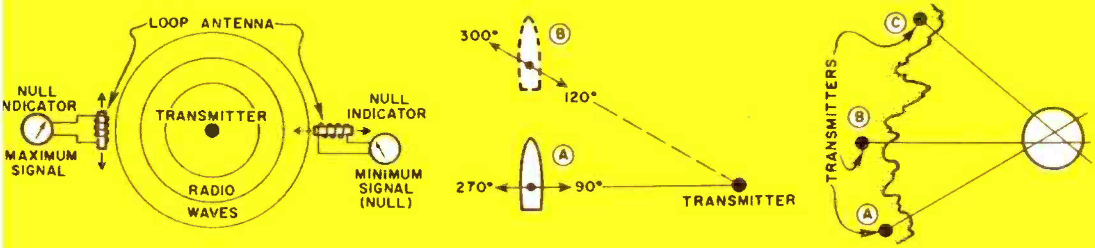
[*Continued on page* 110]

Radio Direction Finders . . .

THEY SHOW YOU THE

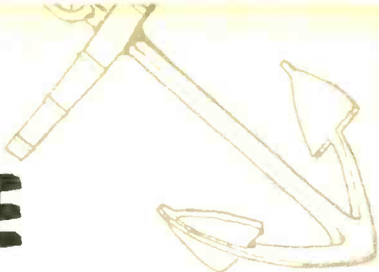
$99.95 Heathkit DF-3 direction finder has 3 bands, sense antenna and 9 transistors. A wired DF-3 costs $169.95. Heath's DF-2 costs $69.95, has 2 bands.

Heath Co., Benton Harbor, Mich.



In using an RDF you tune for a null, produced when loop antenna is 90 degrees from station (drawing at left). To tell which side station is on, boat is steered in a straight course (center); bearings pass astern on station's side. Bearing lines on three stations form triangle (right drawing). Radius of drawn circle equals triangle's long side. Boat is in the circle. In inland waters, the stations may be on opposite sides.

WAY TO GO HOME



By John D. Lenk

NEXT to a compass and a cook, a radio direction finder can be your most valuable companion on a boating trip. Although relatively inexpensive and simple to operate, an RDF reliably steers you home through a pea-soup fog on inland or coastal waters.

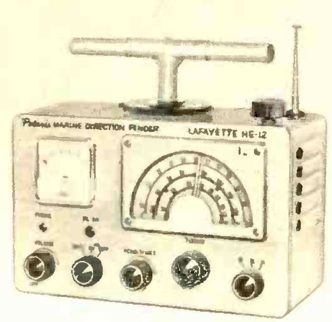
The RDF's basic ability is to give you a bearing on one or more marine radio beacons, broadcast stations or any other transmitters it can pick up. With a good marine chart at hand you use the bearings to find your position and to steer for your destination. With a little experience, you have no qualms about approaching a strange shore in the dark of night with an RDF giving you directions.

The radio direction finder price range is a broad one—all the way from around $70 (kits) to $1,000 or more. The extra money you spend buys additional sensitivity, accuracy and convenience.

Basically, an RDF is a radio receiver with a directional loop antenna. The receiver is tuned to a station and the antenna is then rotated until the signal reaches minimum strength or cannot be heard at all. This is known as tuning for a null. When the null is obtained the loop antenna is facing toward (or away from) the transmitter. You have probably noticed this effect when you pick up a portable radio and turn it around. The portable has a built-in loop which is directional and causes the signal strength to change as you rotate the set. In most RDF's the loop antenna can be rotated 360 degrees without moving the receiver.

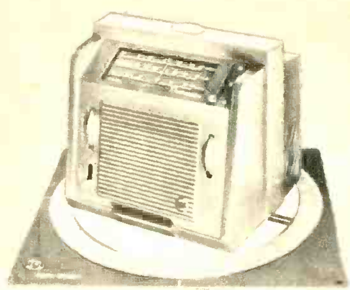
Attached to the loop antenna is a pointer which rotates over an azimuth ring (similar to that on a compass) that usually is aligned with the boat's bow—the bow being at the north or 0-degree position. The RDF's reading then is relative to the boat's compass heading. If you know the relative bearing of a station, the true direction you are heading and the location of the station (from a

$79.50 Lafayette HE-12 covers 3 bands and has a circuit of diode, thermistor, 9 transistors.



Lafayette Electronics
Jamaica 33, N. Y.

$140 RCA model weighs 4 lbs., has 3 antennas and mounts on a compass rose.



RCA Communications Div.
Camden 2, N. J.

$160 Roco RDF includes a compass, pelorus sights. Antenna is built into the handle.

Robinson & Co.
Gardena, Calif.

Hammarlund Mfg Co.
New York 1, N. Y.

$179.50 Hammarlund RDF-10 has 10 transistors, sense antenna, runs on 6 flashlight batteries.

Sonar Radio Corp.
Brooklyn 24, N. Y.

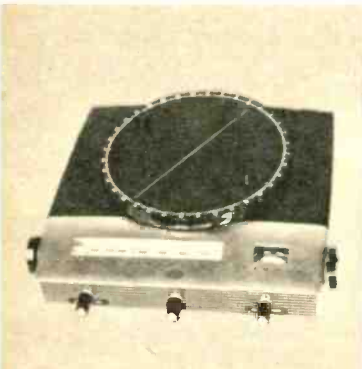
$249.50 Sonar model has 4,000-hour battery, 9 transistors, lays claim to accuracy of 1 degree.

chart) you can draw a bearing line from the station and know you are somewhere along it. Two or three such bearings give you an accurate fix.

Two basic types of loop antennas are found on RDF's: air core and ferrite core. The older air loops have windings concealed in a circular or rectangular tube. In the newer design a ferrite stick forms the core and increases sensitivity. In either case the null or minimum signal occurs when the coil windings are 90 degrees from the transmitter (with the flat side of the coil facing the station). When a ferrite antenna is used this means the core points toward the transmitter.

There is a small problem connected with the null phenomenon. Since the coil antenna has two sides, a null is produced when either side faces the transmitter. Thus, a null on your RDF could mean that the station is, for instance, dead ahead. Or it could mean the station is dead astern. The more expensive sets have a second antenna, called a sense antenna, to solve this problem. The sense antenna and circuitry examine the signal's phase and permit a null to show [*Continued on page* 114]

$250 Sperry RDF offers a sensitivity control, weighs 8 lbs., claims low interference.



Sperry Piedmont Co.
Charlottesville, Va.

$299 DF-O-Matic gives an automatic course reading and has rotatable azimuth on top.

Allen Bradford
Chicago 18, Ill.

$300 Bendix model has the classic plug-in air loop, contains 7-electron-tube lineup.

Bendix Pacific
N. Hollywood, Calif.

HI-FI RECORD GUIDE

by Warren DeMotte

BASIC LIBRARY FOR BEGINNERS

IF I WERE just starting a record collection, the first recording I'd buy would be Benjamin Britten's Young Person's Guide to the Orchestra. This is a modern symphonic composition (1946), enjoyable and stimulating to anyone. It is based on a robust melody by Henry Purcell, the great 17th century English composer, and consists of many variations on the old theme. Each variation displays the characteristic sound and technical capabilities of an individual instrument or combination of instruments.

Listening to this record is one of the most practical ways of getting to know how the instruments of the orchestra sound on your own playing equipment, whether it is a portable record player or an elaborate high fidelity installation, monaural (or monophonic) or stereo.

Two recordings of the Young Person's Guide are available in stereo (and, of course, in monaural). One is by Eugene Ormandy conducting the Philadelphia Orchestra and the other is by Felix Slatkin conducting the Fine Arts Orchestra. Both performances are brilliant and your choice should depend on your preference for what is on the other side: Serge Prokofiev's Peter and the Wolf or Ernst von Dohnanyi's Variations on a Nursery Song. Both are gems.

This is a good time to consider some fundamentals of record collecting. The primary purpose of collecting records is enjoyment—enjoyment of music, or enjoyment of sound, or both. However, if care is not used in selecting records, the collector soon accumulates discs he will rarely play, for a record quickly loses its appeal if the material or the performance is not first-rate. Records cost money, so careless selection is bad economics. The most sensible approach is to buy records that will still offer pleasure after many playings, and it is this type of record that will be favored in my recommendations for a basic collection.

Unless you want to specialize in one kind of music—perhaps classical or jazz or folk-song—a basic collection is more satisfying when it encompasses many types. Especially while the collection is still small, the greater the variety within it, the more [*Continued on page* 104]

WARREN DeMOTTE is known by many hi-fi fans as a knowledgeable and resourceful writer on records and music, and as host of the DeMotte Concert Hall, a two-hour Sunday evening program of good music formerly broadcast by the Concert FM Network. With this issue, he begins a column on hi-fi records, discussing both the new releases and the old standards. His first two columns will be devoted to a basic library for beginners. Warren is a native New Yorker with two professions—he's a free-lance writer and also operates his own public relations agency. He is author of a book, The Long Playing Record Guide, which he is now revising for re-issue. From time to time he goes on lecture tours, talking on music and records. He is married to Ida Hartman, concert pianist.

EI builds a Shortwave Receiver

WOULD you like to be a shortwave listener but find monetary limitations in your way? The Knight-Kit Span Master can be your answer to SWLing on a budget. For a few dollars and a few evenings of work you get a transformer-operated, two-tube (plus rectifier) regenerative receiver whose sensitivity compares favorably with AC/DC superhets selling for double the Span Master's $25.95 price tag.

Four switched bands cover the ranges from 540 kc to 30 mc. Other features include an effective electrical bandspread (which, for example, spreads the 26.96-27.23 mc Citizens Band over a dial circumference of about 1.5″), a 4″ PM speaker, fine and coarse regeneration controls, a headphone jack and a separate speaker cutoff switch.

You'll need a long antenna for DXing with the Span Master for a few feet of wire on the floor won't pull in much. When our unit was checked out in a city apartment with a built-in master AM antenna, local broadcast stations filled the dial with excellent sound quality. However, band D (13.5-30 mc) seemed dead. We checked the receiver with an RF generator and found the signal *was* getting through. It turned out that the extra-long antenna was loading down the regen detector and preventing its normal oscillation. The solution to the problem was to install a 50-mf trimmer capacitor in series with the antenna lead-in. The receiver then turned in a fine performance on all bands, although its selectivity (ability to separate close stations) wasn't quite up to superhet standards, a common failing of all regens.

The construction manual is well done with large pictorials covering each step in detail. All resistors are mounted on a chart with circuit designations printed beneath. Other small parts and hardware are packed in bags and are easily sorted out. At every step you are told whether to solder and how many leads are included. This technique helps catch wiring errors as you progress.

You may encounter two problems. The first involves the speaker mounting.

Since the speaker is installed in the cabinet and then wired to the chassis before the step is logically necessary, the succeeding steps become clumsy. One solution: don't mount the speaker until you've checked the operation of the completed receiver.

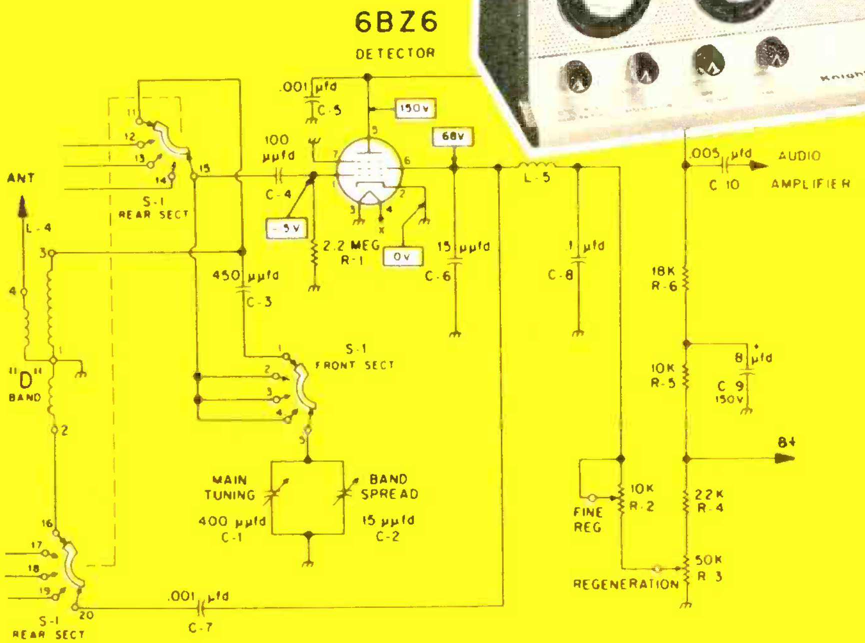
Later, the instructions tell you to mount two plastic dial plates on the front panel with flat-head, self-tapping screws. If these screws don't go in perfectly straight, you may end up with dials that do not operate smoothly. The solution is not to pull the knob and skirt away from the dial (this will only make it difficult to read the dial accurately) but to mount both the dial plates with 4-40 flat-head machine screws.

The Circuit

We show only the detector portion of the schematic here since this is the most interesting part of the circuit. The bandswitch is set to band D. The received signal is tuned by the combination of L-4 and C-1/C-2 and applied to the 6BZ6 detector. Regeneration is obtained by applying a portion of the signal from the screen grid (pin 6) to the input grid (pin 1) via C-7 and the "tickler" winding on L-4. The amount of regeneration is controlled by varying the 6BZ6's screen voltage with regeneration controls R-2 and R-3. Both controls must be adjusted for optimum tuning of each station.

The two audio stages (not shown) are combined in a dual-section 6AW8A tube whose triode is used as a voltage amplifier followed by the pentode section, serving as a power amplifier.

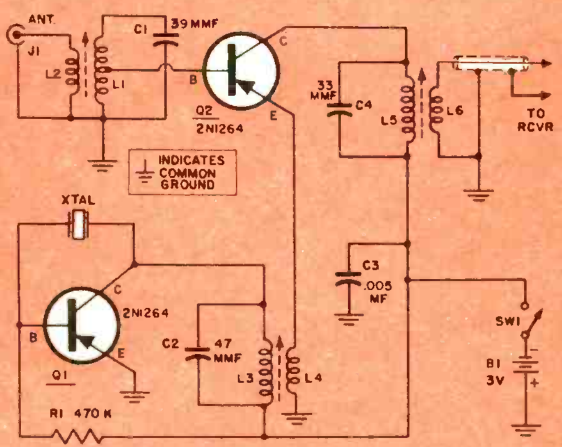
Summing up the Span Master, you can say that at its price level it is hard to beat for sensitivity, simplicity, appearance, and for the hours of pleasure you will receive exploring the airwaves.—*Robert D. Freed*



the *Talking* clock

Tune in WWV on any radio with this simple crystal-controlled converter

By Jules Rivman, W2NOS



PARTS LIST

R1—470,000 ohms, ½ watt, 10% resistor

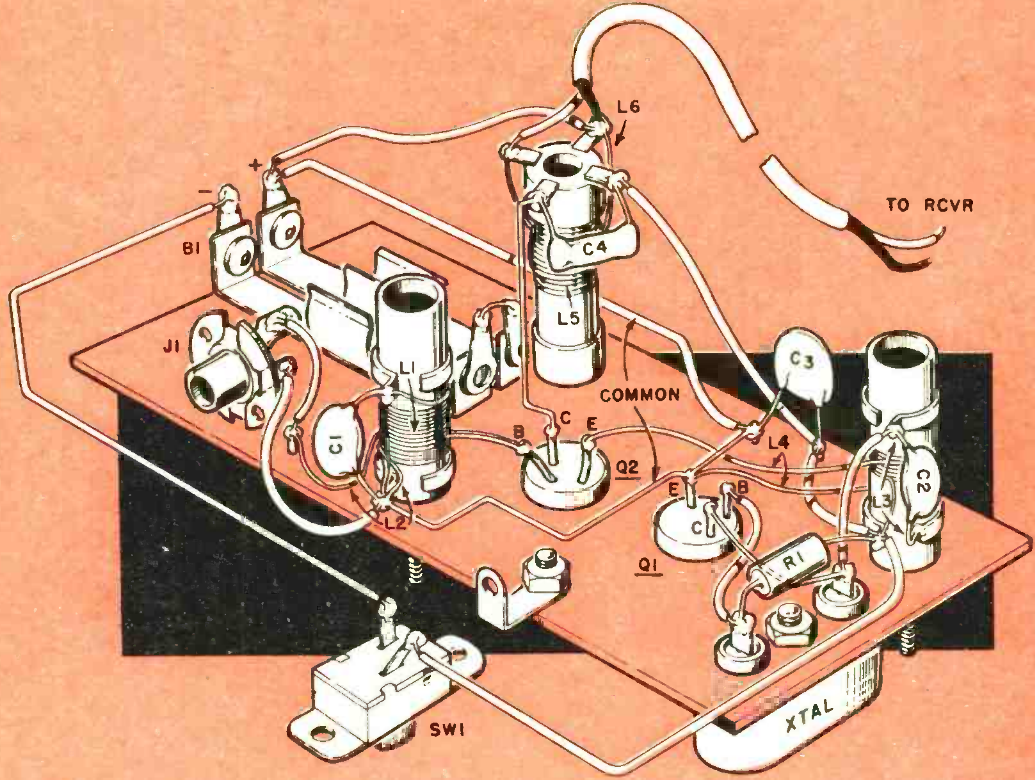
Capacitors

NPO tubular or ceramic disc types unless otherwise indicated

C1—39 mmf
C2—47 mmf
C3—.005 mf
C4—33 mmf

Coils

L1—60 turns No. 34 enameled wire tapped at 15 turns. Wound on ⅛" dia. Cambridge Thermionic Corp. slug-tuned coil form No. LS3 (see text)
L2—9 turns No. 34 enamel wire wound over ground end of L1
L3—⅜" slug-tuned coil (Cambridge Thermionic Corp. No. LS3-5MC)
L4—6 turns No. 30 enamel wire wound over L3
L5—¼" slug-tuned coil, 200-500 microhenries (North Hills Electronics form No. 120-1) Available from Radio Shack Corp. and elsewhere
L6—10 turns No. 30 enamel wire wound over L5
Q1,Q2—2N1264 transistor
B1—Two 1.5-volt "AA" cells plus holder
J1—Phono jack
SW1—SPST slide or toggle switch
XTAL—80 meter crystal and socket
Misc.—Perforated board 1¾"x3¾", 4"x2¼"x2¼" Minibox, 2 transistor sockets, length of shielded wire



Components are mounted on a perforated board with flea clips serving as tiepoints. Avoid shorting out components when installing board in cabinet.

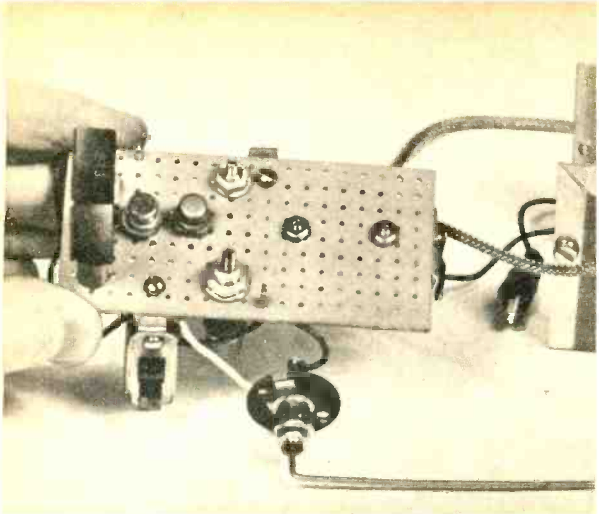
ATTACH the Talking Clock to a standard broadcast radio and you will hear a voice give you the exact time every five minutes. It will also enable you to set your watch to the second. It will give you a perfect "A" (440 cps) for tuning a musical instrument. And it will help you calibrate a signal generator, receiver, or transmitter so accurately that the error factor amounts to only one part in 100 million.

The Talking Clock is a pocket-size transistorized converter tuned to 5 mc, one of the frequencies of WWV, operated by the National Bureau of Standards. The Converter is crystal controlled for stability and uses a standard 80-meter amateur band crystal, available at most electronic supply houses.

Construction

The entire unit, with the exception of switch SW1 and antenna jack, J1 is constructed on piece of perforated board 1¾" x 3¾". The board is mounted in a 4" x 2¼" x 2¼" Minibox or it can be used without the box.

L1 consists of 60 turns of No. 34 enameled wire on a ⅜" slug-tuned form. First wind 45 turns then bring out a 2" loop of wire for the tap. Continue winding 15 more turns then coat with coil dope. When dry, wind L2, nine turns over the fifteen turns. L3 and L5 are standard pre-wound coils with secondaries L4 (6 turns) and L6 (10 turns) wound over them. You will find it easier to wind L4 and L6 if you wrap a piece of Scotch tape over L3 and L5 first.



Operation and Adjustment

Since the Talking Clock converts your broadcast receiver to a double-conversion superheterodyne, overall sensitivity is quite high. The incoming signal from WWV is coupled to L1 which is tuned to 5 mc. Since this parallel turned circuit (L1/C1) has a high impedance at resonance, L1 is tapped to match it to the low input impedance of Q2. The output of crystal-controlled oscillator Q1 is inductively coupled through L3/L4 and fed into the emitter of Q2. Here the signal is heterodyned with the incoming 5 mc signal. L5 is tuned to 5 mc *minus* the oscillator frequency to produce an output between 1000-1500 kc (the exact frequency depending on the crystal used) which is tuned in by the BC receiver.

Install the crystal and the batteries making sure the positive battery terminal is connected to the common ground. To adjust the clock's oscillator, connect the emitter of Q2, through a .001 mf capacitor, to the input of a short-wave receiver tuned to the 80-meter band. Adjust the L3/L4 slug until a signal is heard. A grid-dip meter covering the 80-meter band will serve instead of a receiver. You can also use a VTVM with an RF probe by placing the probe on the collector of Q1 and adjusting the L3/L4 slug for highest reading.

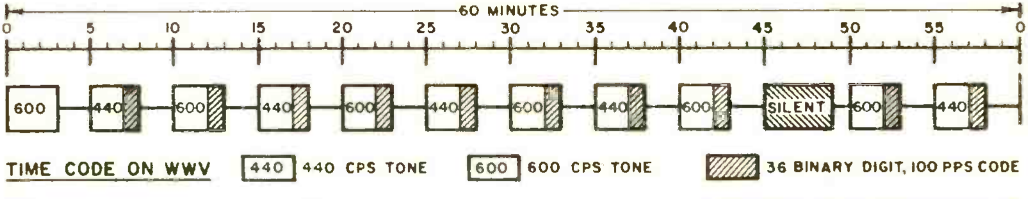
The Clock output is coupled to the antenna terminals of the receiver. If your receiver has a loop antenna, connect a few feet of wire to the converter output and wrap the wire around the circumference of the loop. For receivers with a ferrite rod antenna, wrap the wire around the coil. Keep the shielded output lead as short as possible.

Turn on the receiver and tune it to between 1000-1500 kc. If L1 and L6 are not too far out of adjustment, you should hear either WWV or other stations broadcasting around 5 mc. Adjust the slug of L1/L2 and L5/L6 for maximum volume of whatever you hear. Then carefully tune the receiver until you hear the ticks, beeps, or the voice announcements of WWV.

Although you can use any crystal in the 80-meter band, it would be wise to select one that will prevent WWV from interfering with a local broadcast station. Select a spot on the dial between 1000-1500 kc where there is no station and *subtract* the frequency from 5 mc to determine the crystal frequency.

Since the frequency of WWV is extremely accurate, you can use the Clock as a 5 mc frequency standard by zero-beating a signal generator against WWV. Or by zero-beating your grid-dip meter or a 100 kc crystal calibrator against WWV, you can calibrate them and then use them in turn to check the calibration of your receiver or transmitter.

An hour of WWV standards broadcasting is charted below. Voice announcements of the time are given each five minutes, followed immediately by a 600 or 440 cycle-per-second tone. The special binary digit transmission gives the day, hour, minute and second in a 100 pulse/second code.



OUR ATOMIC WAR ON DISEASE

Medicine finds a valuable ally in radioisotopes.

By Donald F. Klein, M.D., and Richard A. Markoff, M.D.

March 14, 1959: Medical Case Record #101658
History of Present Illness:

The patient, Jane Williams, is an attractive girl of 23. Eight months ago she began to lose weight, although her appetite was good. Her hands trembled. She began to find ordinary room temperatures suffocatingly hot. Her referring physician's note states that her skin is flushed and perspiring, her eyes protrude slightly and stare fixedly. Her pulse is rapid and bounding . . .

(please turn page)

A scintillation counter to which is attached a collimator is used to measure the uptake of radioactive iodine by patient's thyroid gland.

On the preceding page we saw listed the Medical Case Record of Jane Williams. What's wrong with her?

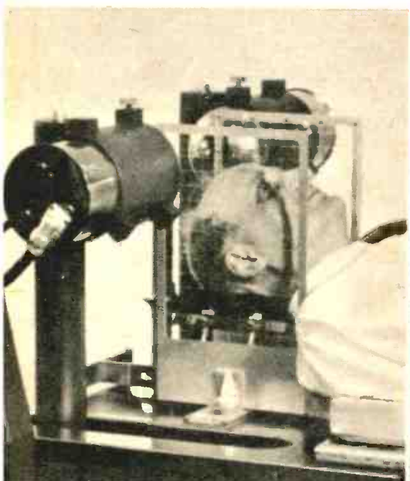
Jane's doctor suspects Graves' disease, a condition in which the thyroid gland is hyperactive. Just a short while ago, that suspicion would have been difficult to confirm. But today the problem of diagnosing thyroid gland disease, and an increasing number of other difficult medical problems, are being solved by a collaboration amongst medicine, electronics and atomic physics. It could someday save your own life.

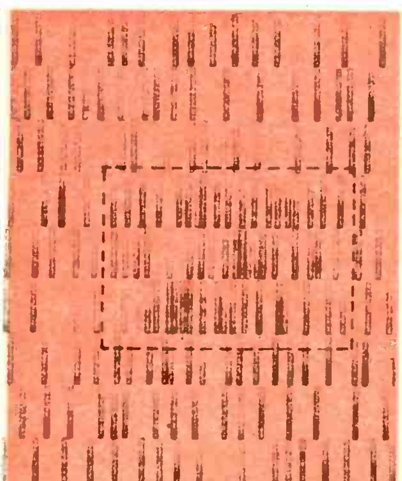
The key to these heartening developments is the radioisotope. To see what a radioisotope is, let's take a quick look at atomic structure. An atom is built up of a central nucleus, in which the weight of the atom is concentrated, and a number of electrons which whirl around the nucleus. The chemical behavior of a substance—the way in which it combines and reacts with other substances—depends on the number of electrons in its atoms.

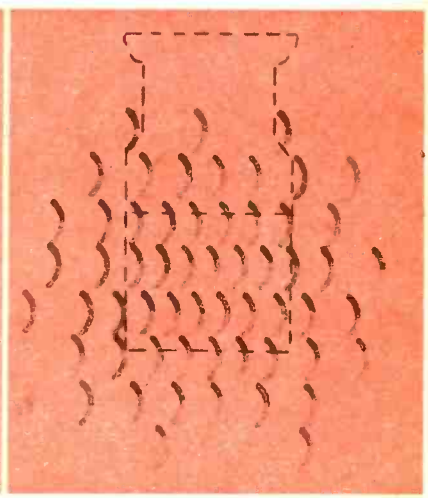
Some substances have close atomic relatives—chemical twins—which have larger mass and more weight in their nuclei but possess the same number of electrons. These are called isotopes of the normal element, such as the *oxygen isotope.* Neither the analytical chemist nor the human body, itself a chemical machine, can tell these twins apart. But some of them are easily identified by the physicist because they are radioactive, emitting particles or electromagnetic waves. A few of these radioisotopes occur in nature but, what is more important, many more can be made at will by the atomic scientist.

One artificial radioisotope is a radio-

Positron scanner locates brain tumor in three dimensions. Scintillation counters on either side scan the head in a set pattern and pick up radiations from isotope, producing print in center (tumor is in area marked off by broken line). Second print compares separate readings and tells which side of head tumor is on. Curved lines indicate left side; straight ones would mean right. Note matrices beside man's head.







active variety of iodine, called iodine-131 (I-131 is the chemical symbol). And that brings us back to Jane Williams, who is believed to have an abnormal thyroid condition.

The thyroid gland produces a hormone which contains iodine, so it must pick up and concentrate considerable amounts of this element as one of the ingredients it needs for its assigned job. An overactive thyroid gland picks up iodine faster and stores more of it than needed. It's like buying 100 pounds of flour to make one cake. If we could tag the iodine a person consumes and keep track of where it went inside the body, we could tell whether a suspected thyroid actually was overactive and stored up too much of the tagged iodine in a given length of time. I-131 is radioactive iodine, so it is possible to trace it by detecting its radiations from outside the body.

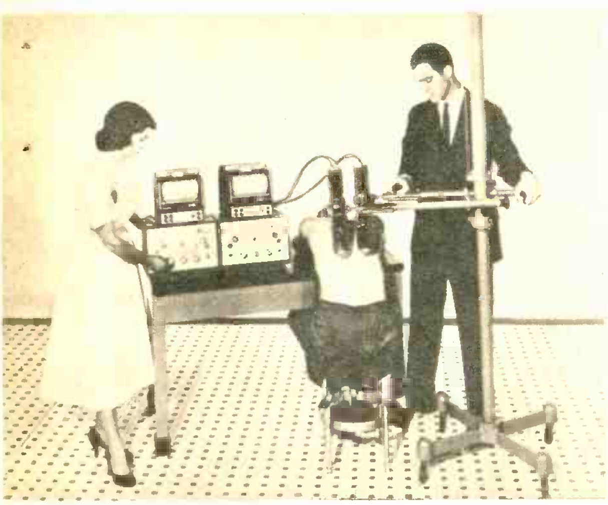
Jane Williams' doctor can confirm his suspicions by giving her a small amount of I-131 and 24 hours later measuring the amount of radiation coming from a spot on the neck overlying the thyroid. In one day and at little inconvenience to Jane he can make a sure diagnosis and begin treating her disease.

There are other similar uses for I-131. Take the problem of the wandering thyroid. In the complicated course of human development the thyroid sometimes gets lost and ends up in the chest instead of in the neck where it should be. This is not serious in itself. But it can cause alarm when it shows up as an abnormal mass of tissue on a chest X-ray picture. Now the appearance of radioactivity in the mass after a dose of I-131 proves it to be merely a thyroid gland with a taste for travel.

Let's turn to the case of John Smith. For the past two months he has been troubled by fever, chills and a pain in his back and left side.

John's doctor has diagnosed an infection of the left kidney and he feels that it should be removed—provided the right kidney is normal. One of the tests he can use to gain that assurance employs a device called a medical ratio analyzer. This consists of a pair of radiation counters, each focused on one of the kidneys, and a computer in circuit with the counters. After John has received a known amount of a substance which is eliminated from the body entirely by way of the kidneys, and which contains a radioisotope, the medical ratio analyzer records the amount of radioactivity from each kidney, graphing the results and automatically comparing them to normal readings. This will tell

Scintillation counters and computers compare functioning of two kidneys with each other and with norm after an injection of radioisotope.



Thai researcher, working on a United Nations project, injects radioisotope in meat which will be fed to animal in new basal metabolism study.

Medical isotope equipment includes Geiger counter (left), scintillation counter (right). Computer in center registers readings from either unit.

the doctor whether John can live safely with only the right kidney.

We've made mention several times of instruments used to detect radiation. Just what are they? Two main types are in use, the Geiger counter and the scintillation counter. The Geiger's main unit is a diode filled with non-conducting gas. When radiation passes through the tube the gas ionizes briefly, becoming conductive. A pulse of current then flows through the tube and associated circuits. The frequency of these pulses depends on the amount of radiation passing through the tube and on the time it takes for the gas to ionize and then return to its normal state. The machine counts these pulses and gives corresponding radiation-level reading.

In the scintillation counter a somewhat different principle is employed. Here the atomic radiations strike a crystal of sodium iodide, which has the property of emitting a brief pulse of light when so struck. The light falls on the cathode of a photomultiplier tube and this produces a pulse of current through the tube and associated circuits. Again, as in the Geiger counter, the greater the amount of radiation falling on the counter, the greater the frequency of current pulses. But because the sodium iodide crystal takes less time to return to its normal state than does the Geiger counter's diode the scintillation counter is more sensitive. It can differentiate between amounts of radiation that would register as the same on the Geiger counter.

As indicated earlier, two types of radiation are produced by radioisotopes. Some radioisotopes are emitters of particles, while others emit gamma electromagnetic radiations. Either kind can be used in medical applications but gamma-ray emitters are employed more frequently for a variety of reasons, the chief being that rays give better penetration and can be easier to detect.

One of the most exciting and ingenious uses for radioisotopes is in detecting the precise location of brain tumors, which must be done before undertaking surgical or X-ray treatments or the newer ultrasonic treatments.

After a doctor diagnoses a brain tumor he is faced with the vital question: what is its exact location? The choice of treatment and even hope of a cure depend on the answer.

How can radioisotopes help? Well, normal brain tissue is quite selective about which substances it allows to enter into itself from the blood which circulates through it. The wildly growing tissues of a brain tumor have no such selectivity. Many substances from the bloodstream are absorbed by tumors.

One could inject a radioisotope into the bloodstream and scan the external surface of the head with a radiation counter. Healthy brain tissues would reject the substance but a tumor would not. So any [*Continued on page* 99]

130-Mile Antenna

AT FIRST glance you might ask what that chap above is doing with his grandma's spinning wheel. Well, his name is Donald Wasmundt and he works for the National Bureau of Standards. On his 6½-foot wheel he is winding an antenna—130 miles of copper wire that fits into the four grooves.

The NBS is taking this antenna and eight others into various parts of the world and burying them. This strange rite is part of a study of pulsations in the earth's magnetic field. The field, portrayed as those circles of dotted lines in our science textbooks, is not constant. Instead, it is racked by pulsations ranging from giant (with a cycle lasting about 200 seconds) to tiny (.5-second cycles). The pulsations have some relationship to solar storms and other phenomena that affect radio signals. With the buried antennas, scientists will listen in on the pulsations to determine exactly what this relationship is, along with the plotting the characteristics of the pulsations themselves.

The antennas had to be specially designed to pick up the pulsations which, with a cycle of more than three minutes, would have to be called ultra-ultra-low frequency.

Tech Editor's Test Bench

by Larry Klein

Troubleshooting Techniques

WHEN the transistor first appeared not too long ago, it caused quite an uproar. Engineers went back to school, factories retooled, products were redesigned and miniaturization became a household word. And, of course, along with new products and techniques, transistors introduced new problems.

First of all, how does one test them and the circuits they inhabit? Answers to that question have ranged all the way from $1,000 oscilloscopes, which automatically present a transistor's family of curves, down to a little $4.95 meter that checks the beta gain of a transistor against its leakage. But how much can either device do for the radio serviceman up to his black bow-tie in transistor radios and their 101 assorted problems? Obviously the serviceman requires transistor test equipment specifically designed for his specific needs.

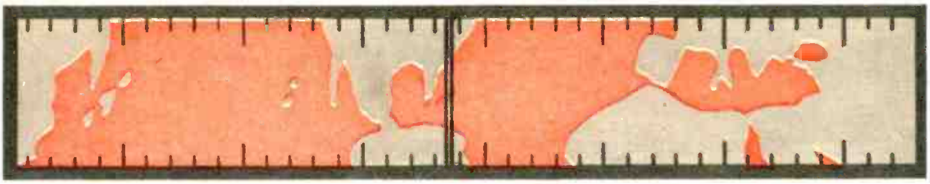
In the good-old pre-TV days, when I was doing my bit to keep the soap operas coming through loud and clear on the neighborhood's radios, four out of five AC-DC sets that came into the shop had nothing more wrong than a burned-out tube. Troubleshooting meant that I would switch on the set to see whether the tube filaments lit. If no spark of life appeared, I'd pull out the 35Z5 (the most likely suspect) and check continuity between pins 2, 7 and 3. The 50L6 was next in line for investigation. After the 50L6 it was anyone's guess which of the other three tubes was the culprit. But even on a bad morning, the whole procedure took no more than five minutes.

Troubleshooting a transistor radio however, is a "horse of another color." Let's say you turn the set on and all you hear is a soft hiss. Then you check the battery voltage—and that's okay. Where do you go from there? Check the transistors? But 99 out of 100 transistor radios use printed circuit boards with the transistors soldered in place. There's a good chance that you'd ruin the little fellows just by trying to get them out for testing. Obviously, new techniques are required.

Since both a need and a fair size market existed, instruments were designed specifically for transistor radio troubleshooting. One of the most interesting and least expensive is the Superior Instrument Model 88 Transistor Radio Tester. In one compact unit, Superior provides a signal tracer, a signal injector and a leakage/gain test which will handle almost any entertainment transistor found in today's sets.

Let's see how you would go about servicing a transistor radio with the Model 88. Suppose the set to be serviced is stone-cold dead. Assuming the battery is okay, the problem is obviously one of localiz- [*Continued on page* 108]

THE LISTENER



Notes for the short-wave listener and DXer

By C. M. Stanbury II

SWL AND DX . . . is there a difference?

Those two terms seem to lack official definitions and are used and misused interchangeably and haphazardly. SWL stands for Short-Wave Listening usually, and sometimes for Short-Wave Listener, although this latter often comes out SWLer. Fortunately, DX is simpler, being Morse Code for distance.

Although SWL and DX are closely related, they seemingly have come to express slightly different ideas. DX now applies to something more specialized than just listening on the short waves. It means bringing in a station which is difficult to hear or one that is in a rare location. The content of the signal itself couldn't matter less to the pure DXer, so long as it can be logged, identified and (usually) verified. And the DXer is not restricted to short waves. He's perfectly happy logging a long-wave beacon down in Ecuador which sends nothing but its identification in code.

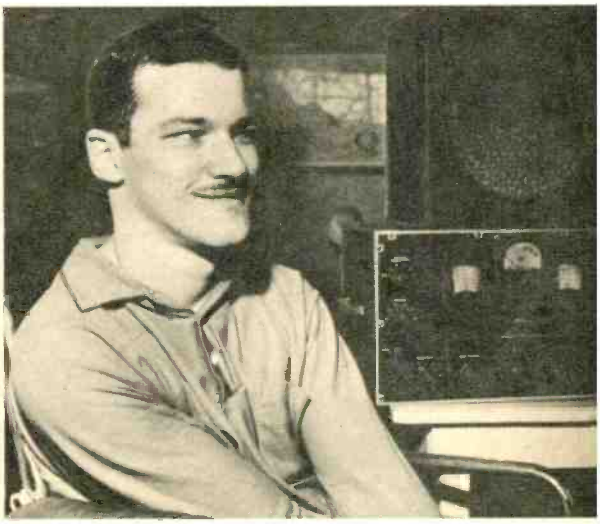
There's such a thing as interesting DX, to be sure. The first-hand account of a Latin American revolution would provide more fascinating listening than an aeronautical weather report (unless you happen to be a meteorologist).

On the other hand, we've come to think of a Short-Wave Listener as being more interested in program content—the news slant from Moscow, a symphony from London, a cultural discussion from a new African nation. If the signal is easily received, so much the better. By definition, an SWLer is restricted to the short waves. If he moves down into the long waves we'd have to call him an LWLer!

But the SWLer also wants to get those distant stations, the ones that are hard to bring in, so he has some DXer in him, too.

The two con- [*Continued on page* 110]

C. M. STANBURY II lives in the small Canadian resort town of Crystal Beach on the shore of Lake Erie. From there, he roams the globe in search of radio signals. If you want to know what is going on virtually any place in the radio spectrum, the ranking authority to ask is C. M. Stanbury. Stan is EI's Contributing Editor on Short-Wave Listening and DXing and in this issue he begins a regular column on his special subject. Stan took up serious DXing in 1951 and was able to turn his enjoyable hobby into a full-time occupation by writing about it. He covers everything from UHF down, and in the way of QSL cards he has verifications from 100 countries in the medium waves (300 to 3000 kc), 397 broadcast-band QSL's from outside the U.S. and Canada, verifications from ten space vehicles and a shack full of other cards. His equipment is a 1939 model Hammarlund HQ-120X, a surplus GE RAX-1 that goes down to 200 kc and a Granco 780 FM set.



The Solar Wheel

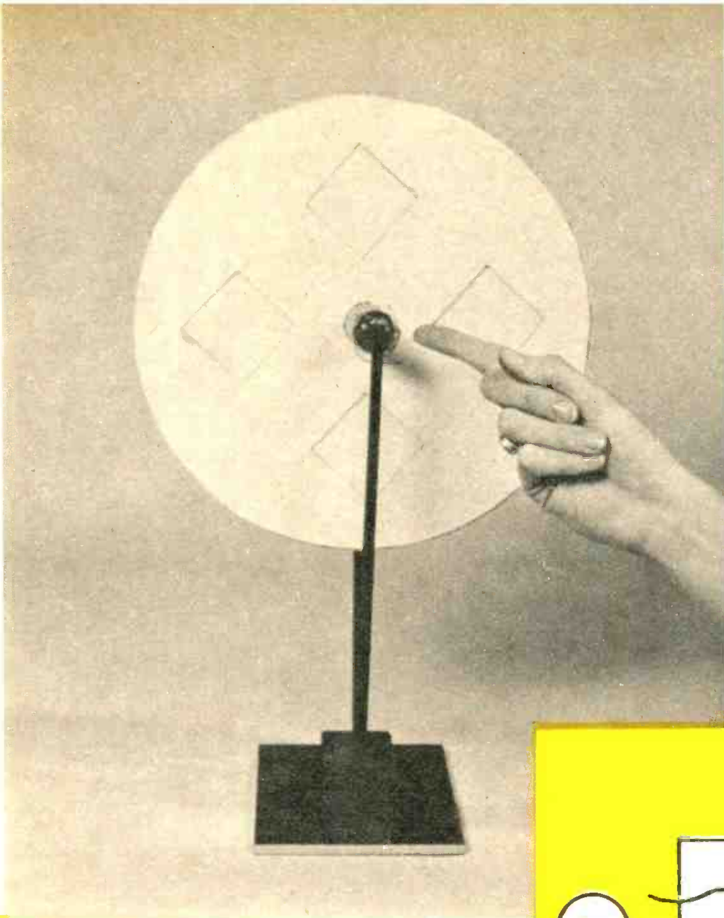
Mystery wheel blends fun with theory of solar cells.

By George Byron

THE mounted motor-driven wheel pictured on this page has no visible power cable, and no dry cell or battery is hidden in the base. However, when sunlight strikes the wheel's surface, it turns. Using a bright lamp will accomplish the same thing. In other words, the wheel is powered by light.

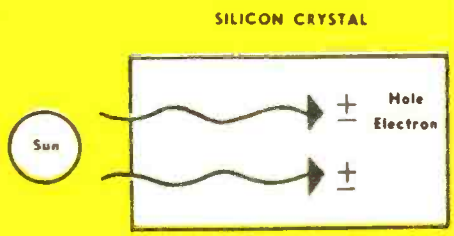
How does it work? The small black disk just above the motor housing provides the answer. It is the remarkable new solar cell which converts ordinary sunlight into electricity. This insignificant looking black chip may one day revolutionize the production of electric power.

Striking spiral effect has been painted on author's wheel. Black disc near eye of the wheel is a high-output Hoffman solar cell.

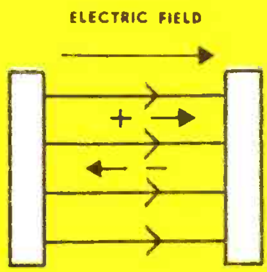


Miniature Aristo-Rev motor converts electrical energy of solar battery to high torque. Wheel is cut out in even sections for proper balance and lower weight.

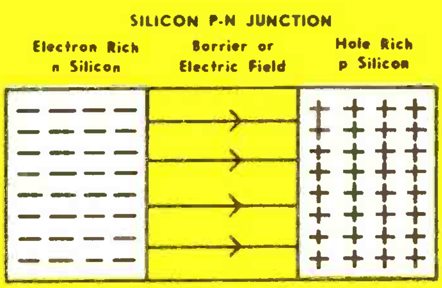
All drawings courtesy
Bell Telephone Laboratories



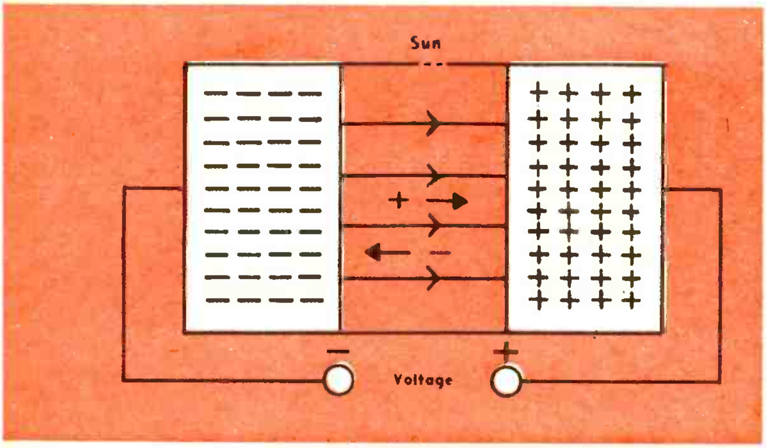
Light is absorbed in a silicon crystal by liberating loosely bound negative charges. (electrons) and the free-to-move holes.



An electric field exerts a force on charged particles, moving them if they are free. The force moves holes in one direction and negative electrons in the other direction.



In a thin barrier at junction between an electron-rich N-region and a hole-rich P-region, a strong built-in electric field exists which keeps the electrons and holes apart.



When the light is absorbed, freeing electrons and holes in the barrier region at a P-N junction, the built-in electric field forces the holes into the P-side, making it positive, and the electrons into the N-side making it negative. This displacement of charges causes a voltage to appear between the silicon crystal's ends.

During any 24-hour period, the amount of energy radiating on earth from the sun totals more than one quadrillion kilowatt hours. Since this figure is meaningless without some tangible comparison, we can express it another way: it is equivalent to all of the potential energy stored in all of the earth's known reserves of coal, oil, natural gas and uranium. Small wonder then that for centuries men have searched for methods of capturing even the smallest fraction of this stupendous energy source for useful power.

In April of 1954, Bell Laboratories made an announcement of outstanding significance. Three of their scientists,* working as a team, had developed a tiny silicon cell which converted ordinary sunlight *directly* into usable amounts of electricity. And silicon, which comes from ordinary sand, is one of the most abundant materials on earth. With one magnificent stroke, this device, now known as the Bell Solar Battery, swept aside the cumbersome process of producing electric power and harnessed the sun as a power source.

Like many important inventions of the past, the solar cell is basically simple in construction and operation. (It is a Solar Battery when two or more cells are connected together.) The cell consists of a wafer of silicon, about 1/25 of an inch in thickness and about the diameter of a quarter, in which a minute amount of arsenic is added as a necessary impurity. A layer of boron, .0001 of an inch in thickness, is diffused on one surface of the wafer to form a P-N junction, similar to that of a transistor. The silicon acts as the electron-rich N layer, while the boron is the hole-rich P layer. Between these two layers is a thin barrier region in which a strong electric field exists, keeping the electrons in the silicon and the holes in the boron.

Theoretically, a solar cell will never wear out, for there are no moving parts and nothing is destroyed or consumed in the energy conversion process. Its present efficiency of 11% compares favorably with the best gasoline and steam engines. Estimates are that the ultimate efficiency can be increased to 23%. It's nice to remember though, that the other 77% will not really be wasted as far as we are concerned, for it will all be supplied gratis, courtesy of old Sol.

The Solar Wheel illustrated can be used in laboratory demonstrations of the energy conversion process, or at science fairs. The Wheel also makes a puzzling window eye-catcher. Since ordinary display lamps will make the wheel turn, placing the entire assembly on a glass plate, with no visible sign of a power supply, will command a great deal of attention. The solar cell can also be dismantled of course and used for further experimentation. The solar cell used in author's model was Hoffman Type 2A, cost $7.50, but other equivalent current cells may be used.

You can [*Continued on page* 103]

* G. L. Pearson, D. M. Chapin, and C. S. Fuller

EI Kit Report

CITIZENS BAND TRANSCEIVER

THE confusion that clouded the first two years of Citizens Band Radio is beginning to clear—you do *not* need a commercial ticket to tune your set into an antenna *if* the kit is supplied with a sealed oscillator.

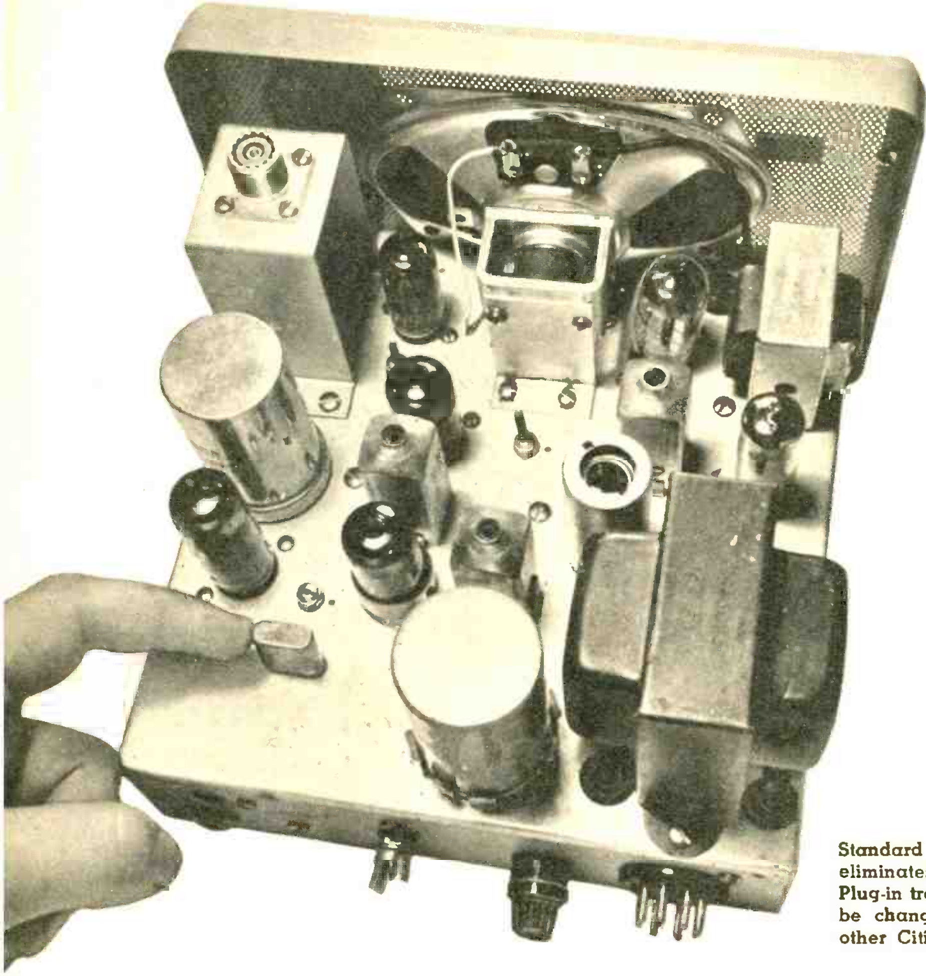
The EICO 762 therefore includes along with the usual complement of kit parts, a small wired, tuned and factory sealed sub-chassis housing the crystal oscillator circuit.

The rig employs a superheterodyne receiver, more expensive than regen types, but a selective performer when stations are piled up on the band. It is tunable over the 23 Citizens Band channels.

The transmitter is a 1-channel job, capable of the 5-watt power maximum. Other EICO crystals may be plugged for operation on any of the other channels with no retuning required. A special feature of the transmitter is a *pi-network* output. Long a popular circuit in ham radio, it allows a close match between transmitter and a wide variety of antenna types. This is helpful when your antenna is not quite the 52-ohm load prescribed for most CB transceivers.

Figure on ten to twelve hours for construction. Even with the prewired oscillators, there's plenty to build. The usual respects should be paid to tight corners and close quarters, but no particular construction problems were encountered.

A test tune-up of the completed transmitter is done with a #47 bulb jacked into the antenna output as a dummy load.



Standard flat chassis layout eliminates wiring problems. Plug-in transmitter crystal may be changed for operation on other Citizens Band channels.

These adjustments must be repeated when the antenna replaces the dummy load. A 100 ma meter (or VOM) is used to adjust the RF input power to the 5-watt maximum set by FCC regulations. And here is where the new FCC rule applies. You may tune the transmitter output with no authorization other than your Citizens Band Radio license. (The oscillator cannot be adjusted without breaking its seal.)

A novel procedure is used for receiver tune-up. The transmitting crystal is made to function temporarily as a signal generator to supply an alignment signal to the receiver. Alignment is then accomplished by tuning the various slugs for loudest hum in the speaker. Simple, but effective!

We built the Model 762, which differs only in power supply from the 761. The first is for 12-volt cars, the second for 6 volts. *Both* have a built-in 117-volt AC supply and are converted from house current to car battery operation by simply changing the power cable and fuse.

Using its handy bracket, the 762 fit readily under the dashboard of the author's car and occupied a space only 6″ high, 8½″ wide and 9″ deep. A field-strength meter came in handy for tuning the transmitter's output into the mobile whip. From the author's car, reliable communications between base station and mobile were achieved at more than 7 miles. Of course, range will vary, depending on antenna height and terrain. EICO states that up to 20 miles can be achieved under optimum conditions. The receiver's built-in noise limiter functioned very well, reducing the sharp pulses of noise originating from the spark plugs.

EICO did not provide a small pocket

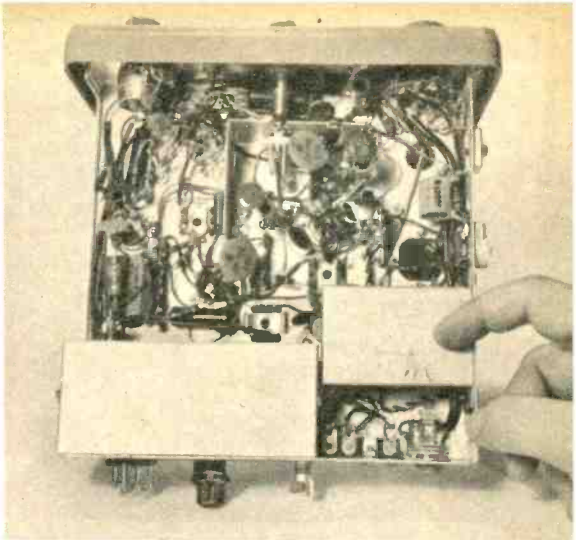
on the case for it, but be sure to mount your Transmitter Identification Card on or near the unit, as required by the FCC regulations.

Two optional antennas are offered as accessories for the unit. The first is the AT-1, a 40" base-loaded whip that plugs in at the top of the case. More effective signals will be radiated by the AT-3 ground-plane antenna. It is intended for roof mounting and provides maximum non-directional coverage.

At $69.95 for the kit, the EICO transceiver is a good buy (price includes mike and 1 crystal). When purchasing, specify a channel if you have a preference. The sealed oscillator will operate on any CB channel without further adjustment if other plug-in crystals are ordered from EICO.

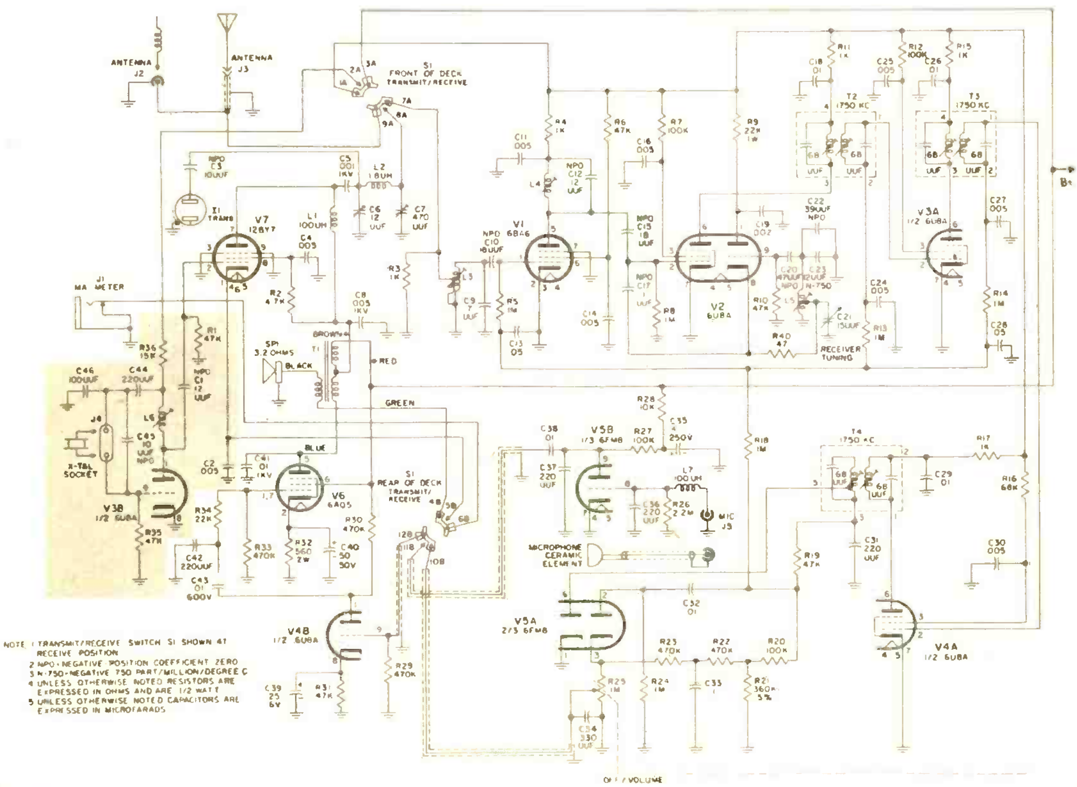
EICO will shortly have available a new CB transceiver. Among its features will be switch selection of four transmitting channels and a push-to-talk microphone. The 770 series will physically resemble the 760s, but sell for about $10 more.

Len Buckwalter, 1W5733



Underchassis view of the completed transceiver.

Transceiver schematic (less power supply) showing superheterodyne circuit with RF stage (V1), mixer-oscillator (V2) and IF amplifiers V3A and V4A. Shaded section indicates sealed transmitter oscillator section.



OUR SECOND WAR WITH JAPAN

You don't usually find an article of this type in the pages of EI, but the subject in this case is of such vital concern to our readers that we are making an exception.—The Editors

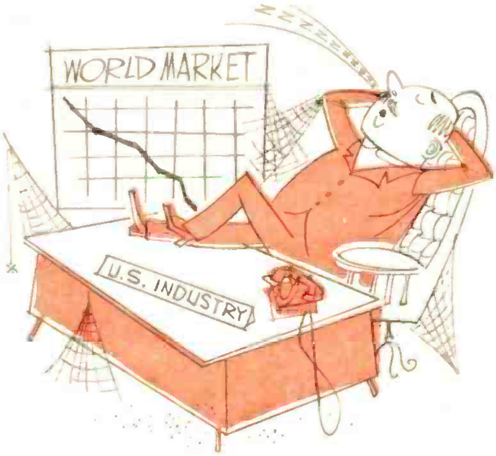
By Paul Daniels

IN A MOVIE that was popular a few months ago a small, impoverished country hatches an ingenious scheme to get hold of the horn of plenty. It declares war on the United States and sends over a band of bow-and-arrow invaders. According to the plan, they will be captured, the country will lose the war and Uncle Sugar will pump aid into the land so the vanquished will recover properly and be friendly.

This being the movies, the plan naturally backfires and the little country wins the war. But in light of recent experience, the original thinking was sound. There's now a standing joke about the man who looks at the condition of the U. S. and Japan and asks, "Say, who won that war, anyway?"

Politically, we have a strong friend and ally in Japan. Economically, we have a competitor who is giving us a good many grey hairs by selling a tremendous quantity of goods on the U. S. market at prices we'd rather not compete with. A large percentage of these imports are in the electronics field and thus have a direct effect on many of EI's readers.

As a consequence of the import situation, businessmen and industrialists, legislators, federal administrators and plain consumers are being bombarded with propaganda from both sides. Some of it is conservative and subtle, and some is of the broadaxe variety. U. S. manufacturers have banded together in various organizations to present their views and fire their broadsides, and the Japanese have replied almost in kind.



"Tomorrow . . . any number of countries may be in a position to wreck our world markets."

Our side, claiming Japanese industry is "inflicting serious and permanent damage on American suppliers," came up with a "Buy American" slogan. An electrical union threatened to quit handling products or components made in Japan, and clothing workers wanted to boycott Japanese fabrics. A U. S. Senator rose on the floor and demanded that the Japanese take voluntary action to stop wrecking the American dry battery industry or face "remedial action" by our government.

With both camps armed and firing, where do we go from here? There is no clear-cut answer, but here are some of the facts in the case.

The American electronics industry is not of one mind in the affair. Some radio manufacturers have beaten the competition by joining it. General Electric, Channel Master and others have arrangements whereby Japanese firms build radios expressly for them and ship the sets to this country for sale under GE or Channel Master labels. Some large mail-order houses have similar arrangements. Still other companies use Japanese components in their products.

Having adopted a live-and-let-live policy, these companies must oppose any severe restrictions on Japanese imports because it would hurt their own business.

Congress and the administration, committed to a policy of free trade and not a little fearful of retaliation, hesitate to impose high tariffs, although at this writing a quota system for textiles is being bruited about and electronic products presumably might be beneficiaries of a similar arrangement.

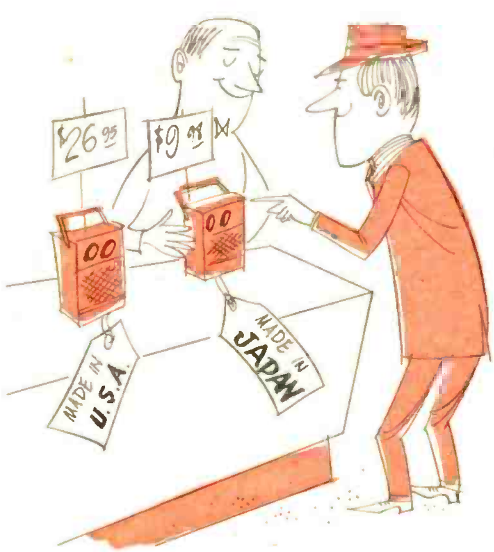
While we talked of restrictions, Japan chopped 720 more items off her import curb list, making 65 per cent of her imports control-free, and contemplated putting a match to the whole list. She also has kept careful control of export quotas so as not to flood the market.

And despite our heavy imports of Japanese electronic equipment, the U. S. still enjoys a balance of trade—they buy more from us than we do from them (we send over mostly such raw materials as coal, cotton and wheat; they ship manufactured goods).

The above picture of Japan knocking down trade barriers while we're rolling out spools of barbed wire does not put Uncle Sam in a good light, but he's probably used to that by now. Sometimes one can imagine the old boy giving California to Middle Bongolia and still managing to look selfish, awkward and thieving while handing over the deed!

Where does the consumer—you and I—fit in? We are interested in the prices

"On transistor radios competition from Japan and not mass production forced prices down."



we pay for what we buy; the lower the cost the more we can buy. But we're also interested in quality. A brand-new TV set that starts sending up smoke signals after three days isn't a bargain even at $49.95. At one point Americans tended to look on Japanese products as cheap replicas in both price and quality. If today Japanese radios, hi-fi components, Citizens Band transceivers, test equipment and other items were both less expensive than their American-made counterparts and lower in quality, we would have no problem as consumers or producers.

But many of our imports from the land of the Rising Sun have in recent years proven to be of quality comparable to our own goods and some even offer extra features. One Japanese transistor radio, for instance, includes a marine short-wave band that is not found on American radios.

Says the Association of Electronics Parts & Equipment Manufacturers, representing small U. S. firms: "We realize that 'Buy American' is a meaningful slogan only when it means 'Get a better deal for your investment.' "

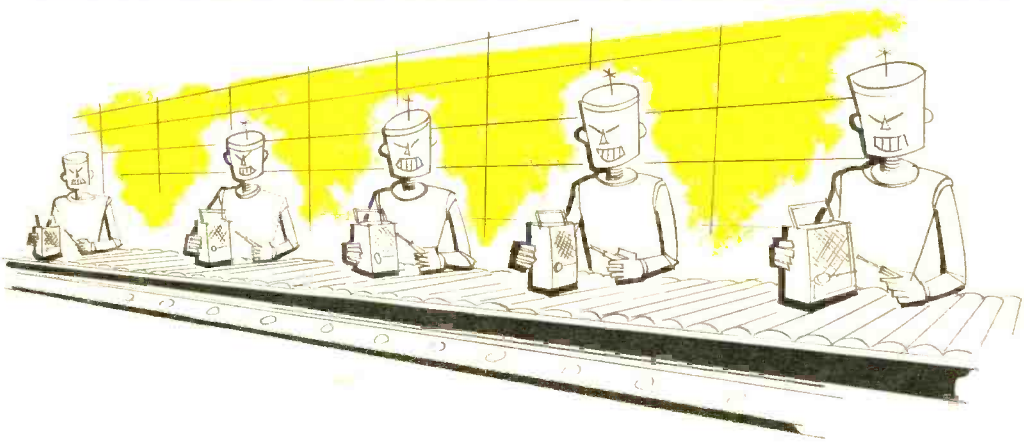
Before the Japanese sent transistor radios to this country the price for a set made and sold here was between $40 and $50. Of course, as mass production brought the price of transistors down, radios would have become less expensive. But there is not one radio manufacturer who would say that the cost for an American made six-transistor radio would have been reduced to $24.95 or less by reason of mass production. The competition from Japan forced the price down. The consumer naturally benefitted but many American manufacturers say they cannot sell their products at such low prices and still make a reasonable profit.

Mosley Electronics, Inc., is a Cleveland manufacturer of TV antennas and other types of antennas and accessories. They produce a flush-mounting socket for master TV installations which wholesales at 79¢. A Japanese copy is available in the U. S. for 29¢. Mosley says it cannot produce the item to sell for 29¢.

Ralph J. Cordiner, chairman of General Electric, says American industry must automate to compete with all comers. But the small manufacturer replies that he can't afford to automate. Then he points to the increase in small manufacturer bankruptcies and warns that if the competition from Japan drives him out of business it will cripple America's defense potential.

In the last analysis, Admiral, Zenith, Mosley and others who advertise the "Buy American" slogan are asking you to put the state of your nation before the state of your pocketbook. And, though the argument at first sounds dubious, it has some merit. If we as Americans don't protect our own industries no one is going to do it for us. Further, the health of our industries affects our pocketbooks as [*Continued on page* 102]

"Automated assembly lines alone aren't the answer; Japan is almost as well automated as we are."

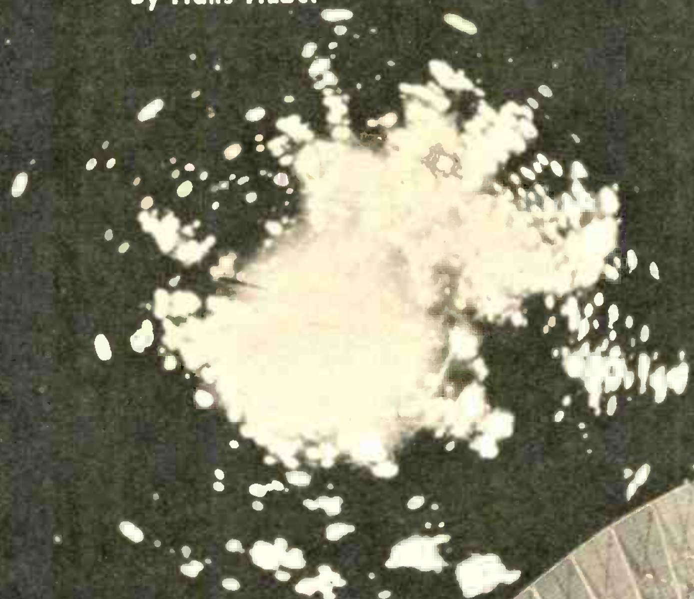


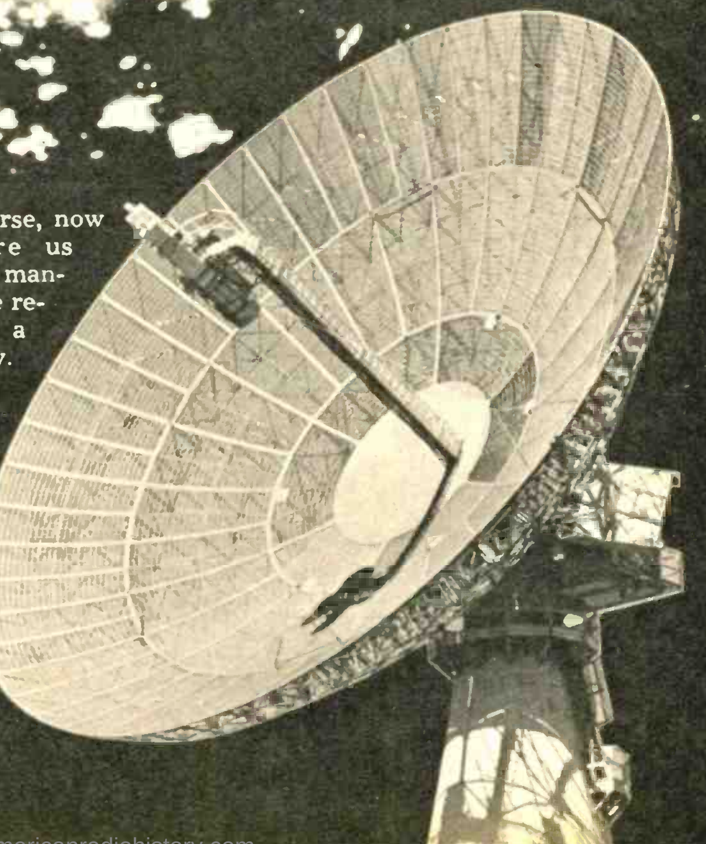
newest celestial art:

RADAR ASTRONOMY

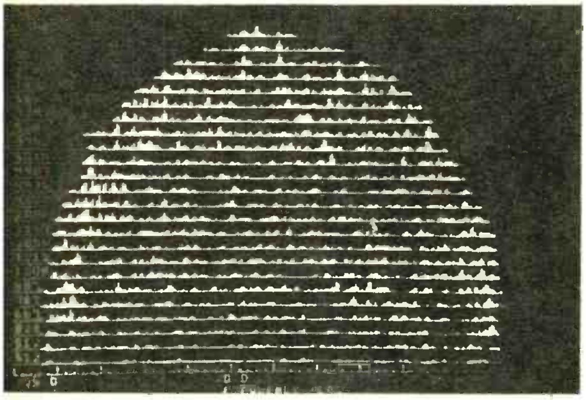
Incredibly accurate maps of our neighbors in space are possible with new coherent light radar.

By Hans Huber





THE mysteries of the universe, now slowly unfolding before us through space probes and man-carrying satellites, may soon be revealed in dramatic detail by a new form of electronic wizardry. For a good many years the probing fingers of radar have been sweeping through the heavens, bringing back messages about what they found. But the sensitivity of those radio-frequency fingers was never great and the facts they gathered were crude. Now we have something new—optical light radar—which, using a fantastically narrow beam of coherent light, may



A radio-frequency radar view of the moon; scale markings on sides were darkened by EI (see text).

SENSITIVITY CHART

Radar astronomy sensitivity required to map celestial bodies, based on requirement of 1 for the moon. Signal flight times shown are for periods when the bodies are nearest the earth.

CELESTIAL BODY	SENSITIVITY REQUIRED	ROUND-TRIP FLIGHT TIME
Moon	1	2.4 sec.
Sun	200,000	16 min.
Venus	20 million	4.7 min.
Mars	200 million	6.3 min.
Mercury	1 billion	8.6 min.
Jupiter	5 billion	1.1 hr.
Saturn	100 billion	2.2 hr.
Uranus	20 trillion	5.1 hr.
Neptune	100 trillion	8.1 hr.
Pluto	20 quadrillion	10.4 hr.

reach out and touch a distant target and then make a minute examination. Light radar promises to draw maps of the moon and other heavenly bodies that will rival aerial photographs for detail.

Man has long known, for instance, about the mountains on the moon. But exactly how tall are they? What is their shape?

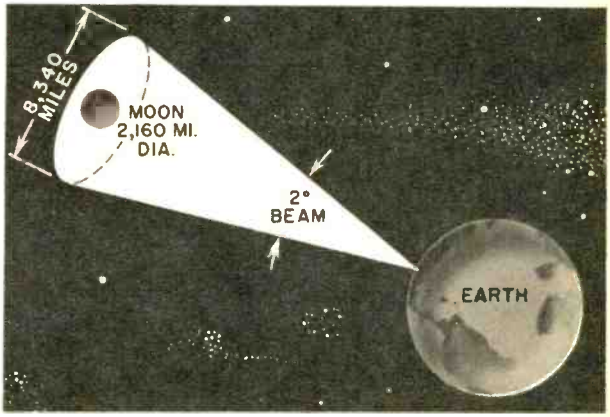
And are there really canals on Mars—or people?

Optical radar finally promises to give us the answers to those questions.

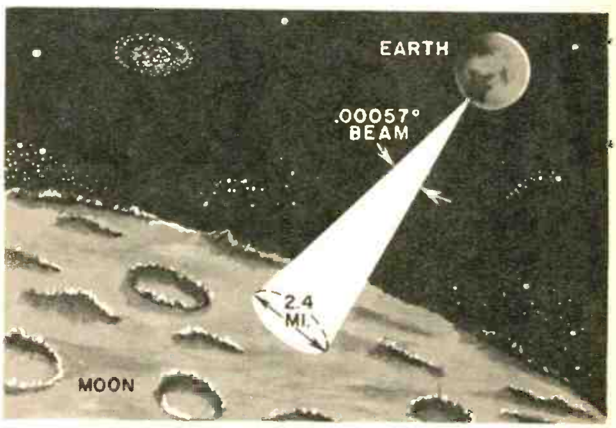
Radar astronomy is not a new concept, as mentioned previously. In fact, in our fast-moving world of science, it is a bit of a greybeard, dating back at least 35 years. But it did not receive public recognition until one day in 1946 when the Army Signal Corps was able to hit the moon with a radar beam and receive a return echo. In the years that followed, techniques became somewhat refined and the moon was sort of a backyard shot for any self-respecting radar set.

Searching elsewhere in the solar system, radar astronomers at the Massachusetts Institute of Technology in 1958 directed a beam toward Venus and, after long study of recorded results, announced that contact had been made with that body. Two years later Professor Von R. Eshleman of Stanford University made radar contact with the sun.

All these contacts were made with the usual radio-frequency radar and, al-



RF RADAR—Detailed mapping of moon is difficult because 2° beam scatters over 8,340-mi. circle.



LIGHT RADAR—Close look becomes possible with its .00057° beam, only 2.4 mi. wide at the moon.

Business end of Hughes light radar shows optical maser transmitter in small tube on top of the reflecting telescope receiver. Detector, amplifier and associated circuitry are in box on instrument's side.

though scientifically interesting, they were primitive and of limited value. Some scientists involved in the experiments referred to them as dry runs. Perhaps the most important information they gave us related to the distances from the earth to the three bodies concerned, which previously had not been known with such accuracy. In the moon's case, a bit more information was obtained (see photo on opposite page) but a large gap remained.

RF radar, it develops, has a handicap in its beamwidth. We're using 2 degrees as a typical beamwidth, although in some cases this figure has been cut to as little as .4-degree, which still is wide compared to light radar's beamwidth, as we shall see. Over moderate distances, an RF beam is satisfactory, with a sufficient amount of power echoing even from small targets. But it crashes into trouble when it hits spatial distances. The moon, for instance, has a mean distance from earth of 238,857 miles. A 2-degree beam aimed in its direction is 8,340 miles wide when it gets there. And, even though the transmitted signal is extremely powerful, the portion of it which strikes the moon is relatively weak (even before starting the return journey) because its total power is dissipated over 55,000,000 square miles! Of this area, some 3,500,000 square miles are occupied by the moon. (See drawings on opposite page.) Under these conditions, no really detailed view of the moon or any of the planets is possible.

One of the answers, of course, is a narrower beam, concentrating more power on target. In the case of RF radar, a narrowed beam can be achieved with a larger parabolic reflector (which also gives the receiver more gathering power). But when you start blowing up an already large dish, it becomes ungainly, difficult to build and maneuver. The Navy now has a 600-footer under construction at Sugar Grove, W. Va., and Stanford University plans an 800-foot dish. Some scientists say we are approaching the maximum size that is practical.

At this point light radar, invented only a few months ago by researchers at the Hughes Aircraft Co., enters the picture. Light radar (called Colidar for Coherent Light Detection and Ranging) was made possible by the optical maser, or laser, which also was invented at Hughes (see LIGHT-AMPLIFIER BREAKTHROUGH, January '61 EI). The laser is a [*Continued on page* 112]

HI-FI  DOCTOR

Second Thoughts on Stereo—Part Four

A few columns ago, I emphasized that the old and honored yardsticks for hi-fi apply equally well to stereo. No audiophile would really argue the point, but what disturbs many audio veterans is that the *price* standards for mono hi-fi don't also apply to stereo. No matter how you cut it, a stereo system *must* cost significantly more than its mono equivalent. The price *isn't* doubled, but the difference is enough for any pocketbook to notice. So let's take a look at what can be done when the spirit is willing, but the wallet is weak.

Stereo the Easy Way

If you now have a mono system and want to convert to a stereo rig of equivalent quality *without* straining your budget, there's only one answer: move a step at a time. After you buy a stereo cartridge don't do *anything* until you can afford to buy either a second speaker system like the one you have, or some kind of satellite system which *can use* your present speaker system as a nucleus. Not every satellite or add-on speaker set-up will work well with your particular speaker. If you're thinking of adding a second speaker which just covers the mid-range and highs, it's smart to get one made by the manufacturer of your present speaker system. This will help you avoid coming up with stereo speakers with such completely different response curves that musical instruments seem to wander back and forth between them. If none of the ready-made satellite speaker systems fits well with your current system, you can rig your own satellite arrangement with mid-range speakers and tweeters of your own choice. Write to Microtran Company, Inc., 145 E. Mineola Ave., Valley Stream, N. Y. and ask them for data on their matrixing transformers.

Some kind of additional speaker should definitely be your first major buy, since it will boost your system's performance even without stereo, but your big decision really comes when you're ready to buy some kind of stereo amplification. If you have and want an integrated amp-preamp combination, the best solution is to trade in your mono unit for its stereo counterpart. If your amp and preamp are separate, add another amplifier of equivalent quality and trade in only your preamp on a stereo model. Both of my suggestions may cost you more than it would just to duplicate your current preamp or integrated units (with adapters thrown in), but the convenience in everyday operation of your rig is *worth* the extra cost.

Start Out Mono

What if you're buying your first hi-fi setup and can't immediately afford to shell out for a top quality stereo rig? Instead of a second-rate stereo, your first system should be a mono rig designed for eventual stereo conversion with *no* waste. In the medium-price range your first system should include a good stereo cartridge, a stereo preamp and a mono basic amplifier in the power range you want. You can then later add a second speaker, picking up the bonus of the pseudo-stereo effect it gives, and finally add a second basic amplifier for a complete stereo rig. In the lower price bracket, you can do the same thing by choosing one of the integrated units made by companies like Sherwood, Harman-Kardon, Arkay, and Grommes, which combine a *stereo* preamp with a *mono* amplifier. The same companies make a matching add-on power amp which you can buy later, and any one of these plus a second speaker will put you in business with no wasted motion.

AND CLINIC

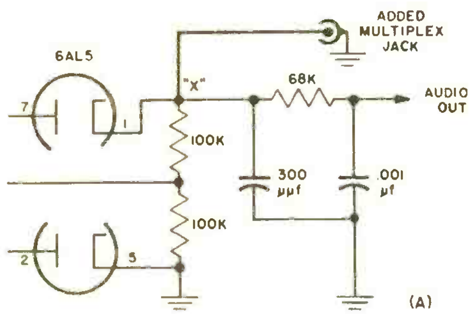
Send your hi-fi questions to: Hi-Fi Clinic, Electronics Illustrated, 67 West 44th Street, New York 36, N. Y. Enclose stamped, self-addressed envelope.

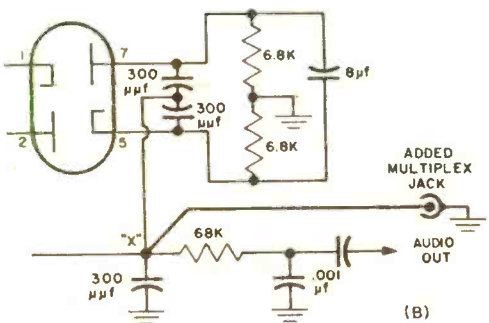
Multiplex Output Jack

I have an older FM tuner that does not have a multiplex output jack. Can I add such a jack or must I buy a new tuner?

R. Latham
Danbury, Conn.

Adding a multiplex output is an easy job. You just mount an output jack and locate the take-off point before the de-emphasis network.





The output jack should be mounted close to the detector tube (usually a 6AL5). Only one lead is required, from the center (hot) lug of the output jack to the circuit. The jack is grounded directly to the chassis.

There are two common FM detector circuits; the discriminator (A) and the ratio detector (B). Refer to the schematic of your tuner and see which detector circuit you have, then connect the lead to the point indicated on the schematic. An article in the April, '59 issue of EI covers this modification.

FM Reflections

My FM radio distorts badly every time an airplane passes overhead. What causes this and how can it be corrected without rewiring the set?

G. Diossy
Montreal, Canada

The distortion you describe is analogous to TV ghosts and has the same cause. The ground wave from the FM transmitter reaches the tuner directly but a second wave arrives by reflection from the plane and arrives somewhat later because of the longer distance it must travel. Hence, the two waves arriving at the receiver at slightly different times are out-of-phase and produce distortion.

You might overcome this kind of distortion by relocating your antenna. There may be one particular antenna position which gives satisfactory reception, yet does not pick up the reflected wave with enough intensity to cause distortion.

Stylus Tracking Force

Recently I read an article which stated that in order to protect your records, the stylus tracking weight should be as low as possible. It went on to say that some arms track as low as 1 gram. I tried this with my arm but the sound was distorted. Does this mean something is wrong with my phono cartridge or tone arm?

T. Rabson
Wheeling, W. Va.

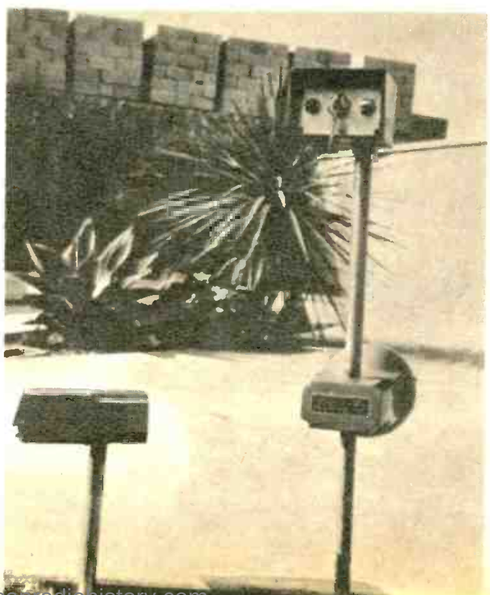
No, but it soon will be if you don't treat your equipment properly. All cartridges are designed to track at a specified force. Any deviation from the manufacturer's recommended tracking force will not only degrade the sound, but possibly damage the record. As your cartridge was designed to track at 5-7 grams, it cannot work properly at 1 gram. The low tracking force may even damage the record grooves.

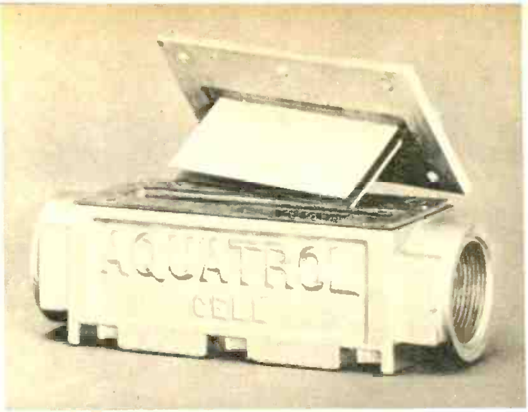
For a dive into hi-fi, you can install a University underwater speaker with plastic diaphragm. Sound is heard only when swimmer is beneath surface.

Electronic Pool Pals

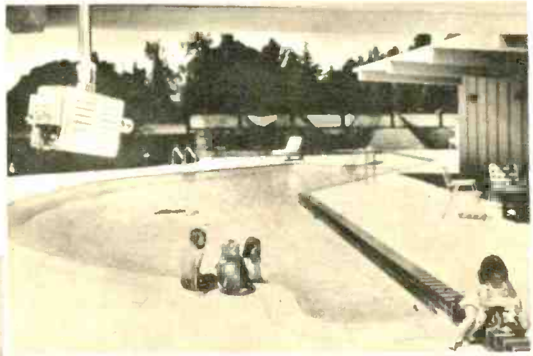
THE 1961 swim season has brought out some interesting new electronic gadgets for pool safety and entertainment. Now an electronic screen around your backyard pool warns you when an uninvited guest takes a plunge. You can have underwater hi-fi when you dive, and those highly touted ions will purify the water. In case you really don't care for swimming yourself you can sit inside and watch the goings-on via closed-circuit TV.

Light fence starts with spotlight (center of pole, right), is bounced around pool via highgrade mirrors to thyratron receiver (being aimed at left). Break in the beam rings alarm. Box on top of post is on-off lock.





Electronic water purifier has copper and silver electrodes (plates under the lid) which give off ions when voltage is applied. The ions kill bacteria in water flowing through, the maker claims. System costs about $300.



Easiest way to keep an eye on your pool is to fire your lifeguard and install closed-circuit TV. Tiny camera at right keeps watch on kiddies. Two different Dage installations are shown in pictures at right and below.

Meanwhile . . . back in the kitchen, Ma gazes at screen while thawing out her TV Dinner.

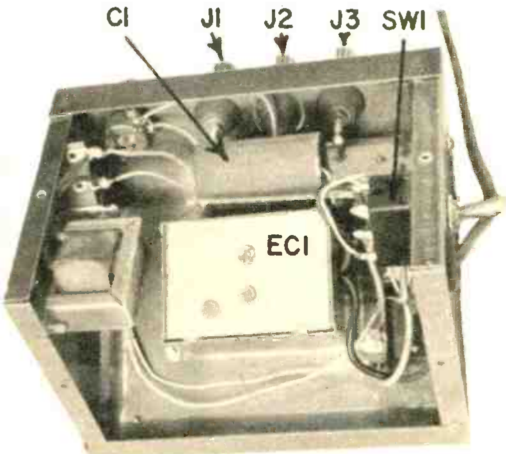
For the man with a need to enumerate electronically . . .

A General Purpose COUNTER

By Ronald Benrey

HAVE you ever needed to count the number of times an event occurred? How often a door has opened or a switch was closed; how many times a light flashed or a machine tool was used? Here's a device that will do the job electronically.

With a choice of input signals or switching devices, this little handyman will count everything from jellybeans to gold coins—from 0 through 999,999 of them—with never a mistake or a dropped digit. The unit can be built for about $17.



View from the bottom rear showing general component location. Arrangement used is non-critical.

Operation

The heart of the unit is a drum-type, solenoid-actuated digit counter. Every time a pulse of 117 V AC is applied to the coil, the counter advances one digit.

A small relay, RY1, driven by a one-transistor amplifier (Q1) energizes the counter's solenoid. Various sensing and switching elements may be attached to the input of the transistor amplifier, making the counter very versatile.

Depending upon the position of SW2, the counter is advanced by either energizing or de-energizing RY1. The choice depends on the input. For example, if closing a switch is to trigger the counter, set SW2 to (b). On the other hand, if RY1 is kept energized by a light beam shining on a photocell connected to the input, use position (a) of SW2 so that the counter advances each time the light beam is broken.

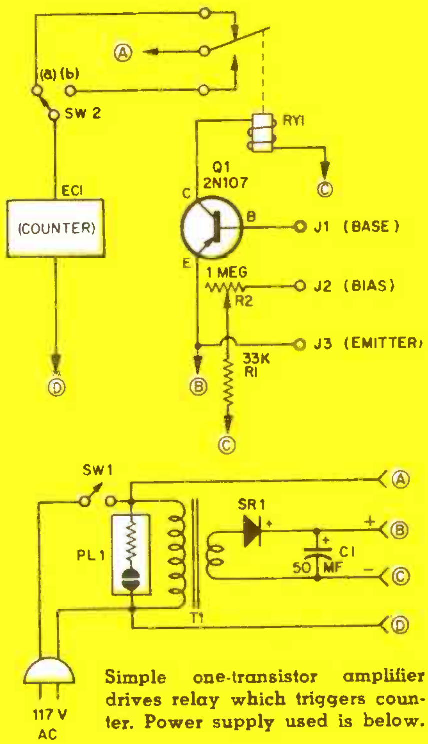
For best operation, the photo-cell should be shielded from surrounding light with a piece of cardboard tubing.

The operating procedure table suggests the connections to be used for typical switching and indicating elements. By using this table as a guide, you can adapt the counter to do almost any counting job.

Construction

Parts placement and wiring are not critical, and any desired layout can be used. Be careful of shorts around the power supply, or you will blow the house fuse. The counter is housed in a small sloping-panel aluminum cabinet, but any wood or metal cabinet will serve. RY1, Q1, SR1 and C1 are mounted on a small piece of perforated Bakelite.

Three insulated terminal posts (J1, J2 and J3) are used to connect input devices to the amplifier. If desired, they may be replaced by other connectors, such as phone jacks or a single barrier terminal strip.



Simple one-transistor amplifier drives relay which triggers counter. Power supply used is below.

PARTS LIST

R1—33,000 ohms, 1/2-watt resistor
R2—1-megohm potentiometer (linear taper)
C1—50-mf, 50-volt electrolytic capacitor
PL1—neon pilot light assembly
Q1—2N107 transistor
RY1—SPDT relay, 2,300 ohms (Sigma 11F-2300-G/SIL)
SW1—DPDT toggle switch
SW2—SPST toggle switch
SR1—130-volt selenium rectifier, 50 ma.
T1—24 or 26 volt filament transformer
EC1—Electric counter (Lafayette F-553, Radio Shack H97L855 or equiv.)
J1-J3—5-way binding posts
Misc.—Piece of perforated board, line cord, 4" x 4 1/4" x 6" sloping-panel cabinet (Bud C-1608 or equiv.), terminal strips, etc.

OPERATING PROCEDURE

Switching Element	Element Connection	Set SW2	Notes
Selenium or silicon photocell	Positive terminal to J3, negative terminal to J1.	To (b) if a flashing beam is to activate. To (a) if interruption of a steady beam is to actuate.	Connect a jumper between J1 and J2. Adjust R2 for correct sensitivity.
Cadmium sulphide or cadmium selenide photocell	Between J1 and J2	Same as above.	Adjust R2 to the lowest value that will still allow counter to operate.
Any switch	Between J1 and J2	To (b) for normally-open switch. To (a) for normally-closed switch	Same as above.
Any resistive element (moisture detector or thermistor)	Between J1 and J2	Depends on element.	Same as above.

CBers! Here's how to get

More From Your Mobile Whip

A simple soup-up job on the antenna gives your transmitter the man-sized reach that you want!

By Herbert Friedman, 2W6045

AS THE chaps at the Federal Communications Commission can tell you, there's been a lot of agitation lately to allow increased power on the 27-mc Citizens Band. Most of the complaining has to do with range, particularly the range of mobile units.

The answer from the FCC, and from a good many informed individuals, is short and to the point: poor range is not in all likelihood due to the power limitations, but rather to inefficiency at the transmitter. Potential signal strength is just not being realized. The fault probably lies in the antenna.

Base-station antennas usually are erected by the CBer with great care and precision, and most stations are attaining ranges that exceed even the most optimistic original estimates. But mobile whips have been a source of trouble from the start. And no end of work and figuring by some licensees is able to correct the situation.

All this trouble is partly because the mobile whip antenna itself has built-in disadvantages. Among the worst is its impedance. A 50- or 70-ohm base station antenna can be matched easily by any length of common coaxial cable (such as RG-58AU or RG-59). But this is not possible with the standard whip because at resonant frequency it has a radiation resistance of 32 ohms, which is not matched by any common coax cable. The lowest impedance of these cables is 50 ohms.

This is what happens: with a 32-ohm antenna and a 50-ohm coax, you start out with a mismatch that results in a Standing Wave Ratio (SWR) of approximately 1.6 to 1. The ideal SWR, of course, is 1 to 1. In this mismatch situation the power delivered to your antenna is reduced by a factor amounting to all the other line losses (there always are some such losses) multiplied by the SWR. It's a little like sighting a rifle with a telescopic sight. With standard sights, a little tremor in the hands doesn't amount to much. But with a telescopic sight the same tremor is blown up in direct proportion to the magnification factor of the 'scope. If you're a little shaky, your aim is all over the landscape. A lop-sided Standing Wave Ratio acts just like the telescopic sight by magnifying normally small transmission problems. If your transmitter has a potential of three watts RF output and you're operating with an SWR of 1.6 to 1, your antenna is not receiving anything like three watts.

An out-of-balance SWR also causes a second problem. Because of standing waves on the coax, the input impedance of the cable can be considerably higher or lower than 50 ohms and it may be difficult to get the transmitter to load into the antenna system with any degree of efficiency at all.

What's the answer? The easiest one is to use the coaxial cable as an impedance matching transformer. If the cable is cut to an *electrical* half wavelength—or any multiple of a half wavelength—the values that appear at one end of the cable also are found at the other end.

In Fig. 1 the coaxial cable is cut to a half wavelength. At the input (left) end the current is high and the voltage

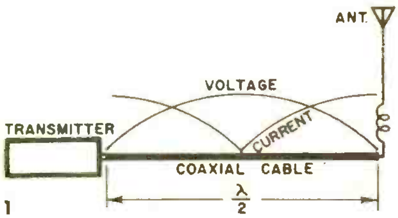


Fig. 1

is low, as shown by the curves. At the output (right) end the current and voltage are found in the same relationship. As far as the transmitter is concerned, it is working directly into the antenna. By using the half wavelength coax the transmitter "sees" only the antenna. It is as if the coax were not even there. Under this condition the transmitter delivers maximum power to the antenna.

When installing a CB unit, you may have noticed that as you changed the length of coax cable the transmitter output went up or down. Although you may not have been aware of it, this was an indication that you were approaching or receding from an electrical half wavelength (or some multiple of it).

To find out how long the coax should be, you must first sit down and figure out a half wavelength according to the standard formula. That would work out this way: length (in feet) = 984/f, where 984 is the radio-wave velocity factor and f is the frequency in megacycles. The CB frequency of 27 mc figures out to a wavelength of 36.37 feet, giving us 18.2 feet as a true half wavelength, as in Fig. 2 (A).

But what we need is an *electrical* half wavelength. Coaxial cable slows an RF wave and in effect shortens the wavelength. This must be taken into account.

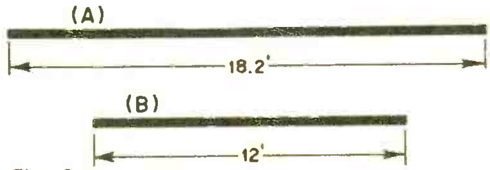


Fig. 2

The speed (Velocity Factor) for common coax is .66. To get an *electrical* half wavelength we multiply this factor by the true half wavelength, which works out this way: .66 x 18.2 = 12 feet, as in Fig. 2 (B). So an electrical half wavelength is 12 feet, and that is the length of coax you need.

After the proper length of coaxial cable is installed it is still possible to increase the transmitter's RF output. Even with ideal cable matching, the transmitter is working into a 32-ohm load. By raising the radiation resistance of the antenna we can make it approach a perfect match with the transmitter, and maximum power can be delivered. To raise the antenna's radiation resistance we simply lengthen the whip itself, and then insert a trimmer capacitor to readjust the frequency (see Fig. 3).

The normal CB whip is 108 inches (102-inch whip plus 6-inch spring). If the antenna is extended beyond 108 inches, the voltage and current relationship at the base of the antenna changes, and that changes the radiation resistance.

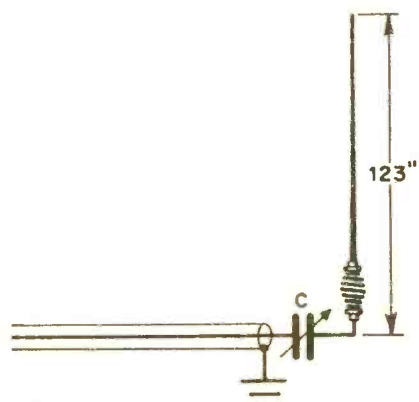


Fig. 3

The practical limit of antenna extension to avoid breaking toll booth lights and striking overpasses is about 15 inches, depending on where on the car the antenna is mounted.

Lengthening the antenna raises the radiation resistance at 27 mc, but the resonant frequency is lowered. So the antenna resonance must be returned to the operating frequency. This is done by installing a 100 mmf trimmer capacitor between the base of the antenna and the center conductor of the coaxial cable. The capacitor electrically resonates the antenna to 27 mc. The capacitor is rotated for maximum loading or lowest SWR. Any small capacitor will do.

When the antenna is extended, two other important improvements result. The increased length lowers the radiation lobe of the antenna. This means that the signal will travel more parallel to the ground, resulting in a stronger signal at the receiving stations. Secondly, the high current area of the antenna is removed from the body of the car. The whip antenna radiates from the high current area of the whip, which is at the base. By extending the whip, the high current area is moved up and away from the car body, increasing radiation and improving the radiation pattern. Figure 4 illustrates this point. (A) is a standard whip with the current distributed as shown. (B) is an extended whip, illustrating how the current node is moved up the antenna.

While other subtle changes can improve performance there is one more major improvement which is possible with those CB transmitters having a fixed output link. Figure 5 illustrates the idea—a souped-up tank circuit. (A) shows a normal output tank coil with a link of one or two turns wrapped around it. These links are designed to operate with 50-ohm antennas. In many instances transmitters do not load up to full plate input because of reactances

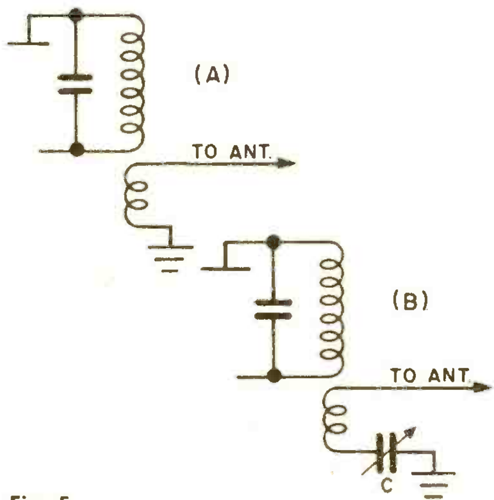


Fig. 5

existing in the antenna system. By adding a trimmer capacitor in the ground lead of the link, the reactances can be tuned out, permitting the transmitter to be loaded to full potential. This modification is shown in Figure 5 (B). The capacitor is a 50 mmf variable, adjusted for maximum loading of the transmitter.

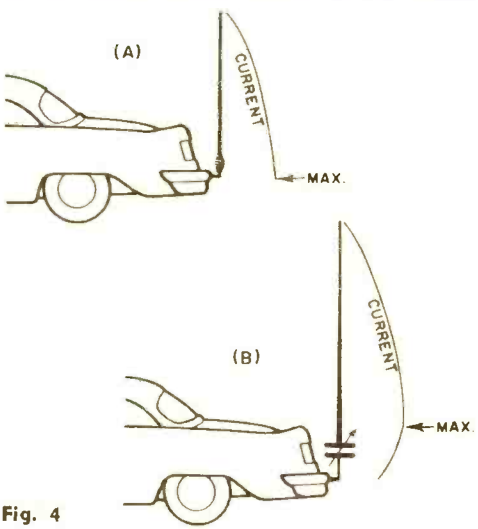
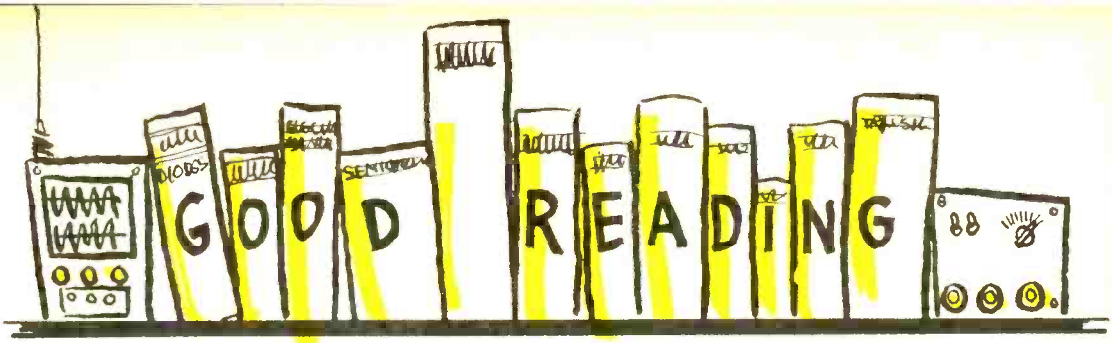


Fig. 4

Any practical method for improving a mobile antenna that you come across should be tried. It is difficult not to better the situation when there is so much room for improvement.

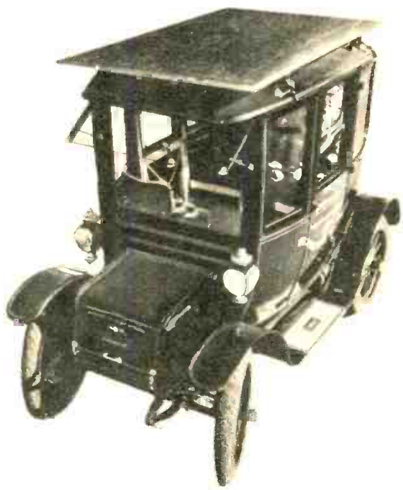
Manufacturers of Citizens Band antennas may in the future offer whips of improved design, incorporating many of the features we've discussed. But they seemingly have been reluctant to redesign their products thus far.

Keep in mind that all improvements made to the transmitting antenna also are applicable to receiving. An antenna system which gives top transmitting performance gives top receiving performance.



INTERNATIONAL RECTIFIER SOLAR CELL AND PHOTOCELL HANDBOOK. By John Sasuga. International Rectifier Corp., El Segundo, Calif. 111 pages. $2.

This slim paper-back may not be easy to find in your neighborhood, but it's worth searching out even if you have to write directly to IR. It is an invaluable reference guide for anyone interested in solar- or photocells. And it is intended not only to outline the theory and uses of these gadgets but also to stimulate the experimenter to find new applications for them. The book provides some 75 practical light-operated projects, gives a wealth of illustrative material and a good many off-beat items (such as the electric car pictured here being operated by the umbrella of solar cells on its roof). Altogether, there's enough useful, interesting information here to satisfy any experimenter.



SEMICONDUCTOR DEVICES. By Rufus P. Turner. Holt, Rinehart & Winston, New York. 278 pages. $6.95.

If the brave new world of semiconductors is a whole or partial mystery to you, here is a must addition to your electronics bookshelf. While it's hard for any book to be definitive in a field that changes so rapidly, Turner's comes close—close enough to forecast a long and useful life for it. Beginning with the basic structure of semiconductors, Turner goes on to cover each important breed in good detail, including the entire family of sensors, such as photoelectric cells and thermistors. After outlining a host of circuit applications, he provides an important chapter on tests and measurements of semiconductor circuits. And, although the book is obviously intended to be a standard text in its field, its style is as readable as the subject is ever likely to allow. A good buy for beginner or old pro.

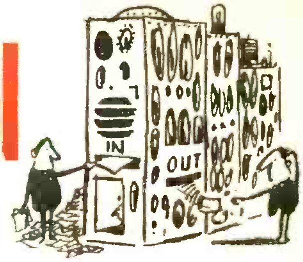
THE R/C PRIMER—RADIO CONTROL FOR ALL. By Howard G. McEntee. Kalmbach Publishing Co., Milwaukee. 65 pages. $2.

Any hobbyist with an interest in radio-controlled model planes and boats will find a great deal of useful information in this book. It does not supply any construction plans for control units or models, but it does provide practical tips on radio control. Starting with a chapter on operating frequencies and licensing regulations, it proceeds to discuss the kinds of control available from various types of equipment and furnishes plenty of guidance on installation, testing and maintenance. If models are your meat, so is this book.

THE PRINCIPLES OF BOOLEAN ALGEBRA WITH CIRCUIT APPLICATIONS. Philco TechRep Division, Philadelphia. 20 pages. 75¢.

Although its title is a mouthful—particularly for a 20-page pamphlet—here is a valuable [*Continued on page* 103]

ELECTRONIC BRAIN



Have a question on electronics? Send it to Electronic Brain, Electronics Illustrated, 67 West 44th St., New York 36, N. Y. Enclose a stamped, self-addressed envelope for prompt reply.

Weak, Garbled Sound

After my radio has been on for a few minutes, the volume drops. When I turn up the volume control, the sound becomes very garbled. What's causing this?

Frank J. Seeley
Santa Ana, Calif.

From the symptoms we would say that your difficulty might be a gassy power amplifier tube or a defective power amplifier cathode bias resistor. First check the tube and if defective, replace it. If the tube is good, the chances are the cathode bias resistor, due to wattage underrating, overheats and increases in value after the set is on for a while. If the output tube is a 50C5, 50B5, or a 50L6, replace the resistor with a 150-ohm, 1-watt unit.

TV Picture Tubes

How are picture tubes for television receivers rebuilt? Is it possible to rebuild these tubes in a home workshop?

H. Davidson
Cincinnati, Ohio

In the TV picture tube rebuilding process, the neck of the old tube is first cut off by a special hot-wire process. This is done slowly and evenly so that the vacuum seal is not broken too suddenly. The old electron gun and tube base are then removed and discarded.

In a good rebuilding process, the entire glass envelope is then acid-cleaned to remove all old cement and the original phosphor on the face of the picture tube. New phosphor is then baked into the inside glass face; a completely new cathode-ray gun, tube base, and neck are then welded into the old glass "bel." Actually, the only part of original picture tube that is used in a good rebuilt is the glass. The air is then carefully removed by efficient vacuum pumps and the tube is ready for service.

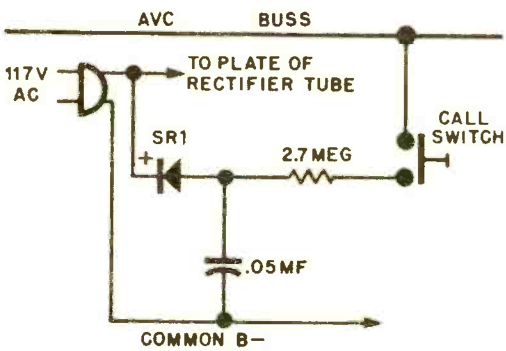
This rebuilding process is certainly not possible in the home workshop. The need for special chemicals and ovens, and the requirements of the vacuum pump system make this process prohibitively expensive as well as dangerous for the novice.

Radio-Intercom Muting

In the radio-intercom described in the October, '60 issue you mention that the radio signal is muted automatically when a call is put through the intercom. How is this done?

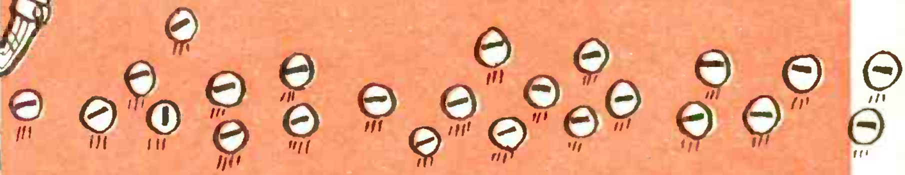
Leonard E. Szymanski
Independence, Ohio

The method used for silencing the radio in radio-intercoms when the system is used as an intercom requires a small (130V AC, 10-20 ma) selenium rectifier, two resistors, and a capacitor. The call switch on the intercom should have an extra pole.



Here's the idea. When the call switch is pressed, the added rectifier applies a high negative voltage to the AVC line of the receiver. This cuts off the IF amplifier without affecting the audio stage in any way. Care should be taken when modifying a receiver to make sure added components do not cause shorts.

the case of the NEGATIVE IONS



The behind-the-ballyhoo story of those negative ionizers—how they work and what they do for you.

By Lee Sheridan

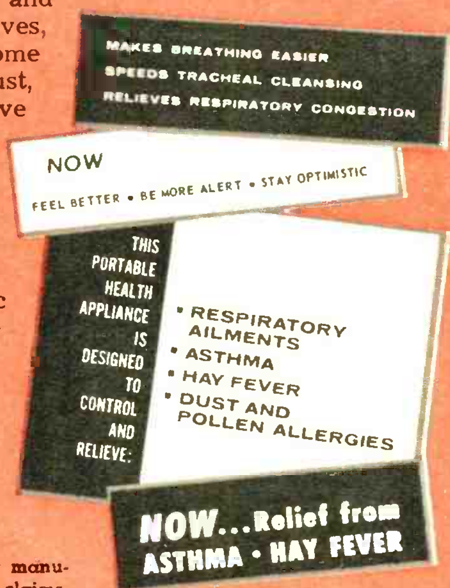
NOWADAYS all you have to do to get relief from asthma, kick hay fever, clean out your trachea, lose that draggy feeling or stay optimistic . . . is flip a switch, one that turns on a negative ion generator.

It is unlikely that negative ionizers are strangers to you. No new electronic product since television has been brought out with more publicity, advertising and general ballyhoo. The gist of it all concerns the marvelously beneficial effects negative ions can have on the human body. The list in our opening paragraph is only a beginning.

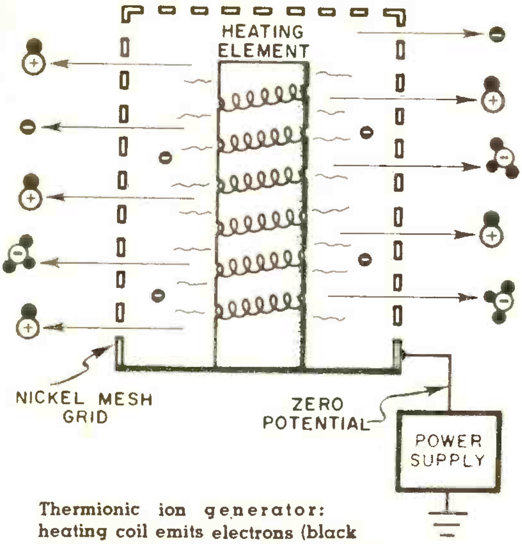
How does an ion generator work? And are negative ions really that wonderful?

Negative ions, which you and I have breathed all our lives, are nothing more than some molecules of oxygen, dust, or water vapor which have picked up a negative electrical charge. Other particles have a positive charge and are called positive ions.

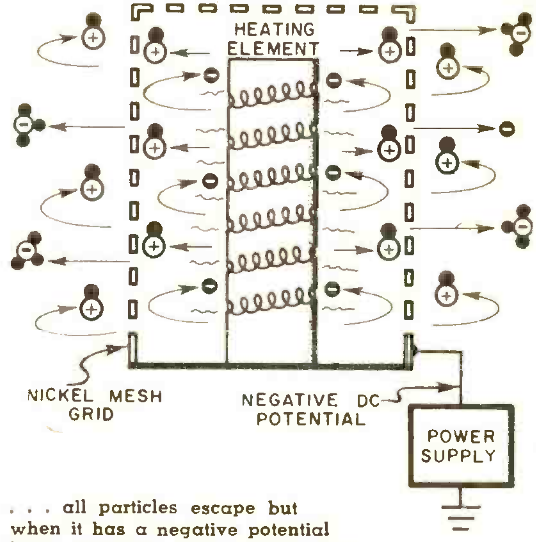
These ions used to be referred to as atmospheric electricity, and people have been talking about that subject for almost two centuries. What they were concerned about back there in the 1700's was how atmospheric elec-



Ion generator literature put out by manufacturers lists a great variety of claims.



Thermionic ion generator: heating coil emits electrons (black dots) which combine with atoms or molecules to form negative ions (shown as having 3 electrons). Some atoms lose an electron, are positive ions (shown with 1 electron). When the nickel mesh grid is at zero potential . . .

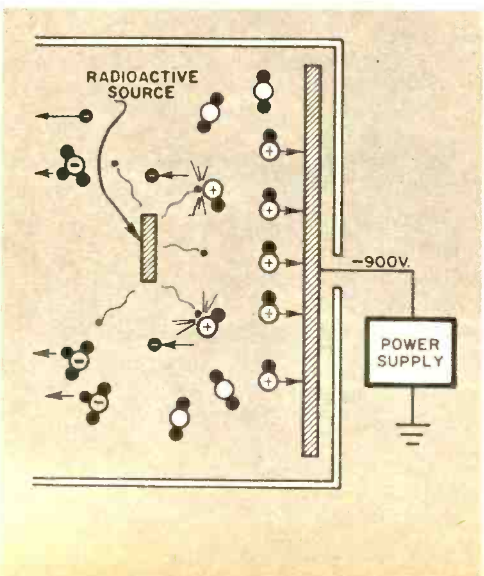


. . . all particles escape but when it has a negative potential (right drawing) the negative ions and electrons are repelled into room or back toward coil. The unwanted positive ions are attracted by the grid and grounded. Grid potential is rapidly pulsed to pump out the negative ions.

tricity affects people, and we're still talking about it, using a different name. The general idea is that negative ions are the good guys, healthwise, and positive ions are black leather jacket characters. And one of the problems of this world, aside from a few wars and H-bombs, is the fact that the air normally contains about five positive ions to four negative ones.

The ratio gets worse during hot, dry spells and just before storms, and you feel dull and depressed as a result. For a long time it has been known that people being belted by hot Sirocco and Mistral winds were more likely to shoot holes through each other than were those living in air-conditioned penthouses. Courts used to adjust sentences accordingly, figuring it was really the wind's fault. Now we think the whole thing should have been blamed on positive ions.

Nature uses a number of methods to produce her ions—radiations from the soil, cosmic rays from outer space, sunlight, ultraviolet radiations and lightning flashes—but she turns them out in



Radioactive ion generator: beta particles (tiny black dots) emitted by radioactive source collide with neutral atoms and knock electron off. Electron combines with another neutral atom to form negative ion, which is repelled into room by negative charge on plate at right. Atom losing electron, now unwanted positive ion, is attracted to plate and grounded. Negative ions are shown with 3 electrons, positive ions 1, neutral atoms 2.

the wrong proportions, as noted above. That is where the negative ion generator has found a job for itself—to produce enough negative ions to offset Mother Nature, at least in a small area.

No one says negative ions actually cure anything. They just make you feel good while you're sick, according to what you read. An asthma sufferer, for instance, gets relief because his breathing is made easier, as is the case with hay fever victims. The human breathing tract has tiny hair-like cilia that wave back and forth and push out pollen, dust

Emerson Ionator has electrostatic air cleaner; a high-voltage field produces negative ions.

Ductless Progress range hood cleans air and gives it a shot of negative ions as it passes.

Lectric-Aire generates ions with radioactive "jewel" in center of the perforated grille.

Ionaire radioactive model is mainly for professional use. It has list price of $149.50.

and other foreign matter. Negative ions are supposed to help the cilia do a better job.

Negative ions, it is said, also kill airborne bacteria and thus prevent the spread of viruses, tuberculosis, scarlet fever, etc. There have even been some claims that negative ions have a beneficial effect on high blood pressure, sinusitis, burns, ulcers, arthritis, rheumatism and other such maladies. But the most oft-stated benefit you hear is the negative ion's ability to make you just feel good all over.

How true are the claims?

The American Medical Association has said it knows of no satisfactory medical evidence that negative ionization has an effect such as is claimed. It also calls the [*Continued on page* 117]

This microphone-shaped Ionaire generator is similar to the unit above, but is meant for home use.

An Experimental *Negative Ion* Generator

Here's an inexpensive home-built device that duplicates costly commercial units

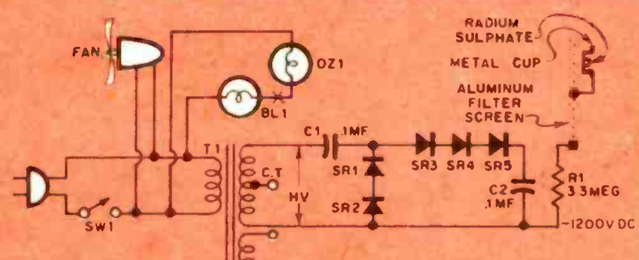
By George Gordon

BY ALL odds, the most-talked about new electronic device now on the market is the negative-ion generator. How well these invisible particles do the jobs claimed for them is open to some question (see EI's preceding article) but the fact remains that a great many negative ion generators are being sold for $75 to $100 and more.

We present the EI Negative Ion Generator as an experimental apparatus. It is an interesting project to build and its method of operation can make an engrossing study. Cost can be held to less than $20.

EI's generator also includes an optional ozone lamp (OZ1) which may be switched on (with SW2) for short periods to rid the air of unpleasant odors. It should not be turned on continuously because high concentrations of ozone can be harmful.

All components of the generator are standard including the radioactive element, which actually is an anti-static "jewel" normally used to keep records dust-free. The radioactive ionizing element is a tiny bit of radium sulphate set in a metal cup. It emits about 90,000 alpha particles (or electrons) a second and has a half-life of more than 1,500 years. It is quite



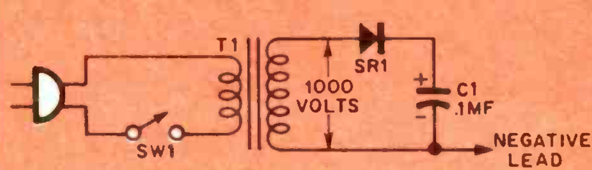
Voltage Doubler

PARTS LIST (Continued)

R1—3.3 meg, ½ watt resistor
Ozone lamp—4 watt G4S11 (Available from Lafayette Radio and elsewhere)
Aluminum Filter—E-Z Kleen manufactured by Research Products Corp. (Available at hardware and air conditioning supply stores)
1—Ionizing Jewel Audiotex Atomic Stat Elem
1—Fan and motor
1—12" speaker baffle

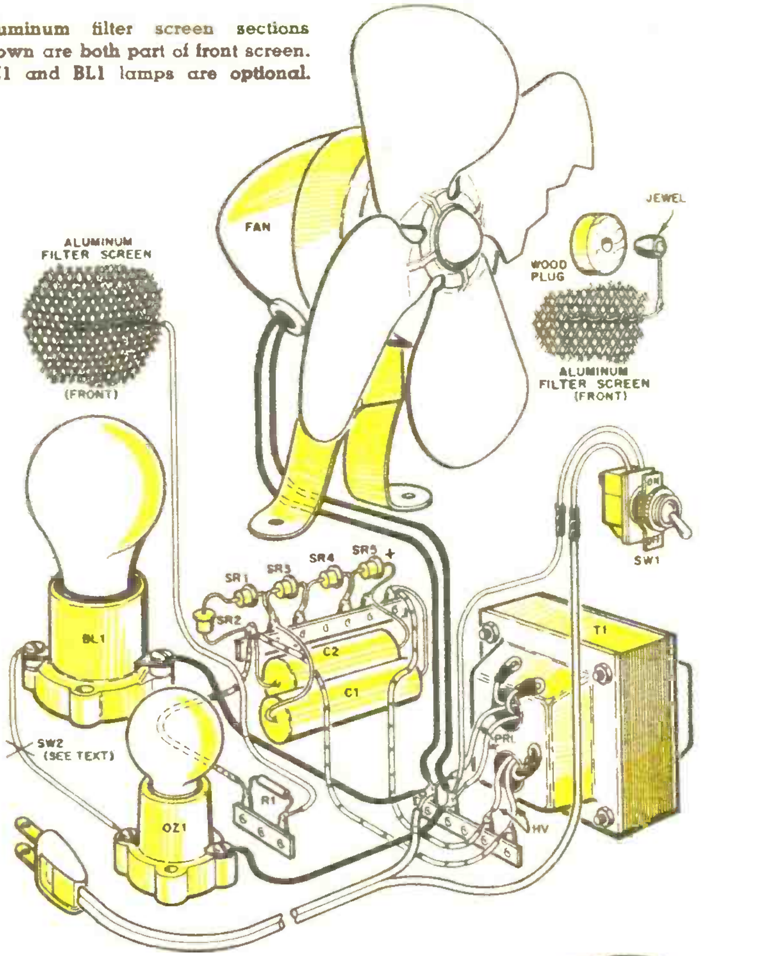
PARTS LIST

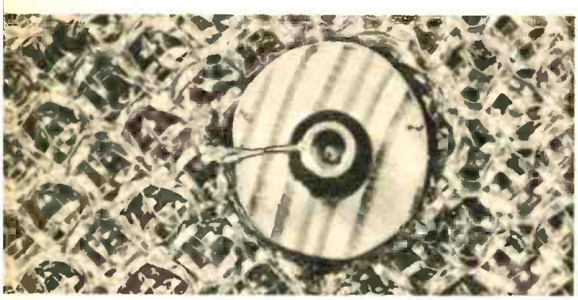
T1—Power transformer, 475 to 525 volt center-tapped high voltage secondary (center tap unused), or 1000 volt secondary for half-wave hookup
C1—.1 mf 1000 volt tubular capacitor
C2—.1 mf 1600 volt tubular capacitor
SR1-SR5—Silicon rectifier, 200 ma, 400 volt peak inverse voltage (Available for 50¢ each at Tab, 111 Liberty St., New York, N. Y.)



Half Wave

Aluminum filter screen sections shown are both part of front screen. OZ1 and BL1 lamps are optional.





Ionizing jewel is glued in a ¼" hole drilled in a 1" block of wood glued to unit's front panel.

harmless unless it's swallowed or held close to the nose for a long period. The electrons emitted by the element join molecules or atoms of oxygen (oxygen usually exists in molecular form in nature). Since each electron carries a negative charge, it upsets the balance of the neutral molecule and transforms the whole mass into a negative ion.

The generator propels these ions out into the room with a 1,200-volt negative charge on the metal cup and aluminum filter screen. Air set in motion by the fan also helps circulate the ions around a room. Keep the enclosure at least a foot away from any wall to insure an adequate air flow through the rear of the cabinet.

The particular filter screen specified for the front and rear of the enclosure is a new product designed as an air conditioner filter replacement and the manufacturer claims that it effectively removes dust, pollen, etc., from air passing through it. Resistor (R1) isolates the screen from the power supply and eliminates all possibility of shock.

Construction

The voltage doubler circuit shown uses the full high voltage secondary winding of an ordinary power transformer to deliver 1,200 volts DC. If you have or can purchase cheaply, a surplus transformer with a 1,000-volt secondary, you can use a high-voltage diode in a simpler half-wave rectifier circuit. Be sure to tape up the ends of unused center taps and filament windings.

The silicon rectifiers employed in this unit sell for about 50¢ each. Their peak inverse voltage rating is only 400 volts, however. Since a 1,200-volt silicon rectifier costs about $2.50, the cheaper ones were used in series for economy reasons.

The ionizing jewel is mounted by drilling a ¼-inch hole in a 1" block of wood, gluing the jewel in the hole and then the block to the front panel.

The smaller the fan, the smaller the enclosure you will need, of course. In this case, speaker baffle for 12" speakers was used because it combines a compact attractive appearance with relatively low cost. If the fan is small enough, a 10-inch baffle will do.

Make certain that you solder a lead from the *negative* side of the power supply to the ionizing jewel. Using the positive side will simply attract the negative ions and ground them. Solder the lead to the metal cup containing the radioactive element with a hot iron and work quickly! The solder will take hold better if you first scrape the metal at the point to be soldered to obtain a shiny surface.

The front filter connected to the negative DC potential serves as a charged screen to repel any negative ions that may wander back toward the enclosure. The amount of aluminum filter needed will vary from 1½ to 2 square feet depending on enclosure size. Since you can't solder to the aluminum, thread the bare end of the negative lead through the screen. Do the same with the lead to the jewel. A 40 watt incandescent lamp must be used in series with the ozone lamp to provide adequate ballast. CAUTION: *Do not expose yourself to or look at the direct rays of the ozone lamp.*

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The Most Trusted Name in Electronics

The Ham Shack

By Robert Hertzberg, W2DJJ

BUILD OR BUY? . . . Here is a letter that is typical of many I've been receiving from readers of the Ham Shack:

"I am not a ham yet but plan to apply for my license soon. I would like to know whether you would advise a new amateur to buy or build his first rig."—Mike Murphy, Toledo, Ohio.

Definitely plan to build at least half the station, Mike. This is an interesting and rewarding way of acquainting yourself with electronic components, assemblies and circuits. There are numerous kits on the market that save you the hard work of forming and drilling a metal chassis and permit you to concentrate on the more important jobs of assembling and wiring. Kits are great fun and, since they are pre-engineered, you can be pretty certain the finished sets will work if you follow all instructions faithfully.

"Which half?" you're probably asking. A lot of would-be hams are surprised when I recommend that they build the transmitter. Neophytes seem to have the idea that receivers are simple and transmitters complicated. Generally it's the other way around. Lining up the multiple circuits of a really good communications receiver is a critical and difficult chore and may well require test equipment that costs as much as the set itself. Adjusting a transmitter is a relative cinch, even for a beginner, and in most cases does not require external accessories.

—o—

Sun Spots. We are just about to enter a period in the 11-year sun-spot cycle when solar ionization will adversely affect short-wave communications. The various reflecting layers surrounding the earth will boil in turmoil and QSO's will be freakish. This is all part of the game and nothing to worry about. In fact, the very uncertainty of band conditions will make unexpected local and DX contacts all the more sporting.

Some of the bands are already starting to act queerly. Recently, on 15 meters, I heard three different New Zealand stations calling CQ with such fantastic strength that I had to back off both the RF and AF gain controls on my SX-101A to keep the loudspeaker from ripping. Other East Coast hams heard them, too, because when each of 'em signed the air was filled with calls. And do you know . . . not a single U. S. station connected! The ZL's tried another few CQ's, and then quit.

—o—

Time, Please. Confused by references to GMT and GCT when times are stated according to the 24-hour clock? You needn't be [*Continued on page* 114]

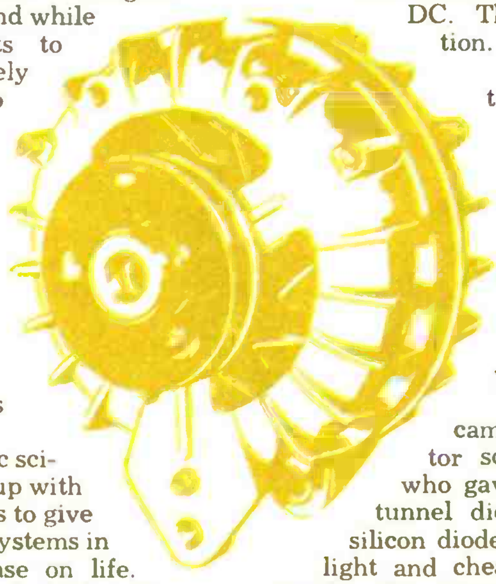
An accomplished ham operator at the ripe old age of 13 is Clifford Magnuson, KN9WMU, of Chicago. Cliff's compact station includes a Johnson Viking transmitter and National HRO receiver. He would rather work CW than phone.

photo by Ben Woodruff, W9UE

ALL ABOUT ALTERNATORS

By Ken Gilmore

WE PUT a tremendous strain on the electrical systems of our cars. We install heaters, radios, air conditioners, electrical windshield wipers, power seats, ham rigs, and now CB transceivers, all of which gobble up every watt of power our batteries and generators can squeeze out. We drive mostly in cities and towns, where the engine idles in traffic jams and while we wait for lights to change. We rarely drive fast enough to let the overworked generator charge the battery properly.



The result: more run-down batteries, more cold winter mornings when the old bus refuses to start, more frayed tempers and jangled nerves.

But now, electronic scientists have teamed up with automotive engineers to give the electrical nerve systems in our cars a new lease on life. They've done it by designing an alternator—an AC generator—to replace the DC job which has been recharging our batteries ever since electric headlights replaced kerosene lamps. The trouble with a DC generator is that it doesn't turn out enough current to do much good until the engine gets to cruising speed. The alternator, on the other hand, grinds out a lot of watts even when the engine is idling. It's also more troublefree than the DC job and has other advantages we'll talk about later.

Alternators themselves, of course, aren't new. Chances are, your city has been using them to generate electric power for a half-century. They've been used in heavy-duty automotive applications—police cars, for example—for many years. But they were impractical for passenger cars. The main problem springs from the fact that alternators produce AC current while our car batteries and electrical systems need DC. This means rectification.

The high-output alternators used in police cars solved the problem with a bank of selenium rectifiers. They did the job but were bulky and expensive. If one part burned out, you had to replace the whole system.

The breakthrough came when semiconductor scientists, the fellows who gave us transistors and tunnel diodes, came up with silicon diodes, which were small, light and cheap—but still able to handle the whopping current loads needed in automobiles.

We'll see what makes an alternator tick in a moment, but first let's look into a standard DC generator, shown in simplified form in Fig. 2. As the armature coil cuts the magnetic lines of force between the field magnets, a current is induced in the coil. When the armature rotates, current first flows in one direction in the coil, then in the other. The commutator serves as an automatic polarity reversing switch which keeps current always flowing through the load (in this case the lamp) in one direction.

Fig. 3 is a simplified diagram of an

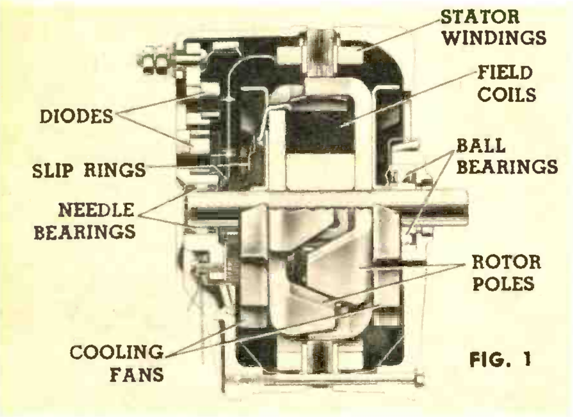


FIG. 1

Alternator is smaller, lighter than generator. Note rectifying diodes that are pressed in end of case.

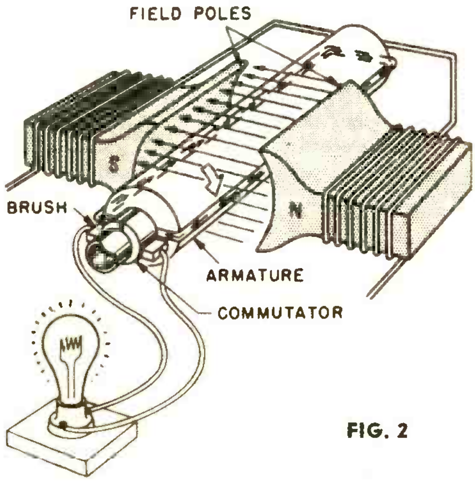


FIG. 2

Generator: its two-direction current in the armature changes to one direction for powering lamp.

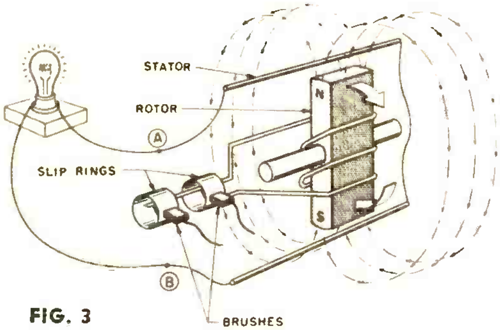


FIG. 3

Alternator: output flows first one way, then the other . . . and the lamp is illuminated by AC power.

alternator. Solid slip rings are used instead of a commutator. Consequently, the output is alternating current. But what we need for the car's electrical system is DC. We get it in exactly the same way we do in a hi-fi amplifier: by rectification. Six silicon diodes connected in a full-wave rectifier circuit do the job.

If the diagram in Fig. 3 looks a little strange it's because we've made a switch. In generating an electric current, it makes no difference whether the magnetic field is stationary and the wire moves, or vice versa. In most generators, the field is stationary. The alternator, however, uses the other approach. The magnetic field rotates, cutting the wires in the stator.

The alternator's big advantage is its ability to generate current at slow speeds—even with the engine idling. But it has other good points. For example, it requires a much simpler voltage regulator than its DC cousin. The regulator on your present car uses three relays. The first one, a circuit breaker, keeps the battery from pumping current backwards through the generator when the engine is idling. Since the alternator always generates current, it doesn't need a circuit breaker.

As the DC generator's speed increases, its current output becomes greater and greater. If there were no regulation, it would soon overheat and burn itself out. The second relay keeps this from happening. The current regulator is not necessary in an alternator because the alternator is self-regulating. As the speed increases, the inductive reactance of the windings increases, too, and keeps the output from rising to a dangerous level.

The third relay is a voltage regulator. It keeps the generator from overcharging the battery. This relay is the only one needed with the alternator.

Although the automotive alternator is still an infant, one manufacturer—Chrysler—has already made this better kind of generator standard on its cars. Other manufacturers probably will follow suit.

Atomic War on Disease

Continued from page 58

localized source of radiation coming from the brain should correspond to the tumor. It sounds simple, but there is a catch. The tumor permits the radioisotope to enter but it doesn't concentrate the element as the thyroid does I-131. A tumor also allows a radioisotope to escape with the result that the tumor contains no more of the substance than does the blood bringing it to the brain. Radiation from the tumor can't be differentiated from the blood's "background" radiation or from stray radiations passing through the air of a laboratory. The outlines of the tumor appear hazy and its size and position are uncertain.

Several methods have been devised to get around this difficulty. For instance, one could place a collimator, which amounts to a long tube shielded against outside radiation, between the radiation counter and the area to be scanned. This would permit only the radiation coming from a small part of the brain directly in front of the counter to be picked up. But while the collimator reduces the blurring of tumor outlines caused by stray radiation, it also cuts down the total amount of radiation falling upon the counter, so that the counter may be unable to "recognize" the presence of the tumor in front of it.

A more successful method has been developed by Dr. G. L. Brownell of the Physics Research Laboratory at Massachusetts General Hospital. Dr. Brownell's device, which consists of a pair of scintillation counters mounted facing one another from opposite sides of a patient's head, takes advantage of the following facts: among the radiations emitted by radioisotopes are particles called positrons. These have the same mass as electrons but are positively instead of negatively charged. When a positron meets an electron—which it invariably does within a fraction of a second—the collision produces two gamma rays moving in opposite directions.

In Dr. Brownell's device when two gamma rays strike the paired scintillation counters simultaneously the occurrence is registered by a special coincidence circuit connecting the two counters. The counters are mounted on a mechanical scanning assembly which moves them back and forth in tandem, slowly scanning the patient's head. At the same time, a printing system follows a duplicate path over a sheet of paper. Each time the coincidence circuit registers a certain number of simultaneous gamma rays, the printer makes a mark on the paper. This locates the tumor accurately and clearly in two dimensions. To place it in three dimensions, the total radiation count from each counter is fed into a circuit that determines which unit receives the greater amount of radiation. It then prints a curved line (left) or a straight line (right) as a visual indication of its findings, and the line indicates the afflicted side.

These are but a few examples of how radioisotopes are used as diagnostic tracers in medicine's atomic war on disease. Radiations from isotopes also can be used directly in treating patients. Radium has long been employed to treat cancer, for instance, and now the man-made radioactive isotope of cobalt is replacing radium because it is cheaper and more plentiful. The radio-cobalt treatment of a patient is depicted in the lead photograph in this article.

There are many more applications for radioisotopes, and techniques already developed have proven so successful that attempts are being made to adapt them to the study of diseases of other organs, such as the liver and pancreas.

In the future radioisotopes will play more important roles in human health than we could hope to mention. That is not the end of the story, of course. Behind the hospital clinic and the doctor's office stands the research laboratory, where medical scientists work to put together, piece by piece, the immense picture-puzzle of human biology. Here, radioisotopes are used to study the intricate processes by which we live, grow and reproduce, and why it is and how it happens that we become ill, and even how and why we die. Radioisotopes, then, offer us all better health and longer life!

Continued from page 31

world. Probably the most complete DX bulletin is issued by the Newark News Radio Club (215 Market Street, Newark 1, N. J.). It usually runs to 60 pages and is full of items about stations on the short-wave broadcast bands, ham bands, utility bands, FM, TV and long wave. You can get a sample bulletin for 25¢ from the club.

The American SWL Club (c/o Ken MacNeilage, 46-C Parkway Village, Cranford, N. J.) will send you a sample bulletin for 15¢. The Universal Radio DX Club (109 Mesa Street, Vallejo, Calif.) publishes a monthly bulletin called the Universalite which contains useful DX data.

It might be noted that C. M. Stanbury II, EI's Contributing Editor on Short-Wave Listening and DX affairs, also is short-wave editor of The Universalite and FM editor of the Newark News.

A great many short-wave stations will send you free programs and frequency schedules on request (such stations are listed by country at the end of this article). When you write to the stations you should ask to be placed on their permanent mailing list.

A few stations offer monthly English-language magazines containing information about station activities and local events. Some of these are free; in other cases the stations ask a small sum. Radio Netherland issues a free seven-page booklet describing DX antennas and grounding systems. Deutsche Welle and Radio Sweden send free bulletins to listeners who contribute DX items.

At 19½ and 49½ minutes after the hour National Bureau of Standards station WWV gives propagation forecasts on 2.5, 5, 10, 15, and 25 mc. The forecasts, sent slowly in Morse code, tell the DXer what to expect in North Atlantic communications in the next six to 24 hours (WWVH in Hawaii gives forecasts for the Northern Pacific). A booklet fully describing WWV's forecasts, as well as its other services, may be obtained for 10¢ from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Specify National Bureau of Standards Miscellaneous Publication 236. The WWV propagation code goes like this: W1—useless, W2—very poor, W3—poor, W4—poor to fair, U5—fair, N6—fair to good, N7—good, N8—very good, N9—excellent.

Below are listed short-wave stations or services offering free program schedules on request:

Aden:	Aden Broadcasting Service Box 1264, GPO Aden
Algeria:	Direction Regionale Algerie Radiodiffusion Francaise 21 Boulevard Bru Algiers, Algeria
Andorra:	Radio Andorra Roc des Anelletas Andorre La Vieille, Andorra
Angola:	Radio Clube de Angola CP 229 Luanda, Angola
Antilles:	Radio Victoria Oranjestad, Aruba Netherlands Antilles
Argentina:	Radio Nacional Ayacucho 1556 Buenos Aires, Argentina
Australia:	Radio Australia Box 428G, GPO Melbourne, Australia
Bolivia:	La Cruz del Sur Cajon 8 La Paz, Bolivia
Bulgaria:	Bulgarian Broadcasting Service 4 Dragon Zankov St. Sofia, Bulgaria
Cameroon Rep.:	Radio Douala BP 986 Douala, Cameroon Republic
Canada:	International Service Canadian Broadcasting Corp. Box 6000 Montreal, Que.
Ceylon:	Radio Ceylon Box 574 Colombo 7, Ceylon
China (Communist):	Radio Peking Broadcasting Centre Peking, Chinese People's Republic
China (Free):	Air Force Broadcasting Station 1507 Chung Cheng Rd. Taipei, Formosa Broadcasting Corp. of China New Park Taipei, Formosa
Congo Rep.:	Radiodifusion Nationale de la Republique du Congo BP 3171 Leopoldville, Congo Republic
Congo:	Radio Brazzaville BP 108 Brazzaville, Congo
Costa Rica:	Faro del Caribe Apt. 2710 San Jose, Costa Rica
Czechoslovakia:	Czechoslovak Radio Praha 2 Stalinova 12 Czechoslovakia
Ecuador:	Radio Station HCJB Talcottville, Conn. (U.S.A.)
Egyptian U.A.R.:	U.A.R. Broadcasting Corp. 4 Sherifein St. Cairo, Egypt
France:	Radiodiffusion-Television Francaise 107 Rue de Grenelle Paris 7, France
Germany (East):	Staatliches Rundfunkkomitee Berlin-Oberschoneweide Nalepastrasse 18-50 East Germany

Germany (West):	Deutsche Welle Postfach 344 Koln, West Germany
Great Britain:	British Broadcasting Corp. 630 Fifth Ave. New York 20, N. Y.
Guatemala:	Radio Nacional 14 Ave. C-47, Z-1 Quezaltenango, Guatemala
Haiti:	Radio Lumiere BP 71 Cayes, Haiti
Hungary:	Magyar Radio es Televizio Brody Sandor-S.u. 5-7 Budapest VIII, Hungary
India:	Director of External Services All India Radio New Delhi, India
Indonesia:	Radio Republik Indonesia Box 157 Djakarta, Indonesia
Iraq:	Broadcasting Station of the Republic of Iraq Baghdad, Iraq
Israel:	Israel Broadcasting Service Jerusalem, Israel
Japan:	Nippon Hoso Kyokai No. 2, 2-chome, Uchisaiwai-cho Chiyoda-ku Tokyo, Japan
Korea:	Korean Broadcasting System Seoul, Korea
Liberia:	ELWA Radio Village Box 192 Monrovia, Liberia
Malaya:	Radio Malaya Federal House Kuala Lumpur, Malay
Monaco:	Trans World Radio BP 141 Monte Carlo, Monaco Radio Monte Carlo 16 Boulevard Princesse Charlotte Monte Carlo, Monaco
Netherlands:	Radio Nederland Wereldomroep Box 222 Hilversum, Netherlands
New Zealand:	Radio New Zealand Box 2396 Wellington, N.Z.
Nigeria:	Nigerian Broadcasting Corp. Broadcasting House Lagos, Nigeria
Norway:	Norsk Rikskringkasting Bj. Bjornsons Plass 1 Oslo, Norway
Pakistan:	Radio Pakistan 71 Garden Rd. Karachi 3, Pakistan
Philippines:	Far East Broadcasting Service Box 2041 Manila, Philippines
Portugal:	Emissora Nacional de Radiodifusao Rua do Quelhas 2 Lisboa, Portugal
Rumania:	Radiodifuziunea Televiziunea Romina Box 111 Bucharest, Rumania
Senegal:	Radiodiffusion du Senegal BP 1765 Dakar, Senegal
Solomon Islands:	Solomon Islands Broadcasting Service Box 115 Honiara, Solomon Islands
Sweden:	Sveriges Radio Box 995 Stockholm 1, Sweden
Switzerland:	Swiss Broadcasting and Television Corp. Neuengass-Passage 2 Berne, Switzerland
Tahiti:	Radio Tahiti Rue Dumont d'Urville 410 Papeete, Tahiti
Tunisia:	Radiodiffusion Television Tunisienne 139 av. de Paris, Tunis, Tunisia
United States:	International Broadcast Station KGEI Box 887 Belmont, Calif. Voice of America Washington 25, D. C. WRUL, Worldwide Broadcasting System 4 West 58th St. New York, N. Y.
Union of S. Africa:	South African Broadcasting Corp. Box 8606 Johannesburg, South Africa
U.S.S.R.:	Radio Moscow Moscow, U.S.S.R.

CB Corner

Continued from page 35

the FCC as a *tool* of communication.

Another entry on the 505 form that could cause difficulty: Item 11 asks if the transmitters are crystal controlled. When applying for the popular Class D band (27 mc), a *no* answer makes the application unacceptable. Transmitters must be crystal controlled in this service. And don't forget to present the filled-out application to a Notary Public for his seal and signature. Then mail it to the FCC, Washington 25, D. C.—not to the local office where you might have received the form.

—o—

Antennas . . . A recent letter from Raymond Gray of Toulon, Ill., raises the question of whether a CB licensee can make his own antenna. We'll split the answer into two parts, legal and practical. There is no barrier in the rules to a home-made antenna if its elements do not raise the height of a man-made structure or natural formation by more than 20 feet. This rule most often affects the vertical dipole which rises to over 17 feet. The important point is that the height rule refers to the tip of the antenna and not to its low end.

The practical aspect? No other single factor is more important to CB range than the antenna. Slight mistuning, mismatch or incorrect dimensions will knock radiated power down to a fraction of the proper level. Thus, the builder must be familiar with antenna design, have test equipment and display the talents of a plumber, especially for a complex array. Best bet is to stick to a pre-engineered job of the commercial variety or one of the detailed plans that appear occasionally in EI.

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employees. If you happen to work for a company which is put out of business, the point is driven home the hard way.

In 1960 Japan sent us some 3,900,000 radios with three transistors or more. In 1961 they expect to ship us over 4 million.

The view that cheap labor permits Japan to beat our prices is not the whole story. Girl radio assemblers in Japan get about $22 a month for a 42-hour week. The employer usually provides dormitory housing for $1 a month, provides free accident insurance and pays two-thirds of the cost of health programs. Where the employee doesn't live in company housing the employer pays the cost of transportation to and from work. Bonuses are given twice a year and range from six weeks to five months of pay. Many companies operate resort hotels where they send their engineers and families for vacations at company expense. Some companies do more, others do less, but as a whole Japanese labor costs *are* lower than ours. However, the price you pay for a Japanese product is not in direct relation to these labor costs or Japan's selling price. The price to the American importer of a six-transistor radio at the port of entry, for instance, is about $9.40. At that point the markup begins.

How great an onslaught of radios, meters, transistors, etc., we get from Japan each year is determined by MITI, the Japanese Ministry of International Trade and Industry. And through quality control standards, this government agency has been able to shake off Japan's prewar reputation as a cheap imitator. There still is a great amount of inferior merchandise made in Japan but the manufacturers have difficulty getting export permission.

Ralph Cordiner's we-must-automate solution to our problem *might* be effective if that automation extended all the way from raw materials to finished products. Automated assembly lines alone are not the answer because Japan is now almost as well automated as we are. Toshiba's Tokyo factory, for instance, is in a modern building and includes up-to-date automated equipment from which pours a locust-like swarm of transistor radios.

One reason American manufacturers are having difficulty competing lies in our distribution system. A typical product goes from the maker to an area distributor, to a city or local distributor, and finally to the retailer, with each man getting his cut of the profits. In contrast, many Japanese lines are imported directly by the retailer, one step from the manufacturer. The retailer's profits are higher, his markup lower. A more flexible or less devious distribution system for American firms would help.

A spokesman for one of the large radio mail-order houses (which does not handle much Japanese goods) sees the situation this way: "We've just got to accept the fact that in certain areas the Japanese can clip our ears. They did it in the 35mm camera field, so our people started making other products. If the Japanese kill us with transistor radios, we've got to make something else where they don't compete."

One possession of this country that the Japanese can't copy is our genius in research, technical know-how and design. And we know the market better. U. S. manufacturers can give a more appealing design to an everyday product and find a waiting market. The Japanese have not so far demonstrated any outstanding ability as designers, especially at designing products pleasing to American eyes.

Further, we can and have exported our research and know-how to Japan in cooperative setups benefitting both parties. It works like this: the American company owns part of the new joint venture in Japan and furnishes engineering know-how, patents and supervisory and administrative personnel. The Japanese do the manufacturing. The products are sold in Southeast Asia and other world markets. Sperry-Rand has set up such an operation for computer manufacturing. Robertshaw-Fulton and Minnesota Mining have somewhat similar arrangements.

Perhaps the real significance in this

second war with Japan is that it is only a prelude to something bigger. Today Japan is hurting our manufacturers. Tomorrow, with increasing industrialization and technical competence all over the world, any number of countries, including those behind the Iron Curtain, may be in a position to wreck our domestic and world markets. We *must* find a friendly way out of the Japanese affair. If we don't, we lose a certain segment of our economy today. But tomorrow we lose the world.

What is the answer? As an old pro politician might say, "That's an interesting question. I'm glad you asked that."

Good Reading

Continued from page 85

introduction to an increasingly important subject. Boolean algebra (named for George Boole) provides the basic system of working logic for today's digital computers, providing the means for translating logical processes into mathematical symbols which a machine can handle. Although symbolic logic is far from easy to tackle, this pamphlet supplies as easy and clear an introduction to this endlessly interesting subject as you're ever likely to find. You'll have to get your copy mail-order from Philco, but if computers interest you it's definitely worth the effort.

—*John Milder*

The Solar Wheel

Continued from page 66

obtain the solar cell from Allied Radio and other large electronic parts distributors.

The motor may be obtained from: Polk's Model Craft Hobbies, Inc., 314 Fifth Avenue, New York, N. Y. Aristo-Rev Motor No. 2, $3 postpaid. There are similar motors available from other distributors but they have a higher internal resistance and may not work properly. The correct motor has an internal resistance of less than 15 ohms.

Constructing the Solar Wheel

On a sheet of stiff cardboard draw a 10" diameter circle. Draw another concentric 15/16" circle. Cut away the area *outside* the 10" circle and *inside* the inner circle. Be sure to maintain balance for a low starting torque.

Force-fit the motor in the 15/16" center hole and fix it in place with glue. The disc should fit around the motor housing close to the end *away* from the armature brushes. Remove a pair of 4" lengths of bare wire from a stranded wire cable. Solder one wire to the back and near the edge of the solar cell. This is the *negative* side and is silvered over. CAUTION: *Use a low-heat soldering iron and apply heat for a short time only.* Solder the other wire to the silvered rim on the other side. This is the *positive* end.

Punch two tiny holes through the cardboard about 1¼" apart, about 1½" above the motor body. Insert a wire from each side of the cell through the two holes until the cell lies flush with the wheel (black surface up). Then solder each wire to a separate armature brush. Obtain two 10" lengths of ¼" wood dowel. Drill a 1/16" hole near the end of each dowel, ⅛" in depth.

Drill two holes same diameter as the dowels in a block of wood, 2¾" apart, center to center. Insert and glue the dowels into the holes. The two 1/16" holes should face each other at the top. Make certain that the two holes are the same distance from the surface of the wood block. Then insert each end of the motor shaft into the holes in the dowels. Since the armature shaft is fixed in the supports, the motor *housing* will turn instead, thus turning the wheel.

The wheel will turn if strong sunlight falls on the surface of the disc at an angle of about 120 degrees or less. If you demonstrate this device indoors, use a 150-watt reflector spot lamp about 12"-18" away from the wheel. The light should strike the surface of the wheel at an angle no greater than 60 degrees. If the wheel is perfectly balanced, it will be self-starting. Otherwise, a slight touch at the edge will provide starting torque.

Continued from page 49

enjoyment it can provide the listener.

Folk-singing bridges the gap between classical and popular music without embarrassing the devotees of either. Although the Weavers are not the purest of folk-singers in the eyes of folk-song purists, they are splendid musicians with a marvelous sense of style and communication. In The Weavers at Carnegie Hall, they sing a program of familiar and little-known songs with an infectious spirit that merits the enthusiasm of the audience and will inspire a similar reaction at home.

The road from folk-song to traditional jazz is fascinating to travel, particularly when the guidance is as compelling as Jazz Begins, which is subtitled, Sound of New Orleans Streets: Funeral and Parade Music. Played with moving fervor by the Young Tuxedo Brass Band, this is a great recording of native American art in the making. It not only belongs in every jazz collection; it belongs in every record collection.

Moving forward rapidly to the jazz of today, we find its spirit exposed with subtle authority in The Modern Jazz Quartet, a disc which takes its name from the four-man ensemble that makes the music captured in its grooves. The playing possesses most of the qualities that appear in performances which attain the status of jazz classics, plus remarkable refinement and sophistication.

Somewhat in the same vein, but based on more familiar material, is My Fair Lady, played by Shelly Manne and His Friends. This disc applies the wit and drive of small-combo modern jazz to show tunes.

The original cast album of My Fair Lady makes a fine starter for the show music section of your collection. However, if you decide on the jazz version instead, an original cast disc of South Pacific, the Music Man or Guys and Dolls will provide variety. And if you crave some solid night club entertainment, make room for Lena Horne at the Waldorf. It's loaded with bistro atmosphere.

Of course, for stage atmosphere and beautiful singing, there's nothing like opera. Carmen is one of the most popular operatic masterpieces, with wonderful swinging melodies for soloists, chorus and orchestra. The plot makes sense, too, with real people in tense, dramatic situations. The late Sir Thomas Beecham recorded a magnificent performance issued in a three-record album. If that seems too big a chunk, a single disc of excerpts from the set is also available, and it contains the highlights of the drama.

When you want to show your admiring friends what your high fidelity rig can do when let out, it's nice to have something like Tchaikovsky's 1812 Overture on hand, complete with cannon shots and all. Antal Dorati leads the Minneapolis Symphony Orchestra and Kenneth Alwyn the London Symphony Orchestra in performances of that sturdy warhorse that should warm any audiophile's heart.

For more discerning sound-fanciers, a large chorus and orchestra will furnish a more stringent test than cannon fire. Prokofiev's Alexander Nevsky, conducted by Fritz Reiner, or Carl Orff's Carmina Burana, conducted by Eugene Ormandy, offer tremendous masses of tone in rhythmically invigorating music. Either provides many hours of exhilarating listening.

This is a good point at which to acquire a symphony for our collection. Probably the greatest symphonic conductor of all time was Arturo Toscanini, and one of his best recordings, Antonin Dvorak's New World Symphony, has recently been electronically doctored by RCA Victor's engineers into a resemblance to stereo. Monaural or pseudo-stereo, this is a fine-sounding example of a superb performance of an ingratiating symphonic masterpiece.

Excitement engendered by one person alone is projected by Artur Rubinstein in a disc of Chopin Piano Pieces.

Since World War II, there has been a vast amount of interest in music composed more than two centuries ago, the Baroque era. Its melodiousness, straightforwardness and general air of

[*Continued on page* 108]

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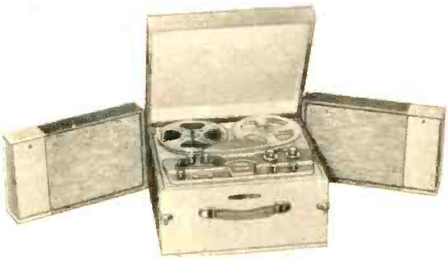

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Hi-Fi Record Guide

Continued from page 104

good health are appealing in these troubled times.

Written around 1725 by Antonio Vivaldi, the Four Seasons, a set of four short concertos for violin and string orchestra, each depicting a season of the year, has become a phonographic favorite. Perhaps the slow movement of Winter, from which the song April Showers seems to have been borrowed, is partly responsible for the popularity of the work. This section is startling at first hearing and its beauty increases with subsequent hearings. The performance by the Kapp Sinfonietta under Emanuel Vardi's direction is as good as any on records, and better than most.

By this time, our basic record collection has a good enough nucleus of vital music and outstanding performances to keep us intrigued and happy for quite a while.

Before winding up, I want to say a word about the terms *monaural* and *monophonic*. At one time the generally accepted term was monaural, and then monophonic replaced it in popular usage. Now the record industry is drifting back to monaural, and that is the term I shall use.

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

Britten: Young Person's Guide to the Orchestra		
Ormandy, Philadelphia Orch.	Columbia ML-5183	$ 4.98
	MS-6027	5.98
Slatkin, Fine Arts Orch.	Capitol P-8373	4.98
	SP-8373	5.98
The Weavers at Carnegie Hall	Vanguard 9010	4.98
Jazz Begins	Atlantic 1297	4.98
	S-1297	5.98
The Modern Jazz Quartet	Atlantic 1265	4.98
	S-1265	5.98
My Fair Lady		
Shelly Manne and His Friends		
	Contemporary 3527	4.98
	7527	5.98
My Fair Lady *Original Cast*	Columbia OL-5090	4.98
	OS-2015	5.98
South Pacific *Original Cast*	Columbia OL-4180	4.98
The Music Man *Original Cast*	Capitol WAO-990	5.98
	SWAO-990	6.98
Guys and Dolls *Original Cast*	Decca 9023	4.98
	79023	5.98
Lena Horne at the Waldorf	RCA Victor LOC-1028	4.98
	LSO-1028	5.98
Bizet: Carmen *Beecham*	Capitol GCR-7207	13.98
	SGCR-7207	16.98
Carmen (excerpts) *Beecham*	Capitol G-7222	4.98
	SG-7222	5.98
Tchaikovsky: 1812 Overture		
Dorati, Minneapolis Sym.	Mercury 50054	4.98
	90054	5.98
Alwyn, London Sym. Orch.	London CM-9035	4.98
	CS-6038	5.98
Prokofiev: Alexander Nevsky		
Reiner, Chicago Sym. Orch. & Chorus	RCA Victor LM-2395	4.98
	LSC-2395	5.98
Orff: Carmina Burana		
Ormandy, Philadelphia Orch. & Chorus	Columbia ML-5498	4.98
	MS-6163	5.98
Dvorak: New World Symphony		
Toscanini, NBC Sym. Orch.	RCA Victor LM-1778	4.98
	LME-2408	5.98
Chopin: Piano Pieces		
Rubinstein	RCA Victor LM-2277	4.98
Vivaldi: The Four Seasons		
Vardi, Kapp Sinfonietta	Kapp 9056	4.98
	S-9056	5.98

Tech Editor

Continued from page 62

ing the stage that's killing the signal. For this we plug one of the 88's shielded test leads into the jack marked *signal output*. At the business end of the test lead the instrument produces a complex signal covering the frequencies from audio up to about 30 megacycles.

Starting at the output stage and working toward the antenna, you simply touch the "hot" lead to points along the signal path in the radio, listening for the tone from the radio's speaker. At the stage where the signal drops dead you'll find the bad component. It's as simple as that!

The injection technique, however isn't much help if the complaint is distortion or noise. Fear not, in that case, you work from the *other* end of the radio; this time using the signal *tracer* function. The tester's built-in transistor amplifier and a pair of 2000-ohm headphones (not supplied) plugged into the *ext. meter* jacks let you monitor the audio quality of the signal at every stage *after the first IF stage*. The 88 comes with a speaker for this function but we found headphones to be far superior. Localizing distortion then becomes a matter of touching the audio or detector probe (depending on whether you're in an RF/IF or audio stage) to various points in the signal path until you *hear* the bad stage. Apropos of trouble-shooting transistor circuits, you really needn't worry about the "complexities" of the printed boards. You'll be surprised how fast you can learn to find your way around them with a little practice.

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	1AX2	.62		6BA6	.50		12AJ6	.46
	1B3GT	.79		6BC5	.61		12AL5	.45
	1DN5	.55		6BC7	.94		12AL8	.95
	1G3	.79		6BC8	.97		12AQ5	.52
	1J3	.79		6BD6	.51		12AT6	.43
	1K3	.79		6BE6	.55		12AT7	.76
	1LN5	.59		6BF6	.44		12AU6	.50
	1R5	.62		6BG6	1.66		12AU7	.61
	1S5	.51		6BH6	.65		12AV5	.97
	1T4	.58		6BH8	.87		12AV6	.41
	1U4	.57		6BJ6	.62		12AV7	.75
	1U5	.50		6BK7	.85		12AX4	.67
	1X2B	.82		6BL7	1.00		12AX7	.63
	2AF4	.96		6BN4	.57		12AZ7	.86
	3AL5	.42		6BN6	.74		12B4	.63
	3AU6	.51		6BQ5	.65		12BA6	.50
	3AV6	.41		6BQ6GT	1.05		12BD6	.50
	3BA6	.51		6BQ7	1.00		12BE6	.53
	3BC5	.54		6BR8	.78		12BF6	.44
	3BE6	.52		6BU8	.70		12BH7	.77
	3BN6	.76		6BY6	.54		12BL6	.56
	3BU8	.78		6BZ6	.55		12BQ6	1.06
	3BY6	.55		6BZ7	1.01		12BY7	.77
	3BZ6	.55		6C4	.43		12BZ7	.75
	3CB6	.54		6CB6	.55		12C5	.56
	3CF6	.60		6CD6	1.42		12CN5	.56
	3CS6	.52		6CF6	.64		12CR6	.54
	3DK6	.60		6CG7	.61		12CU5	.58
	3DT6	.50		6CG8	.77		12CU6	1.06
	3Q5	.80		6CM7	.66		12CX6	.54
	3S4	.61		6CN7	.65		12DB5	.69
	3V4	.58		6CR6	.51		12DE8	.75
	4BC8	.96		6CS6	.57		12DL8	.85
	4BN6	.75		6CU5	.58		12DM7	.67
	4BQ7	1.01		6CU6	1.08		12DQ6	1.04
	4BS8	.98		6CY7	.71		12DS7	.79
	4BU8	.71		6DA4	.68		12DZ6	.56
	4BZ6	.58		6DB5	.69		12EL6	.50
	4BZ7	.96		6DE6	.58		12EG6	.54
	4CS6	.61		6DG6	.59		12EZ6	.53
	4DE6	.62		6DQ6	1.10		12F8	.66
	4DK6	.60		6DT5	.76		12FM6	.45
	4DT6	.55		6DT6	.53		12K5	.65
	5AM8	.79		6EU8	.79		12SA7M	.92
	5AN8	.86		6EA8	.79		12SK7GT	.74
	5AQ5	.52		6H6GT	.58		12SN7	.67
	5AT8	.80		6J5GT	.51		12SQ7M	.78
	5BK7A	.82		6J6	.67		12U7	.62
	5BQ7	.97		6K6	.63		12V6GT	.53
	5BR8	.79		6S4	.51		12W6	.69
	5CG8	.76		6SA7GT	.76		12X4	.38
	5CL8	.76		6SK7	.74		17AX4	.67
	5EA8	.80		6SL7	.80		17BQ6	1.09
	5EU8	.80		6SN7	.65		17C5	.58
	5J6	.68		6SQ7	.73		17CA5	.62
	5T8	.81		6T4	.99		17D4	.69
	5U4	.60		6U8	.83		17DQ6	1.06
	5U8	.81		6V6GT	.54		17L6	.58
	5V6	.56		6W4	.60		17W6	.70
	5X8	.78		6W6	.71		19AU4	.83
	5Y3	.46		6X4	.39		19BG6	1.39
	6AB4	.46		6X5GT	.53		19T8	.80
	6AC7	.96		6X8	.80		21EX6	1.49
	6AF3	.73		7AU7	.61		25BQ6	1.11
	6AF4	.97		7A8	.68		25C5	.53
	6AG5	.68		7B6	.69		25CA5	.59
	6AH6	.99		7Y4	.69		25CD6	1.44
	6AK5	.95		8AU8	.83		25CU6	1.11
	6AL5	.47		8AW8	.93		25DN6	1.42
	6AM8	.78		8BQ5	.60		25EH5	.55
	6AQ5	.53		8CG7	.62		25L6	.57
	6AR5	.55		8CM7	.68		25W4	.68
	6AS5	.60		8CN7	.97		25Z6	.66
	6AT6	.43		8CX8	.93		35C5	.51
	6AT8	.79		8EB8	.94		35L6	.57
	6AU4	.82		11CY7	.75		35W4	.42
	6AU6	.52		12A4	.60		35Z5GT	.60
	6AU7	.61		12AB5	.55		50B5	.60
	6AU8	.87		12AC6	.49		50C5	.53
	6AV6	.41		12AD6	.57		50DC4	.37
	6AW8	.90		12AE6	.43		50EH5	.55
	6AX4	.66		12AF3	.73		50L6	.61
							117Z3	.61

Stereo FM

Continued from page 45

usable monophonic signal. Half this kind of cake is decidedly better than none. This would not be the case with the Crosby system, which also exhibited under certain signal conditions a type of distortion which the FCC felt would be hard to remedy in a listener's receiver.

Another point in favor of the Zenith-GE system is that it allows stations which already use subcarrier frequencies for supplying commercial background music to factories and restaurants to stay in business. If a commercial multiplex station wants to transmit stereophonic programs on its main signal while supplying background material to paying users, it will have to use much more care than conventional stations. Under the Crosby system, however, it could broadcast stereo *or* background, but not both.

Since the Zenith-GE system is new and relatively unfamiliar to makers of hi-fi components, most of them are proceeding cautiously in developing adaptors for their tuners. Test equipment for the new system is still scarce and most audio manufacturers are stressing the need to make sure that any adaptor is bug-free from the start. Here, though, are some likely features of the forthcoming adaptor units.

To begin with, most of them probably will be designed for optimum performance only with a tuner from the same manufacturer. The adaptor must provide an exact match for the tuner's characteristics to come up with linear frequency response and good stereo separation. For the moment, the makers of wideband tuners have a slight edge in designing adaptors, since the approved multiplex system does not mate easily with the peaked IF's of narrow-band tuners. All adaptors probably will require elaborate filtering facilities and, although GE originally foresaw a simple one-tube adaptor for the approved system, it's likely that component adaptors actually will turn out to be fixed-frequency FM tuners with at least three or four tubes and several diodes. (EI is now at work on an adaptor for home construction.)

Several firms have rushed out with adaptors so far. GE's first model is a two-tuber (12AT7 and 12AX7) that has a $39.95 list price.

Before too long, the air should be full of satisfying stereo broadcasts. The makers of tuners and adaptors may trail slightly behind the men at the transmitters, but the road to good stereo broadcasting is finally clear

—*John Milder*

The Listener

Continued from page 63

cepts may be slightly different, but they're still close cousins.

In this column, we'll try to present items of interest to both types of listeners.

—o—

War by Radio . . . One of the best current sources of interesting listening for both DXers and SWLers is provided by that red-hot propaganda war down in the Caribbean. During the recent unsuccessful invasion of Cuba, the airways were fairly boiling with signals.

A fascinating angle in the Caribbean radio war is provided by CMQ Libre y Independiente (rough translation: Free and Independent CMQ) The original CMQ, without the Libre, etc., is a 50,000-watt broadcast-band station at Havana, on 630 kc. Along with six relay transmitters, one on short wave and the rest BCBers scattered throughout the island, this represents one of Cuba's five major networks. Before Fidel Castro came to power, Circuito CMQ was friendly to DXers and always verified reception reports. Today, while technically still under private control, all CMQ news and commentary follows the Castro line.

CMQ itself is not easily heard in much of North America because of interference from numerous regional stations, but it can be received on 31 meters at 9670 kc (station COCQ) during day-light hours before interference builds up. In the Eastern United States you can pick up its Santa Clara relay, CMHQ, on 640 kc after WHLO at Akron, Ohio, signs off just after sunset.

Meanwhile, and not so far away, a group of former CMQ employees have fled Cuba and founded their own version of CMQ, called CMQ Libre y Independiente, as we mentioned. It is an anti-Castro, anti-Communist organization. Of course, CMQ Libre does not have a transmitter of its own and rents time on other stations. One of these is Radio Swan (6000 and 1160 kc), the American-backed commercial station on Swan Island, transmitting paid political broadcasts to Cuba and the Dominican Republic.

Swan Island, situated off the coast of Honduras, was formerly under more or less direct control of the U. S., but now control is to be handed over to Honduras. Looking ahead to the time when Radio Swan might run afoul of Honduras authorities, CMQ Libre purchased a half-hour (at 10:30 P.M. EST) on Nueva Granada (HJKJ) at Bogota, Colombia. With 10,000 watts, HJKJ is a real power on 49 meters at 6160 kc. It probably puts a better signal into Cuba than does Radio Swan.

Nueva Granada is the key station for Colombia's Radio Cadena Nacional, the republic's second-largest network with some 25 affiliates. Just how many Radio Cadena stations carry CMQ Libre is indefinite. It probably depends on how well the individual outlet gets into Cuba. Short wave is an advantage here, of course, and HJFW Transmisora Caldas, also at Bogota, provides 60-meter coverage on 5020 kc. Other considerations when the number of outlets is being decided would be power and jamming. Castro has a habit of switching transmitters to block outside broadcasts but it would take plenty of watts to jam every Radio Cardena facility.

DXers and SWLers wishing to follow the progress of CMQ Libre should keep a close watch on 49 meters (5950-6200 kc), 60 meters (4750-5060) and the broadcast band. If funds hold out, we can expect the free CMQ network to expand.

Continued from page 75

tiny ruby capable of emitting a narrow beam of coherent light that is a million times brighter than the sun. In light radar, this beam takes the place of the radio-wave beam of RF radar. When it strikes a target, part of its energy is reflected back and picked up by the receiver.

The Hughes Colidar uses a laser emitting a beam of coherent red light at a 6,943-angstrom wavelength (an angstrom is one hundred-millionth of a centimeter) which works out to about 500,000,000 mc. The term coherent means the light waves march along in phase, instead of being in a jumble, as is the case with random light.

Light radar is able to concentrate an immense amount of power in a small beam, only half a degree wide as it comes from the laser. And, because this is light we're dealing with, the beam can be narrowed or focused optically—with lenses. Rather than using huge parabolic reflectors to reduce beamwidth, relatively small optics can be employed.

In its first experimental Colidar, Hughes was able to cut the beam to .0189 degree with a relatively crude optical setup. That would make a spot on the moon about 160 miles wide.

"But that is only a beginning," says Dr. Rex C. Mack, who coordinates optical maser work at Hughes. "We are now at work on refinements and we fully expect to reduce that figure to about ten microradians." Ten microradians translates into .00057 degree, which means our spot on the moon now is only about 2.4 miles wide. Researchers say privately that they foresee a 1-mile spot.

But even the 2.4-mile figure shows great promise. It literally means throwing a spotlight into outer space.

Patterns and changes in Colidar's reflected beam will give us a picture of the moon or a planet that includes such distinguishing features as sand, boulders, mountains, water and forms of life, if any. We will be able to see things never before glimpsed with optical telescopes because these instruments depend on the sun's reflected light for illumination. Colidar supplies its own light a million times brighter than the sun's.

Mercury should be one of the more interesting planets to explore. We've never been able to see half of the planet because that side is turned away from the sun and remains in darkness. Light radar can floodlight Mercury's perpetual night until it is brighter (in one spot) than the sunny side.

In order for a human to see an object, the eye must pick up light reflected by it, whether the light comes from the sun or a flashlight. In a way, Colidar's operation is exactly the same, except it supplies its own brilliant beam of red light to illuminate what it's looking at. The reflected beam could be seen by the human eye, which is sensitive to red, if the signal were strong enough (and it is not). Colidar uses a telescope to pick up this beam, and it then converts it into an electrical signal which still is so weak that it must be amplified before it can be processed further.

Physically, Colidar works this way: The laser is housed in a tube with lenses on the end, like a flashlight bulb and its lens. The tube is mounted on an 8-inch reflecting telescope, which picks up the reflected light (plus incidental light of other wavelengths). To get rid of the stray light, which represents "noise" in the signal, the beam is fed through a filter. The filtered red beam is then fed to a phototube which translates the light into an electrical signal. In amplified form this signal can be displayed in several ways—on a graph, cathode-ray tube, etc.

Light radar has its drawbacks, of course. Light beams at times are attenuated quickly in the earth's atmosphere. Water droplets and dust are mortal enemies and a cloud simply cuts off the beam. There are two answers. Colidar could be installed on a mountain, above the dirtiest part of the atmosphere. But a more exciting possibility is offered by a Colidar-equipped satellite. From there, outside the atmosphere, the light beam would have virtually a clear path to any point in space.

Although light radar is an exciting

new tool for astronomers, it can never take the place of RF radar in many applications. In the case of planets which have attenuating atmospheres of their own, such as cloud-covered Venus, Colidar simply leaves the field to its older cousin because radio waves *can* penetrate clouds.

RF radar has shown to best advantage in some mapping experiments of the moon. One such moon map is shown on the second page of this article. That illustration seemingly depicts a half-moon, and it does, except the half-moon is not the same one we see with our eyes.

When a radar signal is sent to the moon, it does not just bounce off a flat disk because the moon is not flat. It is a sphere, just like an orange that you hold in front of your eye. And when you look at the orange, one point on it is closest to your eye. From there, it slopes back toward the edges, or horizon. A radar signal sees the moon the same way. A signal which strikes the nearest point returns before one which strikes halfway down the side, because the second signal has farther to travel.

Radar astronomers draw a small circle on the moon's closest point and then draw rings around it, laying off sections until they reach the horizon. A radar signal reflected from the innermost circle returns first, followed by signals from the second, third, and fourth rings, and so forth. A single transmitted signal is thus broken up into several sections, and it is these sections which form the illustration we show. The top graph line is the first circle, the next line the second circle, and so on.

Thus, the illustration actually does show a half-moon, but a *spherical* half-moon.

In this day we are looking forward hopefully to the discoveries our space travelers will make in our solar system, and we won't be satisfied until the eyes of our voyagers actually see what is there, human nature being what it is. But radar—both the light and radio-frequency types—can give both us and those space explorers a good idea of what they're going to find when they get there.

Ham Shack

Continued from page 96

because they now mean the same thing.

In the original Greenwich Mean Time (GMT) system the day started at noon, which was 0000 hours. Five and a half hours later the time would be 0530, midnight would be 1200, daybreak approximately 1800, an hour before high noon would be 2300 and noon itself would then be 2400 or 0000 hours.

Shortly after World War I the numbering sequence was revised. The day started at midnight, 0000 hours, so until noon, the readings corresponded with ordinary civilian time pieces: 0300 for three o'clock in the morning, 0800 for breakfast, 1200 for noon. However, one hour after noon became 1300, tea time 1600 and so on until midnight, which was 2400 or 0000 hours. This system was called Greenwich Civil Time (GCT) to distinguish it from the older GMT but the expression GMT was so firmly planted in maritime, aeronautical and radio practice that it persists to this day, even though the actual GMT method is no longer in use.

In addition to GMT and GCT for 24-hour reckoning, you may encounter UT, which means Universal Time and is the same as GCT, which is the same as GMT . . . etc.

—o—

Roger, Roger! . . . Or is it Romeo to you? A couple of Ham Shacks back I got into a discussion about phonetic alphabets and the phony phonetics you hear on the air. I talked about three phonetic alphabets, "the old military," the "new international" and the ARRL versions.

A small cloudburst of letters quickly rained down on me, pointing out that I hadn't mentioned the most recent alphabet, a revised military version of the international, which, by the way, has become more or less the official ham alphabet. I say more or less because phonetic alphabets have a way of never quite being accepted, and the FCC hasn't even noticed this most recent alphabet. The changes involve four letters: C—formerly Cocoa, now Charlie; M—formerly Metro, now Mike; N—formerly Nectar, now November; U—formerly Union, now Uniform.

Charlie and Mike are old friends, of course, coming back to us from the old military list after a stay of a few years in some phonetic salt mine.

One is immediately led to ask why, when they made the latest changes, they ignored Quebec (pronounced kaybeck) for Q, which confuses a lot of people because of the variety of its pronunciations. Well, the way phonetics go, in a couple of years more changes probably will be made and Q may turn into Quack-Quack.

One curiously inconsistent feature of international voice procedure is the retention of the word Roger as the signal of receipt or acknowledgement, although old Rog has now been replaced in the phonetic alphabet by Romeo for R.

Of all the phonetics, Roger is certainly the one most firmly fixed in the minds of operators everywhere, and has been used in radiotelegraphy for half a century. If it is good enough to remain in international voice procedure why has it been dropped from the alphabet in favor of Romeo, which may sound more romantic but certainly isn't any better?

Radio Direction Finders

Continued from page 48

only when a given side of the loop faces the transmitter.

There are three methods of indicating null—meter, loudspeaker and headphones. The meter is the most accurate, being better equipped to determine the exact amplitude of a signal than is the ear, and the same movement also can be used as an S meter at other times.

Some RDF equipment covers everything from the long-wave beacons to VHF but unless you're planning to cross an ocean there are only three frequency ranges of interest: the aircraft and marine beacon bands from 200 to 400 kc, the broadcast band from 550 to 1650 kc and the mobile marine band from 1650 to 3500 kc.

Aircraft beacon stations (operated by the Federal Aviation Agency) transmit weather information in addition to providing a fixed point for bearings. Their locations usually are not shown on maritime navigation charts but this information can be transferred from FAA charts to your own chart. The marine radio beacon stations (operated by the Coast Guard) transmit code identification signals. Their locations, along with their operating schedules, transmitting frequencies and identification codes are shown on most marine charts. These stations are best received by sets equipped with a beat frequency oscillator (BFO).

You probably are familiar with the frequencies and call letters of local broadcasting stations. When you learn the location of each station's antenna you have enough reference points for nearly any day's sailing. An RDF that covers the broadcast band also, of course, gives you conventional weather broadcasts and general entertainment. However, BCB bearings are less reliable than those obtained from marine beacon stations.

The principal value of the marine band in RDF work is its coverage of the 2182-kc distress frequency and the reception of weather bulletins.

It is possible to take bearings on signals from boats equipped with radiotelephones, or on signals from any source, but bearing information from moving transmitters is sometimes difficult to calculate and use.

The 200 to 400 kc beacon band probably is the single most useful and reliable band for RDF's.

When installing a radio direction finder in your boat select a location close to the controls and also to the compass so that its pointer-azimuth scale can be aligned with the compass lubber line. Sometimes the most convenient operating location may be unsuitable because of such electrical obstructions as fittings, rigging or structural supports which block or distort signals to the loop antenna. In this case you simply have to check various locations and select some compromise spot. To try out your set, select a station of known location (preferably one that can be seen) and then check the RDF's bearing against what you know is the true bearing. Then take the boat in a slow circle and check the station's bearing every 10 degrees. If dead spots show up anywhere in the circle you must move the set to get away from the obstruction. RDF bearings aren't perfect but they are relatively accurate. A rule-of-thumb rate of error is ± 1 degree on stations up to five miles and ± 5 degrees on stations 50 miles or more away. Daytime bearings are more accurate than those taken at night and bearings over land are less accurate than those over water.

Virtually all radio direction finders come with an instruction book so we will not go into detail on the subject.

If you are offshore and can take bearings on three stations of known location, you draw the three lines on your chart. They will form a triangle. Open your compass a distance equal to the longest side of the triangle, set the pin in the triangle's center and draw a circle. Your location is within the circle. The stations should be at least 30 degrees apart for best accuracy. On inland waters the stations are likely to be on different sides and the fix is even more accurate.

If you are receiving just one station and have no sense antenna you can determine which side the station is on by taking several bearings as you travel a straight course, starting with the station close to the beam (90 or 270 degrees). The readings will then pass to stern on the side where the station is located (90, 110, 120 degrees or 270, 260, 250 degrees, etc.).

It also is possible to determine your distance from a transmitter. First fix the station at 45 degrees off the starboard bow. Then, keeping track of your speed and time, steer a straight course until the station is off the starboard beam at 90 degrees. The distance from fix A (45 degrees) to fix B (90 degrees), as computed from speed and time, will equal the distance to the station (the whole plot makes an equilateral triangle). The same maneuver also can be done on the port side, of course.

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The Case of Negative Ions

Continued from page 89

advertising on behalf of ionizers false and misleading.

An independent non-profit testing organization believes the most charitable thing that could be said about negative ion claims is that they are premature and exaggerated.

A Rockefeller Institute scientist was a bit more blunt. "At this point," said he, "this is all a bunch of hooey."

In the face of such fierce statements is the case of the negative ions a doomed one? Not necessarily. Although the foregoing comments are unfavorable, they only express the feeling that the known facts *at this point* don't support the claims. The claims *could* be true but they haven't been proven.

Negative ionizers have been with us such a short time and came on so suddenly that research is running behind production. We haven't had enough scientifically accurate research to find out what effect negative ions really do have. This is what the AMA opinion implies: the claims could be true but the organization hasn't seen the proof.

In nature, a cubic centimeter of air may contain 500 to 2,500 negative ions. A generator enriches the mixture but no one is yet sure how many ions should be added. According to one recommendation, an optimum amount is 600 to 1,000 units, but where an asthma or hay fever victim is concerned, as many as 10,000 ions should be pumped into each cubic centimeter. No one is sure whether an overly-rich mixture is toxic.

It also is difficult to tell exactly how many ions are coming out of any given source because of a lack of standard measuring conditions. A delicate electrometer is used to count ions, producing a readout in *micromicro*amperes, which means rigid controls are necessary for accuracy.

Some four types of negative ionizers have been produced.

The simplest model resembles a microphone. In its head is a small quantity of radioactive material, tritium, which emits beta particles. The particles collide with atoms or molecules of oxygen (oxygen usually is found only in molecular form in nature) and both positive and negative ions are formed. The positive ions are taken away via a plate carrying a negative charge (which attracts and grounds them). The same plate repels the negative ions into a room. (The operation of two types of ionizers are diagrammed on the second page of this article.)

Another popular ionizer uses a thin (.010-inch) tungsten wire and a U-shaped metal bracket as electrodes. Something in the neighborhood of 4,000 volts DC is placed across the electrodes. The wire, mounted inside the bracket, is negative. A space charge or electrical field builds up and becomes so concentrated around the tiny wire that a bluish light called corona may appear. Under these conditions, electrons are literally pulled from the wire. Some of them join neutral air molecules and thereby form negative ions. Air usually is blown through the generator to sweep the tiny puarticles out into a room. On the way, the air passes a plate with a negative potential which attracts and grounds any positive ions that were formed (and some always are).

A third type of generator also uses a wire, except in this case it is the high-resistance wire of an electric radiant heater. The electrons, instead of being drawn from the wire by an electrical field, are forced out by heat. The critical temperature for formation of negative ions is something above 2,000° F. Below this temperature, ions are still formed, but most of them are positive.

Westinghouse and others have built some ionizers that employ ultraviolet lamps but these have not yet reached the market in quantity because of the ozone problem. Ultraviolet rays usually generate ozone (super-active oxygen) which can be harmful if breathed in concentrated form.

Many ion generators are used in conjunction with regular air purifiers—filters and electrostatic cleaners.

No matter what the final decision may be on negative ions, they certainly have caused a tremendous uproar for something so small in size!

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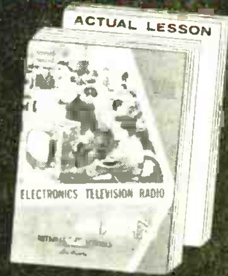

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