

BUILD OUR WIND/CHILL FACTOR METER

elementary Electronics

JANUARY-FEBRUARY
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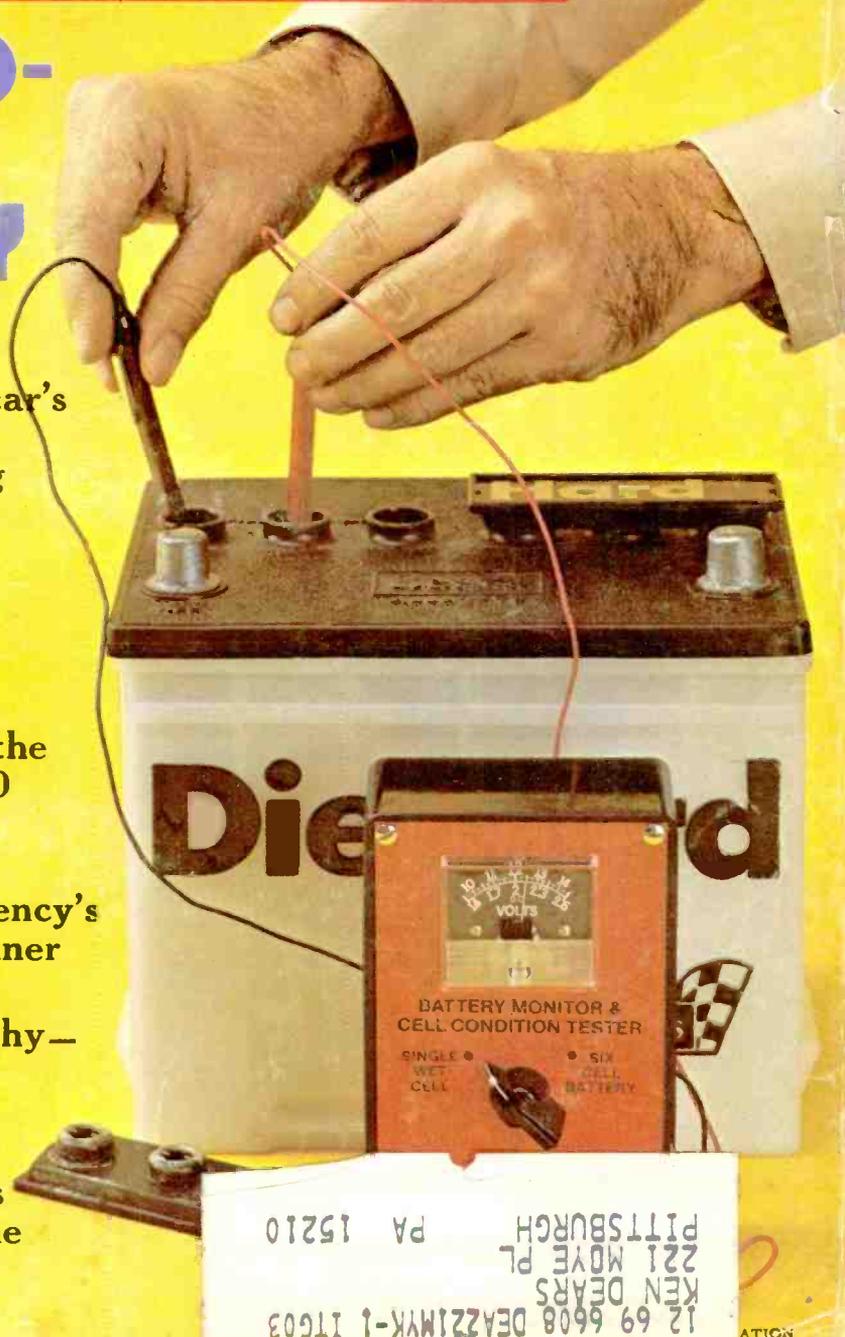
**BEGINNER'S
AC THEORY**
OUR BASIC COURSE
&
**WHAT IS CB
TALK POWER?**

ELECTRO- CHEM BATTERY TESTER

Dip right into your car's
battery, cell by cell,
for foolproof testing

PLUS-

- Kathi checks out the Tram Diamond 40 CB transceiver
- Our lab tests Regency's new low-cost scanner
- Kirlian photography—facts and frauds uncovered
- Today's collector's items are Old Time Radio Magazines



One of our most successful students wrote this ad!

Harry Remmert decided he needed more electronics training to get ahead. He carefully "shopped around" for the best training he could find. His detailed report on why he chose CIE and how it worked out makes a better "ad" than anything we could tell you. Here's his story, as he wrote it to us in his own words.

By Harry Remmert

AFTER SEVEN YEARS in my present position, I was made painfully aware of the fact that I had gotten just about all the on-the-job training available. When I asked my supervisor for an increase in pay, he said, "In what way are you a more valuable employee now than when you received your last raise?" Fortunately, I did receive the raise that time, but I realized that my pay was approaching the maximum for a person with my limited training.

"Education was the obvious answer, but I had enrolled in three different night school courses over the years and had not completed any of them. I'd be tired, or want to do something else on class night, and would miss so many classes that I'd fall behind, lose interest, and drop out.

The Advantages of Home Study

"Therefore, it was easy to decide that home study was the answer for someone like me, who doesn't want to be tied down. With home study there is no schedule. I am the boss and I set the pace. There is no cramming for exams because I decide when I am ready, and only then do I take the exam. I never miss a point in the lecture because it is right there in print for as many re-readings as I find



Harry Remmert gives his CIE Electronics course much of the credit for starting him on a rewarding career. He tells his own story on these pages.

necessary. If I feel tired, stay late at work, or just feel lazy, I can skip school for a night or two and never fall behind. The total absence of all pressure helps me to learn more than I'd be able to grasp if I were just cramming it in to meet an exam deadline schedule. For me, these points give home study courses an overwhelming advantage over scheduled classroom instruction.

"Having decided on home study, why did I choose CIE? I had catalogs from six different schools offering home study courses. The CIE catalog arrived in less than one week (four days before I received any of the other catalogs). This indicated (correctly) that from CIE I could expect fast service on grades, questions, etc. I eliminated those schools which were slow in sending catalogs.

FCC License Warranty Important

"The First Class FCC Warranty* was also an attractive point. I had seen "Q" and "A" manuals for the FCC exams, and the material had always seemed just a little beyond my grasp. Score another point for CIE.

*CIE backs its courses with this famous Money-Back Warranty: when you complete a CIE license preparation course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. Warranty is valid during completion time allowed for your course.

"Another thing is that CIE offered a complete package: FCC License and technical school diploma. Completion time was reasonably short, and I could attain something definite without dragging it out over an interminable number of years. Here I eliminated those schools which gave college credits instead of graduation diplomas. I work in the R and D department of a large company and it's been my observation that technical school graduates generally hold better positions than men with a few college credits. A college degree is one thing, but I'm 32 years old, and 10 or 15 years of part-time college just isn't for me. No, I wanted to *graduate* in a year or two, not just *start*.

"When a school offers both resident and correspondence training, it's my feeling that the correspondence men are sort of on the outside of things. I wanted to be a full-fledged student instead of just a tag-a-long, so CIE's exclusive home-study program naturally attracted me.

"Then, too, it's the men who know their theory who are moving ahead where I work. They can read schematics and understand circuit operation. I want to be a good theory man.

"From the foregoing, you can see I did not select CIE in any haphazard fashion. I knew what I was looking for, and only CIE had all the things I wanted.

Two Pay Raises in Less Than a Year

"Only eleven months after I enrolled with CIE, I passed the FCC exams for First Class Radiotelephone License with Radar Endorsement. I had a pay increase even before I got my license and *another* only ten months later.

"These are the tangible results. But just as important are the things I've learned. I am smarter now than I had ever thought I would be. It feels good to know that I know what I know now. Schematics that used to confuse me completely are now easy for me to read and interpret. Yes, it is nice to be smarter, and that's probably the most satisfying result of my CIE experience.

Praise for Student Service

"In closing, I'd like to get in a compliment for my Correspondent Counselor who has faithfully seen to it that my supervisor knows I'm studying. I think the monthly reports to my supervisor and generally flattering commentary have been in large part responsible for my pay increases. My Counselor has given me much more student service than "the contract calls for," and I certainly owe him a sincere debt of gratitude.

"And finally, there is Mr. Tom Duffy, my instructor. I don't believe I've ever had the individual attention in any classroom that I've received from Mr. Duffy. He is clear, authoritative, and spared no time or effort to answer my every question. In Mr. Duffy, I've received everything I could have expected from a full-time private tutor.

"I'm very, very satisfied with the whole CIE experience. Every penny I spent for my course was returned many

times over, both in increased wages and in personal satisfaction."

Perhaps you too, like Harry Remmert, have realized that to get ahead in Electronics today, you need to know much more than the "screwdriver mechanics." They're limited to "thinking with their hands" . . . learning by taking things apart and putting them back together . . . soldering connections, testing circuits, and replacing components. Understandably, their pay is limited—and their future, too.

But for men like Harry Remmert, who have gotten the training they need in the fundamentals of Electronics, there are no such limitations. He was recently promoted, with a good increase in income, to the salaried position of Senior Engineering Assistant working in the design of systems to silence submarines. For trained technicians, the future is bright. Thousands of men will be needed in virtually every field of Electronics from two-way mobile radio to computer testing and troubleshooting.

Send for Complete Information — FREE

Many men who are advancing their Electronics career started by reading our illustrated school catalog, "Succeed in Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you're "shopping around" for the training you need to move up in Electronics, this interesting book may have the answers you want. We'll send it to you FREE. With it, we'll also include our other helpful book, "How To Get A Commercial FCC License."

To get both FREE books, just fill out and mail the reply card. For your convenience, we will try to have a representative call. If card is missing, use coupon below.

APPROVED UNDER G.I. BILL

All CIE career courses are approved for educational benefits under the G.I. Bill. If you are a Veteran or in service now, check box for G.I. Bill information.

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1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

Cleveland Institute of Electronics, Inc.

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2. Your book on "How To Get A Commercial FCC License."

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elementary Electronics

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

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL. You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis. You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur License. You will build 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 low price you pay. The Signal Tracer worth more than the price of the 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 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 twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable electrolytic capacitors, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit Instructions, 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. 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.

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.



Reg. U. S. Pat. Off.

Training Electronics Technicians Since 1946

FREE EXTRAS

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- SOLDERING IRON
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- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION SERVICE • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE, FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

J. Statatis, 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 \$2.00 for a Course, but I found your ad and sent for your Kit."

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 571DJ Hewlett, N.Y. 11557

Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

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CIRCLE NO. 17 ON PAGE 17 OR 103

WE'RE GROWING!

Yes! Starting next issue, look for your favorite hobby electronics magazine in our new giant-size format with pages a full 59% larger. **Elementary Electronics** will be easier than ever to use. Your favorite features will be printed bigger and better. Our columnists will be here with more new information for SWLers, CBers, Antique Radio Collectors and Hobbyists. And you'll get more out of our better photographs—especially project photos—because there will be more to see.

Sure, we'll keep our same great format. There will be interesting science and electronics subjects, CB radio tests and information (even CBer's construction projects), our no-pain Basic Course for beginners, hi-fi things, and simple and advanced projects with a difference that bring hobby electronics to beginner and engineer alike.

Look for our new digital timepiece—rock bottom cost, time and date display, 24-hour alarm, stand-by battery power, simple wiring, snooze alarm and more in e/e's easy-to-build construction format. Now even better with our new great size.

Look for other project firsts in our first big issue, like a super-efficient audio amp using new Class "D" digital techniques and low-cost ICs, and a goof proof project for CBers that puts SW time broadcasts or local action band channels on a transceiver without modifying it.

All this and more to come in every big issue starting with the March/April '75 **Elementary Electronics**. Watch for it! On sale February 13th. Why not subscribe now and let your mailman do the work!

elementary Electronics

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Jan./Feb. 1975

Vol. 15/No. 1

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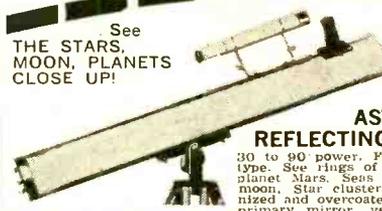
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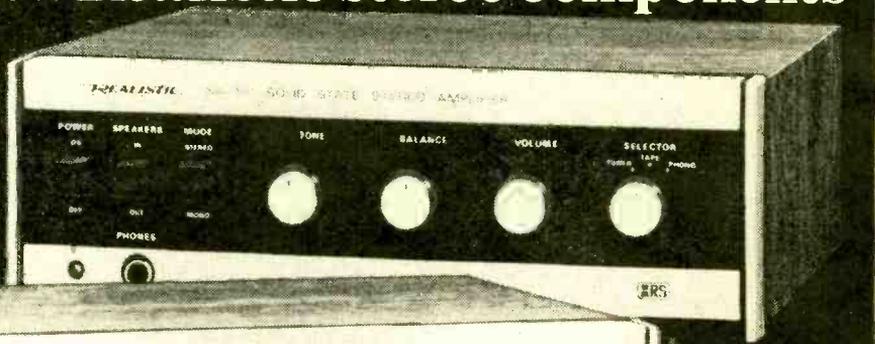


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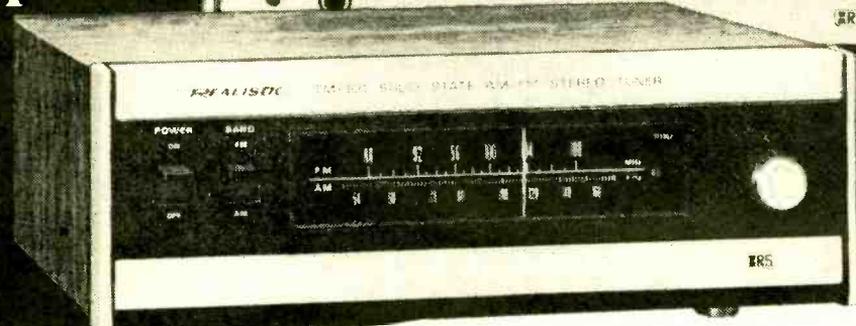
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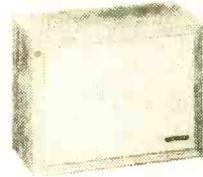
1975 Catalog Mail to Radio Shack, P. O. Box 1052, 471 Ft. Worth, Texas 76101. (Please print.)

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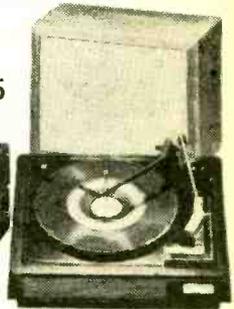
Realistic SA-101 Stereo Amplifier. Inside the handsome walnut-grain wood case is an ITL/OTL amplifier with plenty of power for compact speakers. It's versatile too, with inputs for a magnetic or ceramic phono, tuner and tape. And there are separate volume, balance and tone controls, a speaker in/out switch, and a stereo headphone jack for private listening. U.L. listed. #31-1983.

Realistic TM-101 Stereo Tuner. Our lowest priced tuner, but it pulls in FM stereo and AM the way you like it. You'll hear more stations and less noise thanks to three-ganged FM tuning, ceramic filter, advanced multiplex IC and external FM antenna terminals. Other features include a slide-rule dial, stereo beacon and walnut-grain wood case. It's a perfect "system mate" for the SA-101. U.L. listed. There's only one place you can find it... Radio Shack! #31-1984.

Save \$34.80 on a Complete System



regularly 234.75
199⁹⁵



- Realistic SA-101 Stereo Amplifier
- Realistic TM-101 AM/FM Stereo Tuner
- Two Solo-1 Speaker Systems
- Realistic LAB-12C Changer with Base And \$12.95-Value Magnetic Cartridge



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CIRCLE NO. 32 ON PAGE 17 OR 103

Hey, look me over

Showcase of New Products

CB On Your Finger

Not every hobbyist can wear a ring to show off his hobby, but now the lucky CBer can! Regal Lapidaries, Inc. is the manufacturer of this beautifully designed CB ring. The ring is a masterpiece in sculpture, depicting the handclasp of friendship, a mike, and an an-

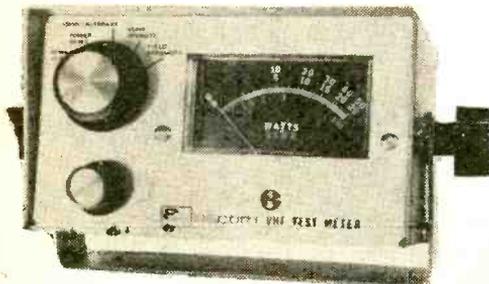


Circle No. 41 on Reader Service Page 17 or 103

tenna, all beautifully done in three-dimensional form. The ring is available to all CBers, and is priced at \$9.95. The company invites all clubs to write in for special club information. Their address is: Regal Lapidaries, Inc., 420 Madison Avenue, New York, NY 10017, and tell 'em you read about it in ELEMENTARY ELECTRONICS!

VHF Transmitter and Antenna Checker

A new multi-tester, the Ascom Model ASMR-100, checks both transmitter and antenna



Circle No. 16 on Reader Service Page 17 or 103

JANUARY-FEBRUARY, 1975

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Use your regular
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Get functions of four antennas with Monitor-Match for reception of AM-FM plus low-band, high-band and UHF monitor radios. Excellent performance. Connect and operate.

MODEL 5M5

HEAR IT **ALL** WITH
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ANTENNA!



NO ADJUSTING
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40 to 700 MHz Total
Coverage

Get superior all directional reception on low-band, high-band and UHF including 88-108 MHz FM entertainment radio with this 50" antenna. Includes SO-239 coax connector and mounting hardware. MODEL DCX

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NEW-TRONICS CORP.

15800 COMMERCE PARK DRIVE
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CIRCLE NO. 14 ON PAGE 17 OR 103

CALECTRO panel meters



A SIZE AND SHAPE
FOR EVERY NEED

LEVEL METER AND BATTERY CHECKER

Precision construction. Features D'Arsonval movement, jeweled bearings, and hand calibration.



MINIATURE EDGEWISE
PANEL METERS

NEW
One Hole
Mount



MINIATURE PANEL METERS

Full range of panel mini-meters featuring single hole mounting. Simply bore hole for movement and thats it. Thread nut onto back of meter. Meter in line—every time.

PRECISION PANEL METERS

Rugged construction — 2% accuracy. Hand calibrated and linear dial scales. D'Arsonval movement with jeweled bearings. Crystal clear plastic cover plate.



GC ELECTRONICS
DIVISION OF HYDROMETALS, INC.
ROCKFORD, ILLINOIS 61101 U.S.A. 

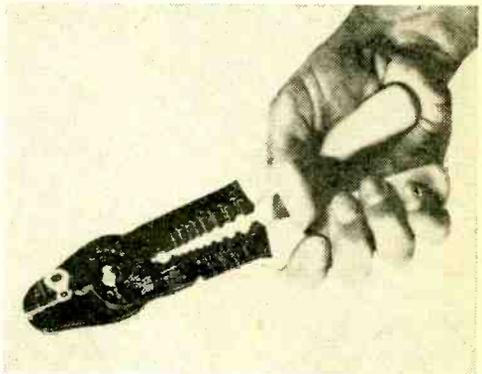
CIRCLE NO. 11 ON PAGE 17 OR 103

HEY, LOOK ME OVER

operation over a frequency range of 144 to 174 MHz. Featured on the new ASMR100 tester is a dual range wattmeter function, 0-25 and 0-50 watts. Transmitter output is indicated directly in watts on either scale with $\pm 8\%$ accuracy. Also provided is a function to measure voltage standing wave-ratio (VSWR) for checking antenna operation and adjustments. To monitor overall system operation a field strength meter function can be used to give indications that the system is radiating. The attractive all-aluminum case is rust and corrosion resistant, making the unit ideal for use on marine pleasure craft. Suggested list price of the Ascom ASMR100 multi-tester is \$69.95. More details are available from Ascom dealers or by writing directly to Ascom Electronic Products, 12435 Euclid Avenue, Cleveland, Ohio 44106.

Wiring Tool and Crimper

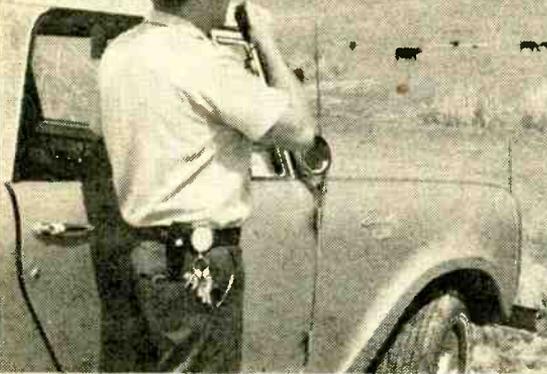
A new wiring tool and crimper called the "Wireplier" has just been introduced by Vaco. The tool has several features not found on other similar tools. These include a crimping die for 6 and 8 gauge non-insulated terminals, a 7 mm crimping die for ignition terminals, stripping dies for 6 and 8 gauge wire,



Circle No. 34 on Reader Service Page 17 or 103

and measurement markings for bolts and wire strip length. These features are in addition to a wire cutter, stripping dies 10-22 AWG, crimping dies for insulated or non-insulated solderless terminals 10-22 AWG and 5 bolt cutting dies (4-40, 6-32, 10-24 and 10-32). The Wireplier measures 8 $\frac{7}{8}$ -in. long, is black oxide finished with white markings, and has giant cushion grip handles for a comfortable squeeze. The tool is individually carded for pegboard displays with a stock number of 19730 and will list for \$7.95. Vaco tools are sold nationally. For further information, write: Vaco Products Company, 510 North Dearborn Street, Chicago, IL 60610. They'll be happy to send you literature.

10-73



TROUBLE? TIME TO CALL ON SILTRONIX

When trouble is riding high on the wind, it's time to avert disaster. SILTRONIX suggests you can cool an emergency situation with advanced preparedness: install an SSB-23 CB transceiver and learn 10-Code signals!

Reliability starts with quality equipment. SILTRONIX' SSB-23 "Tiny T-N-T" includes the extra "talk-power" of single-sideband. SSB increases useful range, cuts through hash, limits channel clutter, effectively doubles channel availability, and above all, has greater reliability than AM units.

Assurance of quality in design and workmanship is upheld when you invest in CB equipment bearing the SILTRONIX label. Investigate our "Tiny T-N-T" . . . it's worth the \$329.00 price tag!

In 1940 the Associated Public Safety Communications Officers, Inc. (APCO) adopted

their, now universally accepted, Ten Signals. Ten Signals help achieve communications reliability and speed. For instance, a 10-73 call, followed by location data, is immediately recognized by the Forestry Service. In a matter of seconds, it tells them where to investigate a smoke report which may lead to protection of life and property.

**WHEN TROUBLE'S IN THE WIND,
IT'S TIME TO CALL ON SILTRONIX!**

As an aid to promoting the use of accepted APCO standards, SILTRONIX offers CB'ers a free copy of the revised official APCO Ten Signals. This handy pocket reference card is available from your SILTRONIX dealer. He also has those beautifully embroidered SILTRONIX SIDEBANDERS emblems for just \$1.95 — wear one as your elite label of distinction among single-sideband CB operators. For convenience, you may send your name, address and \$2 to SILTRONIX — you'll receive an emblem, CB equipment catalog and your free copy of the Ten-Code reference card.



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ENJOY



RELIABILITY

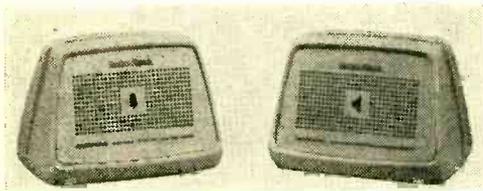
Whatever your CB needs may be, place your confidence in authorized SILTRONIX dealers — they know the meaning of service.

CIRCLE NO. 21 ON PAGE 17 OR 103

HEY, LOOK ME OVER

Walk and Talk Phone

With Radio Shack's new Duofone Electronic Telephone Amplifier you get real "freedom of speech." You can write, work, even walk around the room while carrying on a telephone conversation. The Duofone amplifies calls to room-filling volume so that everyone present can join the conversation. An ultra-sensitive mike picks up your voice from any-



Circle No. 4 on Reader Service Page 17 or 103

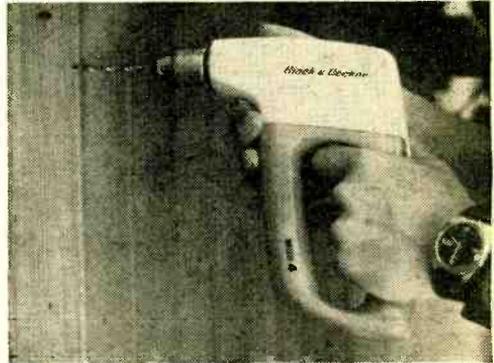
where in the room, and the solid-state amplifier lets you hear callers the same way you listen to a radio. To answer a call, just tap the talk-bar; to hang up, tap the talk-bar again. Outgoing calls are made normally, using your telephone. When the called party answers, press the talk-bar and hang up your phone. Volume may be adjusted as desired. An ingenious "jack-in-a-plug" makes installation easy with most phones. Simply insert this jack in your telephone wall outlet, then plug your phone into the piggyback jack. The Duofone operates on three "D" cells. The Duofone Electronic Telephone Amplifier is priced at \$29.95 and is available at Radio Shack stores coast-to-coast.

Mod Tool

The world's first cordless modular tool system, the Mod 4, features a universal, rechargeable high-Energy Pak handle that connects to seven Mod 4 tool heads. Each head



is designed and engineered to perform its own specific operation when attached to the basic handle unit. Additional tools also are being designed for the Mod 4 system. The initial power tools in the Mod 4 cordless tool system include a grass shear, upright grass shear, shrub trimmer, 1/4-in. drill, sealed beam lantern, 1-quart sprayer and 1-gallon sprayer. The Mod 4 Energy Pak has four 1.2 ampere hour high-energy rechargeable nickel cadmium cells which have a life of over 500



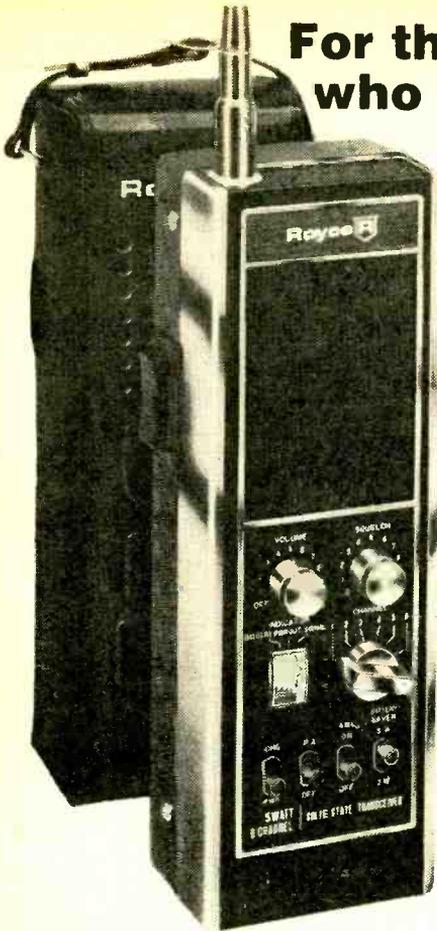
Circle No. 35 on Reader Service Page 17 or 103

charges. They are the highest capacity energy cells currently being produced in the sub-C size. The power cells are housed in an Energy Pak handle that is designed for ease of handling, hand and finger comfort, optimum switch pressure and other human factors. Safety switches are designed in the Energy Pak handle with an automatic lock-off feature to prevent accidental tool starting. (Price: \$11.99). The Mod 4 Recharger plugs into a conventional 120-volt outlet and will recharge the Energy Pak in 16 hours. The Energy Pak can be attached to the recharger when not in use, with no danger of overcharging. The unit can sit on a table, workbench, or be attached to the wall for convenient recharging and storage of the Energy Pak. (Price: \$4.99) The Mod 4 1/4-in. Drill has the capacity to handle most hole boring jobs in or around the home. Rated at 10 inch pounds of torque, the special drive system operates at 750 rpm and is capable of drilling up to 130 1/4-in. holes in 2-in. thick wood. The drill is designed with a minimum offset to allow operation close to the work area. The unit includes a built-in chuck key holder. (\$14.99). The Mod 4 1/4-in. Drill with Energy Pak and Recharger costs only \$29.99. Available at hardware stores and tool outlets all over the country.

RF Signal Generator

The B&K Model 2050 RF Signal Generator is a 100% solid-state, compact, rugged unit ideal for applications in the audio, radio, and TV service field. Some applications are AM receiver alignment; marker source for TV

**For the person
who wants the ultimate!**



**ROYCE
Model 1-408
Professional
5-Watt/2-Watt 6-Channel
Hand-Held Transceiver**

• Optional new battery pack and charger **guaranteed for one full year.** 12.5 volt battery powers Model 1-408 (or any Royce high-powered hand-held transceiver) for a full 8 to 10 hours! Can be re-charged over 750 times! Suggested retail price \$35.45.



- Only 2 lbs. 4 oz., including batteries and carrying case.
- Use only power you need – 5-Watt or 2-Watt.
- 3-way meter monitors battery level, power output, and incoming signal strength.
- 6 channel versatility (Channel 11 crystals supplied).
- High-style chrome and black trim styling.
- Durable, long-lasting carrying case.
- Flick switch, and unit converts into powerful P.A. system.
- Built-in automatic noise limiter circuit with switch.
- Active AGC circuit reduces fading and blasting.
- Fully variable squelch control.
- Heavy-duty telescopic antenna.

All we ask is that you compare the Royce Model 1-408 with any other hand-held transceiver, feature by feature. Then, decide for yourself. Suggested retail price \$109.95 (new battery pack not included).

Do you have our new literature?
Write today to address below.

Royce  **electronics**
corporation

1142 Clay St., North Kansas City, Mo. 64116, CALL: (816) 842-0252, TELEX: 426-145

CIRCLE NO. 19 ON PAGE 17 OR 103

Now! Punch out the Big Signal from 60 feet up!

"The Big Stick" half wave omni-directional base antenna

New FCC regulations allow CBers to boost their base station height to 60 feet for omni-directional antenna.

The Big Stick's unique low angle radiation pattern illuminates 12 times more capture area at 60 feet than comparable antennas.

This half wave beauty is precision-built of superstrong fiberglass that stands up to all punishment—hurricane winds, ice, salt and corrosive elements. It's pretuned. No ground radials. Works anywhere with any length cable.

Move up to tall performance with the Big Stick. Shakespeare Industrial Fiberglass Division, P.O. Drawer 246, Columbia, South Carolina 29202.



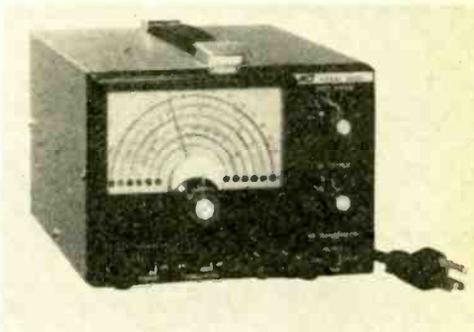
Shakespeare

THE ROYAL LINE OF FIBERGLASS ANTENNA

IN CANADA Len Finkler Ltd., 25 Toro Road, Downsview, Ontario
CIRCLE NO. 28 ON PAGE 17 OR 103

HEY, LOOK ME OVER

sweep alignment; RF amplifier gain tests; signal tracing; signal source for production line and QC testing, etc. The 2050 provides 3 types of outputs: RF, 400-Hz modulated RF, and externally modulated RF. Accuracy is 1.5% of dial setting. Combination HIGH-

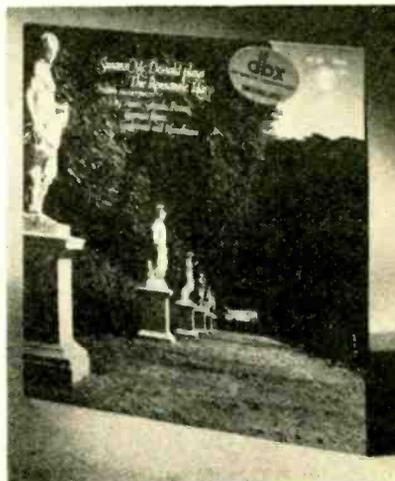


Circle No. 40 on Reader Service Page 17 or 103

LOW switch, plus continuously variable RF output control, provides 20 dB change. Unit features a multi-colored, 4½-in. dial with positive anti-backlash drive. Shielded leads supplied have insulated clip and banana plug. Operation is from 117/234 VAC, 50-60 Hz. Selling price of the B&K Model 2050 RF signal generator is \$107.00. For more information, write to Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago, IL 60602 and tell 'em ELEMENTARY ELECTRONICS sent you.

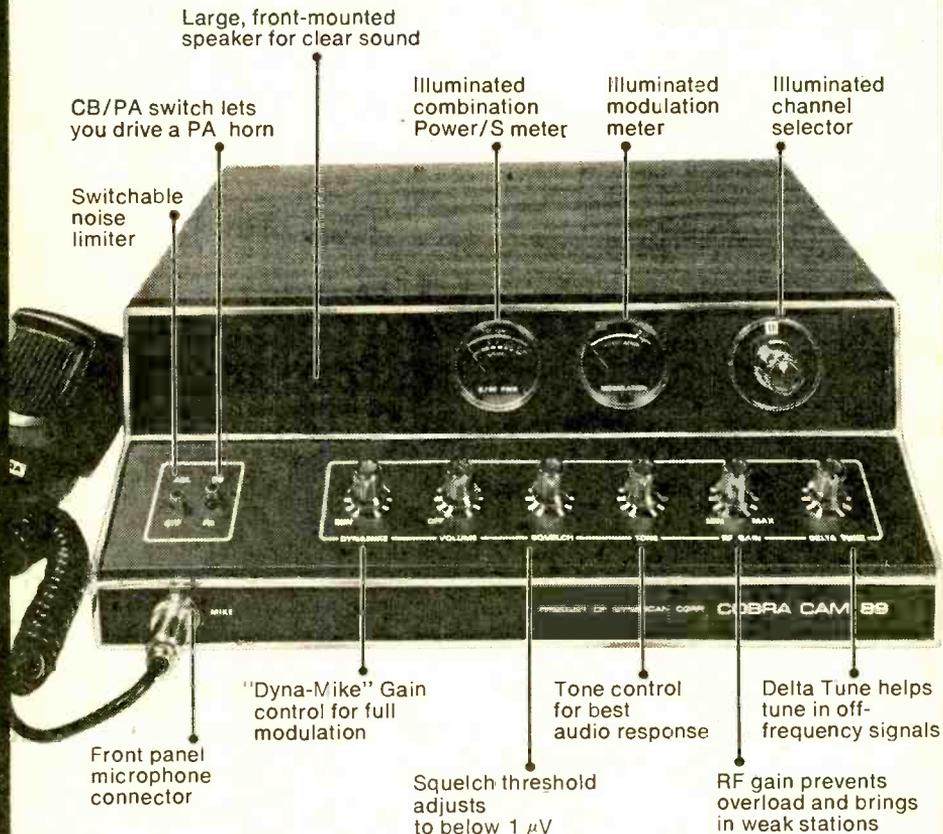
Noiseless Disc

The first commercial record release in the dbx encoded "noiseless" format was made on the Klavier label. The first release is a solo harp recital of French music, numbered KS/



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Talkpower you can see and adjust



"maximum legal power plus ..."

Emergency DC power operation, extension speaker jack, automatic gain control and handsome, efficient slope-front panel. Send for more details or see your dealer.

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ELEMENTARY ELECTRONICS

READER SERVICE PAGE

To find out more about these coupons, turn to page 103

JAN./FEB. 1975

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17	18	19	20	21	22	23	24
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41	42	43					

Please send literature for the numbers I have circled. I understand this is a free service. Allow 6-8 weeks for delivery.

We would like to know something about you. Please help us by placing an "X" in the appropriate boxes. Do you own a Class D CB transceiver? 44 Yes 45 No If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. 46 Base Station 47 Mobile Unit 48 Portable Do you use CB in your work? 49 Yes 50 No

51 Enter my subscription for 9 issues at \$3.97 and bill me.

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41	42	43					

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We would like to know something about you. Please help us by placing an "X" in the appropriate boxes. Do you own a Class D CB transceiver? 44 Yes 45 No If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. 46 Base Station 47 Mobile Unit 48 Portable Do you use CB in your work? 49 Yes 50 No

51 Enter my subscription for 9 issues at \$3.97 and bill me.

Name (print clearly) _____

Address _____

City _____

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Where do the pros get their training?



Almost half of the successful TV servicemen have home study training and with them, it's NRI 2 to 1. It's a fact! Among men actually making their living repairing TV and audio equipment, more have taken training from NRI than any other home study school. More than twice as many!

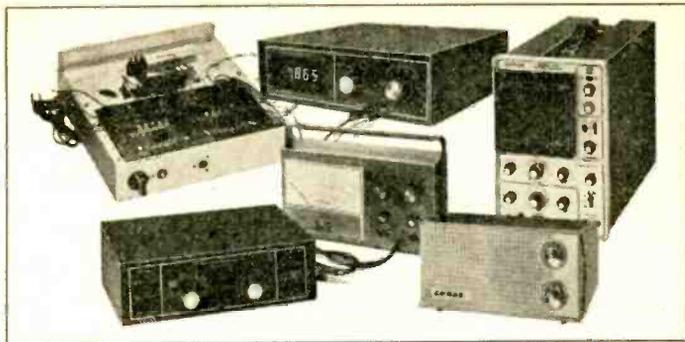
Not only that, but a national survey,* performed by an independent research organization, showed that the pros named NRI most often as a recommended school and as the first choice by far among those who had taken home study courses from *any* school. Why? Perhaps NRI's 60-year record with over a million students... the solid training and value built into every NRI course... and the designed-for-learning equipment originated by NRI provide the answer. But send for your free NRI catalog and decide for yourself.



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As a part of NRI's Master Course in TV/Audio servicing, you build a big-screen solid state color TV with every modern feature for great reception and performance. As you build it, you perform stage-by-stage experiments designed to give you actual bench experience while demonstrating the interaction of various stages of the circuitry. And your TV comes complete with console cabinet, an optional extra with other schools. Likewise, NRI's

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for only \$19.95* this ugly little space-age device makes your FM/AM mobile stereo sound like it's always parked near the radio station



model ASC-100
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**SUPER
CB TALK POWER!**

What gives Johnson CB two-way radios their "extra oomph" for longer range? Built-in Electronic Speech Compression, that's what! It's the kind of engineering you expect from U.S. made Johnson radios. Backed by a full-year parts and labor warranty with over 200 service centers nationwide.

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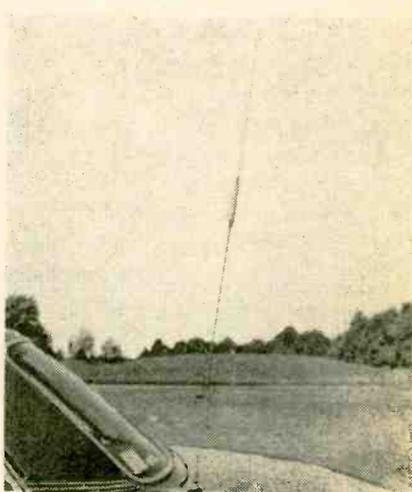
In Canada: A. C. Simmonds & Sons, Ltd.

CIRCLE NO. 33 ON PAGE 17 OR 103

HEY, LOOK ME OVER

(Continued from page 16)

adjustments. On transit, the antenna system has low VSWR and is designed for cool, efficient operation with a power rating safety factor of 20X. The new combination antenna

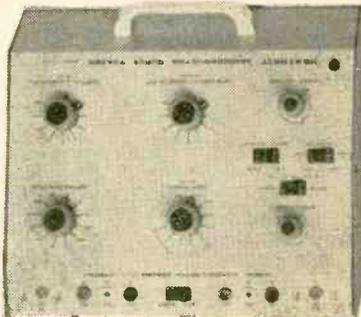


Circle No. 38 on Reader Service Page 17 or 103

system comes complete with cable and connectors for a suggested list price of \$35.60. Complete details are available from any A/S dealer, or by writing to The Antenna Specialists Company, 12435 Euclid Avenue, Cleveland, OH 44106.

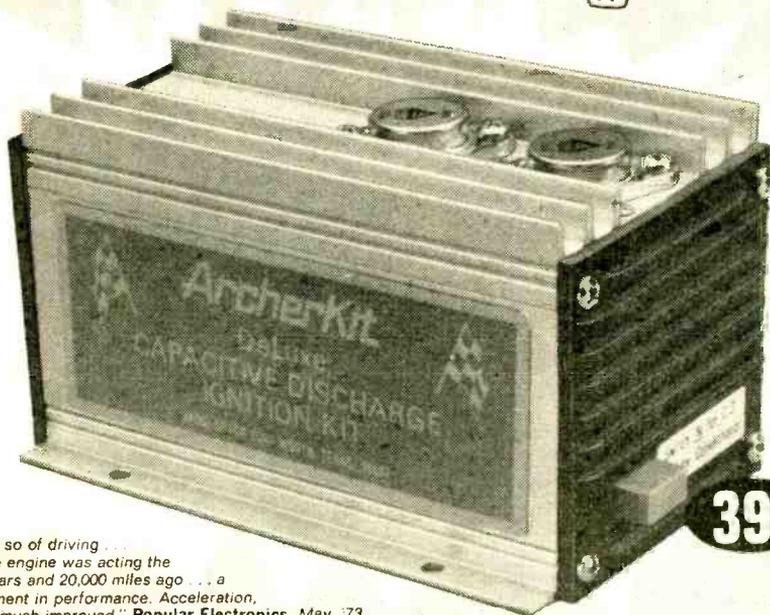
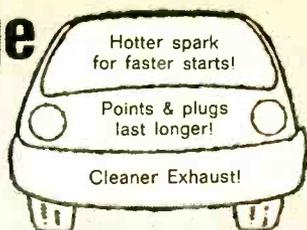
Solid Curve Tracer

Used with an oscilloscope, the Heathkit IT-1121 Semiconductor Curve Tracer accurately displays operating parameters of virtually all types of semiconductors such as bipolar transistors, diodes, SCRs, triacs, FETs, etc. Extra leads are provided for tests of larger devices or for in-circuit tests. Hobbyists, TV servicemen—anyone who works with electronic circuits will find the IT-1121 a valuable aid in selecting devices for specific applications or for sorting, inspecting, testing, and



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Improve your gas mileage with this ArcherKit™ from Radio Shack!



"After an hour or so of driving... we noted that the engine was acting the way it did two years and 20,000 miles ago... a definite improvement in performance. Acceleration, specifically, was much improved." Popular Electronics, May, '73

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470
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Radio Shack's capacitive discharge ignition system puts more "go" in every gallon! It delivers 50% extra spark power for more complete combustion. That means you get easier starting, better mileage and your points and plugs will last 3 to 10 times longer. An in/out button lets you make performance comparisons with your standard ignition. And it makes tuneups easier. The thorough step-by-step manual makes it easy for even a first-time kit builder to assemble. Easy installation, too—no rewiring. Improves any 12-volt negative ground vehicle. #28-3203.

ArcherKit at Radio Shack®

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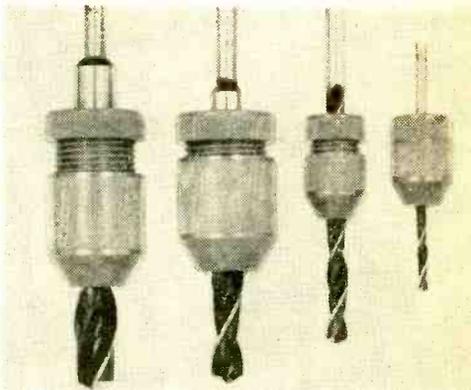
CIRCLE NO. 32 ON PAGE 17 OR 103

HEY, LOOK ME OVER

identifying unknown semiconductors. The kit is mail order priced at \$89.95. For more information, write Heath Company, Benton Harbor, MI 49022 and mention ELEMENTARY ELECTRONICS.

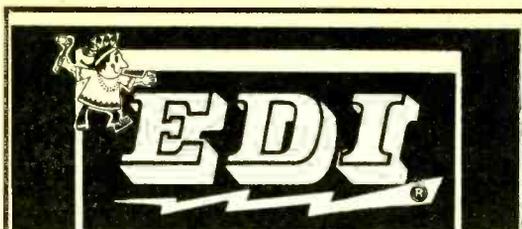
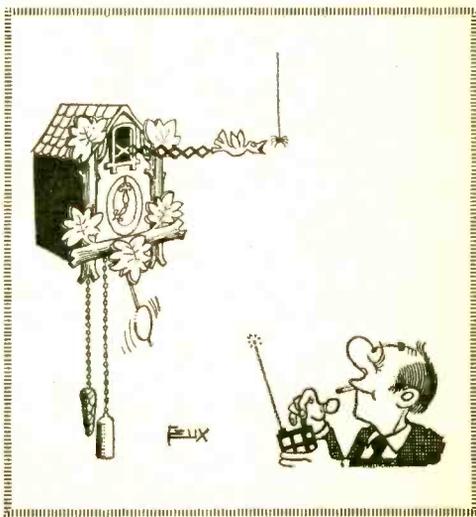
Drill Stops

Two new adjustable DuPont Delrin Drill Stops accommodate drills from 1/8-in. through 1/2-in. diameter. The small Drill Stop, Model DS-101 (\$1.19), fits drills from 1/8-in to 1/4-in. Model DS-201 (\$1.49), covers drill sizes from 1/4-in. to 1/2-in. Both are simply used by un-



Circle No. 39 on Reader Service Page 17 or 103

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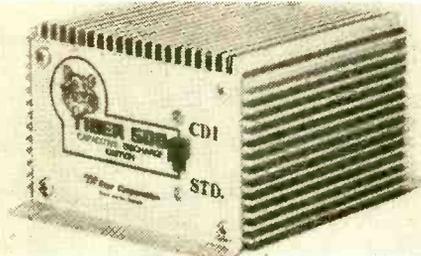
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CIRCLE NO. 32 ON PAGE 17 OR 103



Hank Scott, our Workshop Editor, wants to share his project tips with you. Got a question or a problem with a project you're building—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Personal replies cannot be made. Sorry, he isn't offering a circuit design service. Write to:

**Hank Scott, Workshop Editor
ELEMENTARY ELECTRONICS
229 Park Avenue South
New York, NY 10003**

Bought a Bunch of Junk

How are IF coils numbered? I bought a whole bunch and would like to use them, provided I know what the numbers mean.

—T.D., Fortuna, CA

Usually by the manufacturer's part number or type number. There is no standard nomenclature we know of.

Right Column, Wrong Magazine

I was wondering if you print some plans of a transceiver or matching transmitter-receiver. I would like to use the set for mobile operation from 80-10 meters. If possible, I would prefer transistors and a final output of around 60 watts or better.

—D.W., Port Alberni, BC

The schematic would take up two pages of space which we don't have to spare. Also, the engineering would take days unless we lifted someone else's design. You'll find lots of dope in *The Radio Amateur's Handbook*. Try it!

Lucky if You Find It

Where can I get a five-lead stack rectifier? I need it for fixing a record player.

—R.D., Brea, CA

Order a replacement from the record player manufacturer, or take the rectifier to a radio parts distributor and ask for an identical or equivalent part. But considering the unavailability of parts, especially replacement parts, you may be out of luck.

Gone But Not Forgotten

I would like to know if the Crosley Corp. in Cincinnati is still in operation?

—J.N., Orange, NJ

Unfortunately, not in the radio business. Under the leadership of Powell Crosley, the company introduced a lot of radio innovations in the past.

VOM vs Audio-VOM

I'm not getting good results with my VOM when servicing my audio equipment. In fact, measurements are poor, and often do not repeat themselves. What gives?

—K.J., Boise, ID

The VOM you are using is designed strictly for power work where the line frequency is in the

area of 50-60 cycles. Audio frequencies are usually much higher and vary with the program, hence different meter readings. I suggest you get a VOM rated for audio work—20 to 20,000 Hz minimum.

Do You Dig It?

Hank, I want to put power into my garage out back and don't know what kind of cable to bury. Any suggestions?

—H.W., Sea Girt, NJ

Use type UF cable size no. 12 that can carry up to 20 amperes. Be sure to keep the cable on a separate circuit-breaker from all other circuits. Bury cable at least 18 inches below the surface. Local codes vary so check this out with an electrician.

Conversion Factor

How do I convert RMS readings to peak voltage?

—V.G., Chicago, IL

Multiply by 1.414 (which is the square root of 2). By the way, this holds true only for sinusoidal waveforms. Squarewave, sawtooths, spikes and the like have no meaningful RMS value, hence your VOM can't measure it even though a reading is indicated.

No One Ever Bothers

To what do I connect the green screw on a three-prong receptacle?

—D.M., Wilmington, DE

Just about everybody does not bother to connect it to anything at all. However, I prefer to connect the green screw to the metal box it is installed in. Also, I connect the ground lead from the power cable to the box at the same point. I make these connections by drilling a hole and installing a self-tapping screw. Do this and electrically noisy appliances will not interfere with radios and TVs in the home.

Save \$3.50

Can I use the FCC Rules and Regs in the back of the 1975 CB Yearbook instead of buying a copy from the Feds? Why spend the extra cash is my question?

—T.K., Ft. Worth TX

You bet you can, and send 10% of your savings to me. Why? That's my question!

(More on page 96)

DX central reporting

A world of SWL info!

□ Of all the shortwave broadcasting bands—and there are a dozen of them from 11 to 120 meters—probably the least appreciated by SWLs is the 75 meter band, the frequencies between roughly 3900 and 4000 kHz. Why is 75 the forgotten band? A couple of reasons, basically. First, it's riddled with QRM, interference from the hams

OK, OK, before those of you who are amateur radio operators start throwing rocks, I concede the question of who is QRMing whom depends on one's viewpoint. In the western hemisphere, broadcasting stations are not licensed to operate in these frequencies, but hams are. But in other parts of the world, 75 meters is a perfectly proper broadcast band. The inevitable result is mutual interference.

So the American ham considers the broadcasters as a QRM culprit while the SWL hunting for SWBC DX on 75 looks upon the proliferation of amateur signals as a nuisance.

Another reason why SWLs have not discovered the DX potential of this forgotten band is that, compared to other SWBC ranges, relatively few broadcasters operate here. A recent study of shortwave broadcasting shows that something under 700 program-hours are transmitted on 75 meters during a 24-hour period. Forty-one meters, a band also partially shared with the hams of North America, has over five times as many program-hours a day. And the popular 49 meter band was found to carry over 5,000 program-hours each day.

Statistics don't lie, but they do conceal one important fact: Quantity may be lacking, but DX quality is not! There are some tremendous DX catches to be heard on the 75 meter broadcasting band. Let's scan through the band for SWBC DX, easy and hard:

● **3910**—*The Far East Network*, an American armed forces shortwave outlet in Tokyo operates on this 75 meter band frequency. The programming is all in English and sounds typically American, from the announcers' accents to the pop music and feature programs. On occasion this outlet can be heard across the continent, but western reception is more likely. Early, early morning is the time to listen. *(Turn page)*

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Sentinel III: 30-51MHz.

Sentinel V: 450-470MHz.

Sentinel VI: Hi-450-470MHz,
Lo-144-171 MHz.

Sentinel VII: Marine, 156-164MHz.



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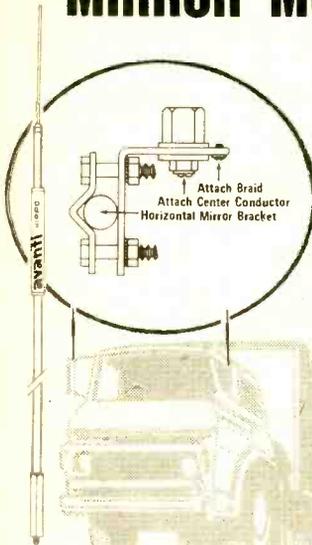
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CIRCLE NO. 24 ON PAGE 17 OR 103

DX Central Reporting

● **3945**—One of the real DXciting items on the band is *Radio Vila*. It is located at Vila in the New Hebrides, that strange Pacific territory that is jointly governed by both the British and the French. It is a rare catch but definitely possible from around 0800 to sign off shortly after 0900 GMT.

● **3955**—South Africa probably makes as much use of 75 meters as does any country in the world, with the exception of Indonesia which has numerous low powered stations seldom heard in North America. At the time this column is being written the *South African Broadcasting Corporation* used this frequency for its Afrikaans language service beginning at 0358 GMT.

● **3965**—At the same time, SABC airs its English language home service just 10 kHz up the dial. And on 3980 kHz, there is *Springbok Radio*, an English and Afrikaans commercial operation of the SABC network which signs on at 0300 GMT. And, finally, the foreign service of SABC, *Radio RSA*, familiar to many SWLs, has been broadcasting on 3995 kHz. All four of these South African frequencies have been well heard in North America in past months.

● **3985**—An Ecuadorian station, *Radiofonicas Populares* at Riobamba is one of those odd Latin American stations that you can go for weeks or months without hearing, but suddenly one morning they're bombing through. Programming is in Spanish, but the "echo chamber" identification may help you log it. Listen in around 1030 GMT, or during the evening if the ham QRM—oops, I let my bias show again—isn't too severe.

● **3990**—The *Voice of America* has relay stations around the world from Germany to the Philippines. One of its relay bases is located in the west African country of Liberia. A VOA English language news broadcast can be heard on this frequency at 0600 GMT.

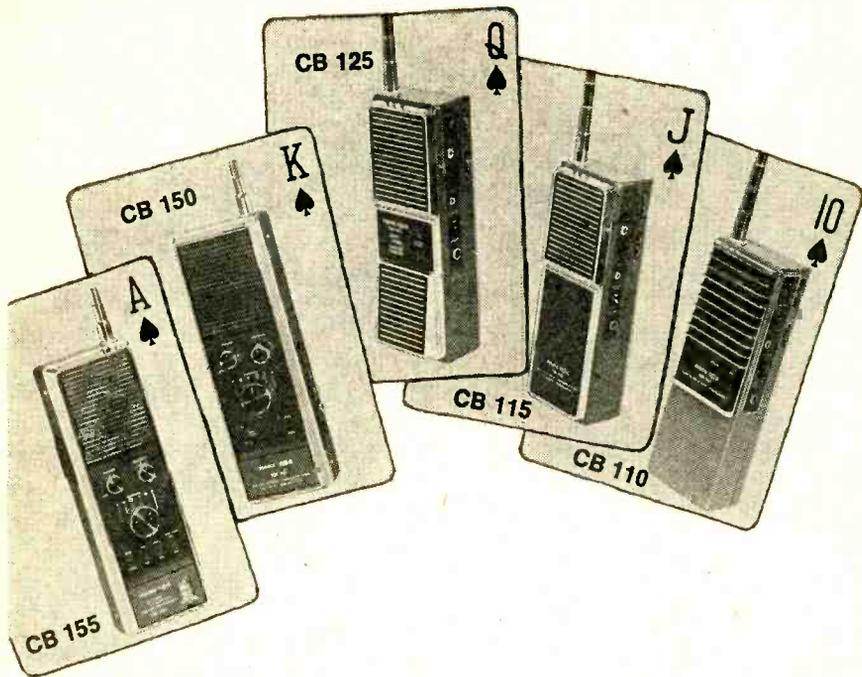
● **3995**—Another nice bit of DX, although it sometimes slows up fairly good signal levels, is the shortwave outlet of the *Solomon Islands Broadcasting Service*. This is another Pacific region station that might be heard during the pre-dawn hours.

● **3999**—More exotica: *Gronlands Radio* at Godthaab, Greenland. Programming from this nordic nicity is in Danish and Greenlandic. Persistence and, yes, luck, may reward you with a logging shortly after its sign on at 1015 GMT.

And that's a quick sampling of some of the SWL targets to be heard on the forgotten band of 75 meters.

Tip Topper. Every DXer knows that you can log shortwave broadcast stations on six continents: Asia, Africa, Australia, Europe, North and South America. But wait a minute. A

(Continued on page 102)



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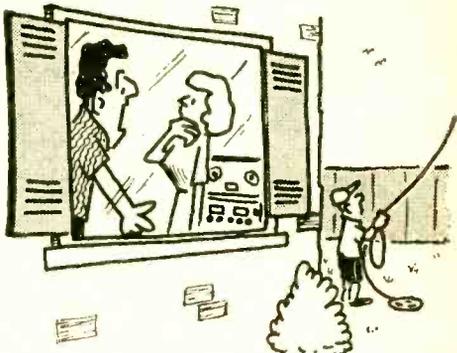
CIRCLE NO. 18 ON PAGE 17 OR 103

TAPE TENSION

by Jack Schmidt



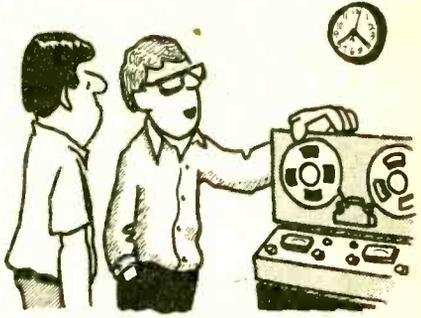
"Hey, how old is this stuff??"



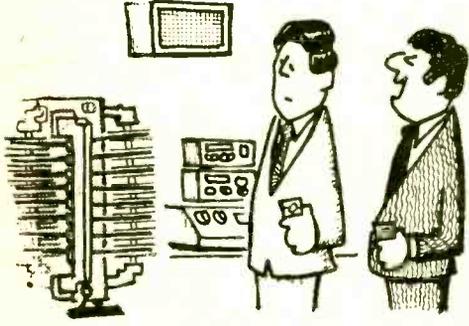
"Whaddya mean . . . he couldn't find any string, so you gave him some tape?!"



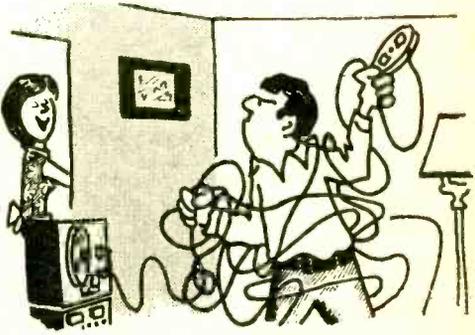
"You're right, sir. This tape reel only has 598 feet of tape!"



"It runs at one, three, or seven dollars a minute!"



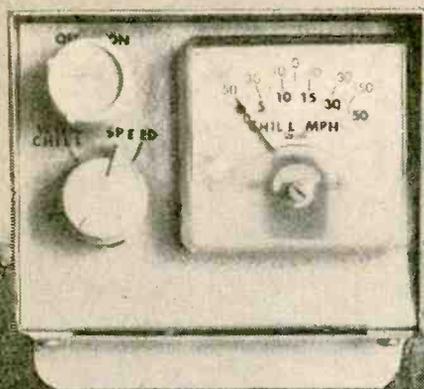
"... eight track . . . built it myself . . ."



"Dinner's on . . . start the music, love."

Experiment with this solid-state...

elementary JAN-FEB
Electronics 1975



WIND SPEED AND CHILL FACTOR METER

Building this project is a breeze.
Calibration can be a drag! See why . . .

by Thomas R. Fox

Those bitterly cold winter days when the air seems to have knifelike teeth in it are more often caused by brisk winds than bitterly cold temperatures. The U.S. Army recognized this, so they set up the often used *wind chill chart*.

Although it's not terribly inconvenient to use, the wind chill chart requires a knowledge of the wind speed and the temperature. Gusty, shifting winds make its use questionable. (See the wind chill chart elsewhere in this article.)

Instead of just a meter to tell you the wind speed, why not build one that will also tell you the instantaneous wind chill? The totally solid-state device described here does both and uses *no moving parts* to wear out. It will tell you the wind chill index directly!

How It Works. In order to understand how the meter works, you should first understand how wind chills exposed skin.

Our bodies are heated by an internal furnace that is run by a process called oxidation. This furnace is in effect thermostatically controlled. In summer, our bodies frequently become too warm; the thermostat then cuts down our metabolism rate. If this doesn't cool our body enough, the thermostat turns on our air conditioner—our sweat glands. In winter we have the reverse problem, our body loses heat. The thermo-

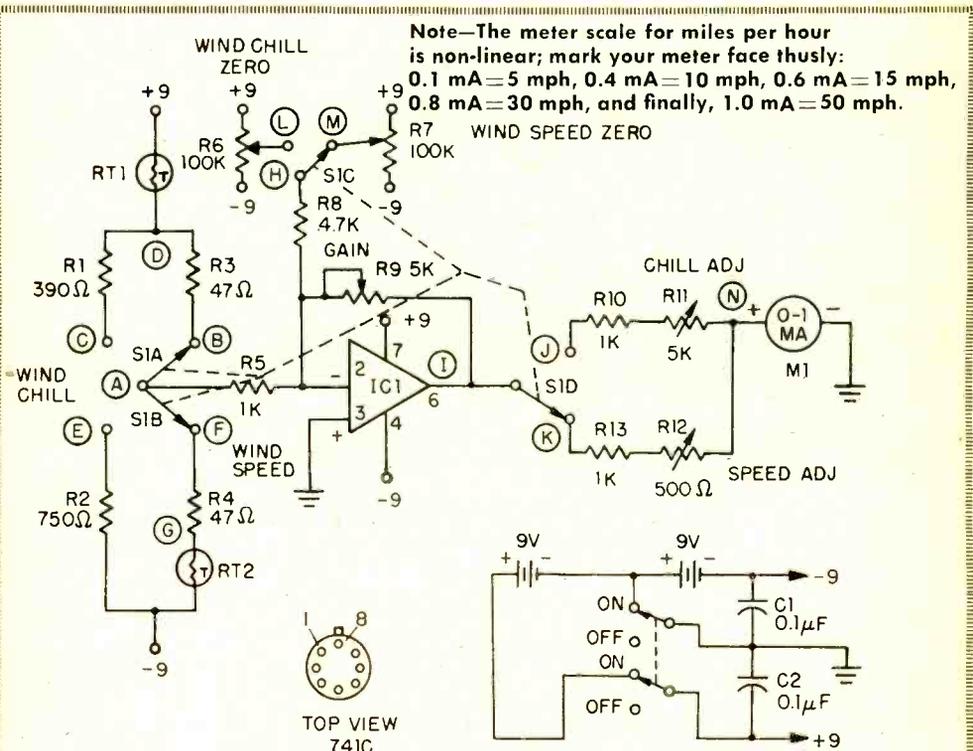
e/e WIND CHILL METER

stat then steps up our metabolism rate just enough to add as much heat as we lose to the outside air.

Bare Facts. Our body heat warms the air immediately adjacent to our skin (within about 1/250 inch) to the same temperature as the skin. This heated air forms a buffer, or insulating layer, between our body and the cold outside air. But then a wind can come along and blow away part of this

warmed layer of air taking with it some of the natural insulation. Winds around forty miles an hour blow away nearly all the insulation. This is why winds over 50 mph have no further affect on the skin—once the insulation is gone, the protection is gone!

In our wind chill meter, thermistor RT1 is heated to around 40° F above the surrounding air. (This is quite similar to the heating effect of our bodies.) Then the wind will blow some of the warm air insulation away and lower RT1's temperature. With winds over 50 mph, RT1 is cooled to the

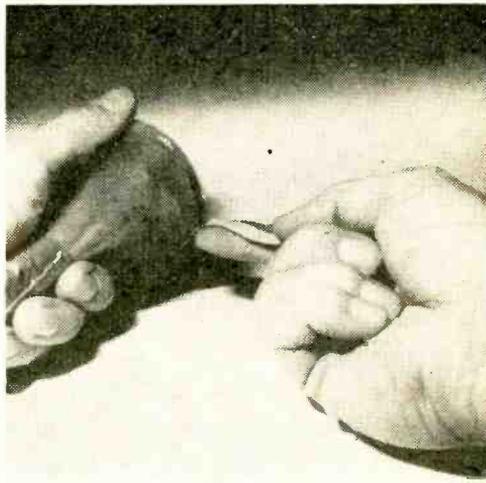
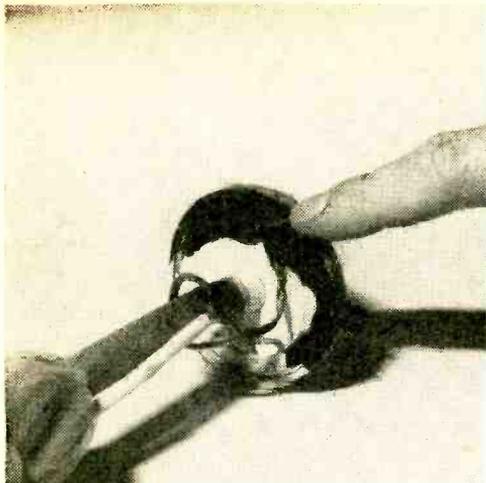


PARTS LIST FOR SOLID-STATE WIND CHILL METER

- B1, B2—Eveready 266 battery (Radio Shack 23-011 or equiv.)
- C1, C2—0.1 μ F, capacitor, 25 VDC or better (Radio Shack 272-1069 or equiv.)
- IC1—741-type integrated circuit (Radio Shack 276-010 or equiv.)
- M1—0 to 1 mA panel meter (Radio Shack 22-018 or equiv.)
- R1—390-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R2—750-ohm, 1/2-watt, 5%, resistor
- R3, R4—47-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R5, R10, R13—1000-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R6, R7—100,000-ohm miniature potentiometer (Radio Shack 271-220 or equiv.)

- R8—4700-ohms, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R9, R11—5000-ohm miniature potentiometer (Radio Shack 271-217 or equiv.)
- R12—500-ohm miniature potentiometer (Radio Shack 271-226 or equiv.)
- RT1, RT2—500-ohm @ 25 degrees C. bead thermistor such as Fenwal JB25J1 (Allied Electronics 791-0604)
- S1—4pdt rotary switch (FUNCTION) (Radio Shack 275-1384 or equiv.)
- S2—dpdt toggle or rotary switch (ON-OFF) (Radio Shack 275-607 or equiv.)

Misc.—perf board, push-in clips, knobs, case 4 1/2 X 3 1/2 X 4 1/2-in., 4-wire cable, hook-up wire, solder, etc.



Start your thermistor probe with a 4-in. diameter wood block or the large plastic knob shown here. A drawing on the next page provides additional detail. As shown in the upper left photo, thermistor RT2 is emersed in cement to isolate it from the wind—it responds only to air temperature. RT1 is exposed to the wind (top right) through a nylon stocking screen.

same temperature as the surrounding air. It is obvious that both the temperature and the wind affect RT1's resistance similarly—both raise RT1's resistance as RT1 is cooled. The values of R1 and R2 have been chosen to limit current flow to a value that keeps RT1 at approximately 40° F above the surrounding calm air. Variable resistors R6 and R11 are pots used for adjustment purposes in the wind chill mode.

If you decide to include a wind speed mode, the wind speed circuit uses the same basic principle—wind cools a heated thermistor. Here, however, two identical thermistors are used, RT1 and RT2. While RT1 is exposed to the wind, RT2 is protected from it, so it only responds to the tempera-

ture of the air—not the wind.

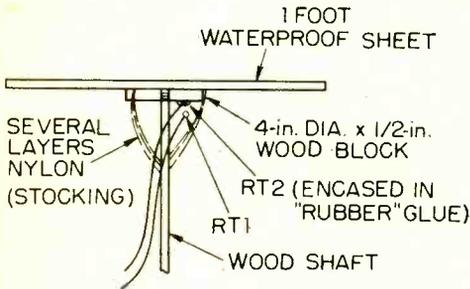
Refer to the circuit diagram; with no wind blowing, point A should be near 0 volts. As the wind picks up, however, RT1's resistance increases, which results in point A becoming negative. This negative voltage is inverted and amplified by the 741 amp which makes the meter move upscale with an increase in wind. Notice there are no moving parts and thus no bearings to be greased or wear out.

The circuit is simple enough for perf board construction. The thermistors recommended in the parts list are inexpensive 500-ohm 10% units. If thermistors other than the one's recommended are used, current limiting resistors R1, R2, R3, and R4

e/e WIND CHILL METER

may have to be changed.

Before mounting thermistors on a wood shaft, both should be thoroughly sprayed with several coats of a plastic insulating material. Encase RT2 in a "rubber" adhesive compound of the bathroom fix-it variety to keep it from being affected by the wind. RT1 must be left exposed to the wind; however, several layers of nylon stocking should be used to cover both



Outdoor thermistor probe assembly.

thermistors; check the photos. Plus, in order to protect the thermistors from the sun and rain, cement a 1 sq. foot piece of plywood into place over them.

Calibration. Before attempting the following calibrations, make sure RT2 is protected from the wind and RT1 is exposed to it, and that both thermistors are covered with several layers of nylon stocking. Set the selection switch to the *speed* position. Set master gain control R9 to its *maximum* resistance position. While indoors and away from drafts, adjust wind speed

zero adjust control R7 for a zero reading on the meter. Now go back and set R9 near its midpoint and leave it there for now.

With someone driving at a constant 50 mph (on a calm day), stick the two-thermistor assembly out of the window and adjust speed adjust control R12 so that the meter reads full scale—50 mph. Check the adjustment by making several more runs at different speeds. If necessary, adjust master gain control R9 slightly.

Set the selection switch to the *chill* position. Put RT1 into a refrigerator (but not the freezer). Adjust wind chill control R6 so

AIR TEMPERATURE (degrees F)	CAR SPEED (mph)
40	55
35	38
30	20
25	15
20	10
10	5

the meter reads 38-40 degrees—depending on the actual temperature in the refrigerator. You will need a thermometer to take the refrigerator's "temperature." Then place the R1 probe in the same position you had the thermometer. (First "center" R11.)

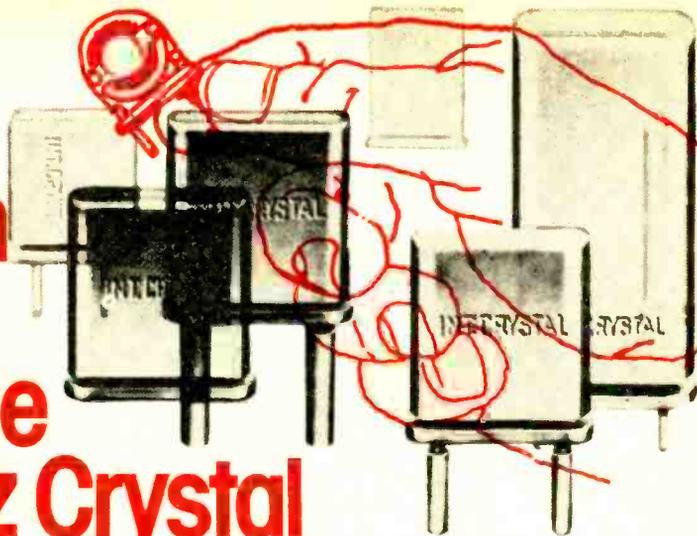
For the final adjustment, stick the probe out the car window while keeping the car traveling at the speed (see the above chart) which corresponds to the outside air temperature. Adjust chill control R11 so the meter reads zero (mid-scale on the meter). If it is warm when you build your chill meter, stick the probe in a zero degree freezer and simply adjust R11 for 0 degrees.

(Continued on page 99)

WIND CHILL CHART

WIND SPEED (MPH)	AIR TEMPERATURE (°F)											
	50	40	35	30	25	20	15	10	5	0	-5	-10
	EQUIVALENT SKIN TEMPERATURE (°F)											
CALM	50	40	35	30	25	20	15	10	5	0	-5	-10
5	48	37	33	27	21	16	12	7	1	-6	-11	-15
10	37	23	21	16	9	2	-2	-9	-15	-22	-27	-31
15	33	20	16	11	1	-6	-11	-18	-25	-33	-40	-45
20	30	15	12	3	-4	-9	-17	-24	-32	-40	-46	-52
25	28	11	7	0	-7	-15	-22	-29	-37	-45	-52	-58
30	26	9	5	-2	-11	-18	-26	-33	-41	-49	-56	-63
35	24	7	3	-4	-13	-20	-27	-35	-43	-52	-60	-67
40	23	6	1	-4	-15	-22	-29	-36	-45	-54	-62	-69
45	23	5	1	-6	-17	-24	-31	-38	-46	-54	-63	-70
50	22	4	0	-7	-17	-24	-31	-38	-47	-56	-63	-70

The Action Band and the Quartz Crystal



Here is basic information you should know about your Action Band Radio!—by Don Jensen

□ Okay, so you've made the plunge into VHF monitoring. You've heard all about the VHF (very high frequency) public service bands where you can hear the exciting world of action radio, police calls, fire-fighters in action, highway emergency crews, and all the rest. You've forked over your hard-earned bucks for a fancy new VHF scanner with those flashing red lights and all that space-age circuitry. You're ready to go, right? Well, not quite. First you've got to stock it with crystals . . . and maybe that's the point where things aren't so crystal clear.

What, you may be wondering, in the blue-eyed world are crystals? And why are they necessary anyway? Basically, a crystal is a sliver of quartz, mounted in a tiny metal case. The quartz crystal is cut and ground so as to vibrate at only one specific VHF frequency.

Without getting hung up on the whys and hows, suffice it to say that crystals are necessary to allow your receiver to discriminate among the radio signals on the air and permit you to hear those on the handful of specific frequencies you've chosen to monitor. *You need a separate crystal for each desired frequency.*

Happily, none of this really has to concern you. You do need crystals for your receiver, but all you really have to specify is the make and model of your set and the

frequencies of the stations you want to hear. Here's where you may run into a hitch. For, in order to hear your local police and other public service VHF signals, you've got to know the channels they use.

First of all, there are two VHF "action bands." One, the so-called low band, covers the frequencies between roughly 30 and 50 MHz. The other, the high band, includes channels in the 150 to 174 MHz range.

Hopefully, before this you've determined which of the two VHF bands holds most of the action in your community . . . or else you've bought a scanner that covers both frequency ranges. After all, there's no point in investing in a low-band-only rig if

(Continued on page 40)

WHERE TO FIND CRYSTALS

- American Crystal Co., 1623 Central Ave., Kansas City, KS 66102
- Bomar Crystal Co., 201 Blackford Ave., Middlesex, NJ 08846
- International Crystal Mfg. Co., Inc., 10 N. Lee, Oklahoma City, OK 73102
- JAN Crystals, 2400 Crystal Drive, Ft. Myers, FL 33901
- KW Industries, Inc., P.O. Box 508, Prague, OK 74864
- Radio Shack, P.O. Box 1052, Ft. Worth, TX 76107
- Savoy Electronics, Inc., P.O. Box 7127, Ft. Lauderdale, FL 33304

NOW there are 3 new small-screen Heathkit COLOR TVs with digital readout... and lots more!



GR-300
15" (diagonal)

GR-400
17" (diagonal)

GR-500
19" (diagonal)

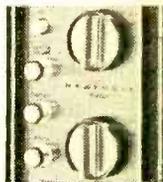
Simulated TV pictures

Now famous Heathkit quality and advanced engineering also comes in your choice of small screen sizes — 15, 17 and 19" (diagonal). They all have on-screen digital channel readout and accept an optional plug-in clock module. And in the tradition of the famous Heathkit GR-2000, the world's first digital-design color TV, they also feature important design innovations of their own. Each uses a precision in-line gun and slotted shadow mask for an unusually bright, sharp picture. In the GR-400 and 500, a black (negative) matrix picture tube provides superior contrast. Black level clamps in the video and luminance circuits assure realistic brightness, even with difficult night time scenes.



A factory-sealed static toroid yoke and magnet assembly completely eliminates convergence and

purity adjustments — and the picture is superior to manually adjusted sets. The list of significant advances goes on and on — dual-gate FET mixer, FET RF amplifier, 4 tuned circuits (instead of the 3 most sets have), wide-band IF with fixed LC filter, automatic fine-tuning and preset picture control, hi-fi output jack, slide out chassis. The GR-300 and 400 come complete with walnut veneer cabinets, cabinets for the GR-500 start at \$39.95*.



Kit GR-500, less cabinet, 88 lbs., Exp./frt. 499.95*
 Kit GR-400, with cabinet, 104 lbs., Exp./frt. 489.95*
 Kit GR-300, with cabinet, 90 lbs., Exp./frt. 449.95*
 GRA-2000-1, Clock module for GR-300, 400 & 500, 1 lb.,
 mailable 29.95*

5 unique new Heathkit products you can build yourself

Heathkit AM/FM Digital Clock Radio

The GR-1075 is no ordinary clock radio. Big, bright Beckman planar gas discharge tubes display the time. The readouts automatically adjust their brightness as room lighting changes. A standby battery power supply keeps the clock — and you — on time (without the display) even if the electricity is interrupted. The GR-1075 wakes you to your favorite station or a gentle, electronic beep with adjustable volume. The radio section uses the same design philosophy as our famous AR-1214 series receivers including fixed ceramic filters for AM and FM and a factory-



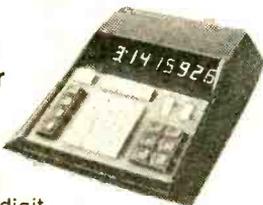
assembled and aligned FM front-end with 5 μ V sensitivity. With 4 IC's, 41 transistors and 35 diodes, the GR-1075's design is years ahead of ordinary clock radios.

Kit GR-1075, less batteries, 10 lbs., mailable . . . 129.95*

Desktop Electronic Sliderule Calculator

At last, a sliderule calculator that's big enough to use. Our IC-2100 has finger-sized keys, a bright, 1/2"-tall 8-digit display, cumulative memory and register exchange keys. Performs arithmetic plus trig and arc trig in degrees or radians, common and natural logs, powers of e, square roots, inverses, pi and exponential functions.

Kit IC-2100, 4 lbs., mailable . . . 119.95*



Digital Electronic Clocks with standby power

The GC-1092A is a digital clock with a snooze alarm; the GC-1092D reads the time in 6 digits, the month and date in 4. Both have standby power to keep the clock on time (without the display) even during power interruptions.

GC-1092A & D, less batteries, 5 lbs., mailable . . ea. 82.95*



GC-1092A Time/Alarm



GC-1092D Time/Date

Digital Electronic Car Clock/Timer

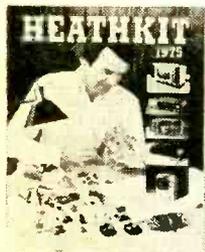
A truly accurate timepiece for your car, boat or plane. It's an electronic clock and a 20-hour rally timer, both with quartz-crystal accuracy. Bright 1/2"-tall digits dim automatically at night. 12 VDC, mounts on or under dash.

Kit GC-1093, 2 lbs., mailable . . . 62.95*



HEATHKIT ELECTRONIC CENTERS —
Units of Schlumberger Products Corporation
Retail prices slightly higher.

ARIZ.: Phoenix; CALIF.: Anaheim, El Cerrillo, Los Angeles, Pomona, Redwood City, San Diego (La Mesa), Woodland Hills; COLO.: Denver; CONN.: Hartford (Avon); FLA.: Miami (Hialeah), Tampa; GA.: Atlanta; ILL.: Chicago, Downers Grove; IND.: Indianapolis; KANSAS: Kansas City (Mission); KY.: Louisville; LA.: New Orleans (Kenner); MD.: Baltimore, Rockville; MASS.: Boston (Wellesley); MICH.: Detroit; MINN.: Minneapolis (Hopkins); MO.: St. Louis (Bridgeton); NEB.: Omaha; N.J.: Fair Lawn; N.Y.: Buffalo (Amherst), New York City, Jericho (L.I.), Rochester, White Plains; OHIO: Cincinnati (Woodlawn), Cleveland, Columbus, Toledo; PA.: Philadelphia, Pittsburgh; R.I.: Providence (Warwick); TEXAS: Dallas, Houston; VA.: Norfolk (Va. Beach); Wash.: Seattle; WIS.: Milwaukee.



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CL-545	

CIRCLE NO. 1 ON PAGE 17 OR 103

e/e ACTION BAND CRYSTALS

(Continued from page 35)

all the traffic is up around 150 or 160 MHz.

Police use of the low VHF band is somewhat limited these days, though other users can be found here. A large number of police, sheriff, fire, and other governmental agencies and private users can be found transmitting on the VHF high band these days. If you spot a law enforcement vehicle with an antenna about 18 inches long, high band usage is indicated.

A growing number of the metropolitan areas are switching to the UHF band. If this is the case in your area, make sure your receiver also covers the ultra-high-frequency range. After determining the band or bands, VHF or UHF, your monitoring will have to cover, you need to pinpoint the exact crystal frequencies.

Where to Look. A good starting point is your dealer, the guy who sold you your scanner. He's in the business of selling sets, and more than likely knows the frequencies of the local VHF/UHF services. He may, if sales volume is great enough, stock standard crystals for the frequencies used by local law enforcement officers. He may also stock the standard 162.55 MHz (in some areas, 162.40 MHz) crystals required to receive the 24-hour-a-day weather broadcasts by the National Weather Service, if your area is one of those covered by an NWS VHF station.

If he doesn't have crystals in stock he probably can tell you the popular local frequencies and can sell you a crystal certificate. Each certificate is good for one crystal. All you have to do is fill in the blanks, including the one for the crystal frequency desired and mail it off to the manufacturer. In a week or so, you'll get a little package

in the mail with the proper crystal, all set to be plugged into your receiver.

If you didn't buy your scanner from a local dealer you may have to work a bit to find out the locally used frequencies. Unless you're dodging the law, one possibility is to contact your police or sheriff's department. Now it's a good bet that the average cop probably has no more idea than you have about the frequency his department uses. All he has to know is how to punch the mike button and say 10-4. But a few inquiries should put you in contact with the radio officer or police radio technician.

He may or may not be helpful. There's no big secret about the frequencies a department uses. But some police agencies have had bum experiences with ambulance chasers and self-styled volunteer cops and are reluctant to give out information.

In recent years many citizen band operators (CBers) have worked closely with local police departments in many communities. There are local CB groups that provide emergency communications, operate special patrols on Halloween Eve and the like to support the uniformed officers. As a result, many CBers also are active police frequency monitors. The frequency information you're seeking may be available from a local CB club or REACT team.

If you don't know any CBers personally and can't locate a CB club in your community, keep an eye open for a passing motorist with the tell-tale marks of a CB operator—a citizens band antenna or a bumper sticker proclaiming his radio interest. When he stops at the next traffic signal, roll down the window and ask him if he can provide you with the necessary info. Even if he can't, it may be the beginning of an interesting friendship with a like-minded radio nut!

Still No Luck? It's a bit far out but you

An early morning derailment can screw up commuter travel long into the day without the aid of VHF walkie-talkies. New Jersey State Trooper totes hand-held unit as he assists in crowd control and calling for assistance. Trains were rolling in three hours thanks to quick action on Action Band radio.



might give a call to the regional office of the Federal Communications Commission nearest your home. To try out this ploy I placed a long distance call to the FCC office about 70 miles away. After much explaining to assorted receptionists and secretaries, I was finally transferred to an understanding guy who dug up the frequency information on one local police department I asked about.

The fellow was a real gem (and keep that in mind next time you're tempted to badmouth the FCC). But, frankly, the FCC field offices just don't have the personnel to answer countless inquiries of this sort. Consider this technique only as a last resort and, even then, you may get a flat turndown unless you're lucky.

You can also pay to get the action band frequency information you need before you order your scanner crystals. Several publishers sell frequency listings, usually arranged by area of the country, states or even metropolitan regions.

One such source is Communications Research Bureau, P.O. Box 56EE, Commack, NY 11725. A stamped self-addressed envelope to CRB will bring you information on the various lists available and the prices. Another data publisher is Hollins Radio Data, P.O. Box 35002, Los Angeles, CA 90035. Hollins has published a series of Police Call Directories by area for the past decade. Also available are Fire-Emergency Radio Monitor Handbook and Public Safety 2-Way Radio Data.

Don't Forget Clubs. There are several DXing clubs in the country which, while devoting only a relatively small section in their monthly bulletins to VHF-UHF monitoring, may be helpful. And you may make personal or correspondence contacts with members who also are interested in public service band monitoring with whom you can exchange tips and information.

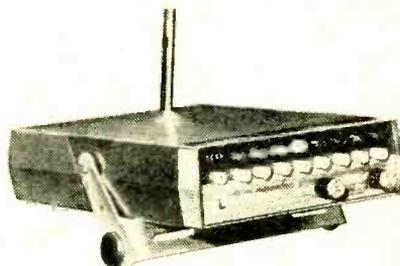
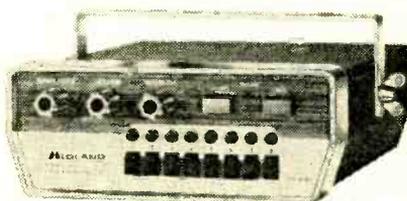
Three likely clubs which operate on a nation-wide scale are Worldwide TV-FM DX Association, P.O. Box 163, Deerfield, IL 60015; SPEEDX, P.O. Box E, Elsinore, CA 92330; and Newark News Radio Club, P.O. Box 539, Newark, NJ 07101.

One way or another you should be able to dig up the dope on the frequencies used by your local VHF services—and don't forget these include taxi dispatchers, forestry crews, radio paging stations, railroad communications, and many more in addition to the fuzz and fireladdies. ■

Pace Scan 216
VHF-Hi, UHF, \$149.95



Midland dual band 13-930, \$199.95

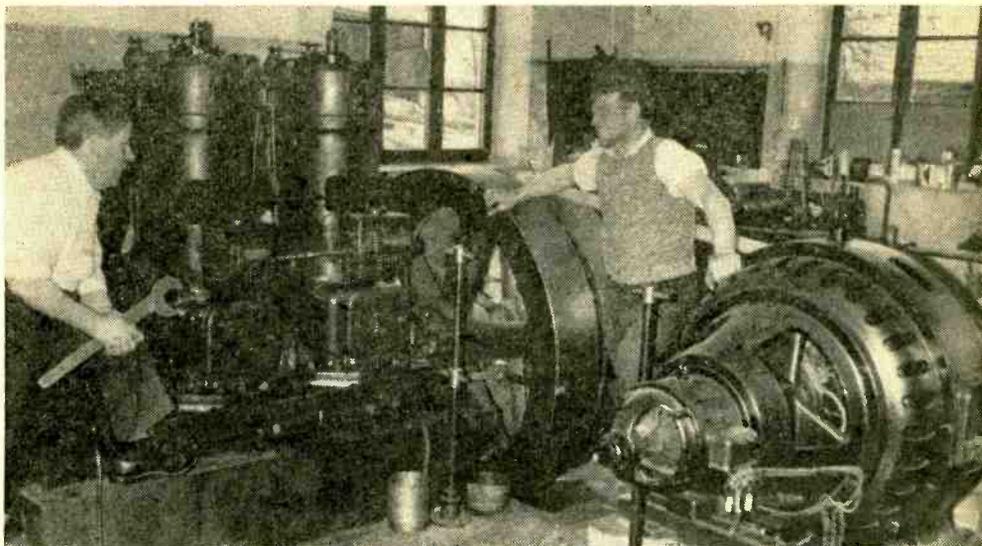


E. F. Johnson Duo Band Scanner for \$169.95

Robyn Model 200, VHF-Hi,
UHF to 512 MHz, \$179.95



THIS U-BOAT CAME HOME



□ Sometimes the latest is not the best, and the most modern and even “far-out” technology cannot surpass good old-fashioned well-made equipment. In this case the equipment and the power technology might be almost something out of Jules Verne’s early science-fiction stories, because the stuff that makes the lights go on in a little German town was at the bottom of the Atlantic in 1914!

The town in question is called Ohlstadt near Garmisch-Partenkirchen in Upper Bavaria, Germany, and the equipment that supplies its power comes from a peculiar installation: an old motor and generator which powered a German submarine in World War I. The mayor of Ohlstadt, Josef Schwinnhammer (the man with the hat in the photograph above) says, “I don’t know how the thing got here. It was

long before my time.” He says that the installation as it is shown here has worked for as long as he can remember. As a child he had come to have a look at it, and it was already ancient even then.

Supervisor Paul Mayer is quite happy with the set-up. “It has never failed us,” he says. “Perhaps these motors were built to last, since they were made for submarines. It is a heavy piece all right, providing 70 hp at 375 revs/minute. I presume the thing has never failed us because it doesn’t have to work as hard as in a submarine.” Mayer, too, doesn’t know how Ohlstadt wound up with submarine-power, but he doesn’t see any reason to modernize the installation, since modern equipment probably wouldn’t work any better. We can believe that! ■



Build a Better Telephone and the World May Ignore You

□ From grandma’s old crank-up phone to your newest pushbutton Trimline model—telephones have gone through quite a few transformations over the years, most of them for function’s sake. This latest twist is supposedly for art’s sake, rather than just usefulness, and it carries \$575 price tag to boot!

Artist-sculptor Peter Leve has designed a telephone in the shape of a head carved out of walnut, with a receiver covered in elkskin. The instrument’s works are inside the head. Grab the nose, pull it forward, and the face drops on hinges to reveal the dial. When answering, should you say “Heads up!” instead of hello? ■

Looking back on... **YESTERDAY** **ON THE NEWSSTAND**



Reminiscence with a collector whose hobby includes both the magazines of now and bygone times.

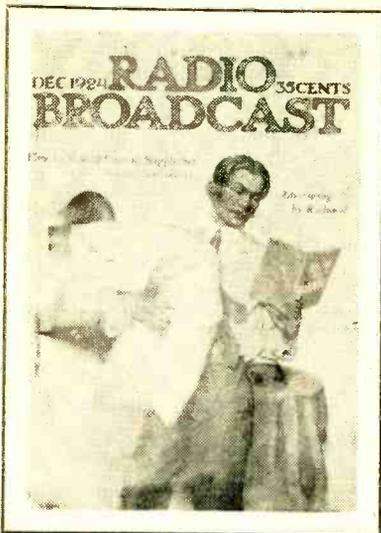
by George S. Haymans, Jr.

□ The earliest publications with articles on wireless or radio were those covering the then relatively new hobby of electricity and its experiments. I might say here that the word "experiments" as used then could easily be replaced by the term "construction projects" today. These were most popular at the turn of the century, so watch for magazines and books whose titles include "Electricity" and "Experiments."

While many earlier books and magazines probably included articles on "How to Build Wireless Sets," we find that a magazine

called POPULAR ELECTRICITY that began publication in May of 1908 (lasting for 18 issues, until January 1915) had articles on wireless in almost every issue. One earlier publication, TECHNICAL WORLD, whose Volume 1, Number 1 was issued in March 1904, did, at times, include articles on wireless.

Other early magazines included MODERN ELECTRICS, first issued in April 1908 and continued for six or seven years, which always carried wireless articles. WIRELESS AGE, beginning with their first issue in Octo-



A rare magazine from the collection of Jim Fred, e/e's Antique Radio Corner helmsman. Cover lines ask the musical question, what about "Advertising by Radio . . . ?" and, "How to Make a Current Supply Set." Thanks, Jim!

ber 1913 and continuing for almost twelve years (lacking but one issue), was the first successful publication devoted exclusively to our hobby.

The same year, 1913, saw ELECTRICAL EXPERIMENTER join the field with their May issue. It continued through July 1920, when the name was changed to SCIENCE AND INVENTION, a title probably more familiar to our older readers. Here again we find a magazine devoted to the "experimenter" with many construction articles on "wireless" and, later, "radio" as the terms' popularity changed. It continued publication until mid-1929 when the effects of the depression brought a long career to an end.

Still Around. Starting in December 1915 was QST, the monthly publication of The American Radio Relay League (ARRL). It is still being published and is still the official organ of the ARRL. It is, by far, the longest lived wireless radio magazine, and with the exception of a few months during World War I, its over 60 years of publication show it truly to be a voice of amateur radio. Rare is the collector who has a complete file of QST.

In the same year and month (December 1915) WIRELESS AGE, which had begun in

1913, started their Directory of Amateur Calls. This gave them the distinction of publishing the first "call book," other than earlier Department of Commerce listings.

PACIFIC RADIO NEWS started in 1917, but soon changed its title to RADIO. An unusual policy they followed was to publish only ten issues a year, omitting August and September. While we do not know the true facts behind this ten-issues-a-year idea, it would appear that the then accepted theory that radio was "no good during the summer" could have been the basis for their policy. Another interesting fact about this magazine is that the name of Samuel R. Cowan appeared as Business Manager and Treasurer. This same name later was listed in CQ magazine as publisher.

RADIO BROADCAST published Volume I, Number 1 in May 1922 and covered radio as a hobby and business. In 1929 it changed to an "industry" publication, dropping the format that interested the builder. Its earlier issues are some of the treasures that can still be found.

One of the most prolific publishers was Hugo Gernsback. He started with MODERN ELECTRICS in 1908 and followed in order with ELECTRICAL EXPERIMENTER (1913), PRACTICAL ELECTRICS (1921), THE EXPERIMENTER (1924), SCIENCE AND INVENTION (1920). This man left the entire radio industry in his debt because of his work to make wireless and radio popular hobbies. The most successful of Gernsback's many magazines was RADIO NEWS. The first issue in June 1919 brought builders modern—for that day—projects and the same objective was followed for 40 years, lacking just *one* issue. Here again, a complete set of RADIO NEWS is a challenging goal for the collector and one that, due to its large



The only technical book on the non-fiction best seller list, said Time magazine about the Radio Amateur's Handbook. Begun in '26.



These three reprinted volumes make an excellent beginning for your library or collection. They and more are from Vintage Radio, Dept. E, Box 2045, Palos Verdes Peninsula, CA 90274. Expertly revised, these are fast becoming the standard reference books for pro antique radio collectors.

circulation, is possible to attain. (Keep looking . . . I am!) Another very popular Gernsback magazine was RADIO CRAFT. It was begun in 1929, about the time that Gernsback was having problems retaining control of RADIO NEWS, and it followed the same format as its predecessor but gave more emphasis to set construction. Due to this, it will be of real interest to the set collector.

The Next Decades. The thirties brought MODERN RADIO to life, though a short one; only eleven issues were published—July 1931 through March 1933. Probably the effects of the depression prevented this excellent magazine from obtaining the necessary circulation to be able to continue, but its editor, Robert S. Kruse, was a qualified and recognized radio engineer and his construction articles were outstanding.

January 1945 saw CQ magazine's first issue with Samuel R. Cowan, previously mentioned in connection with RADIO, as the publisher. This magazine continues its popularity today, and while it is orientated toward ham radio, it does at times print excellent articles on construction of simulated models of early transmitters and receivers popular in the '30s. These issues, though recent, are popular with collectors because of the information in such articles.

Then 73 magazine was started by Wayne Green with the October 1960 issue. Wayne had been editor of CQ magazine for a number of years. He did provide a new ham magazine and even today its early issues are scarce and hard to find. The first several issues, especially Volume I, No. 1, are collector's items.

POPULAR ELECTRONICS issued Volume I, Number 1, in October 1954. Its early issues were filled with construction articles which gained popularity with set builders, but a

later shift in the publisher's policy gave emphasis to hi-fi and industrial electronics. Current issues do show signs of a return to articles for builders, but little for the collector.

HAM RADIO (first issue in March 1968) is a well founded technical magazine covering developments in amateur radio. It, too, has little to interest the old time radio buff, but its well written technical articles do offer a means to keep abreast of new developments, especially in the solid-state field.

ELEMENTARY ELECTRONICS, the bi-monthly magazine, has adopted a policy of offering articles covering many aspects of radio and electronics. This broad appeal to those interested in almost any aspect of radio, including the growing number of antique and collector hobbyists, makes it a well accepted construction-orientated publication on electronics. It not only provides the basics for the beginner, but makes the more involved projects understandable for all.

Looking Back Again. The "heyday" of the '20s brought a number of hardback "how-to" books for the would-be builder. I still have my original copy of RADIO SIMPLIFIED by Lewis Kendall and Bod Koehler (1922). It was my first book about radio and my notes in it remind me of my first transmission (with a high frequency buzzer, no less) when I attempted to QSO the local Naval wireless station, and their reply scared me off the air!

Laurence M. Cockaday wrote RADIO-TELEPHONY FOR EVERYONE back in 1922, wherein he covered the basics and also gave instructions for simple receivers and antennas. It must have been written before he developed his famous Cockaday Circuit, as that was not mentioned in his book.

Hugo Gernsback of RADIO NEWS fame

e/e YESTERDAY'S NEWSSTAND

published **RADIO FOR ALL** (1922) following the same format of basic technical data and simple construction projects.

Charles R. Leutz of later "Golden Leutz Set" fame followed in 1924 with his volume on **MODERN RADIO RECEPTION** with slightly more complicated projects.

The trend seems to have been to make radio appeal to everyone as most titles were so worded. **RADIO FOR EVERYONE** by Austin Lescarboura (1923), who was managing editor of *Scientific American*, is another example. There were many similar volumes with similar titles—any and all of which you will find interesting and worthwhile additions to your collection.

Electronic Fiction. Those of us who show a touch of gray at the temples recall many titles of the once popular juvenile books, the most famous of which are the Tom Swift series . . . or perhaps you only date back to the Tom Swift Junior series. Every series, whether it was Tom Swift, *The Rover Boys*, *The Hill Top Boys*, *The Boy Inventors*, or whatever, always had at least one title dealing with the series hero's adventures with wireless or radio. All of these books, though even more juvenile today insofar as reading is concerned, are nice additions to one's library collection.

Probably the most interesting will be the

Radio Boys series—and there were two of these—one written by Allen Chapman back in the early '20s and published by Grosset & Dunlap and the other, probably the better known, written by Gerald Breckenridge about the same time and published by A. L. Burt Co. Both series showed author's creative imagination by their titles. However, Breckenridge built his stories around adventures in different parts of the world, while Chapman appears to have gone in for a bit more technical thought behind his stories; but he, too, had the kids running all around the globe, without thought of school, home, or parental guidance. You will laugh at their antics, but also will enjoy finding these volumes lying around waiting to be recognized.

The search for the buried treasures of old-time wireless and radio—the books and magazines printed back in the '20s and '30s—is one of the most fascinating and rewarding activities for the antique radio buff. But where to find them, that's the question! The answer is that there is no single source, and looking is half the fun.

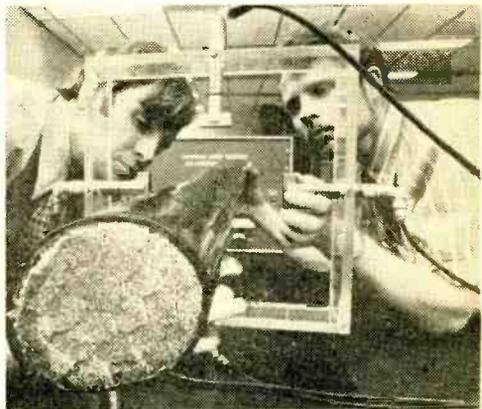
There is no possible way in this article to try and list each and every magazine or book that would be of interest or value; the ones that have been listed and discussed are used as examples so that you would be guided in your treasure hunt to the many "lost lodes" that can be found, just by looking, with some knowledge of their titles and subjects. Good luck! ■

BEEP BEEP FOR SOUND SAVINGS

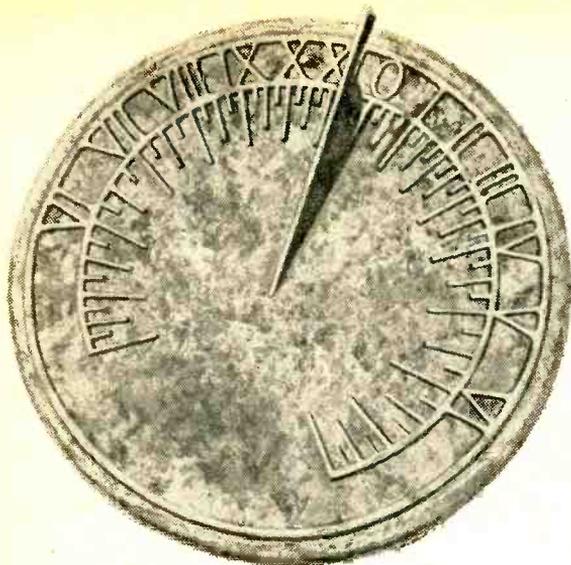
It's a game children play. Just count the seconds between a flash of lightning and its clap of thunder and you can roughly calculate—at a little over one mile for every five seconds—how far away an approaching summer storm is.

It's also a game that can give you a good idea of how Western Electric's new ultrasonic test set works. Conceived and developed by engineers at WE's Atlanta Works Product Engineering Control Center, the test set measures the thickness of the plastic jacket applied to communications cable.

As in the children's game, sound is used to measure distance, not in miles but in millimeters. The set actually bounces high-frequency sound pulses (pressure waves) off the inner and outer surfaces of the cable's polyethylene jacket, records the time intervals between echoes and translates the recorded times into corresponding jacket thicknesses. These measurements are used to maintain uniform jacket thickness and eliminate waste of expensive plastic. ■



WE engineers Luther Boggs (left) and Howard Flichman demonstrate the way the set's four sensors pick up the echoes of high-frequency sound pulses (pressure waves) bounced off the inner and outer surfaces of polyethylene cable jacketing.



Stop Wasting Energy! **BUILD TIME TALLY**

With electric power at top price,
you will want to conserve it more than ever!

by Thomas R. Fox

Something's been hanging in there too long drawing current all the time, and it's costing you a bundle! What is it? Who knows? But you can find out with this simple electromechanical counter driven by a single integrated circuit and connected to the "on" switch of an electrical device, or appliance, or any electric-start engine.

By combining an up-to-the-minute integrated circuit with the old reliable electromechanical counter, you can make an ultra-simple and inexpensive elapsed time meter. The 555-type timer used here is a very handy IC because it is amazingly stable and accurate; its timing isn't significantly affected even if the supply voltage varies widely.

The circuit, centering around the 555 timer, emits half-a-second negative pulses once every 60 seconds. This short, power-stingy pulse triggers the electromechanical counter whose memory requires no power whatever. The 555 output is sufficient to drive the counter directly, which simplifies things quite a bit.

Put It Together. Since the entire project minus power supply has fewer than ten parts, construction is a snap. If the meter is to be used in outdoor equipment, one of the first things to be done is to find a protected spot in the equipment to mount the circuit.

If the meter is to be used indoors to count the minutes a TV is on a month, for instance, a case should be used to mount the counter. An IC socket can be used for the 555 or connections can be soldered directly to its leads if proper precautions against overheating are taken. Use a 20-ohm, 1/2-watt resistor in series with one lead of counter Z1 if the meter is to be built into outdoor equipment that uses a 12-volt battery. With 6-volt systems or with one of the AC power supplies, eliminate the series resistor.

Connect a 6 or 12-volt battery used in the machine or, if it is to be built for indoor use, use four "D" cells in series or a 6-volt lantern battery to calibrate the meter.

With R1 set near its mid-point, the counter should advance one step every 55-60 seconds. Adjust R1 so that the counter clicks exactly every 60 seconds (decreasing the resistance of R1 decreases the time).

For Outdoor Engine Use. Since it is the most common, your machine probably has a negative ground electrical system (negative battery terminal connected to chassis). However, make sure by either examining the electrical wiring diagram or by using a voltmeter.

In negative ground systems, connect a wire to a terminal on the key switch (not to a terminal that is connected directly to the battery) to point "A" on the schematic.

e/e TIME TALLY

Connect a wire from point "B" to the negative terminal of the battery or to any convenient ground. If the timer runs even with the switch off, you've connected point "A" directly to the battery, bypassing the switch. Try another terminal on the key switch (a voltmeter comes in handy when tracing circuitry). Before making the final installation, make sure the Time Tally works only when the key switch is on.

With positive ground systems, connect point "B" to a terminal on the key switch and point "A" to a ground. The counter itself can be mounted in any location where the numbers can be read. It is not necessary to mount it in the front panel.

Since the Time Tally records minutes, not hours, the "hours" usually referred to in the owner's manual should first be converted to minutes by multiplying the hours by 60. For instance, a 25 hour maintenance schedule should be changed to a 25X60=1500 minute schedule. It is most convenient to make the change right in the manual. It is also helpful to record the last minute you serviced the engine.

For Indoor Appliance Use. Use the Time Tally to find out which appliances are gobbling up those expensive kilowatt-hours. Use the following formula to find the exact costs of those "suspected" appliances.

$$\$/\text{MONTH} = (\text{MINUTES USED} / 60,000) \times (\text{APPLIANCE WATTAGE}) \times (\text{RATE IN } \$/\text{KWH})$$

The electric rate is now usually in the vicinity of \$.05 a kWh.

There are two ways of connecting the Time Tally to the appliance being timed. The simplest, in theory at least, is to connect a 6 or 12-volt power supply directly to the appliance on-off switch as shown in Fig. 1. However, because the switch is often in a tight corner, this approach is sometimes difficult. Another approach,

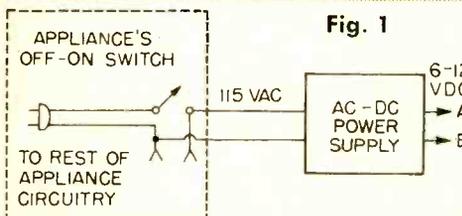
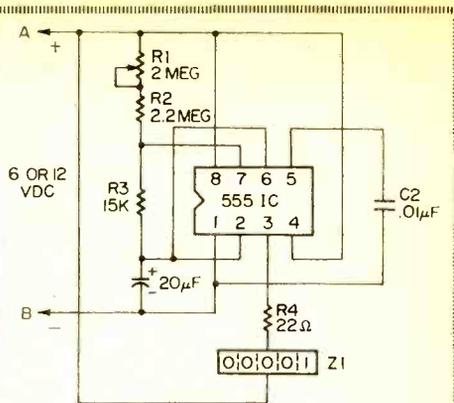


Fig. 1

Putting Time Tally to work. Use Fig. 1 set-up with permanent installations; Fig. 2 shows AC-DC supply. Diode D2 is rated at 1 amp., capacitor C3 is 10 uF at 15 VDC or better.



PARTS LIST FOR TIME TALLY

- C1—20 uF Tantalum capacitor, 20 VDC or better
Note. Common electrolytic capacitors may be used with some loss of timing accuracy.
- C2—0.01 uF capacitor, any type, 12 VDC or better (Radio Shack 272-1065 or equiv.)
- IC1—555-type timer (Radio Shack 276-1723 or equiv.)
- R1—2 Megohm potentiometer, linear taper (Radio Shack 270-093 or equiv.)
- R2—2.2 Megohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R3—15,000-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R4—22-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- Z1—Electromechanical counter, 6-VDC, 5-digit, surplus type
Note. Author used ITT type CE508N5014U. These units are available for \$4.95 each plus postage for 10 oz. from BA, 3199 Mercer, Kansas City, Mo 64111.

which makes the Time Tally even more versatile, is shown in Fig. 2. With this set-up, one merely plugs the appliance into the Time Tally plug. The appliance switch is left on so that the appliance can only be turned on or off by using the Time Tally switch.

Other Uses. The Time Tally can be used in an auto to, say, time the length of driving time for a trip. Here the Time Tally should be connected as described in the outdoor engine use section.

(Continued on page 100)

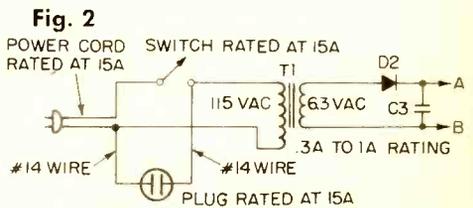


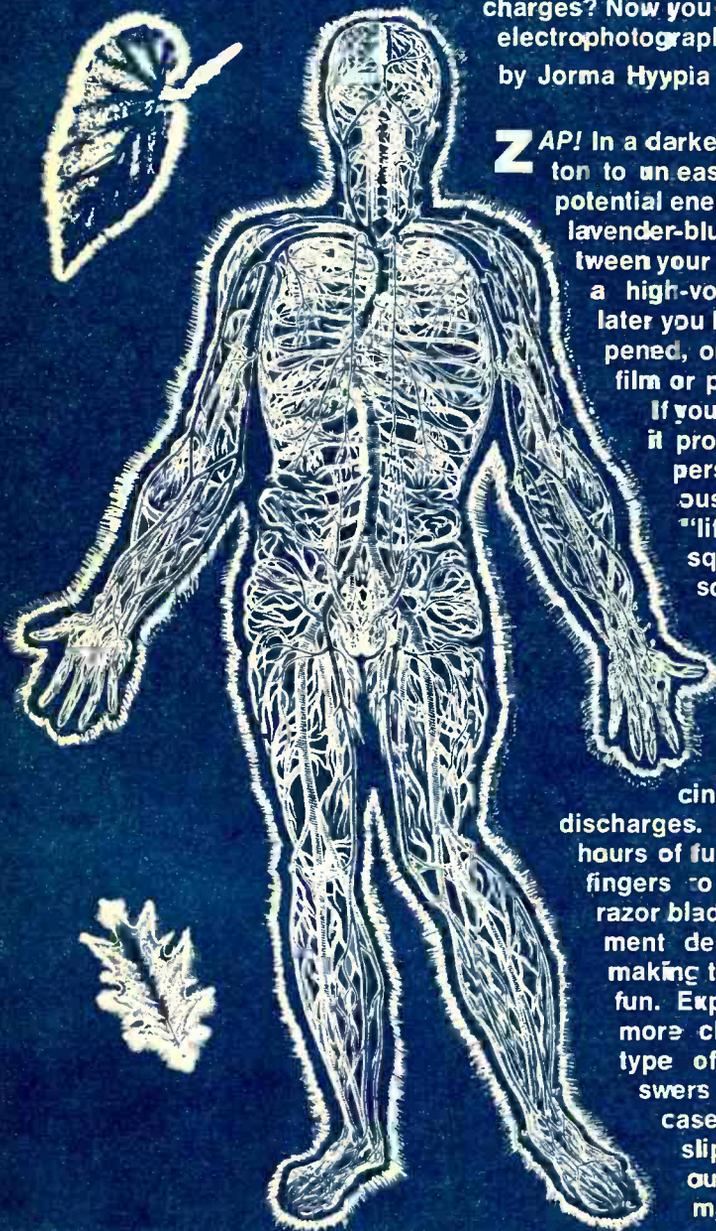
Fig. 2

You can make your own...

Kirlian Photographs

Are Kirlian electrophotographs actually pictures of *life forces* as many parapsychologists contend, or are they nothing more than fascinating corona discharges? Now you can make your own Kirlian electrophotographs and decide for yourself!

by Jorma Hyyppä



ZAP! In a darkened room you press a button to unleash 12,000 volts or more of potential energy to generate a crackling lavender-blue electrical discharge between your finger and the electrode of a high-voltage generator. Minutes later you have a picture of what happened, on a sheet of photographic film or printing paper.

If you are a parapsychology buff, it probably won't take much to persuade you that those curious "Kirlian" images reveal "life forces" that are being squirted out of your bio-aerosol system by the electro-Freon pressure of applied potential. If you have as much trouble accepting this kind of electro-ectoplasm theorizing as I do, you will see only some fascinating pictures of corona discharges. Either way, you can have hours of fun zapping everything from fingers to begonia leaves and old razor blades using the simple equipment described here. Of course, making the pictures is only half the fun. Explaining them fully is the more challenging aspect of this type of experimenting; the answers don't come easily in all cases even if you by-pass those slippery metaphysical think-outs. For example, if you make your electrophotos in

KIRLIAN PHOTOGRAPHY

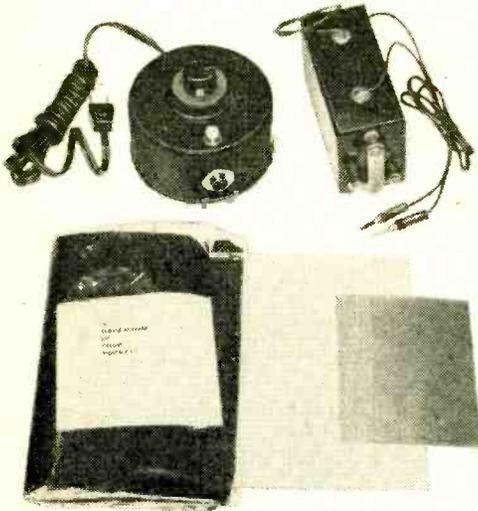
color, you will now and then obtain bright red flares as well as the more common bluish patterns. I think any hot-shot color photographer would know the probable answer off hand, but the parapsychologist will be stone deaf to such explanations. What I'm getting at is this: whatever your viewpoint may be, Kirlian photography is the stuff of which controversy is generated!

The Beginning. Actually, there's nothing very new about electrophotography per se; it's the psychic interpretation that is giving the technique a new look. It all started with Mr. and Mrs. Kirlian—citizens of the USSR—who “rediscovered” what Nikola Tesla had fooled around with a very long time ago. Now there is a world-wide Kirlian cult composed of folk who seem to think the supposed psychic phenomenon is adequately explained just by coining such descriptive phrases as “energy flow,” “life force,” “bioplasma,” “glow of life,” “life aura,” and so on ad infinitum. And then there are the scientific “experts” who whip up ready explanations that are equally incomprehensible. Like the NASA consultant who had to bring in chemical fog, the Xerox process, electromagnetic wave physics, particle acou-

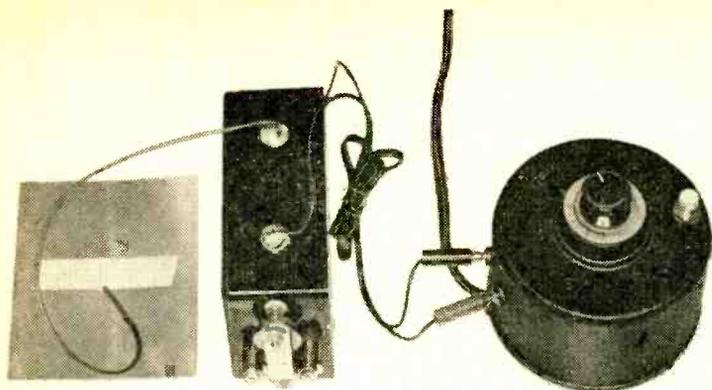
stics and even microwave ovens to explain how “non-visible” radiation could produce images on photographic film. *Non-visible?* The learned consultant needs new glasses! He theorizes that electromagnetic “heat” radiation in the finger of the subject creates a heat fog effect on the silver in the photographic emulsion to produce the image. But whence cometh such heat radiation when a stone-cold razor blade is used to make virtually identical pictures? The point is this: don't make any heavy bets on anything you read about Kirlian photos unless you have done at least a little experimenting on your own. If you want such first hand knowhow, here's how to get it.

Power Sources. Kirlian photographs can be made using any equipment capable of generating high-voltage, low-amperage currents—notably Tesla or Oudin coils, or an auto ignition “spark” coil. If you don't have such equipment on hand, you can get all you need from Edmund Scientific Co. (Barrington, NJ 08007) by ordering a new Kirlian Kit (stock No. 71,938 . . . \$49.95 ppd.). The kit includes a variable 3-8 volt transformer; a high-voltage, high frequency induction coil; aluminum plate electrode; plate glass dielectric; connecting wires; a photographic changing bag for use as a portable darkroom; full instructions. An extra ten bucks will bring a box of 20 color slides (Stock No. P-42116) showing Kirlian patterns of subjects ranging from the fingers of a faith healer to coins and wedding rings. Also available is a book covering subjects related to electrophotography: *Galaxies of Life* by Stanley Krippner and Daniel Rubin (Stock No. 9461 . . . \$6.75) contains the proceedings of the “First Western Hemisphere Conference on Kirlian Photography, Acupuncture and the Human Aura,” and other related information.

To make a Kirlian photograph you simply plug the induction coil into the low-voltage transformer, attach the single high-voltage lead on the coil to the underside of a 4-in. x 5-in. aluminum plate, and cover the aluminum with the ¼-in. thick sheet of glass which acts as a dielectric. Set the transformer voltage anywhere within its range (start with the lowest setting when making pictures of your fingers), place a sheet of photographic film or even enlarging paper emulsion side up on the glass, place your finger on the film or paper, and expose by turning the transformer switch to



Kirlian kit available from Edmund Scientific Co. includes a 3-8 volt variable transformer, high-voltage induction coil, aluminum plate electrode, plate glass dielectric and a photographer's changing bag for use as a portable darkroom.



Pre-wired induction coil is simply plugged into transformer, and high-voltage lead is taped to underside of aluminum electrode to prepare the kit for operation.

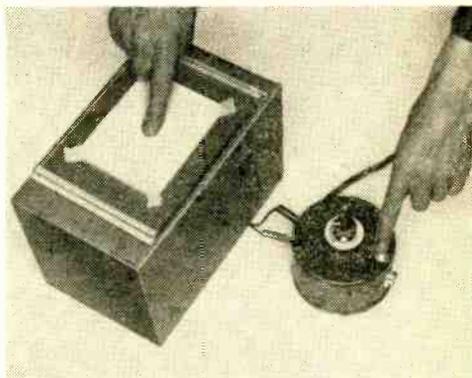
ON position for a short time—anywhere from a fraction of a second to a half minute. Process the film or paper in the conventional manner to obtain a *negative* image of the corona discharge (black pattern on a white or clear background); print from this negative to produce a positive showing a white image on a black background. Actually, the negative image contains all the visual information needed to make an analysis of the picture.

Color pictures of course are far more dramatic than black-and-white photos, and they also have the advantage of showing up various colors that monochrome emulsions cannot detect. Edmund suggests that you use Polaroid 4x5 sheet film, type 58, to make color shots quickly and easily. In addition to the film, you need a Polaroid Land Film Holder No. 500 or 545 for developing the film. Note that you do *not* need a camera. Instructions that come with the Edmund Kirlian Kit provide hints about proper exposure times. You are also told how to utilize such other color films as high speed Ektachrome and Kodachrome X.

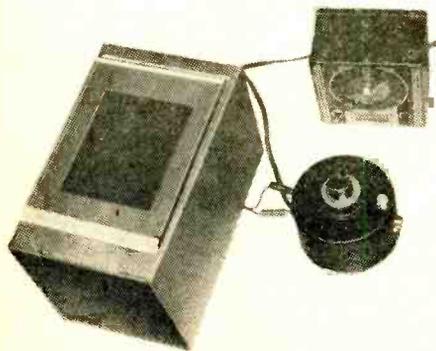
Start With Paper. I would strongly urge that you begin your Kirlian experimenta-

tion using photographic enlarging *paper* rather than film for several reasons: (1) the paper is *plenty* fast enough for short exposure times, (2) it's far less expensive than film, especially color film, (3) you see the results within minutes after making each exposure, (4) you can work under a darkroom safelight rather than fumble around in the dark as is necessary when using film.

There are no special tricks to making the paper negative. Just expose and develop in the normal fashion. Using a fast-speed enlarging paper in water until it is limp, is best), I found that good exposure times



Photographic paper (or film) is taped to top of glass plate. To make an exposure, as of finger, place subject on the paper or film and apply power momentarily.



Electrode with covering glass plate are taped to top of cardboard box used to ship the kit. For safety, induction coil is placed inside the box. Photo timer (not included in Edmund Kit of parts) is convenient accessory when making a series of comparative exposures.

e/e KIRLIAN PHOTOGRAPHY

ranged from about a half second to five seconds, depending on whether the transformer was set at the high or low end of the 3-8 volt range. The longer you expose, the larger will be the discharge pattern in the print. Incidentally, this is just one reason why I am inclined to be very skeptical about photographs that purport to show changes in a subject's emotional state as evidenced by variations in Kirlian images. The image can be materially altered by such factors as time of exposure, development time, temperature and freshness of the developing solution, dampness of the subject, and how firmly the subject is pressed against the photographic emulsion during an exposure. If you have a dark-room timer of the kind used to control exposure times of a photo enlarger, by all means operate the transformer with it so that can provide reasonably consistent exposures in any comparative series you make. Also stick to a set development time.

If you want to print positive images from your paper negatives, first wash the paper negatives thoroughly to remove most of the fixer. Soak an unexposed sheet of enlarging paper in water until it is limp, then lay it emulsion side up on flat surface (sheet of glass, formica, for example). Place the *wet* paper negative on it face down (emulsion-to-emulsion) and roll the sheets into intimate contact with a print roller. The light from an enlarger can be used to expose the fresh sheet of paper, through the paper negative. Again develop in the normal manner. As I said, single-weight glossy paper is best for this purpose.

Incidentally, all the black-and-white Kirlian photos shown in this article were made in just this manner. Unfortunately, the reproduced pictures do not even begin to show the fine detail present in the original pictures. If the first *negative* prints you make look blurred, it's probably because you are not getting the subject flat enough against the paper (or film) during the corona discharge exposure. Hold the subject down with a block of wood or other non-conducting object during exposure.

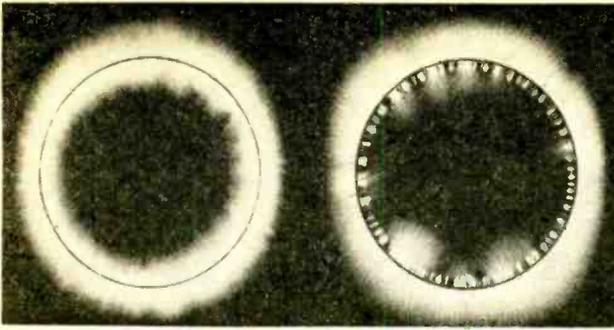
Cumulative Events. Actually, Kirlian still photographs are *not* pictures of single events, but in fact represent the cumulative total of a great many short-term discharge



Wire to earth ground is used when Kirlianizing objects other than humans. The corona discharge, as around this silver dollar, is clearly visible in a dark room. A double exposure was used in this camera shot to show the wire and coin surface, and the cumulative effect of prolonged Kirlian discharge.

events. It's akin to opening the shutter of a camera and leaving it open throughout a dark night to record on the same film dozens of lightning flashes during a storm. The result is a Wow! Gee whiz! effect with streaks of lightning all over the film.

The only way to study the electrophotographic sequence of events is by taking motion pictures—a job not within the scope of a low-budget experimenter. A procedure has been worked out by G. K. Pooch and P. W. Sparks researchers at the U.S. Naval Postgraduate School, Man-Machine Systems Design Laboratory, Operations Research and Administrative Sciences Department (Monterey, Calif.). Instead of using an opaque metal electrode as in the experiments described here, they prepared an electrode that could transmit 90% of light beamed at it by vaporizing a thin coating of aluminum onto glass. Thus it was possible to aim a movie camera *through* the electrode at the underside of the subject being Kirlianized. However, this in itself wasn't enough because the corona discharge light was too feeble to create an image on the movie film. The answer: intensify the weak light first by passing it through an image intensifier capable of strengthening the light image by a factor of about 50,000! The resulting color motion pictures of the fluctuating discharge coronas are



Discharge corona at left was obtained by placing an aluminum lens shade on the photo paper. Reproduction does not show the fine, fur-like texture of the corona. For right picture, rim of the lens shade was dampened slightly. Corona inside the ring now consists mainly of compact flare bristles not unlike the bristles on a toothbrush.

truly spectacular, according to Poock and Sparks.

Caution Advisable. Edmund Scientific warns that the equipment they provide for making Kirlian photographs is *not* a toy for children! They advise that you "exercise care around the high voltage induction coil where voltages in excess of 12,000 are present. The power output of the equipment is insufficient to cause injury to a healthy person, but careless use could result in unpleasant shocks."

To avoid very unpleasant shocks, keep the 4x5 inch aluminum electrode covered with the sheet of plate glass at all times. You can then place your *finger* on the glass and feel nothing more than a prickly sort of tingle. If you feel squeamish, make your first tests with the transformer set at 3 volts, and increase the voltage gradually to the maximum of 8 volts. By all means start with the low voltage setting if you place the entire palm and fingers of your hand on the glass because the far larger surface that is exposed produces a much stronger tingle!

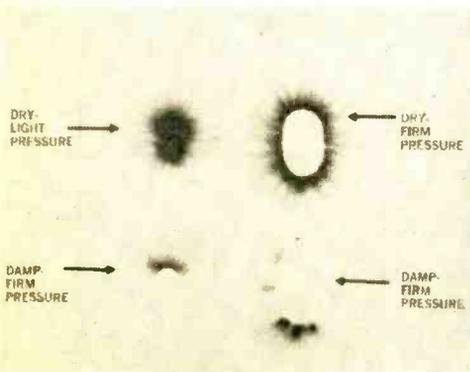
Every object placed on the glass must be grounded in some fashion or the corona discharge will not occur. Your body is enough when you Kirlianize your finger.

If you want the picture of a leaf, you can ground it by holding it down with a fingertip. But don't do that when the subject is metallic—a coin for example—because you will feel it much more strongly. My practice is to ground all subjects (with one exception: me!) by running a wire from the object to an earth ground, like a water pipe. This leaves my hands free to make the exposure without risking being zapped.

Be especially careful to avoid touching an earth ground or an electrical appliance with any part of your body when you have your finger on the activated discharge plate. When you reach to turn on the transformer touch *only* the switch button. Better yet, let someone else turn the transformer on and off.

The transformer supplied with the Edmund kit has two output jacks—one for banana plugs (which you use) and another for connecting microscope accessory equipment. You don't need the latter jack, but because it is on the side of the transformer, just below the on-off push button, it's very easy to touch accidentally when making an exposure. The result? ZAP! Cover this unused jack with thick rubber electrician's tape and then with regular plastic electrical

(Continued on page 100)



Variations in corona effects are often attributed to waxing and waning of "Life Forces," but at these finger patterns show, the different effects are more likely to be due to such factors as the dampness of the object or how firmly it is pressed against the photographic paper or film. Images shown here are paper negatives which could be contact printed to yield positives (white coronas on black backgrounds) shown in other electrophotos in this article.

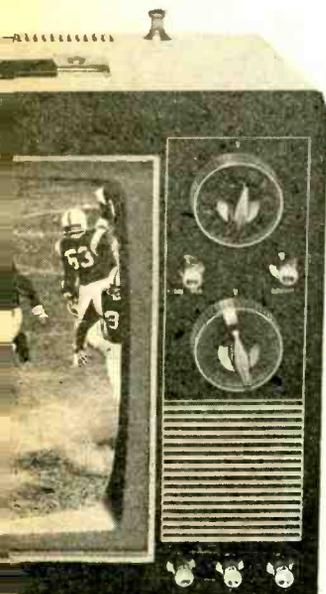
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Electronics in the News!

It Started With an Iceberg

More than 1500 persons lost their lives when the submerged foot of an unseen iceberg ripped the luxury liner Titanic from stem to stern on her maiden voyage in 1912. The International Ice Patrol was launched the following year and U.S. Coast Guard cutters began their annual patrols of the North Atlantic shipping lanes off Newfoundland. To dissolve the oversize ice cubes they tried explosives and even painted the ice islands in heat-absorbing colors, but the giant bergs were indestructible. Turning to ways to improve detection, whistles were blown in hopes of hearing a warning echo and changes in water temperature were observed carefully.

The following year, Submarine Signal Company proposed an excellent experiment with an underwater noisemaker called an oscillator. The scheme involved sending out an underwater "thunder clap" and listening for the echo that bounced back when the sound wave hit an iceberg.

Professor Reginald Fessenden, the oscillator's inventor, and two other scientists from the Boston firm sailed for the Grand Banks in the cutter *Miami* during the 1914 Ice Patrol. When they sighted their first berg the ship came close aboard, the oscillator was lowered ten feet below the surface, and the noise pulses were begun.

Professor Fessenden used a stop watch to measure the time that it took for the signal to leave the ship and return. Earlier researchers had determined the speed of sound in water so the distance to the iceberg could be calculated from the elapsed time.

The echoes were strong at 200 yards. Although special hydrophones had been installed inside water tanks in the ship's bilges, the returning echoes were heard clearly throughout the ship without listening equipment.

The ship moved out to a half mile, a mile, and then a mile and a half. But a strong echo persisted at one mile even after they opened the range to two miles. The non-directional sound waves were bouncing off the mile-deep ocean floor as well as off the iceberg.

World War I brought an immediate priority for research into underwater sound detection of submarines and depth sounding research was postponed.

Following the war, a complete bottom de-

tection system was built for the Coast and Geodetic Survey ship *Lydonia*, which immediately went to work collecting soundings for chart-making at an unprecedented rate.

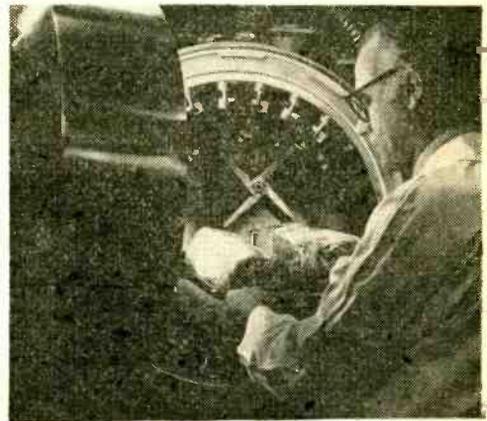
Professor Fessenden's oscillator never did become popular as an iceberg detector. The Coast Guard still maintains the "find and tell" patrols locating bergs and broadcasting their positions, but all over the world millions of boatmen and professional mariners enjoy the convenience and safety of electronic depth sounding.

3 Ways to Cook a Roast

A special "omni-oven" developed for the U.S. Army Natick Laboratories is aiding researchers in a long-term, computer-controlled cooking project to bring better meals to the nation's soldiers, sailors, marines, and airmen.

A cousin to large steam sterilizers used in hospitals, the stainless steel chamber is really a pressure cooker to which have been added an infrared energy source and special generators to produce microwave energy at two different frequencies.

Most servicemen and women who were ever stationed at a large base or aboard a capital ship are familiar with the dried-out, overcooked



Raytheon's Omni-Oven combines microwave energy, infrared, and a steam pressure cooker in one oven.

roast. Raytheon's theoretical studies suggest that military cooking can be optimized and arrive at a combination of cooking methods. Exact instructions can be standardized and keyed to the packaging of roasts so that our military cooks can consistently serve roasts that are more appetizing and more nourishing.

There are economic benefits, too. Beef is the government's largest commissary procurement item in terms of both price and quantity. Roast beef is served an average of 40 times a year at military bases and the ordering formula provides for 40 pounds of beef for every 100

(Continued on page 94)



TALK POWER

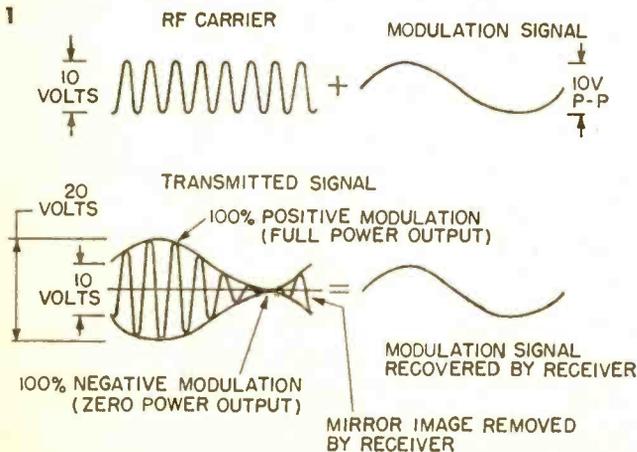
by the Elementary Electronics Editorial Staff

□ Everything considered, the most important characteristic of a given CB communications system is the *modulation*. In fact, modulation is the most important characteristic of any system which relies on the human voice for transmitting intelligence—CB, amateur radio, military or space exploration. The most sensitive receiver is worthless if an incoming S9 signal is garbled, or masked by noise and distortion. The most powerful transmitter is similarly worthless if there isn't enough modulation to get the intelligence-carrying voice over the atmospheric or man-made noise level.

If we assume that a transmitter's basic modulation system is distortion free, there exists a fixed limit to the amount of modulation that can be impressed on the carrier signal. If we attempt to exceed the limit of modulation by simply turning up the modulation level, say by increasing the gain of the microphone pre-amplifier, we then generate excess distortion which will tend to garble the voice when the received signal is weak. When the received signal is strong, distortion often *appears* to be

increased talk power because there appears to be more modulation. It is this characteristic of *apparent* increase in the talk power of strong signals that often gives the CBer a false sense of accomplishment. He fails to realize that when the signal strength falls into the noise level the audio becomes almost unintelligible; it might sound to the ear as though a lot of *talk power* existed, but the truth is, little in the way of intelligence is extracted by the listener.

The fixed limit of modulation for an AM or SSB transmitter is termed 100 percent modulation. Actually, there is a condition known as 100 percent negative modulation, as well as a condition of 100 percent positive modulation. Fig. 1 shows how modulation is handled for AM transmitters. Assume the carrier wave produced by the transmitter is 10 volts. If we impress a 10 volt peak-to-peak audio sine wave on the RF carrier, at the positive peak of the sign wave, the output voltage would be 20 volts peak—twice the RF level. When the positive peak is twice the quiescent RF value we say the modulation is 100 percent positive.



When modulation is any value up to 100 percent positive and negative, the recovered audio in the receiver is an exact reproduction of the modulator's input—the voice. Distortion is minimal and maximum intelligence is received.

e/e INSIDE CB TALK POWER

Note that at the negative peak (trough) of the sine wave, the RF output voltage has been driven precisely to zero output; when the RF output is zero we say we have 100 percent negative modulation. The receiver strips away the RF in the detector, and what remains to be fed to the speaker is a sine wave which is a replica of the original sine wave modulation.

Moving On. But look what happens if we increase the modulation voltage as shown in Fig. 2. The positive peak simply increases the RF output more than twice the quiescent value. No great problem here, even though the FCC does not allow greater than 100 percent positive modulation of CB equipment. But now look at the negative modulation. The carrier has been driven to zero output (cutoff) for an extended period. The recovered waveform at the receiver no longer represents the original sine wave modulation; it is distorted. The greater the degree of excess negative modulation, the greater will be the distortion.

In addition to modulation distortion, the transmitter now produces sideband interference which doesn't exist if the modulation is limited to 100 percent. Up to 100 percent modulation, the sidebands are exactly as wide as the highest modulating frequency. If the modulating frequency is 3000 Hz, there will be a sideband 3000 Hz above and below the carrier frequency. That's as it's supposed to be. But when the RF signal is driven into negative overmodulation, the clipping produces *harmonics of the 3000 Hz modulation*; therefore, the highest modulation frequency becomes that of the harmonics: 6000 Hz, 9000 Hz, 12,000 Hz and higher. The greater the degree of overmodulation, the greater the harmonic sidebands. These sideband frequencies now extend the carrier signal into adjacent channels, so the overmodulation (in addition to

the signal's distortion) now interferes with users of other CB channels.

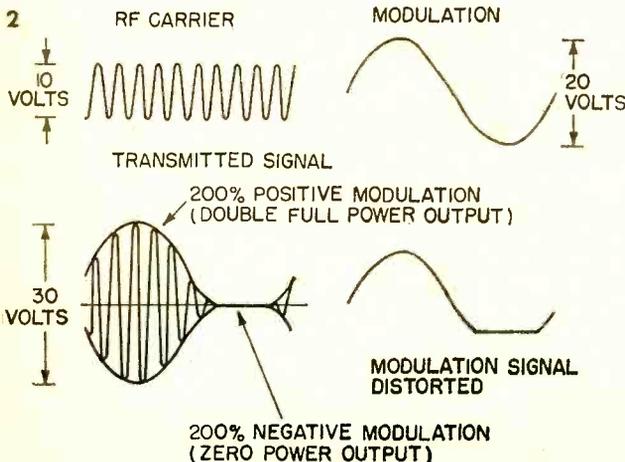
Since exceeding the 100% modulation limit results in severe modulation distortion and sideband interference, how then can we increase the talk power of a CB transceiver and still maintain no higher than 100 percent modulation? The answer is in the several varieties of talk power boosters.

What Should You Boost? Talk power boosters depend on two characteristics of the human ear. First, intelligence is carried predominantly by the higher voice frequencies; the lower frequencies provide the essential tone characteristics by which we can recognize the speaker. They convey little intelligence, yet they use the most modulation power. Secondly, the ear is primarily sensitive to average, not peak, power; yet the peak power of the human voice is 10 to 100 times that of the average power (10 dB to 20 dB higher). For most applications it is accepted that peak power of the voice is considered to be 10 dB higher than average power.

Though the ear responds to average power, it is the peak modulation power which determines the percent modulation of the transmitter.

A first step to increasing talk power is the suppression of those frequencies which require modulation power but do not contribute much to intelligence. By eliminating the frequencies below approximately 300 Hz and above 3000 Hz—either at the microphone or through pre-amplifier design—better than 80 percent of the intelligence is preserved, while the power-hungry lower frequencies are eliminated. (The telephone is a good example of this technique; its "tinny" sound might not be natural, but most of the message gets through without much power behind it.) We can now raise the level of the 300 to 3000 Hz frequencies and still stay within 100 percent modulation, thereby increasing talk power at the receiver end of the system.

What Can You Chop? Next, we chop off the



Excessive distortion in your transmitted signal is caused by overdriving the modulator, which, in turn, can overmodulate the carrier. Overmodulation causes the carrier to be "pinched off" during excessive negative-going portions of the modulating signal as shown. Actually, since over 100 percent modulation on the positive peaks can increase talk power without introducing distortion, the FCC allows some services to engage in this "selective" overmodulation.

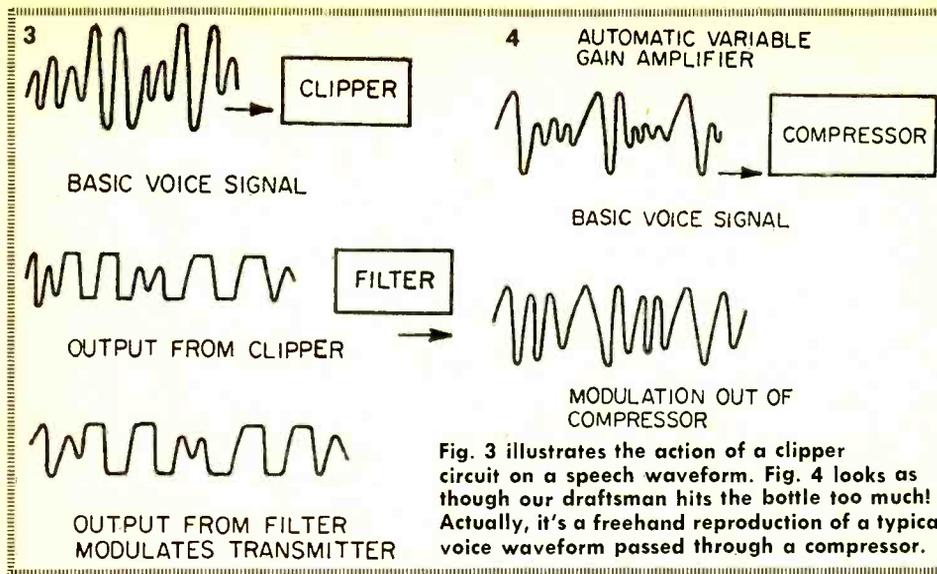


Fig. 3 illustrates the action of a clipper circuit on a speech waveform. Fig. 4 looks as though our draftsman hits the bottle too much! Actually, it's a freehand reproduction of a typical voice waveform passed through a compressor.

peaks of the signals, for they contribute very little, if anything, to what the ear senses. The earliest form of clipping was a device called ... you guessed it, a *clipper*. Figure 3 shows how it works. The audio signal is passed through the clipper and the peaks are eliminated. If this signal was fed to a transmitter, we might get anywhere from 10 to 50 percent modulation depending on the amount of clipping, called *clipping depth*. So we increase the signal level by exactly the degree of clipping, thereby raising the average voice level some 6 to 10 dB. But what of the harmonics caused by the clipper? Since we're distorting the modulation waveform through clipping, won't harmonics be generated which will cause sideband splatter? The answer is no! The output of the clipper is passed through a filter which attenuates all signals above 3000 Hz, thereby reducing or eliminating the harmonics and their interference.

But clippers are difficult to adjust to precise operating level, difficult to maintain once in adjustment, and good filters cost money. Thanks to modern solid state devices we can accomplish the same ends through *compression*, a form of automatic electronic microphone gain control which suppresses the peaks and boosts the weaker voice sounds *without* generating excess distortion. Not only is the compressor basically efficient and inexpensive, there is no need for signal filtering.

Voice Cinch. Figure 4 shows how a compressor works. The compression amplifier normally works at maximum gain so the weaker sounds get maximum amplification. As the voice tends to get louder, electronic feedback control automatically reduces the amplifier's output so that the strong voice sounds are not much louder than the weaker sounds. Everything is now at more or less the same volume level, and the

signal peaks of the stronger sounds have been eliminated. If this compressed modulation is applied to the transmitter so that the strongest sounds are at 100 percent modulation the weaker sounds will similarly be at 100 percent modulation, or close to it. Through one device we have substantially increased the average voice power and brought up the weaker voice sounds to 100 percent modulation—that's what talk power is all about. (It's the same technique used in making TV commercials, and is the reason the commercials sound so much louder than the normal program level.)

Combine a limited frequency response with compression and you end up with a transmitted signal that comes in like gangbusters on a wave of audio.



Whisper Or Shout? Back in the early days of CB, very few transceivers incorporated a talk power booster such as a clipper or compressor; most were only available as optional accessories. As solid-state devices were improved, compressors were designed into some of the higher priced rigs; these talk power boost circuits were called range gain, range boost, or some such similar term which implied extra range through extra talk power. On the other side of the coin, however, some manufacturers tried to take advantage of the reputation of true talk power boosting devices by simply providing tremendous microphone preamplification, which saturated the following amplifier; in effect, the saturated amplifier functions as a clipper, but there is no harmonic filter. The signal is heavily distorted and when received at "S9" sounds terrific, but at low signal strengths the modulation is garbage. Many inexpensive transceivers still try getting away with this trick, and the only way to avoid garbled modulation

MIKES

is to drop the voice level to a whisper.

On the other hand, some CB transceivers do not have 100 percent modulation limiting at the lower voice frequencies, so the microphone preamplification was designed to be low to prevent overmodulation: with these rigs, you virtually must scream into the mike to get sufficient modulation on the carrier.

How To Add Talk Power. If your present transceiver doesn't already have some form of built-in talk power booster, you can easily add your own: several microphones are available which have some form of talk power amplifier built into either the case or the base.

For example, the Turner +3 stand base microphone and M+3 mobile microphone both have built-in preamplifiers and compressors. Other microphones such as the Shure 444T have built-in preamplifiers with output control for providing "extra" gain for those transceivers which require a shout for full modulation. Bear in mind, however, that a modulation meter must be used with amplified mikes to avoid overmodulation—not every transceiver which makes the claim to 100 percent modulation limiting really has it at *all* frequencies.

If your rig is putting out just the right amount of talk power for you, there's always the possibility of getting *better* sound quality with a better mike. CB transceivers are usually

Communication mikes made by Turner are made for CB operators. M+3 for mobile, left, and Plus Three, right, for base both have built-in compressor amps with gain pots.



Circle No. 22 on Reader Service Page

supplied with the least expensive microphone, and the sound quality isn't all that good to begin with. Every microphone manufacturer has a communications microphone line with sound quality ranging from just passable to superb. You can always upgrade your station with a quality communications mike from Astatic, Electro-Voice, Shure, Turner, etc. For those of you who would like *hands-free* operation, Telex has a line of headphones with attached boom microphones.

SSB Is A No No. While talk power devices are very effective for AM transmitters they can often result in the destruction of an SSB transmitter. In particular, the steep wavefronts caused by a clipper can *attempt* to drive an SSB RF amplifier towards infinite power output—it does nothing for the modulation and can destroy the amplifier. Compressors which work on the voice's dynamic range—boosting the lower volume but not affecting the signal peaks—offer

(Continued on page 104)

MORE MIKES



Electro-Voice 619TR clipper-compressor microphone.



Shure 444T base mike has gain control, push-to-talk bar.

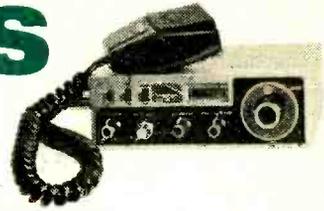


Turner Roadking 70. New amplified mike has road noise cancellation feature.



Kathi takes a peek inside the Tram Diamond 40 transceiver

KATHI'S CB CAROUSEL



by Kathi Martin KGK3916

□ Celia was always willing to lend a hand when I was putting up sky hooks or doing a mobile installation, so I was just paying back many favors by driving this new college student up to her home away from home for the next four years. The college was bad enough, giving hundreds of ex-high school students a handful of nothing on their first day, but the New England Tel Co had a real swifty going. Seems they pulled out every dormitory phone so that incoming students had to cough up a \$5 installation charge every year. And to make sure they got their pound of flesh there was like *one* public phone per several hundred students—you get your own phone or forget about using it!

The problem was that Celia couldn't open a bank account in town to cash Pop's checks without a P.O. box number, and the college computer was running several hundred students behind on the numbers. I offered to drive to the bank in town and call back for her number (if it ever came out of the computer), but then we remembered! No phone until she coughed up five clams.

Okay, we'll use CB. But I had cleaned out the car to pack Celia's trunks, and all I had was my mobile and a small box which contained a new Tram Diamond 40. No high power walkie-talkie, no portable

antennas, no nothing. Just the Tram and my emergency kit with tools and a fluorescent trouble lamp (one of those lamps that is powered by nine D-batteries). While I could always jam the Tram's power leads into the lamp's battery pack, what would I use as an antenna?

Celia's dormitory room was as bare as a prison cell: a bed, a bare mattress, a desk screwed to the wall and a couple of metal hangers left by the previous student (phones they take out, old hangers they leave).

What's That you say? I should unfold the hanger and use the wire for an antenna? That's what I also thought, but solid state transmitters take a dim view of high SWR ratios, and a stunt like that could "blow" the RF final in many a rig.

But when the phone company has you up against the wall you've got to come out fighting, so it was the wire hanger and crossed fingers. Would you believe the Diamond 40 not only didn't blow, but put a solid signal into my mobile three miles into town. I straightened out the bank account, bought some personal items Celia radio'd for, picked up the Tram and headed back for e/e's test lab, 'cause I wanted to take a closer look at a rig that could put out a 10-4 signal under the worst possible conditions.

Even at first glance you know there's

The Tram Diamond 40, a full 23-channel transceiver with delta-tuning and PA switching, also packs both a noise blander and ANL. Costs only \$209.95.

Get all the facts by circling No. 43 on Reader Service Coupon on page 17 or 103.

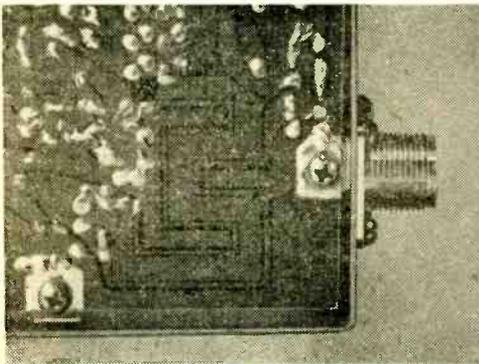


e/e DIAMOND 40

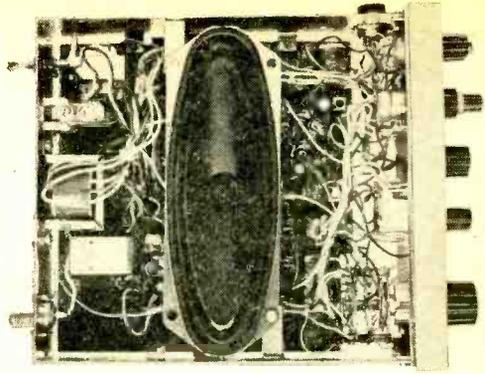
something different about the Diamond 40. To start with, though it's an AM rig the Diamond 40 has both a noise blanker and ANL, the same noise squashing pair found on the finest high performance SSB rigs. Another *big* plus is a built in SWR meter, controlled directly from the front panel; flip a switch and the same meter which indicates relative signal strength and RF power output becomes a calibrated (full-time, if desired) SWR meter. Another unusual feature—one that I'm not too crazy about, out which many CBers go for—is a microphone gain control. The trouble with having a user adjustable microphone level is that it's usually cranked wide open, and winds up producing intelligence-garbling distortion. But if you set the Diamond 40's control to about the 12 o'clock position the overall gain is about equal to "standard" microphone gain, and if you're using a modulation meter such as shown in *e/e's* book *101 Electronic Projects For Under \$15*, you can, of course, adjust the modulation for optimum results with your particular voice level.

Other Operating Features of the Tram Diamond 40 are more or less standard. There's full-23 channel coverage, a PA output, Delta tuning (needed because of the very high selectivity, see below) and lastly, the rig can operate from either a positive or negative ground.

Overall, the rig looks impressive, feels like a solid piece of equipment (nothing



The zig-zag printed foil pattern at the lower right corner of the circuit board is the SWR bridge RF sampler. Gone are the large metal box units popular long ago.



Two reasons for the Diamond 40's excellent sound on send and receive are the extended cone speaker and an "oversize" modulation transformer. Note how cone utilizes total transceiver width.

chintzy about the cabinet), and inside, the construction is strictly first class. One cute and successful trick is a printed circuit SWR RF pickup. If you can make it out from the photograph, those wild-looking printed circuit foils near the antenna jack form a capacity-coupled RF sensor for driving the SWR meter. (How easy it looks compared to the precision metal-work used in the "old days" to build an SWR bridge.)

But most important is the performance. The signal sniffer section had a sensitivity of 1.1 μV for a 10 db S+N/N ratio (signal plus noise to noise). The selectivity was a whopping 62 dB adjacent channel rejection, while image rejection checked in at 54 dB. Really outstanding, almost as important and as good as the selectivity, was an AGC action of 3 dB for an input signal range of 2 to 10,000 μV . In plain terms, with the volume cranked wide open to receive a very weak signal, a strong signal coming on the channel would not blast the speaker, being received just slightly louder.

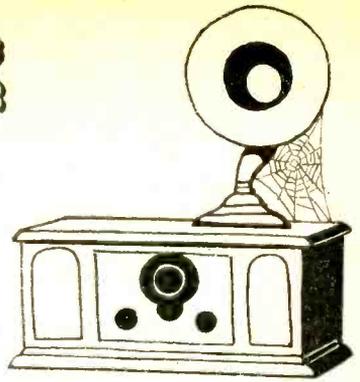
Best of All, the received signal came out clean and crisp, without the usual tinny sound associated with small mobile rigs. The excellent sound is probably due to a speaker stunt pulled by manufacturers in many TV receivers. If there's not much room for the speaker, stretch it out so there's a large cone dimension for the lower voice frequencies. It works in the better TVs and works in the Diamond 40.

The transmitter put out 4.6 watts into a 50-ohm dummy load with a 13.8 volt
(Continued on page 97)



ANTIQU RADIO CORNER

BY JAMES A. FRED

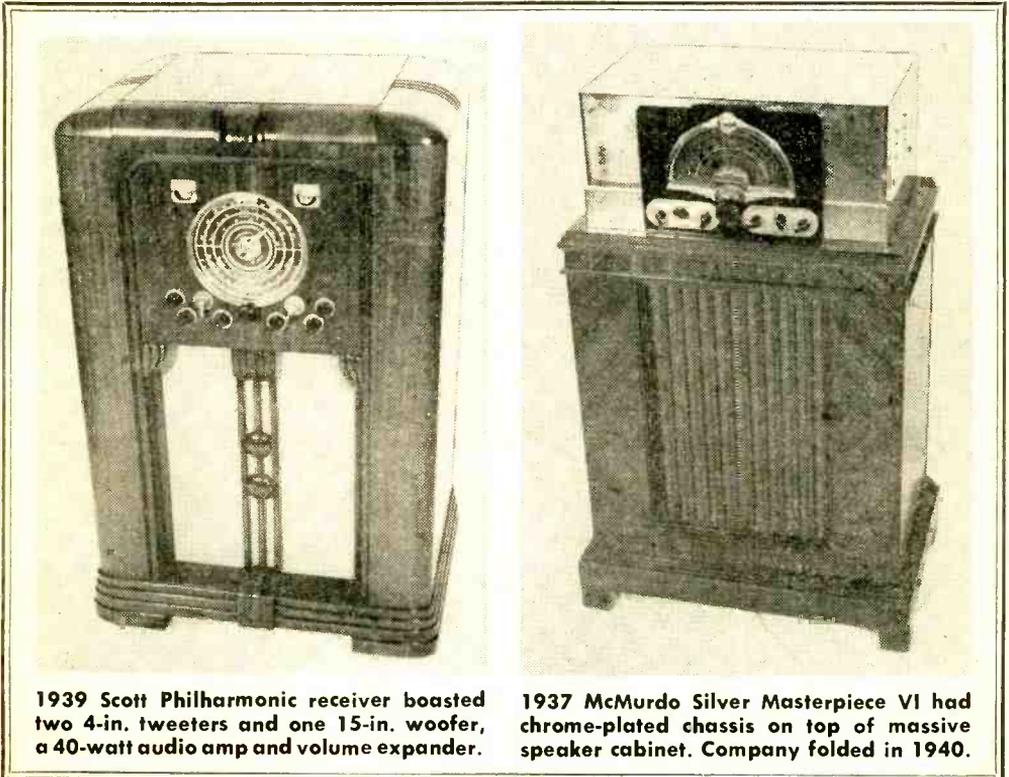


□ Hello out there in Radioland! Here we are in the middle of winter and you should be busy restoring the radios you found last summer. Since most of us need all the help we can get I want to mention some books that will provide some much needed information for you. "Most Often Needed Radio Diagrams" covers the years 1926 to 1950. There are eight volumes providing circuit details and notes on over 3,000 radios. There are only a limited number of the original volumes available, and when they are gone there may be a long wait for reprints. Address your requests for information about these books to: Vintage Radio, Dept. F, Box 2045, Palos Verdes

Peninsula, CA 90274.

Morris Beitman of Supreme Publications, who originally compiled the books mentioned above, is offering to supply almost any radio or TV circuit diagram ever published for a reasonable price. You can reach him at: Supreme Publications, 1760 Balsam, Highland Park, IL 60035.

One of the most fascinating divisions of the radio collecting hobby is that of "Classic" radios. These radios are not antique radios by the strict definition that an item must be 50 years old to be an antique. Nevertheless, there is a great interest in classic radios, and we are going to devote most of this column to that subject.



1939 Scott Philharmonic receiver boasted two 4-in. tweeters and one 15-in. woofer, a 40-watt audio amp and volume expander.

1937 McMurdo Silver Masterpiece VI had chrome-plated chassis on top of massive speaker cabinet. Company folded in 1940.

ANTIQUE RADIO CORNER

Perhaps it would be wise to first define the word "classic." Many collectors feel that the term "classic radio" should only be used when referring to the period from 1928 to 1939. It might be well to see what Webster has to say about the word "classic": "Superior, of highest class, most representative of the excellence of it's kind."

Some of the radios brought to mind as being classics were E. H. Scott, McMurdo Silver, Lincoln, Capehart, Norden-Houck, and perhaps others. Like a classic automobile, a classic radio should be an example of the very finest of it's kind. We are going to discuss three of such radios in this column.

Some Scott Radios. E. H. Scott, a brilliant engineer, opened his first laboratory in Chicago, Illinois in 1925. In 1930 Scott introduced the first 12-tube all wave receiver using plug-in coils. Three years later he offered an improved model in which the coils were switched into place. These sets were followed by a 15-tube, a 23-tube, a 30-tube; and even a 40-tube radio was put into production. The Scott Philharmonic was a 30-tube receiver. It was perhaps the most classic of all radios. Included was a volume expander, a record scratch suppressor, and two magic-eye tubes. The audio amplifier was rated at 40 watts RMS with less than 1% harmonic distortion. The speaker system consisted of a 15-inch woofer and two separate 4-inch tweeters.

During World War II thousands of marine receivers were built by Scott Radio Laboratory for the U.S. government. A few

NEW 1975 FACT SHEET

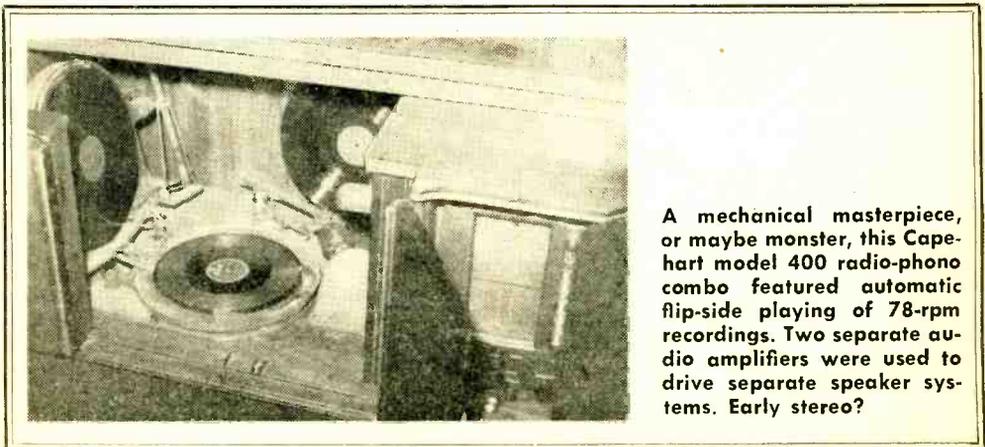
□ Collectors of antique radio and wireless equipment can get an updated Fact Sheet from ELEMENTARY ELECTRONICS which includes information on antique radio publications and clubs, and a listing of public and private radio and wireless museums. To get your copy send a long stamped self-addressed envelope to Antique Radio Corner, ELEMENTARY ELECTRONICS, 229 Park Avenue South, New York, NY 10003. ■

less elaborate radios were built in the early fifties, then E. H. Scott retired and the company was sold. I remember when the John Meck Company in Plymouth, Indiana was sold at auction in either 1955 or 1956, I was there and saw partially-assembled Scott radios sitting on the assembly line. What a sad end to the most classic radio of all times.

Another classic radio was the Silver-Marshall built by McMurdo Silver. McMurdo Silver first became known to the radio industry when he developed one of the first practical super-heterodyne radio kits. These were the Haynes Cockaday and Radio Broadcaster Supers.

McMurdo Silver moved to Chicago in 1924 and founded Silver-Marshall, Inc. In 1932 he changed the company name to McMurdo Silver, Inc. In 1933 the first Masterpiece receiver was produced. In November 1933 the Masterpiece II was advertised as the official general coverage receiver for the Byrd Antarctic Expedition. The Masterpiece III was introduced in 1934, followed by the IV in 1935, the V in 1936, and finally the VI in 1937. From 1932 to 1938 several lesser sets were pro-

(Continued on page 97)



A mechanical masterpiece, or maybe monster, this Capehart model 400 radio-phonograph featured automatic flip-side playing of 78-rpm recordings. Two separate audio amplifiers were used to drive separate speaker systems. Early stereo?

e/e checks out
a low cost scanner...

REGENCY'S ACT-C 4H Action Band Monitor



Four channels in a low-silhouette desk top package!

□ With scanning monitors packing more and more features as each new model is introduced, the user who needs just a few channels to monitor his local fire and/or police frequencies is hard pressed to find something *inexpensive* which could handle just a few local, strong signals. Even if his only interest are these local signals, he still must pay for enough performance and hardware to satisfy the most discriminating hobby DXer—someone who wants to pick up the signal farthest from his home or office.

But now there's a VHF scanning monitor tailor-made for both the hobbyist and police and fire volunteers who need something both inexpensive and reliable enough to keep up with the local action. This month's entry in the "budget-price/high-performance sweepstakes" is the Regency ACT-C4H scanning monitor. Covering the VHF hi-band of 150 to 174 MHz, this \$89.95 monitor provides for up to four crystal controlled frequencies, has automatic scanning or manual selection of the four channels, has an adjustable squelch, a volume control, and a built-in telescoping antenna. (There is no connection provided for an "external" antenna.)

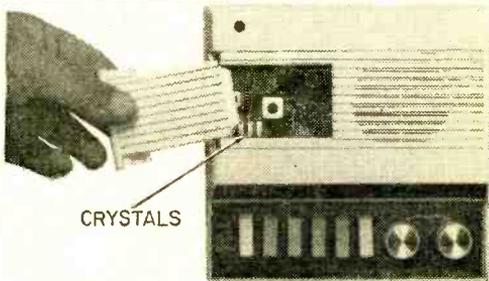
The entire unit is housed in a plastic cabinet just about the size of a small table-top intercom: 6¾-in. wide x 2-in. high x 6¾-in. deep. The control strip at the top-front has the *squelch* and *volume* controls and six slide switches. Four of the switches are the channel selectors (on and off). The switch on the extreme left has three positions, providing *power off*, *scan* and *manual* channel selection. The switch on the extreme right is spring-return and provides

the step sequence for manual channel selection. Any of the channel selectors can be locked in or out of both the scan and manual selection.

Even before we get into the performance of this gem, there's one outstanding feature that must be singled out. On most scanning monitors the changing of a crystal can be a first class pain-in-the-neck. Either a mechanical trap door must be opened or the entire cabinet must be removed. On the Regency ACT-C4H, all it takes to change a crystal is the sliding open of a door on the top left of the cabinet—no screws, no locks, just slide back the plastic door. Under the door is a rather large compartment housing the crystal sockets and a few coils. You simply reach in to remove and replace any desired crystal.

The receiver is a single conversion super-

The Regency 4-channel desk top scanner model ACT-C4H is from Regency, 7707 Records Street, Indianapolis, IN 46226 and is priced at \$89.95 Circle No. 42 on the Reader Service page for more information.



Here's a big plus feature. The crystals are accessible through a trap door on the top of the cabinet. Simply slide back the plastic door and crystals can be changed in a matter of seconds, without any cabinet removal or disassembly.

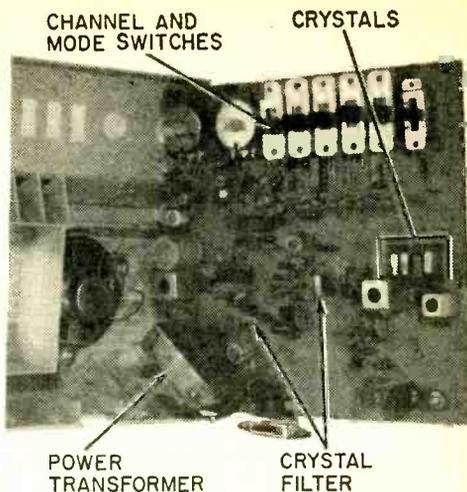
e/e DESK TOP SCANNER

het with a 10.7 MHz IF amplifier and two crystals in a 2-pole filter for selectivity. The crystals used for frequency control are the third overtone type, and the exact crystal frequency is simply determined. For example, suppose you want to receive a station on 155.55 MHz. Plugging the numbers into a formula we get $155.55 \text{ MHz} - 10.7 \text{ MHz}/3$, or 48.2833 MHz. You would order a 48.2833 MHz third overtone crystal to receive 155.55 MHz. Note that third overtone crystals are the most commonly used and are the type most likely to be stocked in your local parts store.

Inside Action. The Regency ACT-C4H scanner is powered by the AC powerline through a linecord which plugs into the back of the cabinet. As normally supplied the unit is tuned for maximum sensitivity in the range of 152 to 160 MHz with reduced sensitivity outside this range. The frequency range of usable sensitivity is 150 to 162 MHz. At all times, the maximum sensitivity is ± 4 MHz of the "center frequency tuning," while the usable sensitivity is ± 6 MHz. If the frequencies you are interested in lie outside this range, the necessary coils can be easily repeaked by a service technician. The coils are in the crystal compartment, but, unfortunately, no schematic or alignment instructions were packaged with the unit.

Generally, most of the "action" frequencies lie within the maximum sensitivity range of the ACT-C4H as factory aligned; the National Weather Service frequency of 162.55 MHz, however, lies at the end of the normal usable frequency range and cannot be received unless you are in a strong signal area. If you need the weather frequency, have your dealer shift the alignment slightly higher for optimum reception.

Checkout. The receiver is spec'd for a sensitivity of 0.6 μV for 20 dB quieting and a selectivity of ± 32 kHz 50 dB down. Because there is no standard antenna input we could not check the device with a signal generator. Instead, we compared the Regency ACT-C4H against several other monitor receivers which could accept telescoping antennas. As far as we could determine, the Regency unit is at least as sensitive, if not more so, than VHF scanners priced to almost \$200, and just as selective as many of the higher priced scanners.

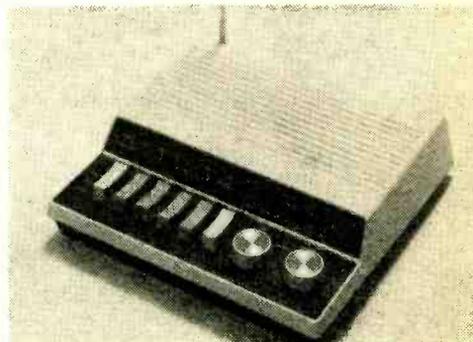


From the outside the ACT-C4H looks like a plain jane, but inside it's packed with circuitry—most of it multi-purpose ICs. Even the plug in linecord is a quality touch.

Actually, using just the built in telescoping antenna we were able to receive—well over the noise level—signals from the New York City police and fire departments at distances exceeding 20 miles.

In short, if you have no need for a rooftop antenna the Regency ACT-C4H will deliver outstanding reception. It is most likely that if the ACT-C4H was packaged in a fancy, chromed cabinet it could easily justify a price tag nearly double its price of \$89.95.

Summing up. The Regency ACT-C4H is an excellent value, both performance and pricewise. You actually must see and try one at your dealer's to believe how good it is. For more information circle No. 42 on the Reader Service coupon on page 17 or 103.



No larger than a desk-top walkie-talkie, the Regency ACT-C4H packs a performance level essentially the equal of the best "communications" scanners.

Electro-chemical action tests your car battery!

BATTERY MONITOR & CELL CONDITION TESTER

Are you one of the many who are servicing their own cars? It pays to make sure that the battery is in good shape to prevent that slow, grinding start when you are in a big hurry. Just adding water at intervals isn't always enough to ensure that the battery will be in good condition when you need it.

With our expanded scale battery tester you can make periodic tests of your battery to insure that the battery is in good shape. The tester is built in a compact plastic cabinet and includes easy-to-make special probes for the cell electrolytic tests as well as overall battery voltage tests. The construction of the tester is simplified for ease in building.

Tester Circuit. When S1 is set to the "single wet cell" position and voltage is at J1 and J2 (from the test leads), M1 will indicate only when the test voltage at J1 and J2 is higher in value than 1.4-volt battery B1. For example, if the test voltage is 1 volt (positive polarity at J1 and negative polarity connected to J2), the meter will not indicate since the B1 voltage is 1.4 volts. When the test voltage is 1.5 volts, there is a 0.1 volt difference over that of B1, and M1 will indicate a current flow (voltage) in the circuit. The 1.4-volt meter scale marking is equivalent to meter zero.

When S1 is set to the "six cell battery" position, zener diode D1 operates similarly to battery B1 in the other position.

by Charles Green



e/e WET CELL TESTER

Since D1 is a 10-volt zener diode, a test voltage higher than 10 volts is required to allow M1 to indicate voltage.

Potentiometer R1 is the calibration pot for the *single wet cell* meter circuit, and R4 is the calibration adjustment for the *six cell battery* circuit. Series resistor R2 provides a minimum current flow through the zener so that it will operate properly.

Construction. The Tester is built in a 6 x 3½ x ⅞-in. plastic box with a plastic panel. The box dimensions are not critical, and any convenient size can be used. To minimize possible electrical short circuit hazards, do not use a metal box. Most of the components are installed with push-in clips on a 3 x 2½-in. perf board with remaining parts mounted on the box panel.

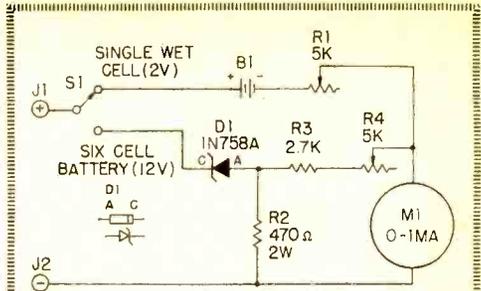
The best way to start construction is to cut out the M1 mounting hole in the panel and install the meter in approximately the position shown in the panel photo. Then locate and mount S1, and J1 and J2. Cut a section of perf board to size, and drill two holes to fit the M1 terminal screws to mount the board. Install the perf board to the meter terminals with two solder lugs supplied with the meter.

Mount the board components with push-in clips at the approximate locations shown in the board photo. Use short leads for best mechanical rigidity, and wire as shown in the schematic. Make sure that D1 and B1 are connected with the proper polarities as shown in the schematic. Carefully solder B1 to the push-in clips with a minimum of heat, or the mercury cell may be destroyed. If desired, you can use commercial mounting clips for the battery that do not require soldering.

Wire the remainder of the tester circuits and the panel components. Carefully check the wiring and make sure that M1 is connected with the proper polarity.

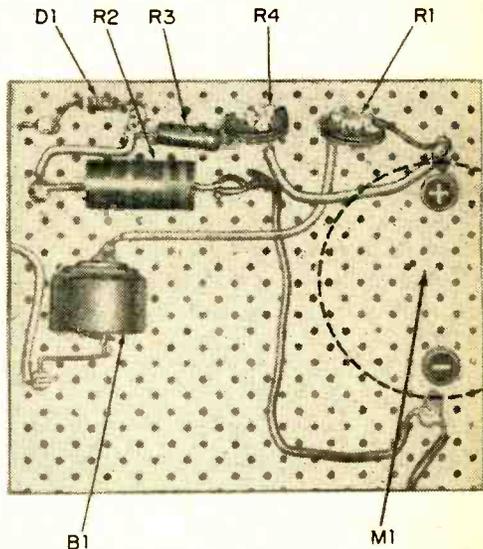
Test Probe. The tester requires special probes for the electrolyte test. As shown in the drawing, the probes are made from solder wrapped around the end of a plastic tube (we used a plastic body of a mechanical pencil and #18 60/40 rosin core solder).

Begin construction by selecting a pair of mechanical pencils with black and red plastic bodies for your test leads. Carefully

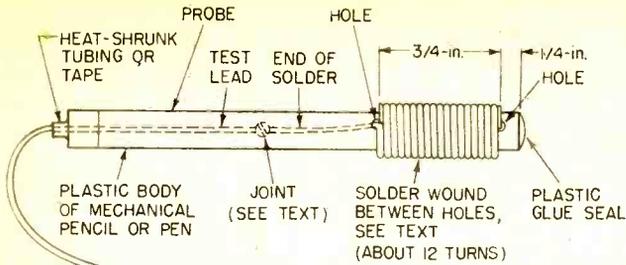


PARTS LIST FOR BATTERY MONITOR & CELL CONDITION TESTER

- B1—1.4-volt mercury cell, Eveready E640 (Radio Shack 23-1515 or equiv.)
- D1—10-volt, ½-watt zener diode (1N758A or HEP ZO220 or equiv.)
- J1, J2—binding posts; red, black (Radio Shack 274-662 or equiv.)
- M1—1-mA DC meter (Radio Shack 22-018 or equiv.)
- R1, R4—5,000-ohm miniature potentiometer (Radio Shack 271-217 or equiv.)
- R2—470-ohm, 2-watt resistor
- R3—2,700-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
- S1—spdt rotary or toggle switch (Radio Shack 275-603 or equiv.)
- Misc.—plastic chassis box and panel 6 x 3½ x 1⅞-in (approx.), perf board, push-in clips, plastic mechanical pencils and solder for test probes (see text), wire, etc.



Perf board showing all components including location of meter as dashed line. Mercury cell battery will last its shelf life, which is generally two years for a fresh battery. Eliminate D1, R2, R3, R4, and S1 for a dunk-test only meter. Two volts is center scale.



Use the plastic body of a mechanical pencil or modify a set of old VOM leads. Either way, wrap 10 to 18 turns of "wire" solder around the end to

serve as the electrolyte contact surface. Shrink tubing makes a neat job. Connect the wire lead and the solder together before trying to put the lead into the hole.



cut off the metal pointed end of each pencil and remove the entire mechanical assembly from inside the pencil. Clean out the inside of the pencils so they are completely hollow and have no inside obstructions.

Drill two holes spaced $\frac{3}{4}$ -in. apart approximately $\frac{1}{4}$ -in. from the end of each pencil body, and wrap wire solder between the holes as shown. Insert the ends of the wire solder into the holes to hold the turns in place. The end of the wire solder in the hole toward the other end of the pencil body (the former eraser end) should be long enough to reach through the body end to be carefully soldered onto the test lead. Then carefully push the solder back into the plastic body with a portion of the test lead. Do not try to stretch the wire solder or use too much tension or the solder will break. Carefully insert short plastic sections into the body end to wedge the test lead in place and prevent it from being pulled out, then tape or use heat shrink plastic tubing on the lead end of both test probes. We used hot plastic from an electric glue gun to seal up the open end of the test prod and at the places where the solder is fed into the holes. Do not put any hot plastic over the solder turns.

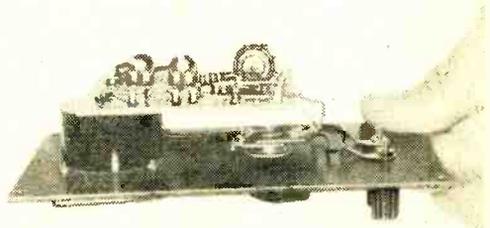
Calibration. If you have a 1 mA meter for M1 of the same size scale as in our model, and the same type of zener diode specified, you can copy the photo of the meter scale and cement it over the meter scale of your meter. Set S1 to the *single wet cell* (2 volt) range and connect the tester to an exact source of 2 volts DC. Adjust R1 for an M1 indication of 2 volts (at center scale). Then set S1 to the *six cell battery* (12 volt) range. Adjust R4 for a 12-volt center scale indication with exactly 12 volts input to the tester. Make sure that you have connected the right polarity input for these calibration adjustments (J1 connected to positive (+) voltage and J2 connected to negative (-) voltage terminals).

For a more accurate meter calibration

(and if you are using a different size 1 mA meter or a different type of 10-volt zener diode) you will need a calibrated variable voltage DC power supply or a DC supply with a potentiometer and a monitor voltmeter. Calibrate both ranges of the tester by adjusting R1 and R4 for midscale indications as in the previous (cemented meter scale) procedure, and then marking the meter scales in accordance with the calibrated DC power supply or the monitor voltmeter. Our model was calibrated from 1.4 to 2.6 volts on the 2-volt range of S1, and from 10 to 14 volts on the 12-volt range.

Operation. Automobile storage batteries consist of a number of 2-volt cells connected in series—three cells for a 6-volt battery and six cells for a 12-volt battery. As shown in the drawing, the tester probes are inserted into the electrolytic filler holes of a pair of *adjacent* (series-connected) cells so that the tester will indicate the voltage between the electrolytes in each cell. This voltage is approximately 2 volts, depending on the condition of the battery cells. The test will show the condition of the *positive plate* in one cell and the *negative plate* in the paired cell. By making tests of each

(Continued on page 96)



Inside the meter. Mount perf board to meter using screws in meter terminals. Solder to battery B1 terminals directly or use a clip.

When you're exploring technology.... books



a fascinating new alone are not enough.

If you're like most men, deep down inside there's still a bit of the boy who loved to go exploring... and who'd love to go again. Well, now you can.

Only this time you'll explore the expanding world of electronics... a world more fascinating than any you ever dreamed of as a boy.

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Everybody enjoys learning something new, but why learn it the old way? Classes to go to. Lectures to sit through. And only a bunch of books to keep you interested.

Bell & Howell Schools' adventure in learning is a far cry from all that.

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Among the things you'll discover is how the development of tiny integrated circuits has made possible an electronic calculator small enough to fit into a shirt pocket! And a wristwatch that flashes the time with the push of a button.

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1. To seek out a job in the electronics industry.
2. To upgrade your current job.
3. As a foundation for advanced programs in electronics.

You build and perform many exciting experiments with Bell & Howell's Electro-Lab®. An exclusive electronics training system.

Using our successful step-by-step method,

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1. A design console, for setting up and examining circuits.
2. A digital multimeter for measuring voltage, resistance and current (it displays its findings in big, clear numbers like a digital clock).
3. A solid-state "triggered sweep" oscilloscope—similar in principle to the kind used in hospital operating rooms to monitor heartbeats. You'll use it to monitor the "heartbeats" of tiny integrated circuits. The "triggered sweep" feature locks in signals for easier observation.

Step-by-step you'll build and experiment with Bell & Howell's new generation color TV—investigating digital features you've probably never seen before!

This 25" diagonal color TV has digital features that are likely to appear on all TV's of the future. As you build it you'll probe into the technology behind all-electronic tuning. And into the digital circuitry of channel numbers that appear right on the screen! You'll also build in a remarkable on-the-screen digital clock, that flashes the time in hours, minutes and seconds. Your new skills will enable you to program a special automatic channel selector to skip over "dead" channels and go directly to the channels of your choice.

You'll also gain a better understanding of the exceptional color clarity of the Black Matrix picture tube, as well as a working knowledge of "state of the art" integrated circuitry and the 100% solid-state chassis.

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Simulated TV picture test pattern

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BOOKMARK

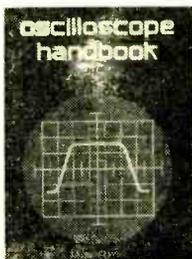
BY BOOKWORM

Above 30 MHz. The Worldwide TV-FM DX Association (WTFDA) has a new booklet entitled *Beyond Shortwave—An Introduction to TV, FM and V-UHF Radio DX*. This thirty-two page booklet will entertain and inform the novice and pro. *Beyond Shortwave* is an introduction to the world above 30 MHz. It starts off with propagation basics, followed by individual chapters on TV, FM and V-UHF radio. *Beyond Shortwave* is illustrated and includes



information on such topics as meteor scatter reception, choosing DX equipment, photographing TV-DX, improving your FM reception, and hearing "private" V-UHF communications. The price is \$1.00 postpaid. WTFDA is a nonprofit organization, and a member club of the Association of North American Radio Clubs. A sample copy of WTFDA's monthly *VHF-UHF Digest* is 75¢, and includes full details about the club. Write directly to WTFDA, P.O. Box 163, Deerfield, IL 60015.

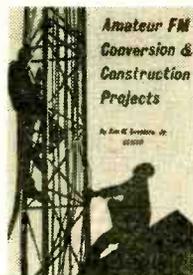
Scope Poop. In response to the rapid advances in oscilloscope technology in the last ten years, *Oscilloscope Handbook* was written by Clyde Herrick. Various special-purpose scopes have been developed recently right along with the double-ended input facility scopes for specialized tests, vertical-input systems calibrated for rapid measurement of peak-to-peak voltage values, and dual-trace scopes for use



Hard cover
214 pages
\$12.95

in television repair shops. Although this book was written for the beginning student or technician, the author assumes that the reader either has studied electricity, electronics, radio communication, and television, or is at least familiar with these subjects as a result of on-the-job experience. This text begins at pure fundamentals of the oscilloscope, covers horizontal-deflection systems and vertical amplifiers, then discusses applications, signal tracing, troubleshooting (for both black-and-white and color television), and maintenance. It surely is a comprehensive text offering vital data and procedural instruction necessary for the beginning student and technician. Published by Reston Publishing Company, Inc., Box 547, Reston, VA 22090.

Big For Ham Builders. *Amateur FM Conversion & Construction Projects* by Ken W. Sessions, Jr. K6MVH has more than 60 articles containing the most-asked-for construction and conversion information in ham radio. From the very simple (converting a transmitter from AM to FM in 10 minutes) to the complex (building a synthesized transmitter); from the



Soft cover
187 illustrations
256 pages
\$5.95

primitive (converting vintage two-way FM units to the ham bands) to the most advanced (an integrated-circuit Morse code generator for identifying an amateur station automatically)—it's all here, brought together in a single volume by the acknowledged dean of amateur FM. Published by Tab Books, Blue Ridge Summit, PA 17214.

TV Repair. These latest additions to TAB's Schematic/Service Manual series are one-stop sources of complete servicing data on the latest color TV chassis of RCA. These two fact-packed *RCA Color TV Service Manuals*—Volumes 3 and 4 offer up-to-the-minute alignment, adjustment and servicing info, plus full-size schematics, waveform photos, circuit descriptions, test-point identification, and replaceable-parts lists. In addition, a full complement of waveforms is included: all the reader has to do is compare his scope response with the waveform pictured to determine instantly whether or not the stage he's looking at is functioning normally. Set-up instructions, alignment steps,

(Continued on page 96)

THE SWINGOMETER IS NEXT TO THE ODOMETER



□ As though we needed another gadget on our already overloaded dash, General Motors has been testing what we call the "Swingometer," a small dial with a swinging needle, alongside which are two buttons, one marked PASS and the other RESET. The point of the Swingometer is to cut down on road deaths due to driving under the influence of drink and/or drugs. The U.S. National Safety Council has estimated that road deaths could be cut by one third if a perfect anti-drink-drug device were fitted to cars so that intoxicated drivers couldn't even start them.

One such device is presently being tested by General Motors, and it works somewhat like the car safety-belt/ignition interlock system. Just as on your '74 models if the seatbelts aren't buckled the car won't start, with this device

if the driver can't control the swing of the needle it's no go, Charlie.

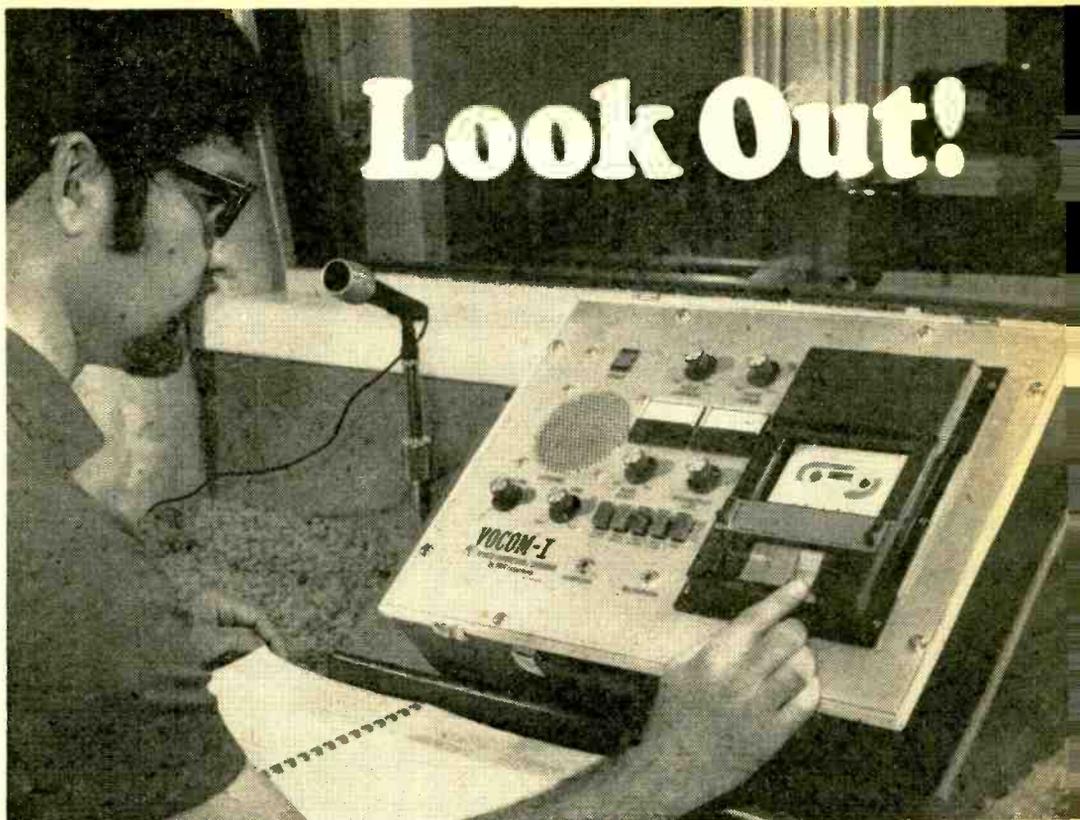
When the ignition is turned on the needle starts to swing erratically. The swing can be controlled by turning the steering wheel. All the driver has to do is turn the wheel and keep the needle in the shaded central area of the dial. If he manages to do this for the short (ten-second) required time, the PASS button lights up and the engine starts. If, however, the driver fails to make the needle stay on center then the red RESET button lights up. He presses the RESET button and tries again. If he can't center the needle after three tries the ignition system cuts out for a while, after which time he can try again. The GM people say their system works. We'll drink to that! ■

YOUR CHICKEN OF THE SEA IS ON TV

□ While you're home watching the Super Bowl on the big color set, Dave Baxter, owner and captain of the 56-foot Canadian fishing trawler *Ocean Wonder*, can watch the fish come aboard on his closed-circuit TV installation.

Actually, there's more than the catch to keep track of, Baxter says. The TV camera is mounted on the back roof of the wheelhouse and the screen is inside, right by the steering wheel. This makes it possible for him to watch the action on the stern deck during rough weather, when his crew are hauling in lines or nets. If anyone falls overboard he does so on-screen, and Baxter doesn't need instant replay to fish him out! ■





Look Out!

The Commercials Are Coming To Get You...

by Marshall Lincoln

OPEN WIDE and say "Ahhh." Not for a check-up at a doctor's office, but to demonstrate a key feature of a new tape recording technique designed for speeded-up audio instruction applications.

This method is used in a new audio tape machine which has among its capabilities the seemingly human ability to recognize vowel sounds in human speech, such as the "ahhh" in "father," for instance, and use this unusual ability to help persons learn more from audio tapes and learn it faster. This machine is a new solution to a long-standing quest by psychologists and speech researchers for a practical method of speeding up voice recordings.

The need for such a method stems from

the fact that the average human speaker is a waste of time . . . literally. People cannot speak clearly as fast as the human brain is capable of understanding spoken words. The brain is faster than the tongue, you might say.

For example, it's not hard to read at 300-400 words a minute, or faster, but it's impossible to speak clearly at more than 100 or so words a minute. The brain can understand words faster than the human voice mechanism can produce them.

So, many researchers have thought if recordings of instructional material could be speeded up, more could be learned from them in a given time. The busy businessman using audio tapes for training and the col-

Special electronics turns cassette deck into word compactor. Talks back four times faster than you did while making the recording!

lege student using them for lecture review would be obvious beneficiaries of such material.

More Uses. Another less obvious, but equally appropriate, user would be the blind person seeking to speed up his "reading" rate. Braille readers are limited to rather slow reading speeds because of the physical limitations of that type of reading. Normal-speed audio tapes are faster, but still not as fast as most sighted readers. So, early researchers sought ways to speed up voice recordings so blind persons could more nearly achieve normal visual reading rates.

Before the days of the tape recorder, speeding up of audio instructional material was tried with disk recordings. Speeding them up was easy . . . just spin the turntable faster. Of course the words came out of the loudspeaker faster, but they also were distorted—the now-familiar "Donald Duck" or "chipmunk" effect occurred—because speeding up the playback also raised the audio frequencies and transformed the pitch of the speaker's voice into a garbled squeak. So, little was accomplished because recordings couldn't be speeded up very much before this distortion made them unintelligible.

Later, experimenters tried a new technique—removal of very brief bits of recordings, each a fraction of a second long, with the remaining audio portions placed together in a new recording without noticeable breaks. Since the finished recording was played at normal speed, rather than being speeded up, the chipmunk effect was avoided and normal voice quality was preserved. Portions removed were taken out at fixed intervals, without regard to what portions of words were removed. This audio manipulation technique became known as "sampling" or "systematic deletion" or "periodic chopping."

A wide variety of mechanical, optical, and electronic methods were devised by experimenters to accomplish this. All suffered one fault, though; if too many bits of the original recording were dropped, or if the individual pieces dropped were too long, then vital sounds disappeared, and the resulting playback was hard, or impossible, to understand. This defect severely limited the

amount by which a recording could be speeded up using this method.

In more recent years, three researchers at the University of Minnesota found two new ways of speeding up spoken material without making it hard to understand. They did it by devising a tape recorder that speeds up speech the same way a person does when he talks faster, but they extended the process to much higher speeds than persons can speak clearly.

"Research shows that when people speed up their speech, they shorten their pauses. If they want to speak even faster, they shorten their vowels sounds," explains Vinay Khanna, one of the inventors of a new machine used for speech compression. He and William Mortimer, when both were graduate students at the University of Minnesota, worked with their professor, John Park, in researching methods of compressing speech and devising a machine to accomplish the task successfully.

Lost Time. Researchers have found that vowel sounds in our speech are wastes of time, as far as communications go. They are prolonged and repetitious—the sound waves which form these sounds, when viewed on an oscilloscope, are seen to be formed by a fairly simple wave form repeated several times. Consonant sounds are shorter and more complex.

Experiments have shown that much of the prolonged repetition of vowel sounds can be eliminated without reducing intelligibility. The sound becomes somewhat clipped, but it can be understood. Consonant sounds, being more complex and non-repetitious wave forms, must be preserved reasonably intact, or their intelligibility is lost.

The invention by Park, Khanna, and Mortimer (who formed the PKM Corporation to market their machine) duplicates human speakers' rapid-speaking methods—first, by shortening pauses, and then, if some time compression is wanted, by shortening vowel sounds. They named their invention the "Vocom I," for "voice compressor, model one." It's self-contained in a case about the size of a large attaché case.

A Difference. Vocom provides "selective deletion," in which specific material is chopped from the recording, based on cer-

SPEECH COMPACTOR

tain audio characteristics, instead of the older "systematic deletion," in which material is chopped out at a pre-set uniform rate which is not related to the information content of the spoken material.

Pauses in speech which the machine will shorten include pauses between words, and the longer pauses between sentences, and even the very short pauses between syllables in some words. Removing these pauses increases the speed of the speech when the tape is replayed without creating frequency distortion, and without excessive deletion of vital sounds. When additional time compression is desired, Vocom also will delete portions of vowel sounds, so that not only are pauses compressed, but words also are compressed.

How is this accomplished? A key element is a rapid-response cassette tape transport mechanism—a spin-off of computer technology. It starts and stops tape movement with sufficient speed and precision to drop out unwanted pause time and shorten selected portions of words without affecting the voice pitch of the material recorded.

The capstan pressure roller used in the Vocom tape transport is solenoid-actuated, and operates in response to signals from the machine's audio circuitry to stop tape movement for fractional-second periods during recording whenever the control circuit determines time compression is to occur.

Although the main purpose of the machine is to compress pauses and vowel sounds, it also can be used on playback to expand pauses (but not vowel sounds) when slowed-down speech is desired. The effect is achieved by lengthening the pauses between words and sentences, and if desired, even the intersyllabic pauses within words. Applications include slowed-down dictation speeds for typists transcribing spoken material, detailed analysis of sounds for language instruction, and for specialized training of "slow learners" in various fields.

The "brain" of the Vocom I, giving it the ability to compress or expand speech pauses and compress vowel sounds as it records, is contained in its "compression-expansion controller."

Inside Story. Four front panel controls affect operation of this controller. Two switches select pause and vowel shortening,

pause shortening alone, or normal recording. A pause compression potentiometer controls the amount of pause retained, and a noise reject potentiometer adjusts the controller's sensitivity to discriminate between meaningful speech sounds and spurious background noise.

The input to the controller is the audio signal coming from the microphone amplifier—an analog signal of infinite complexity—but the ultimate signal needed to determine if the tape transport should run or stop is a simple "on or off" signal. To produce it, the Vocom controller uses two "schmitt" triggers—one for pause expansion, and the other for vowel compression. These transform an incoming analog signal into a digital "on-off" signal used for control purposes.

As might be expected, the pause control function is achieved with voice-actuated circuitry. Setting of the pause compress potentiometer determines the decay time of an RC network in an envelope detector circuit. The detector's output is coupled to a schmitt trigger which in turn produces "on-off" signals which control the solenoid-actuated capstan pressure roller. In operation, any pauses longer than the RC decay time determined by the pause compress potentiometer are shortened to this length by the stopping of the tape travel for this period.

Machine, Say Ahhh. Vowel recognition by a mindless machine is something else again, though—just how do you teach a machine that vowels are a, e, i, o, and u? Research by Vocom's inventors determined this is easier than might be thought. It turns out that vowel sounds are simple low frequency wave shapes, while consonants are complex wave shapes containing much higher frequencies. Consonants fall approximately in the range of 1,500 to 2,000 Hz, while vowels are typically in the range of 200 to 600 Hz, according to Khanna. So, a band pass filter, centered at 500 Hz, is used in the Vocom controller circuit to distinguish vowel sound frequencies from the full range of audio frequencies being recorded and use these lower frequencies, when vowel shortening is desired, to control the tape transport.

In the vowel control circuit, vowel sounds are sampled and 45 milliseconds out of every 100 milliseconds are eliminated. This is accomplished by means of two "one shot" circuits which provide for passage of the first 55 milliseconds of vowel sound reaching the circuit and elimination of the next

45 milliseconds. This alternating pattern is repeated as long as the vowel sound is present, with the result that sufficient vowel sound is preserved to maintain speech intelligibility, but the unnecessary time span of vowel sounds is shortened in the interests of time compression of the speech.

Ah So! An interesting sidelight turned up by use of the machine, according to Khanna, is that vowel compression is usable in any language with which the machine has been tried. It seems the nature of vowel sounds is essentially the same in all languages, so speech compression techniques will work regardless of the language used by the speaker making the recording.

With this machine, typical voice recordings may be compressed easily into 75 percent of their original length just by shortening pauses. Its inventors quote university studies which measured improvement in comprehension when listening to the speeded-up recordings. This apparently results from the listener's mind being kept more alert by the faster pace of the speech.

Listening to a tape which has been made on a Vocom machine is an interesting experience. When sufficient pause time is removed to compress a narrative to 75 percent of its original time—a saving of 15 minutes out of an hour—the compressed speech sounds only slightly faster than when the same speaker is recorded normally.

Removing a little more pause time, to make a recording that takes up 60 percent of the original speaking time, adds a definite speeded-up tempo to the playback of the recorded speech, but it is not difficult to follow. In fact, the faster pace of the playback speech seems to hold the listener's attention, since he must concentrate a bit more to follow the spoken words. PKM officials say testing of listeners shows most people remember more of instructional information presented this way than at slower "normal" speech rates, because the listeners have little opportunity to let their

minds wander while listening to compressed speech.

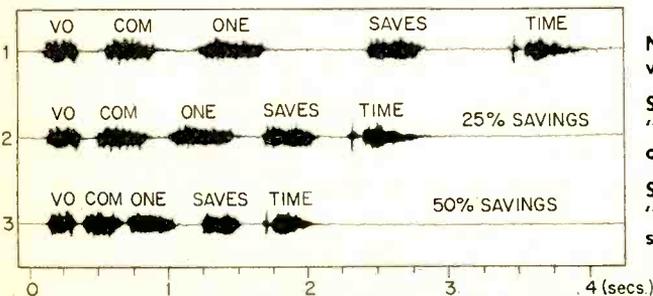
How Much Faster? Normal speaking speed is about 100 words a minute, with informal conversational speeds getting up to around 140 words a minute, according to Khanna. Average reading speeds are closer to 400 or more words a minute, he says, pointing out that the human mind is obviously capable of absorbing material at this faster rate, but it is impossible for people to speak words clearly at this rate.

With pause shortening as accomplished by Vocom I, a speech rate of about 175 words a minute can be reached. When vowel compression is done in addition to pause deletion, speeds up to around 400 words a minute are achieved on the audio tapes. A short period of practice generally is needed for a person to get used to this faster pace of listening, since most people have become what Khanna terms "lazy listeners"—their mind has not been forced to absorb spoken material at this rate, but it can easily learn to do so.

Even faster speeds—up around 600 to 700 words a minute—are possible with Vocom, he says. These speeds require the listener to do "audio scanning" in listening, just as speed readers learn to visually scan printed pages.

Remember the Title? The ability of the Vocom machine to speed up spoken material also has been put to use by audio engineers making sound tracks for film narration and for broadcast commercials, and for mass-producing duplicates of taped instructional material when the original recording time was just a bit too long to fit a standard cassette.

Since the amount of pause deletion may be varied by the machine operator, such material may be easily speeded up by a small amount to fit it into the required time slot in a film narration or a broadcast commercial, without the listener being aware of the change. ■



Normal non-compressed spoken words.

Same words compressed by "pause" compression to 75% of original time.

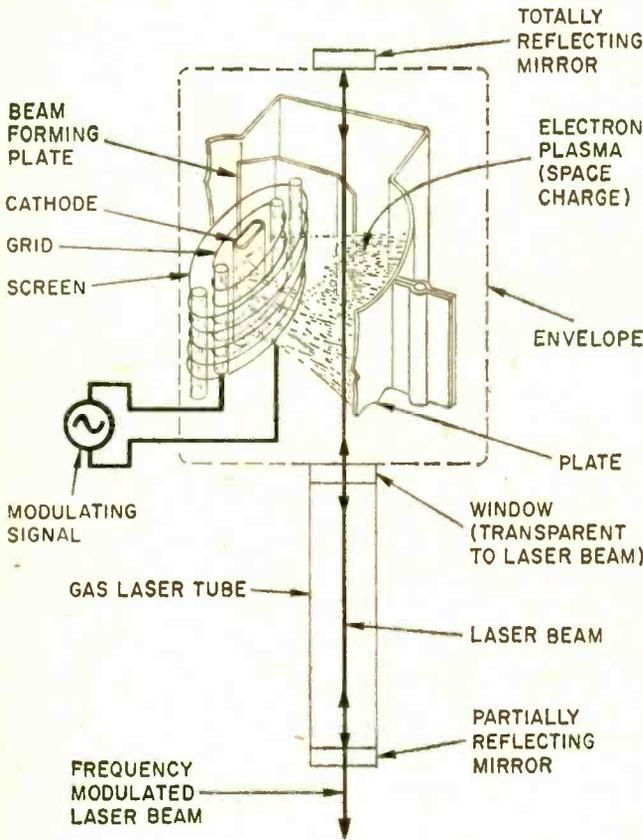
Same recording compressed by "pause" and "vowel" compression to 50% of the original.

There's Life in the Old Beam Pentode Yet

□ Who would have ever suspected the old beam-pentode of new life in the communications world? But it's true! The modulated space charge in the pentode, now called

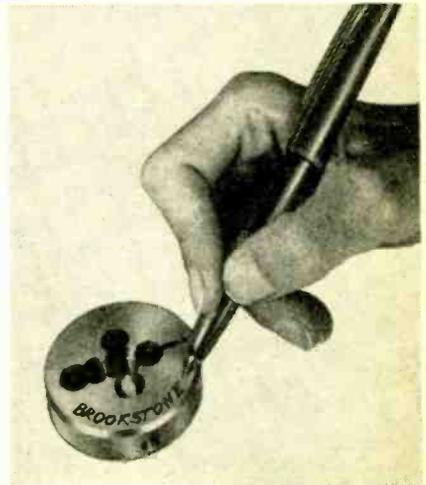
electron plasma, modulates the laser beam, yielding an information bandwidth on the order of one billion Hertz. This is an improvement of at least an order of one magnitude over conventional crystal modulators.

When a laser beam is passed through an electron plasma inside a pentode tube, the beam's light frequency is shifted by an amount proportional to the plasma density. The plasma density is varied with a modulating signal on the control grid of the pentode. The laser beam is passed through this space charge region. The pentode's envelope has a window transparent at the laser frequency and a totally reflecting mirror to direct the beam back through the plasma. Mechanically, it's very easy to gang up a gas laser tube that generates the laser beam with its modulator, the pentode. Over 300,000 phone calls ride the laser beam when modulated by the beam pentode. The old workhorse pentode is still on the job. —*Jackson Kaye*



GET BACK THE NEXT TOOL THAT'S BORROWED

□ The tool thief you should fear the most is your friendly next-door neighbor who has a poor memory. Now you can jog his memory into action by putting identifying marks on tools, parts, or any metal items without muss or fuss. This metal-marking pen looks and works like a regular ballpoint, yet it permanently marks all metals for easy identification. Works on steel, stainless steel, silver, aluminum, brass, copper, cadmium plate, zinc plate, nickel plate—everything except chrome plating. The pen has a replaceable cartridge that holds special acid for etching metals. Comes with screw-on cap for safety. Pen point is part of cartridge. Pen with cartridge, \$8.10 postpaid, extra cartridges, \$4.00 each, or write for their 60-page catalog of "Hard-to-Find Tools" to the Brookstone Company, 6678R Brookstone Bldg., Peterborough, NH 03458. ■



O/O's ALL NEW O/O's BASIC COURSE IN ELECTRICITY & ELECTRONICS



This series is based on
BASIC ELECTRICITY/ELECTRONICS,
Vol. 1, published by HOWARD W. SAMS & CO., INC.

WHAT AC IS

What You Will Learn . . .

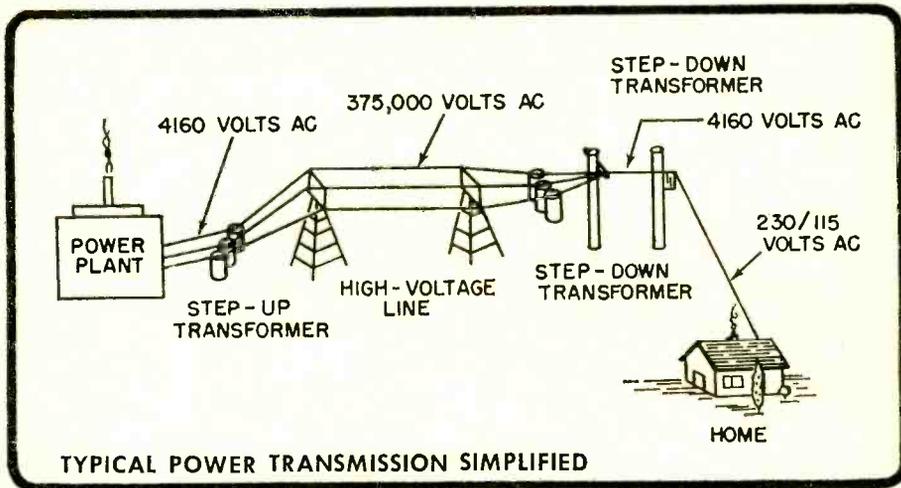
When you have finished this basic course you will be able to explain what alternating current is. You will be able to recognize AC and pulse forms. In addition, you will be able to describe the different types of AC waveforms.

Alternating current (AC) differs from direct current (DC). The electrons in a direct current always flow in the same direction. Electrons in an alternating current reverse directions periodically.

ALTERNATING CURRENT SOURCES

Alternating current is the most common type of electricity used. Because its electron flow reverses direction rapidly, the value of an alternating voltage is easily increased or decreased by passing it through a transformer. For example, when it is necessary to transmit electricity over great distances (from the power plant to a city miles away), the power-plant voltage is increased by a transformer to a very high value (such as 375,000 volts) and sent through a relatively small-diameter transmission line. If the AC electricity were sent at the power-plant voltage (such as 4,160 volts), the diameter of the transmission line would have to be much larger. This is because a lower voltage makes a higher current flow necessary. Thus, a larger-diameter line from the power plant to the user would be required. At the

city end of the transmission lines the voltage is reduced by transformers, and then still further reduced to 230 and 115 volts by another transformer at the utility pole outside the user's house. It is far more difficult and costly to change DC voltages than to change AC voltages.



Alternating currents are generated in very large quantities in power plants. The electricity used in your home comes from a power-plant. The total current capacity of a power plant can reach several thousand amperes at 4,160 volts.

Another source of AC, usually for specialized purposes, is the oscillator. The current output of an oscillator is quite small, usually in the milliampere range. Oscillators are used primarily as signal sources in electronic equipment.

QUESTIONS

- Q1. It is difficult and expensive to transmit DC current over long distances, or to raise or lower DC voltages. State two advantages of alternating current.
- Q2. Alternating current is used in many applications in homes and industry. Two sources of power used to generate this AC are ----- and -----.

ANSWERS

- A1. Two advantages of alternating current are: It is less expensive and easier to transmit over long distances, and it is easier to obtain and keep a constant voltage level.
- A2. Alternating current is used in many applications in homes and industry. Two sources of power used to generate this AC are steam and falling water.

WAVEFORMS

Waveforms are pictures showing how currents and voltages change over a period of time. The value of voltage or current is usually represented in the vertical direction, while time is represented in the horizontal direction. For example, the illustration shows that most DC waveforms are straight lines, although pulsating DC voltages may have various shapes. The two most common types are shown.

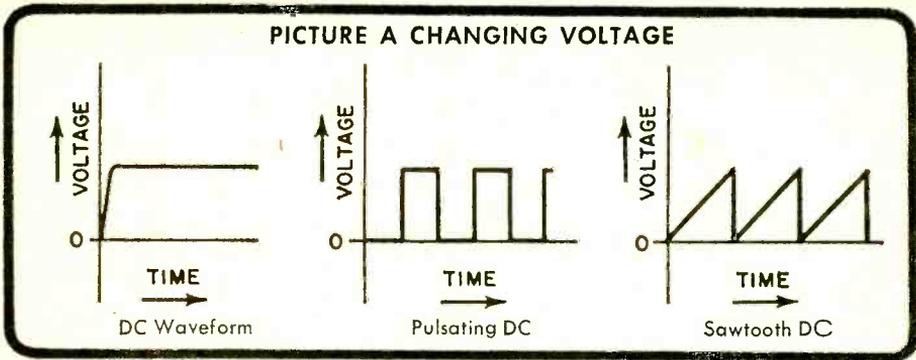
By far the most common AC waveform is the sine wave. In fact, the sine wave is so widely used that when we think of AC, we usually think of sine waves.

QUESTION

- Q3. The most common DC waveform is a ----- . The most common AC waveform is a ----- .

ANSWER

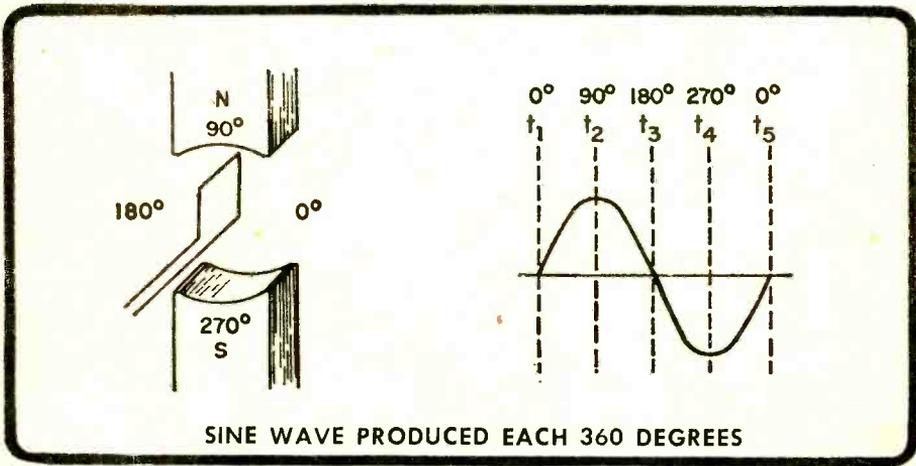
- A3. The most common DC waveform is a straight line. The most common AC waveform is a sine wave.



GENERATION OF A SINE WAVE

A sine wave is the most common AC waveform. It is also the simplest. You can visualize the way it is generated by looking at the illustration.

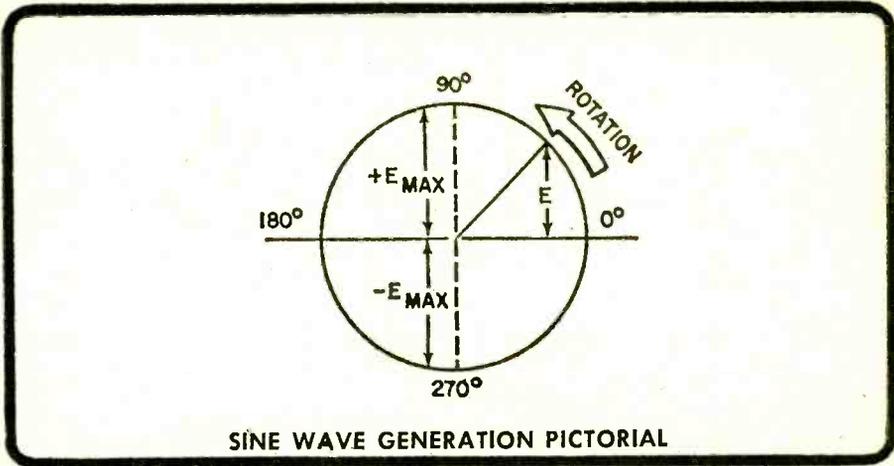
As the coil cuts the lines of force between the magnetic poles, a voltage is produced that will cause current to flow if the coil is connected to a complete circuit. As the coil rotates at a constant speed, it cuts more and more lines of force in the magnetic field, and the voltage increases. At 90° it is moving at right angles to the lines of force, so it cuts the maximum number of lines per second. Therefore voltage is maximum.



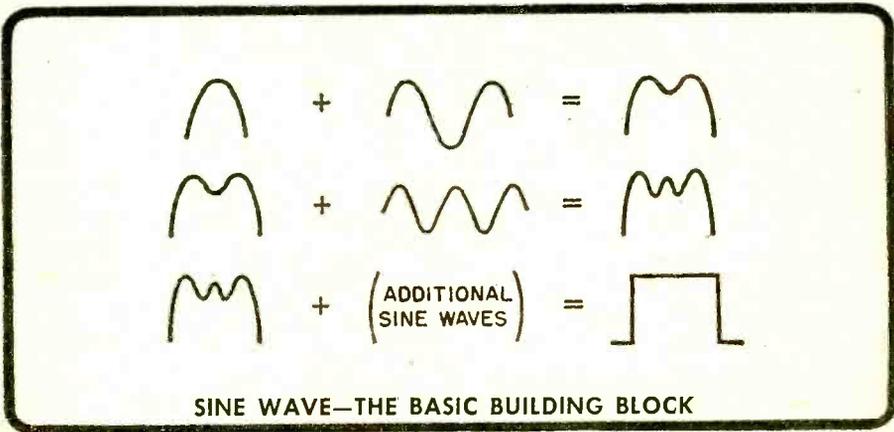
At 180° (and at 0°) the coil is moving parallel to the lines of force and, therefore, cutting none. Thus, the voltage generated is zero. Beyond 180° the coil is cutting lines of force in the opposite direction, so the generated voltage has the opposite polarity—negative in this case. The output waveform of the generator is a sine wave like the one shown.

Imagine a line like the hand of a clock. This line is called a voltage vector. A voltage vector rotates counterclockwise through the full 360° of a circle. The distance measured from the end of the voltage vector to the base line at any time during the rotation of the vector represents the exact value of voltage at that instant. As you can see, the value of voltage is zero at 0° and 180° . At 90° the value of voltage is maximum positive, and at 270° it is maximum negative.

One complete cycle of a sine wave (from zero to a positive peak, down to a negative peak, and back to zero) simply represents one complete rotation of the voltage vector.



Actually, the simple sine wave is the building block from which all AC waveforms are constructed. Even sawtooth and square waves are really just complicated combinations of simple sine waves.



QUESTIONS

- Q4. A sine wave represents the rotation of a line called a voltage
- Q5. With the right mixtures of sine waves, can sawtooth and square waves be made?

ANSWERS

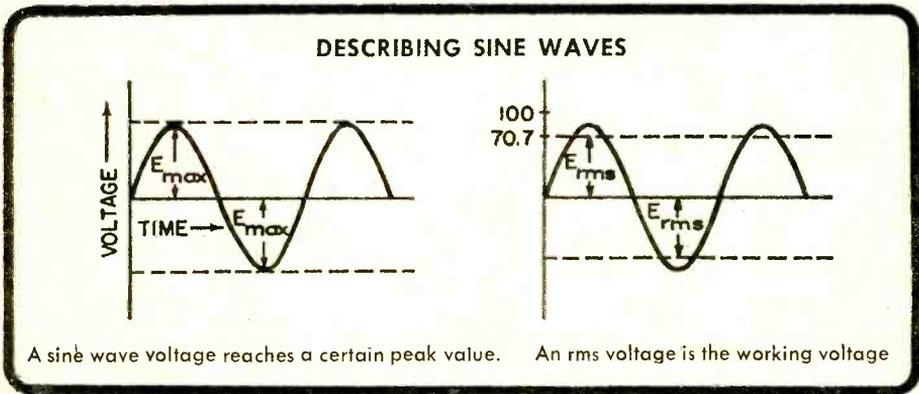
- A4. A sine wave represents the rotation of a line called a voltage vector
- A5. Yes. In fact, any kind of AC waveform can be made with the right mixture of sine waves.

SINE-WAVE MEASUREMENT

In a previous chapter you learned that DC voltage has only one value. This value is measured in volts. In AC, however, the voltage is constantly changing, so no one voltage value exists for more than an instant. Looking at a sine wave you can see that it reaches a certain peak. That value is known as maximum voltage, or peak voltage (E_{max}). Notice that the waveform has the same shape and value both above and below the zero line.

A more practical value of AC voltage and current is the rms value (rms stands for root-

mean-square). The rms value is the actual "working value" of a voltage or current and is equivalent to the DC value which would accomplish the same amount of work.



The current and voltage value most often used is rms. In fact, the standard household voltage of 115 volts is the rms value. An rms voltage of 115 volts corresponds to a peak voltage of 161 volts. In all sine waves the rms value is equal to 0.707 of the peak value. Conversely, the peak value is equal to 1.41 times the rms value.

You have seen how AC voltage first increases in value to a peak value, then decreases to zero, increases to a negative peak value, and then returns to zero. This sequence is known as a cycle. The cycle is normally repeated many times each second and is identical in waveform with the one before it and the one following it.

QUESTIONS

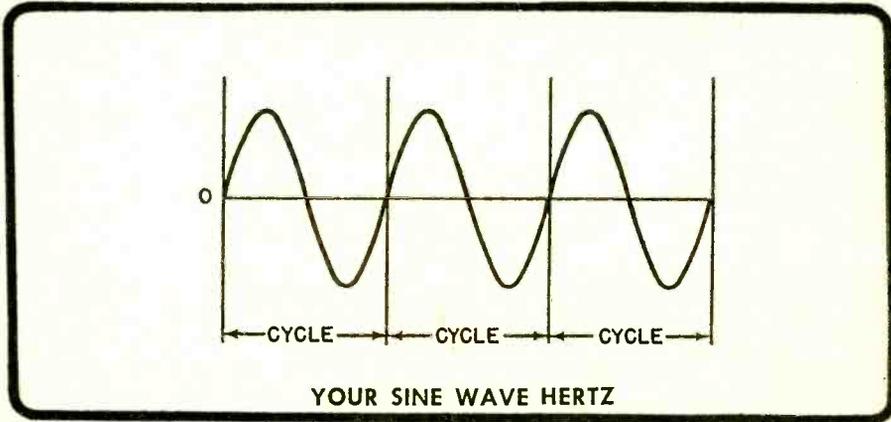
- Q6. Another name for peak voltage is _____.
- Q7. Rms is the working value of voltage. Which is less, rms or peak voltage?
- Q8. Maximum voltage is also called _____.
- Q9. Working voltage is called _____.
- Q10. The symbol for maximum voltage is E_{max} . The symbol for rms voltage is _____.
- Q11. Rms voltage is 0.707 times peak voltage. If peak voltage is 100, rms voltage is _____.
- Q12. Peak voltage is 1.41 times rms voltage. That is, if rms voltage is 100, peak voltage is _____.
- Q13. To change rms voltage to peak voltage (which is larger), multiply by _____. To change peak voltage to rms voltage, multiply by _____.
- Q14. To give a complete picture of how an AC voltage (or current) changes, a waveform diagram must show at least _____ complete cycle(s).

ANSWERS

- A6. Another name for peak voltage is maximum voltage.
- A7. Rms is the working value of voltage. Rms is less than peak voltage.
- A8. Maximum voltage is also called peak voltage.
- A9. Working voltage is called rms voltage.
- A10. The symbol for maximum voltage is E_{max} . The symbol for rms voltage is E_{rms} .
- A11. Rms voltage is 0.707 times peak voltage. If peak voltage is 100, rms voltage is 70.7.
- A12. Peak voltage is 1.41 times rms voltage. That is, if rms voltage is 100, peak voltage is 141.
- A13. To change rms voltage to peak voltage (which is larger), multiply by 1.41. To change peak voltage to rms voltage, multiply by 0.707.
- A14. To give a complete picture of how an AC voltage (or current) changes, a waveform diagram must show at least one complete cycle.

Frequency

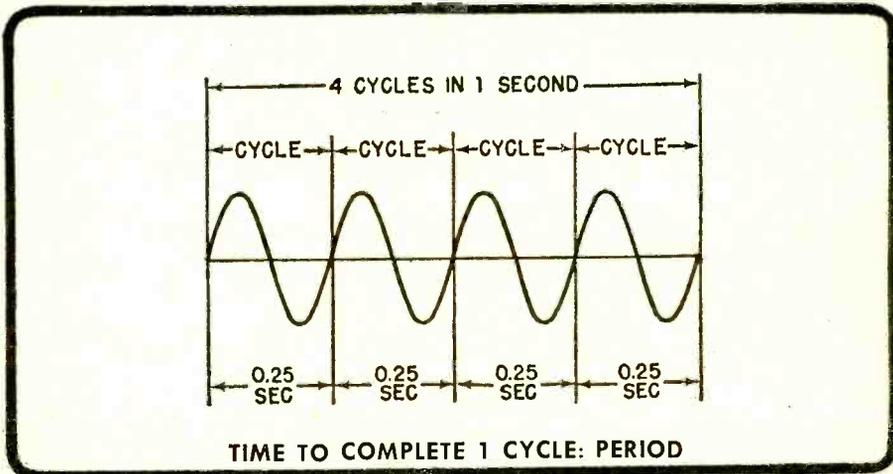
It is sometimes necessary to know how many times a cycle is repeated each second. The number of cycles completed each second by a given AC voltage is called the frequency.



Frequency is measured in cycles per second (Hz). The symbol for frequency is f . The most common type of current (household current) has a frequency of 60 Hz in most localities of North America.

Periods

The time required for one cycle is called a period. A period is measured in seconds, milliseconds, or microseconds. A millisecond is $1/1,000$ of a second, and a microsecond is $1/1,000,000$ of a second. Since household electricity has a frequency of 60 Hz, its period is $1/60$ of a second, or 0.0167 second. This time can also be expressed as 16.7 milliseconds.



The period of a sine wave represents the time needed for the voltage vector to make one complete rotation. The frequency of a sine wave depends on how rapidly the voltage vector rotates.

QUESTIONS

- Q15. The ----- of household current is 60 Hz.
- Q16. If the frequency of a voltage is 60 Hz, how would you find its period?

ANSWERS

- A15. The frequency of household current is 60 Hz.
- A16. Divide 1 second by 60 cycles. Thus the period of a 60 Hz current is $1/60$

- Q17. How many milliseconds are there in a second? How many microseconds are there in a millisecond?
- Q18. If the frequency of an AC voltage is 1 million cycles per second, state period in the most convenient unit.
- Q19. In a certain sine wave the rms voltage is 20 volts. What is the peak voltage?
- Q20. A sine wave has a peak value of 70.7 volts. What is the effective (rms) voltage?
- Q21. If a current has a frequency of 100 Hz, what is the period of one cycle? Give two answers—one in seconds and one in milliseconds.
- A17. There are 1,000 milliseconds in a second, and 1,000 microseconds in a millisecond.
- A18. 1 microsecond.
- A19. $20V_{rms} \times 1.41 = 28.2V_{max}$
- A20. $70.7V_{max} \times 0.707 = 50V_{rms}$
- A21. 0.01 second, or 10 milliseconds.

PULSES—NON-SINE WAVE AC

A very simple digital principle is an assembly line; for example, a series of cans moving on a conveyor belt. A light beam to a photoelectric cell is cut every time a can goes by, and the resulting on-off digital "pulse" signal is then counted. Computers employ various operations with pulses at very high speeds.

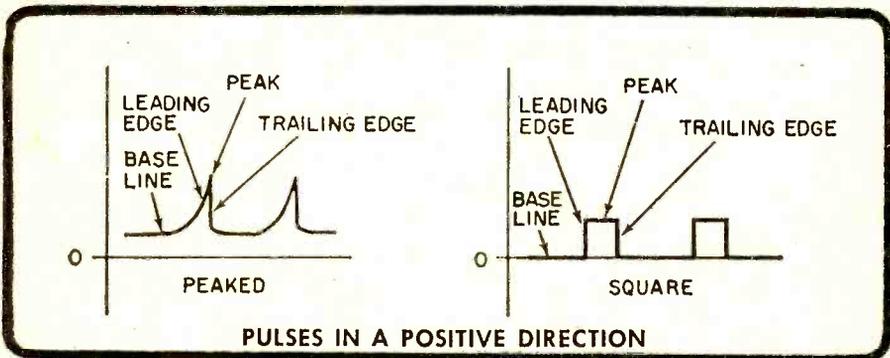
Another very important type of pulse is the sawtooth waveform.

Sawtooth waves are primarily used in accurately timing. In other words, sawtooth waveforms are used when time measurement is required, and they act as triggering devices.

Some of the most important uses of sawtooth pulses are in television sets and oscilloscopes, and for timing radar pulses.

PULSE MEASUREMENT

Pulses are usually described in terms of four parts—base line, leading edge, peak, and trailing edge. It is easiest to understand these parts by looking at them.



It is often necessary to know how long it takes a pulse to rise from the base line to its peak (rise time) or to go from its peak value back to the base line (decay time). These times are measured between 10% and 90% of peak value.

Like AC sine waves, pulses have an rms value. Unfortunately, there is no simple formula to find the rms value of a pulse. The rms value of a pulse is its working value. (turn to 94)

The better the the better you

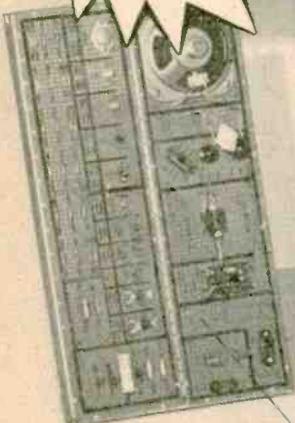
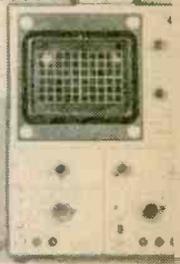
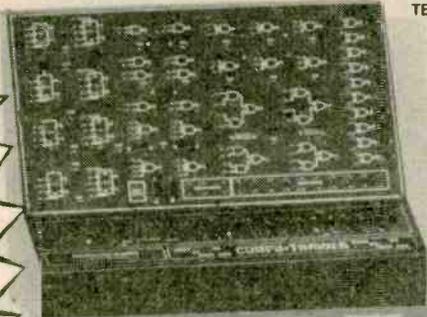
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ELECTRO - LAB

NTS DIGITAL GR-2000 SOLID STATE COLOR TV WITH 315 SQ. IN. PICTURE AND VARACTOR DIGITAL TUNING

TROUBLESHOOTER VOM

As an NTS student you'll acquire the know-how that comes with first-hand training on NTS professional equipment. Equipment you'll build and keep. Our courses include equipment like the 5" solid-state oscilloscope, transistor and tube-tester, vector monitor scope, 74 sq. in. B&W TV, and solid state stereo AM-FM receiver. The unique NTS **Digital GR-2000 color TV** with first ever features like silent varactor diode tuning; digital channel selection, (with optional digital clock.) and big 315 sq. in. ultra rectangular screen. This is just a sampling of the kind of

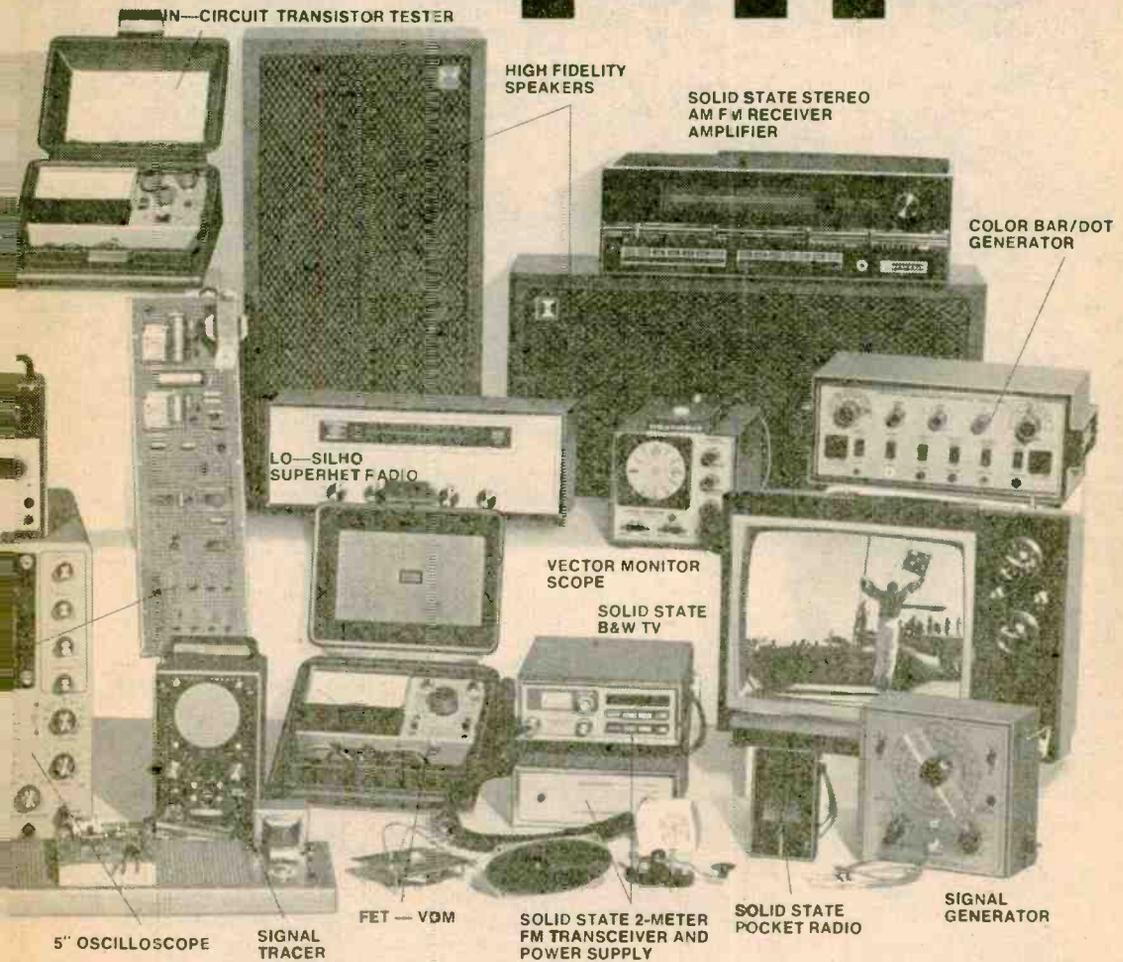
better equipment that gets you better equipped for the electronics industry.

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When pulses are repeated at a regular rate, the number of pulses per second is called the repetition rate.

QUESTIONS

- Q16. Rise time is the time during which the pulse goes from 10% of peak to — of peak. During decay the pulse decreases from — of peak to —.
- Q17. The time required for a pulse to go from 10% to 90% of peak is called ---- time. The same time along the trailing edge is called ---- time.
- Q18. The number of times a pulse is repeated per second is called its

ANSWERS

- A16. Rise time is the time during which the pulse goes from 10% of peak to 90% of peak. During decay the pulse decreases from 90% of peak to 10%.
- A17. The time required for a pulse to go from 10% of peak to 90% of peak is called rise time. The same time along the trailing edge is called decay time.
- A18. The number of times a pulse is repeated per second is called its repetition rate.

WHAT YOU HAVE LEARNED

1. AC current changes polarity regularly.
4. AC is created by generators and oscillators.
5. The working voltage of a sine wave AC is the rms voltage, which is 0.707 times the peak voltage.
6. A cycle is one complete change from zero to the positive peak value, back through zero to the negative peak, and back to zero. This represents the rotation of a voltage vector around the 360° of a circle.
7. Frequency is the number of cycles generated in a second, and a period is the time it takes to complete one cycle.
8. The four main parts of a pulse waveform are the base line, the leading edge, the peak, and the trailing edge.

This series is based on material appearing in Vol. 1 of the 5-volume set, BASIC ELECTRICITY/ELECTRONICS, published by Howard W. Sams & Co., Inc. @ \$22.50. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

NEWSCAN

Continued from page 58

persons. It's been determined that every 100 pounds of beef presently yields only 60 pounds of table meat. By contrast, home cooking methods should produce about 80 pounds of table meat from 100 pounds of raw beef. If the roasting process can be automated, as much as 5 percent on purchases of beef for roasting can be saved.

Using the Natick Laboratories' computers, researchers have computed theoretical combinations of cooking methods, intensities, and times to achieve optimum results. The new Raytheon one-of-a-kind "omni-oven" will be used to verify the findings empirically. The "omni-oven" has its own logic system that de-

termines which cooking techniques will be employed, in what combination, in what order, and for how long. The three selected cooking methods produce different cooking effects. The fast-cooking microwaves penetrate the food and cook at a high rate of speed, the infrared energy provides a source of radiated heat for browning, and the pressurized steam enables cooking in a hot environment. In the laboratory, punched cards developed from the theoretical computer studies will be inserted into a special card reader on the "omni-oven" and the cooking will proceed automatically.

Next program may be a punched card inserted into a GI telling him how long to chew and when to swallow.

Undersea Cables Girdle Globe

North America's transatlantic telephone cable circuits were suddenly doubled this past

June 1974, when 1,840 additional circuits in a new high-capacity undersea cable were added by the flip of a switch.

Then, a month later, the British telephone authorities announced a 3,900-channel cable to connect the U.K. and Belgium. Concurrently, the authorities of Australia and New Guinea ordered a 480-circuit cable to connect their countries. Italy has just made plans for a system capable of carrying up to 5,500 channels between Rome and Palermo, Sicily.

In view of recent satellite developments, many people wonder why there is rapidly expanding interest in submarine cables, the standard for intercontinental communication since the 1866 telegraph cable. The answer is simply that submarine cable technology has been moving forward as well. A modern cable system provides reliable, secure, high-quality transmission at a cost below satellite service. This cost drops steadily with each new generation of cable systems.

Satellites and submarine cables complement each other. Submarine cables serve better on routes with large traffic between two points, such as U.S. to Europe.

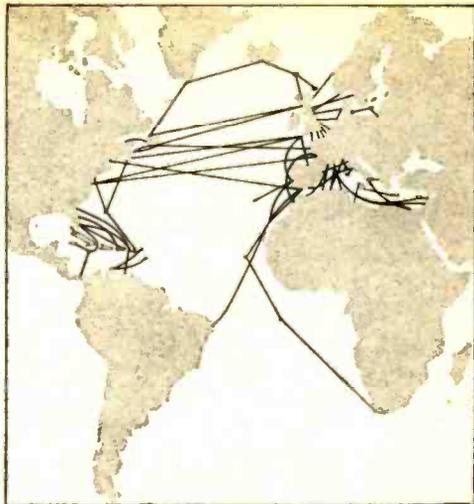
Satellites are economical on long "thin" routes with less traffic. Satellites have also been very useful in providing international service to developing nations. They permit communication from any ground station to any other within range, giving flexible service to small countries with low traffic density. When the first communications satellite, *Early Bird*, was launched, it supplied 240 transatlantic circuits and was thought to herald the end of the submarine cables, at least on long-haul routes. Cable installations did slow for a time. But it was soon realized that satellites should be complemented by cables.

First of all, the existence of both allows alternative routing in the event of outage on one or the other. Secondly, the quality of communication must be considered.

Voice quality over a satellite system is normally good. However, the waves must travel as much as 40,000 miles from the transmitter up to the satellite and down again to the receiver, causing a delay of a large part of a second, which compounds technical problems. This delay is so great that two satellite "hops" are not permitted in tandem on a phone circuit. By comparison, in a cable system of several thousand miles, the delays are undetectable.

When it comes to transoceanic transmission of color television pictures, the satellite has an advantage simply because of its circuit capacity. In a live transmission, color television channels use the equivalent of about 1,000 telephone circuits. It is also not particularly important if a program broadcast in America is received in Britain with a half-second delay.

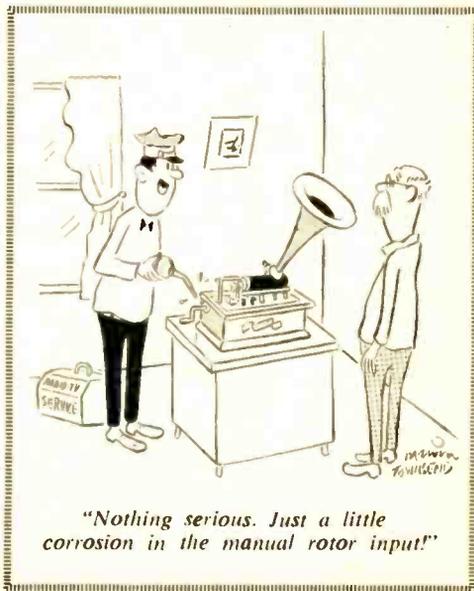
Telecommunication authorities find some other attractive advantages to transmission by cable. In these times of increasing pollution,



The complex Atlantic, Caribbean, and Mediterranean submarine telephone cable networks as of 1974. TAT-6 will shortly add 4,000 circuits and double the transatlantic path. Not shown is the less-developed Pacific network of 4.2 million circuit miles. Networks tend to develop along commercial and social interchange routes.

the world's scientists are becoming increasingly concerned with one type that is not visible or detectable by any human sense. This is pollution of our limited radio spectrum. Since the radio waves used to transmit over cables are restricted to the interior of the cable, they do not pollute the "ether." Thus, they cannot interfere with other vital services that must use radio waves, such as radar, aerial navigation, and so forth.

Countries with the highest volume of traffic



"Nothing serious. Just a little corrosion in the manual rotor input!"

have invested in both satellite and cables—currently there are over 140 submarine cable systems through the world and there are 79 satellite earth stations using 89 antennas in 53 countries. This dual arrangement safeguards international voice and code traffic by providing alternative facilities.

The vast majority of these facilities are North American and European. In the past 10 years the number of telephone calls between the U.K. and North America increased from 900,000 a year to 8.5 million and by 1980 the telephone authorities are planning to handle 30 million calls a year.

Thus, today's undersea communication cables are rapidly expanding with the number of circuit-miles doubling every two to three years. They are maintaining their economic place in the worldwide communication network that forms the vital nervous system of the growing world's commercial, industrial, and social relationships.

Bookmark

Continued from page 76

and the listed convergence routines have all been taken from the manufacturer's recommended procedures. Volume 3 covers RCA's all-solid-state receivers, including these chassis: CTC 48, CTC 54, CTC 58, CTC 59, and

Battery Monitor

Continued from page 71

pair of cells along the battery, the overall condition of the battery can be determined. Make sure that you observe proper test probe polarities.

If you are not sure which cell is the correct mate of another cell (since the arrangement of cells under the plastic top of the battery cannot be seen), momentarily place the probe into the electrolyte of a cell and quickly withdraw the probe if the meter (M1) swings sharply upscale, indicating overvoltage. The 1/4-in. plastic section at the end of the probes should minimize the possibility of shorting out the cell between the plates, but use care in placing the probes into the battery holes; hold them in your hands—do not just drop them into the electrolyte while taking readings. Place the probes just far enough into the electrolyte to obtain an M1 indication. The probe electrodes may have slight tendency to polarize

Ask Hank, He Knows

Continued from page 26

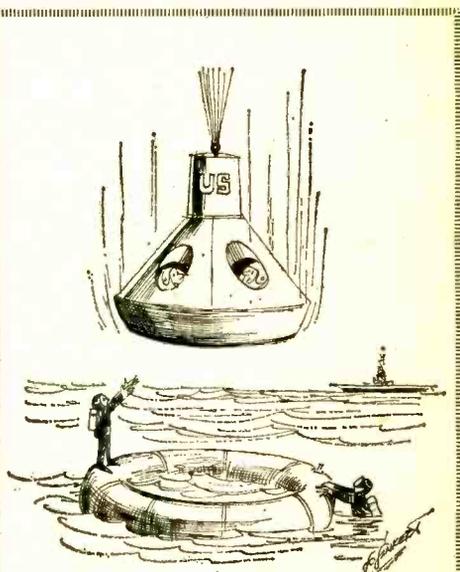
High Cost of Experimenting

I walked into my parts dealer and discovered him increasing the value of some peg-board marked parts to almost double. Who should I report him to?

—C.H., Terre Haute, IN

The poor guy is just trying to stay in business. If he were to sell you the parts at the old price, he probably would have to pay the same amount or more to restock his shelves. There will be nothing left for his rent, taxes, salaries, etc. We all lose when inflation strikes. To save on fixed resistor prices, buy assorted value resistor kits. Lafayette stores sell a kit of 100 1/2-watt resistors (32E99047) for only \$2.98—that's about 3¢ each. Some savings!

CTC 60. Volume 4 is devoted to the service and alignment of RCA's *hybrid* color sets, and simplifies the servicing of the late-model RCA hybrid chassis. You can get your volumes by writing directly to Tab Books, Blue Ridge Summit, PA 17214. Both color TV service manuals come in soft cover editions, contain 169 pages, and sell for \$5.95 each. Tab will be happy to send you a book catalog if you drop them a line. ■



Holy smoke! I hope they got pictures of this landing. . . . the Russians will never believe it!"

(act like little miniature storage batteries due to electrochemical action on the solder) and affect the meter indication. To prevent this, slightly agitate the probes in the electrolyte while testing.

Test your storage battery at periodic intervals and note the cell readings. This will give you a performance record to check when you suspect that the battery may be defective. When a battery starts to go bad, it will show up as widely different voltages between cells (usually one cell will start to go bad before the others—not all the cells at once). For best results, make your periodic tests when the battery is in approximately the same electrical state of charge; the battery should be fully charged and have stabilized for some time before making tests. The probes should be washed and dried after each use to prevent corrosion from affecting the readings. The 12-volt scale of the tester can be used with a normal set of test probes to periodically check full battery voltage across the battery terminals. ■

Antique Radio Column

Continued from page 66

duced, but none to compare with the Masterpiece series. In November 1938 the company folded and the following year it was purchased by E. H. Scott.

A Turnover Changer. Another set I consider a classic was the Capehart, manufactured in Fort Wayne, Indiana. It used the most unique record changer ever seen in a home radio. The record changer played both sides of a 78 rpm record. It had a magazine in which the records were placed. The changer would take the first record from the stack, place it on the turntable and play one side, it would then turn the record over and play the other side. One of the photographs, sent to us by Norman Warren of Norfolk, Virginia, shows his Model 400 Radio-Phonograph Combination, with turnover record changer. This radio has separate audio amplifiers, with speakers for each amplifier. I can remember as a boy reading about Bing Crosby having a Capehart radio-phonograph combination that cost nearly \$2,000.00. There were even news reports that the Sheiks in the oil-producing eastern countries were having special models made with jewels decorating the Cabinets. (*See top of the next column*)

I am greatly indebted to the **Horn Speaker**, published by Jim Cranshaw, for the information on E. H. Scott and the McMurdo Silver radios. J. W. F. Puett publishes a newsletter for collectors of classic radios. If you collect classic radios or are interested in receiving the classic radio newsletter send a long, self-addressed, stamped envelope to J. W. F. Puett, 3008 Abston Drive, Mesquite, TX 75149 and he will send you complete information. He has contributed information and two photos of the McMurdo Silver Masterpiece and the E. H. Scott Philharmonic radios shown here.

So long for now. We will be back again in the next issue with answers to some of the questions you have been sending in, and with information to help you in restoring antique radio equipment. ■

Kathi CB Carousel

Continued from page 64

power supply (simulating typical voltage in a moving vehicle). The modulation had 100 percent capability, and though there was some form of 100 percent modulation limiting it was possible to exceed 100 percent with the microphone gain turned wide open (see why I don't like user-adjustable microphone gain). But under typical *intelligent* operating conditions, the modulation did not exceed 100 percent. As with the received audio signal quality, the modulation was excellent—clean, crisp and full-bodied—due perhaps to a relatively large modulation transformer with a lot of iron.

Since I had such phenomenal success working this rig into a coathanger, I deliberately tried to destroy the RF output transistor by working the rig into both a dead short and an open circuit. No matter what I tried, the rig wouldn't blow. Whether working into a matched antenna, open circuit, dead short, or a coathanger, the Tram Diamond 40 hung in there, delivering outstanding performance.

Next time I drive a friend to college, you can bet there'll be a Diamond 40 packed along in the trunk!

The Tram Diamond 40 comes complete with all crystals, microphone, mobile mount and DC power cable and is priced at \$209.95. For additional information circle No. 43 on the Reader Service Page. ■



LITERATURE LIBRARY

101. Kit builder? Like weird products? EICO's 1974 catalog takes care of both breeds of buyers at prices you will like.
102. International Crystal has a free catalog for experimenters (crystals, PC boards, transistor RF mixers & amps, and other comm. products).
103. See brochures on Regency's 1975 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service/emergency broadcasts).
104. Dynascan's new B&K catalog features test equipment for industrial labs, schools, and TV servicing.
105. Before you build from scratch, check the Fair Radio Sales latest catalog for surplus gear.
106. Get Antenna Specialists' cat. of latest CB and VHF/UHF innovations: base & mobile antennas; test equipment (wattmeters, etc.), accessories.
107. Want a deluxe CB base station? Then get the specs on Tram's super CB rigs.
108. Compact is the word for Xcelite's 9 different sets of midget screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.
109. Bomar claims to have C/B crystal for every transceiver . . . for every channel. The catalog gives list of crystal to set interchangeability.
110. A Turner amplified mike helps get the most from a CB rig. This free brochure describes line of base & mobile station models.
111. Midland's line of base & mobile CB equipment, marine transceivers & accessories, and scanner receivers are illustrated in a new full-color 16-page brochure.
112. The EDI (Electronic Distributors, Inc.) catalog is updated 5 times a year. It has an index of manufacturers literally from A to Z (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or \$699.95 for a stereo AM/FM receiver, you'll find it here.
113. Get all the facts on Progressive Edu-Kits Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.
114. From Olson get their new, bargain-packaged 36-page, full-color tabloid (a new issue every 2 months). It contains their latest electronics parts, supplies, and hi-fi components. Pick up a copy at Olson stores coast-to-coast or send for a free copy today.
115. Trigger Electronics has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.
116. Get the HUSTLER brochure illustrating their complete line of CB and monitor radio antennas.
117. Teaberry's new 6-page folder presents their 6 models of CB transceivers (base and mobile): 1 transceiver for marine-use, and 2 scanner models (the innovative "Crime Fighter" receiver and a pocket-size scanner).
119. Besides Browning's colorful leaflet on their Golden Eagle Mark III base station, their packet includes other surprises. The LTD is pictured in actual size on a card for you to test on your car's dash. Specifications are given for both the SST and LTD.
120. Edmund Scientific's new catalog contains over 4000 products that embrace many sciences and fields.
121. Cornell Electronics' "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.
122. Radio Shack's 1975 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.
123. It's just off the press—Lafayette's all-new 1974 illustrated catalog packed with CB, hi-fi components, test equipment, tools, ham rigs, and more.
124. Mosley Electronics reports that by popular demand the Model A-311 3-element CB beam antenna is being reintroduced. Send for the brochure.
125. RCA Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable projects.
126. B&F Enterprises has an interesting catalog you'd enjoy scanning. There are geiger counters, logic cards, kits, lenses, etc.
127. There are Avanti antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.
128. A new free catalog is available from McGee Radio. It contains electronic product bargains.
129. Semiconductor Supermart is a new 1974 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors.—all from Circuit Specialists.
130. Heath's new 1975 full-color catalog is a shopper's dream—chockful of kits and gadgets everyone would want to build and own.

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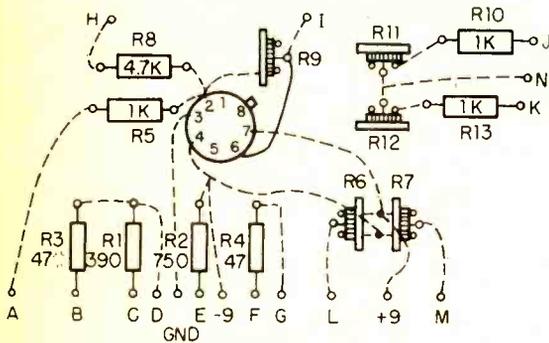
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Wind Chill Meter

Continued from page 34



Layout of perf board. Lettered terminals connect to switches shown on the schematic diagram. For example, terminal "M" is wired to the "wind speed" side to 4pdt switch S1C, terminal "I" connects to the wiper of S1D, etc. Terminals "D" and "G" connect to one end of thermistor RT1 and RT2 respectively.

Now go back and stick the probe into the refrigerator again. If the meter correctly reads the inside temperature (38° or so), fine, if not, readjust R6 and R11. Overall gain control R9 may also have to be re-adjusted; if so go back and readjust speed adjust control R12 also.

Final Installation. Your TV mast is a good location to mount the completed probe. Notice that the wind chill meter only reads down to minus 50. This is sufficient for all except the extremely cold winter areas like Alaska, northern Minnesota, and North Dakota.

Since the danger of frostbite starts with a wind chill index below -10 to -15, all possible precautions should be taken if the needle on the wind chill meter becomes pinned offscale.

If just a wind chill meter is desired, the circuit can be greatly simplified—eliminate switch S1 and RT2, R3, R4, R7, R12, and R13. ■

131. E. F. Johnson's new full-color catalog for CB transceivers and accessories is now available. Send for a free copy. They also have a free brochure on their line of scanner receivers.

132. If you want courses in assembling your own TV kits, National Schools has 10 from which to choose. There is a plan for GIs.

133. Get the new free catalog from Howard W. Sams. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

134. Sprague Products has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

135. The latest edition of Tab Books' catalog has an extensive listing of TV, radio and general servicing manuals.

136. Leader's catalog features "Instruments to Believe In." They have a complete line for industry, education and service, featuring oscilloscopes/vectorscopes, many generators, accessories, etc.

137. Pace Communications has a packet of information for you. The "Citizens two-way radio" answers all the questions from how to operate one to how much they will cost to operate. A booklet on Pace's scan/monitors to keep you informed is included.

138. Pearce-Simpson has a booklet, "Citizens Band Radios & Scanners," which pictures and describes the various models in this line. A section on CB antennas is included.

139. For the latest information on CB transceivers by Courier, send for their literature.

140. Featured in Siltronix's brochure are single sideband/AM citizen band transceivers, pictured and described with extra features and specifications listed. VFO sliders for monitoring are pictured as well as export models of linear amplifiers.

141. Lee Electronics Labs has an inexpensive circuit analyzer, which is featured in this catalog.

142. Available from Royce Electronics is a 28-page, full-color catalog for CBers (base, mobile and handheld transceivers; accessories; and test instruments).

143. A set of Abraxas/4 speakers contains a rugged 12-inch long-throw woofer with a 22-oz. Alnico magnet, a 5-inch sealed-back rubber-damped midrange, and two 3-inch dome tweeters from Designers Audio Products.

144. For a packetful of material, send for SBE's material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

145. For CB'ers from Hy-Gain Electronics Corp. there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

146. Robyn International has 4-color "spec" sheets for each model of their CB (base and mobile) transceivers and monitor-scanner lines.

147. Telex's 4-page, 2-color folder illustrates their new line of boom microphone head-sets for CB'ers and hams, as well as their line of communications headphones.

148. Surveyor Manuf. Corp. offers you two catalogs in 4-color. One features their Electronics 2000/Surveyor CB, pictured with descriptions and specifications. Their Monitor/Scanner, Surveyor Model 4H 4U, is featured in the second catalog.

149. Cush Craft has a catalog on Citizens Band Antennas for every purpose. The Ringo base antenna is featured, as is the new Superfire 8-element horizontal/vertical power beam.

150. For TV or communications towers, aluminum spells rugged strength. An 8-page brochure from ASCOM details 30 models to fit every need for CB, ham, commercial 2-way radio, or home/institutional installations.

151. For a complete audio accessory line-TV, tape, phono and radio for home and auto, send for Audiotex catalog FR 73-A.

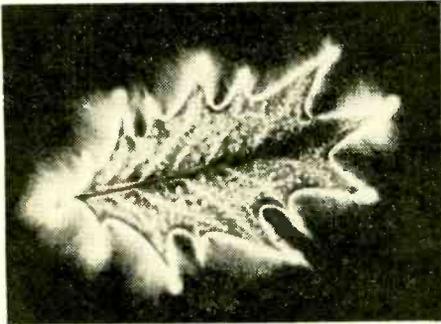
152. Send for the new, free descriptive bulletin from Finney Co. It features the Finco line of VOM multimeters (and accessories) for electronics hobbyists and service technicians.

153. A full-color brochure on Tennenec's scanners is available. They have portables, 3 bands—12 channels and 3 bands—16 channels. Outstanding features and specifications of the tri-bands are listed.

Use Coupon on Left!

Kirlian Photography

Continued from page 53



Sharp points on an object such as this holly leaf provide points of discharge concentration although additional discharge occurs along all edges and even from veins and surface irregularities.



Corona discharge from a begonia leaf, that some parapsychologists would argue consists of "Life Force" emanations, has a fine fur-like quality not fully evident in the reproduction shown here.

tape to keep the rubber tape in place. Another tip: avoid touching the aluminum dial plate under the center voltage control knob. It too can shock if your other hand is on the corona discharge plate.

The Edmund kit includes a double-zippered, light-proof changing bag used by photographers for handling film when a darkroom is not available. In this application, you poke the single high-voltage wire of the induction coil through the bag fabric and attach it to the aluminum electrode which, together with the glass dielectric, is placed inside the bag. Do *not* put the induction coil inside the bag! After placing

your film inside the bag, you can poke your hands in through two light-tight sleeves to handle the film and prepare it for exposure. Since both hands must be in the bag, and light could leak in if you try to take one out, you will need someone else to push the transformer on-off button; or you can rig up a foot switch if you must work alone. Better yet, wait until after midnight, when all others in the house are asleep, so that you can darken a room and work unencumbered. You miss a lot of the fun if you can't watch those "life forces" sputtering between the electrode and your fingertip. ■

Time Tally

Continued from page 48

The indoor version of the Time Tally, if used with the power supply shown in Fig. 2, can be used as a digital cooking timer. Just flick the switch the minute an egg goes into boiling water or a TV dinner goes in the oven, and watch for the recommended minute to show up. Here a resettable 6-volt counter would come in especially handy, but you can mentally note the present reading and watch for the desired one. ■



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Package # 1

DX Central Reporting

Continued from page 28

seventh continent has joined the SWBC ranks . . . Antarctica! No, this isn't the phony *Radio Amundson* some character in England claimed to have heard a few years back. This one is for real and it's known as the *American Forces Antarctic Network*, with a one-kilowatt short-wave transmitter at McMurdo Base. The station has been heard with good signals by SWLs in Australia and New Zealand on a frequency of 6012 kHz. So far North American listeners have managed to detect a very weak carrier and snatches of modulation on rare occasions during the 0800 to 0900 GMT time period. A solid logging of AFAN Stateside has yet to be reported, however.

According to scraps of information pieced together, the station suddenly popped up on the air in midsummer, without any advance warning that such a hot DX prospect was even being considered. The station is operated by U.S. Navy personnel stationed at the Antarctic base. Its programs—aired regularly during the 0700-1000 GMT time slot and irregularly at other times—are aimed at other Navy men and civilian scientists at smaller outlying Antarctic bases.

Bandsweep. (Frequencies in kHz, times in GMT) **840**—The Haitian missionary station *4VEH* is quite well known to SWLs for its shortwave programs. But if you live in the eastern half of the U.S. you may find this one on medium wave as well. A Virginia DXer recently heard it there about 0000 GMT . . . **4730**—*Radio Abarou* is a Bolivian station that can offer a real DX challenge to even experienced Latin American DX aficionados. But because there isn't much else in this part of the band during the evening hours, even a beginning DXer might stumble across it around 0200-0400 . . . **4810**—A very nice LA—that's Latin American in the DXer's jargon—is HC8VG, *La Voz de Galapagos*. It is located on one of the Galapagos Islands, a part of Ecuador but some 600 miles out in the Pacific. It has been logged on this relatively new frequency by a number of DXers from Ontario to Pennsylvania around 0400 to 0500 . . . **6060**—Perhaps you've heard Italy's SW station, *RAI* at Rome. But have you logged the *RAI* outlet at Caltanissetta, Sicily? During the evening hours you may hear the multi-lingual *Notturmo dall'Italia* program . . . **9460**—You asked for it: When and where can we hear Korea? Well, *Radio Korea* (formerly known as the Voice of Free Korea) at Seoul can be logged on this frequency at 0630, when English news is aired . . . **11850**—The long-awaited relay station of West Germany's *Deutsche Welle* on the island of Malta is now on the air.

Get More Information

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It has been logged on this frequency circa 1900-2100 with strong signals. But it is still testing at this writing and other 25 m.b. channels traced at various times include 11705, 11795, and 11865 . . . **15200**—Austria's *ORF* offers some interesting daytime listening. An English program you can hear is broadcast from 1830 to signoff at 1855.

(Credits: Edward Shaw, VA; Robert Hill, CA; Ernest Behr, Ontario; Kenneth Earhart, PA; Charles Brunner, PA; Albert Garrou, MA; Jeff Bowlsby, Br. Columbia; National Radio Club, Box 12, Boonton, NJ 07005; North American SW Association, Box 8452, S. Charleston, WV 25303.)

Backtalk. "I read your DX Central Reporting every time a new *ELEMENTARY ELECTRONICS* comes out," writes Alan Nacht of New York City. "I thought you might be interested in learning that I received *Radio National Venezuela's* North, Central, South America and Europe Special Service. I've received it as early as 2200 GMT on 15390 and 11750 kHz. It came in very well."

Yes, *Radio Nacional* surprised many SWLs when they first stumbled across this English language service from Caracas. The English broadcasts seemed keyed to the "Law of the Seas" international conference held in the Venezuelan capital. The big question now is whether the English programs will continue after the conference ended.

"Could you give me the address and frequencies of *Windhoek Radio* in South West Africa?" asks reader Pat Tobin of McDonald, Pa. Quick question, quick answer, Pat. This non-broadcast utility station, *ZUN*, identifying as *Windhoek Radio*, transmits on 11451 kHz. The address is Post and Telegraph Department, P.O. Box 2884, Windhoek, So. West Africa. ■

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READER SERVICE PAGE

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Inside CB Talk Power

Continued from page 62

some slight advantage in SSB, but not too much. Best SBB talk power boost is attained from compression built into the RF amplifiers of an SSB transmitter, and most better units already incorporate this feature. The best way to upgrade typical SSB transceiver modulation is to upgrade the microphone, and that's assuming the modulation needs an extra push. Most SSB rigs are premium models to begin with, and they provide the best SSB modulation possible for the particular transceiver.

Summing Up. If your transceiver already incorporates a talk power booster, you are probably already getting optimum modulation, and accessory equipment can only make things worse. If your modulator runs barefoot with nothing to give your voice an extra push, a compressor, an amplified microphone, or just a better mike will work wonders toward getting your signal out above the noise level. Remember, maximum modulation makes a very heavy contribution towards getting your CB message through. ■

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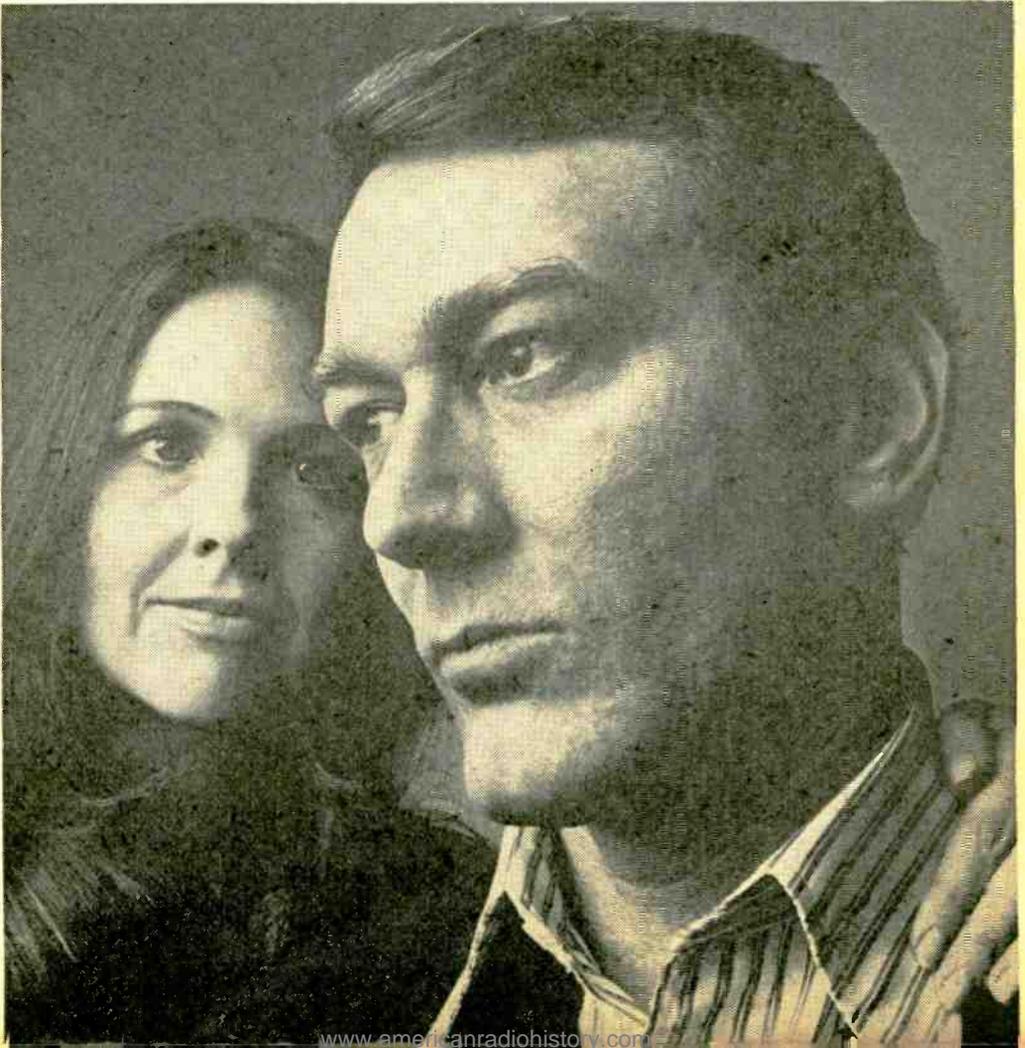
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