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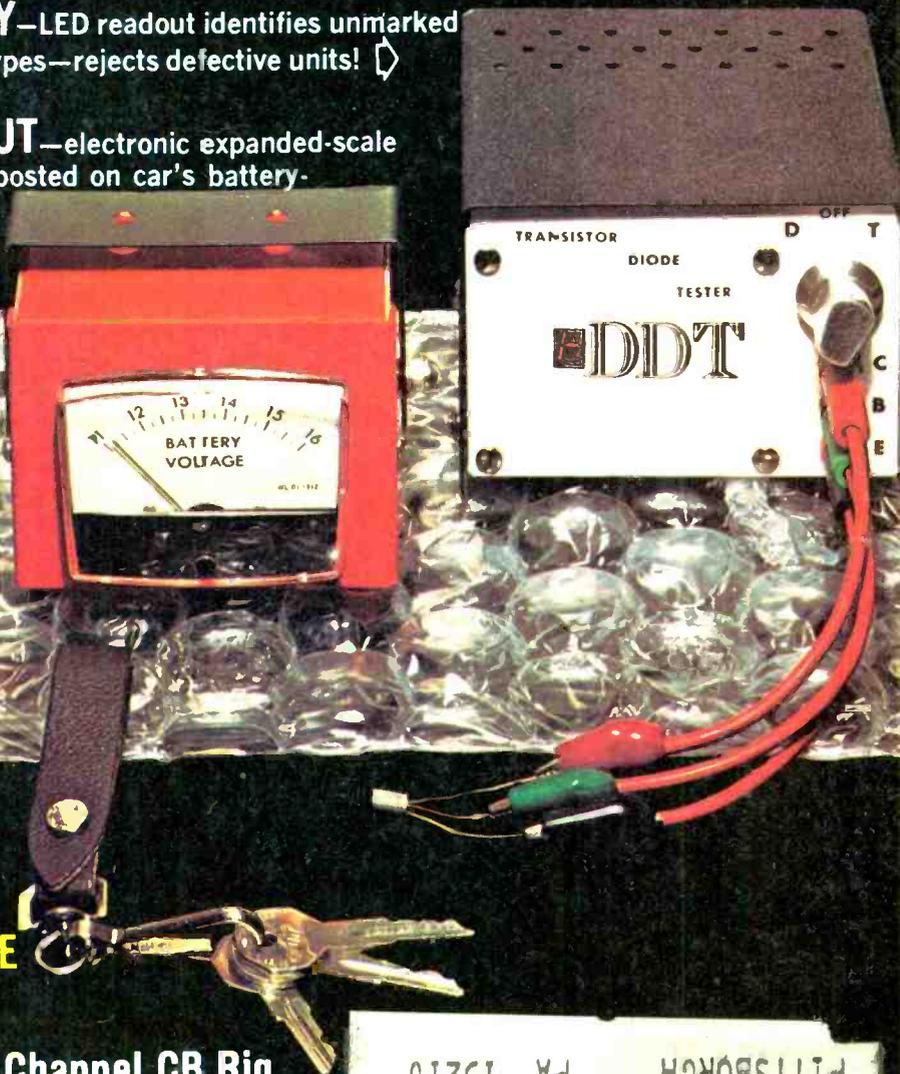
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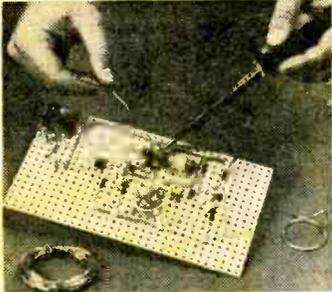
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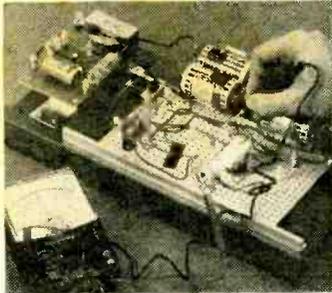
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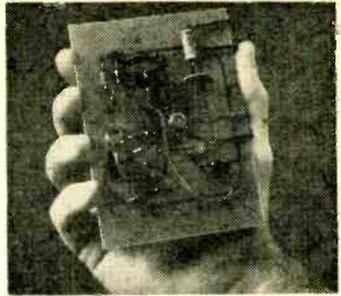
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Marvin Hutchens, Woodbridge, Virginia, says: "I was surprised at the relevancy of the CIE course to actual working conditions. I'm now servicing two-way radio systems in the Greater Washington area. My earnings have increased \$3,000. I bought a new home for my family and I feel more financially secure than ever before."

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JULY-AUGUST, 1974

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# elementary Electronics

Dedicated to America's Electronics Hobbyists

## ZANY CONSTRUCTION PROJECTS YOU CAN BUILD

- ☆ 31 Hang an Expanded Scale Voltmeter from Your Dash—*don't rely on an idiot light to spot battery/alternator problems*
- ☆ 54 Pushie Button—*just a fun circuit for everyone*
- ☆ 57 Stamp Out Semiconductor Bugs with Our Electronic DDT—*dig its digital readout*
- 61 Old-Time Crystal Radio—*this working replica looks like it came from the antique store*

## IT TAKES A LAB TO TELL THE TRUTH

- ☆ 43 e/e Checks Out the B & K Transistor Equipment Analyst—*a super-modern ultra-multitester*
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## BREAK FOR CITIZENS BAND RADIO

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☆  
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## AUTHORS IN THIS ISSUE

Martin W. Bajor, James A. Fred, Joe Gronk, Don Jensen, Janus Kodrun, Kathi Martin, Charles Rakes, Hank Scott, Gary W. Towner, Art Trauffer, and the ELEMENTARY ELECTRONICS editorial staff.



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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.

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In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. 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.

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- HIGH FIDELITY GUIDE & QUIZZES
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- MEMBERSHIP IN RADIO-TV CLUB
- CONSULTATION SERVICE & FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

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**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 \$240 for a course, but I found your ad and sent for your kit." Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to 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."

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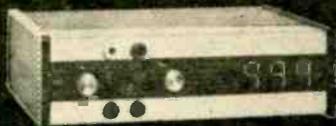
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CIRCLE NO. 12 ON PAGE 17 OR 103

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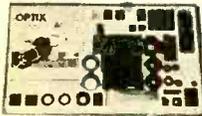
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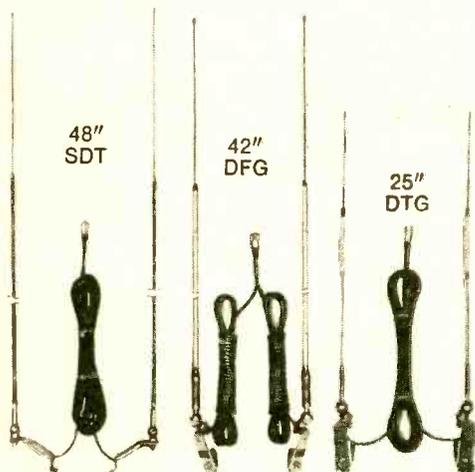
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CIRCLE NO. 23 ON PAGE 17 OR 103

# Attention CB Mobilers!

The Hustler "Double-Talk" CB mobile antenna system gives guaranteed superior performance over a single antenna installation — more uniform signal pattern because of uniquely detailed phasing design. Get twice the signal capture area, twice the power capability, more consistent communications with virtually no fading or blind spots when changing direction in travel.



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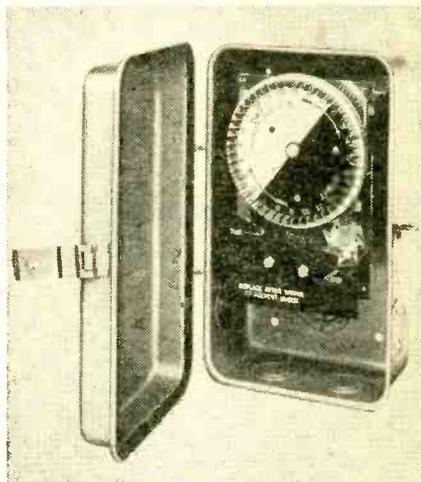
CIRCLE NO. 16 ON PAGE 17 OR 103

# Hey, look me over

## Showcase of New Products

### Energy Control

Zenith Controls designed its new, Compact Series 2400 program time switch to provide precise 24-hour ON-OFF control of a variety of equipment including oil wells, pumps, fans, heaters, air conditioners, process equipment, and recorded music. Of utmost importance is the control of energy loss during time periods when nobody is present to turn off lights and motors. The Series 2400 switch



Circle No. 170 on Lit-Lib Coupon on page 86

has 96 self-contained clips offering ON-OFF operation in 15 minute increments or multiples thereof. No tools are needed to change schedule. A snap-in bracket assures easy mounting either open or enclosed. U.L. listed, Zenith's new Program Time Switch is synchronous motor driven for accurate operation. S.p.d.t. snap action contacts rated 20 amps, noninductive to 480 VAC. Available with or without day selector device. Basic unit priced at \$32.00. For more information contact Zenith Controls, Inc., 830 West 40th Street, Chicago, IL 60609.

### Gilfer Catalog

A new 16-page catalog for 1974 of supplies for shortwave listeners and radio monitors is being mailed by Gilfer Associates, Inc.

# THERE'S A BETTER WAY TO GO.



Energy shortages tell us we have to change our driving style. Now! It doesn't mean we have to go back to horse and buggy days. But it does mean we have to make every drop of gas give us the most go for our money. Anyone with horse sense knows that a well-tuned car gets better mileage, and in times of fuel shortages, better mileage means a lot.

The Mark Ten B Capacitive Discharge System keeps your car in better tune so it burns less gas. Using Mark Ten B is more than horse sense. It's the smart move under the hood, helping a nation survive an energy crisis and keeping you on the road. Delta Mark Ten. The best way to go.



## DELTA PRODUCTS, INC.

P.O. Box 1147, Dept. EE  
Grand Junction, Colo. 81501  
(303) 242-9000

Please send me free literature.  
Enclosed is \$\_\_\_\_\_  Ship ppd.  Ship C.O.D.  
Please send: \_\_\_\_\_ Mark Ten B assembled @ \$59.95 ppd. \_\_\_\_\_ Mark Ten B Kit @ \$44.95 ppd. (12 volt negative ground only) \_\_\_\_\_ Standard Mark Ten assembled, @ \$44.95 ppd. \_\_\_\_\_ 6 Volt: Neg. Ground Only \_\_\_\_\_ 12 Volt: Specify \_\_\_\_\_ Pos. Ground \_\_\_\_\_ Neg. Ground \_\_\_\_\_ Standard Mark Ten Deltakit® @ \$29.95 ppd. (12 Volt Positive or Negative Ground Only)

Car Year \_\_\_\_\_ Make \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_ Zip \_\_\_\_\_

CIRCLE NO. 10 ON PAGE 17 OR 103

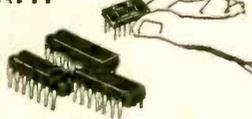


**CALECTRO®**

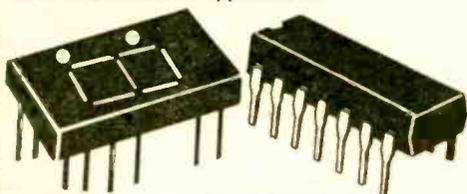
# DIGITAL DISPLAYS AND LOGIC

## ATTENTION HOBBYISTS!

### BUILD THIS DIGITAL COUNTER/ L.E.D. DISPLAY KIT.



Everything needed to build a complete decade counter (0-9) including a printed circuit board. Operates from a 5 Volt D.C. supply. Can be used in hundreds of applications.



See your nearby CALECTRO distributor for all the most popular digital displays and integrated circuits. Also, get your copy of the new CALECTRO DIGITAL PROJECTS HANDBOOK!

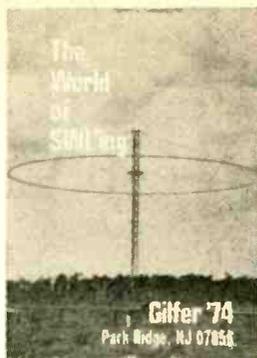


**GC ELECTRONICS**

Division of Hydrometals, Inc.  
Rockford, Illinois 61101 U.S.A.

CIRCLE NO. 15 ON PAGE 17 OR 103

## HEY, LOOK ME OVER

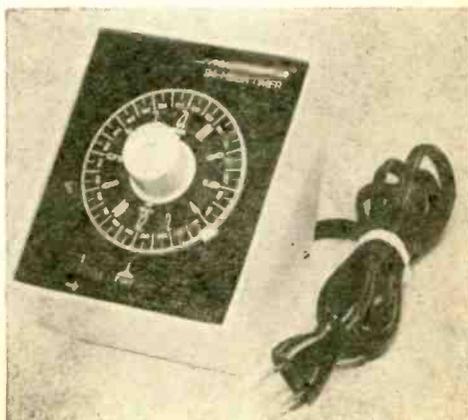


Circle No. 40 on Reader Service Page 17 or 103

The basic catalog will be updated by periodic Supplement mailings throughout 1974. The new catalog contains details on receivers, books, antennas, headphones, clocks, and accessories. Copies of the catalog are free. Gilfer is the stocking agent for many well-known products including: Joystick, Barlow Wadley receivers, Telex headphones, Hamgear preselectors, Mosley antennas, Drake receivers, Franklin wall clocks, and more. To get Gilfer's catalog write to P.O. Box 239, Park Ridge, NJ 07656 today.

### 24-Hour Timer

Now you can turn any lamp or appliance on and off automatically at any preset time with the new Micronta 24-hour Automatic Timer from Radio Shack. Simply set the timer to the correct time, set the "on" and "off" trip levers to the desired time, plug the appliance into the timer and plug the timer into any AC outlet. Operation repeats every 24 hours automatically. You can use it to wake up to radio, stereo, or TV, start your morning coffee, and control air conditioners or electric



Circle No. 161 on Lit-Lib Coupon on page 86

# 10-43



## SILTRONIX BREAKS THROUGH CONGESTED TRAFFIC

Whether you're concerned with heavy communications traffic or you're caught in a freeway jam-up, rely on SILTRONIX to get your message through. When extra "talk-power" is needed, you don't have to waste half of your valuable power in the unused sideband of an AM transmission. SILTRONIX' SSB-23 fully converts your voice to far-reaching RF power in one efficient, suppressed carrier, sideband that out-performs any conventional AM signal in citizen band service.

Snarled traffic situations call for a presence of mind suggesting caution, calm patience and clear thinking. A 10-43 call will advise traffic control authorities of the problem, while a call to your office or home can avoid worry about your delayed arrival.

Presence of mind also suggests a determined search for quality when choosing a CB transceiver. After all, when you do encounter an emergency, it may well be the reliable performance of your equipment that you will depend on for help. Your investment in a SILTRONIX transceiver — now — will insure that you get the performance you expect to receive . . . when you'll need it most.

Look for an SSB-23 in the showroom of your local CB dealer. By insisting on a transceiver that carries a SILTRONIX label, you will be insisting on quality. Visit him this week.

**SILTRONIX SSB-23 Transceiver**  
"The Tiny T-N-T"

Suggested Retail Price.....\$329.00

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

### SILTRONIX

A Cubic Corporation Company  
269 Airport Road • Oceanside, CA 92054  
(714) 757-8860

Dealers interested in adding quality merchandise to their stock are invited to inquire on their letterhead.

CIRCLE NO. 5 ON PAGE 17 OR 103

**PACE...((p))  
 GUARANTEES  
 PERFORMANCE  
 SERVICE**



**For  
 Outdoor  
 Safety**



**HAND HELD  
 CB TRANSCEIVERS**  
 from \$29.95 to \$94.95

- Reliable range
- Dependable performance
- Versatile operation

PACE has a complete choice for CB Hand Held transceivers to work with your mobile, base or other hand held units for any type of radio communications need. For "safety sake" as well as fun, your outdoor activity should include a "PACE in your POCKET."

WRITE PACE FOR FREE  
 CITIZEN TWO-WAY RADIO GUIDE  
 OR STOP BY YOUR LOCAL...

... SIGN OF QUALITY



**PACE COMMUNICATIONS**  
 DIVISION OF PATHCOM INC.  
 24049 S. FRAMPTON AVE., HARBOR CITY, CA 90710

Name \_\_\_\_\_  
 Street \_\_\_\_\_  
 City \_\_\_\_\_

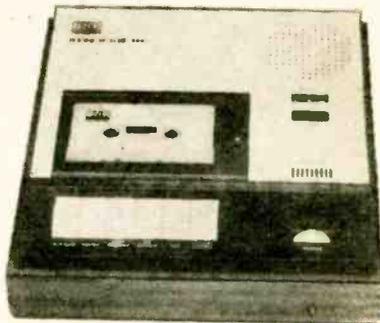
CIRCLE NO. 6 ON PAGE 17 OR 103

**HEY, LOOK ME OVER**

heaters. According to Radio Shack the Micronta 24-hour Timer even helps save on your electric bill by having appliances, such as air conditioners, come on only when you need them, rather than letting them run all day. The Micronta 24-Hour All-Purpose Timer is priced at \$7.95. 1875 watt capacity. U.L. Listed. A similar model, designed for build-in installation in a wall switch or outlet box, is sold for \$9.95. Micronta timers are available from more than 2,500 Radio Shack Stores and Radio Shack Authorized Sales Centers nationwide.

**Phone Butler**

The Phone Butler, a telephone answering device and home message center, with a suggested retail price of \$99.95, is designed for home as well as office use, and incorporates



Circle No. 28 on Reader Service Page 17 or 103

operating and design features particularly suited to the general consumer. It is shipped with a professionally pre-recorded answering message for an authoritative, attention-commanding sound, and to aid microphone-shy users. But there is also provision for home recording of personal messages with a built-in condenser microphone. The Phone Butler can record up to 30 messages on a special cassette, and a "Message Waiting" indicator light is illuminated whenever a call has been taped. Made by BSR, the Phone Butler measures only 9-in. x 10-in. x 2 3/4-in. and may be conveniently placed alongside a telephone or anywhere there is phone wiring. For more information write to BSR Electronics, Inc., 401 Railroad Avenue, Westbury, NY 11590.

**Phone Lock**

Protect your phone absolutely from unauthorized use with Phone-Guard. For home and office, Phone-Guard attaches to any wall or desk phone in minutes, even Touch-Tone types. Electrically operated, Phone-Guard does not interfere with your incoming calls, and the combination you have will prevent

# Be amazed!



**Add Realistic® 4-channel sound to any stereo system this low-cost, easy Radio Shack way**

Quatravox® uncovers a new world of sound hidden in your stereo recordings ...

The magic of reflected sound: It's responsible for the spaciousness and magnificence of a live performance. But it lies buried in your records — unless you add Quatravox QV-3 to your system! It uncovers that hidden, reflected sound to recreate the atmosphere of a live show. It's amazing — for the first time you'll experience *all the music* on records, tapes and FM. The QV-3 out-does the competition with its two synthesizer circuits, blend and rear-level controls, walnut-grain wood case plus all hookup cables. Just add two speakers. Our price is pretty amazing, too. #40-2011, only **21<sup>95</sup>**

Save 6.90 — Complete Quatravox Add-On System



Reg. Separate Items Price  
61.85

**54<sup>95</sup>**

- Two Realistic Solo-103 Full-Range Acoustic Suspension Speaker Systems
- Realistic QV-3 4-Channel Synthesizer With Connecting Cables and Wood Case



Free catalog at our 2500 stores coast-to-coast— or mail in for it.

Retail prices may vary at individual stores Prices and products may vary in Canada 417

**REALISTIC**  
at  
**Radio Shack®**

A Tandy Corporation Company

P. O. Box 1052, Fort Worth, Texas 76107

CIRCLE NO. 32 ON PAGE 17 OR 103

# COLLECTORS!

## We've just added the 1927 Radio Encyclopedia to your growing library-

**S. GERNSBACK'S 1927 RADIO ENCYCLOPEDIA** is your technical book on wireless and early radio. Deluxe illustrated reprint of the original. 175 pages. \$12.95 hard-cover, \$9.95 soft-cover.

**VINTAGE RADIO** is the fascinating photo reference for collectors and historians 1887-1929. 263 pages, over 1,000 photos. \$6.95 hard-cover, \$4.95 soft-cover.

**RADIO COLLECTOR'S GUIDE** is the data book for collectors, 50,000 facts, 1921-1932. 264 pages, \$3.95 soft-cover.

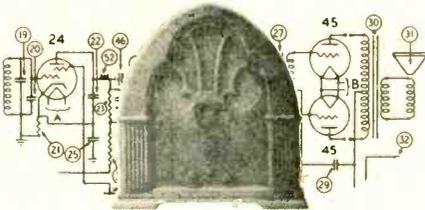


## And now while they last- Most-Often-Needed 1926-1950 Diagrams

The original Supreme Publications books. Schematics of over 3,000 radio models from 1926 thru 1950. Restore those old sets, or use your books for valuable historical information.

- 1926-1938 volume, 600 models, \$7.00.
- 1940, 41, 42, 46, 48, 49, 50, \$4.00 each.
- All eight volumes, special price \$31.50.

Quantities of original books are limited. Order now and avoid a wait for reprints.



SEND TODAY to Vintage Radio, Dep't E, Box 2045, Palos Verdes Peninsula, CA., 90274. Postage Paid. California residents add 6% tax.

\_\_\_\_\_ \$  
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 \_\_\_\_\_ \$  
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 \_\_\_\_\_ \$  
**TOTAL \$**

Name \_\_\_\_\_  
 Street \_\_\_\_\_  
 City \_\_\_\_\_ St. \_\_\_\_\_ Zip \_\_\_\_\_

# COLLECTORS!

## HEY, LOOK ME OVER

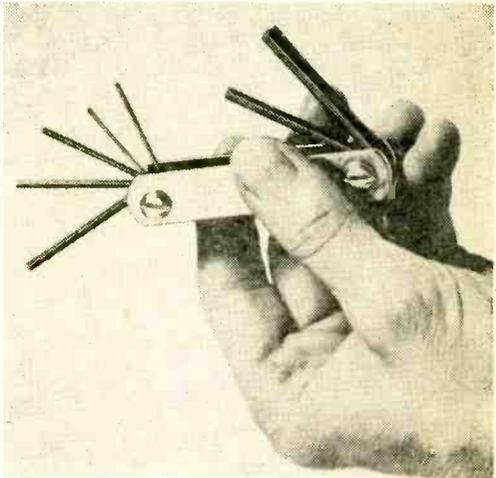


Circle No. 162 on Lit-Lib Coupon on page 86

others from using your phone. A handy item for the household with small children, or anywhere that outgoing calls must be controlled. Suggested retail price: \$9.95. For more information write to Goodrich Products, 137 Sierra St., El Segundo, CA 90254.

### Metric Hex Key Set

A compact folding set of metric hex keys has just been introduced by Vaco. The set of seven works on the jackknife principle and includes sizes 1.27 mm, 1.5 mm, 2 mm,



Circle No. 163 on Lit-Lib Coupon on page 86

2.5 mm, 3 mm, 4 mm, and 5 mm. Blades are made of finest quality nickel-chrome-moly wrench steel and are precision drawn to assure accurate fit. List price is \$2.48. All Vaco tools are unconditionally guaranteed. For further information write to Vaco Products Company, 510 North Dearborn Street, Chicago, IL 60610.

### No Noise

Is the clearest sound on your CB rig's speaker the whine of your car's alternator?

**BRAND NEW!**

# WILD BUNCH

**THE GRRREAT MOBILES  
FROM PEARCE-SIMPSON**



**COUGAR 23B**

True RF noise blander,  
built in SWR bridge, S/RF/  
Modulation/SWR Meter.  
Total of 12 controls.

**Sound of Excellence**

**\$229<sup>95</sup>\***



**TIGER 23C**

Mike gain control, S/RF/  
Modulation Meter, Tone  
Control.

**Wild as it Sounds**

**\$199<sup>95</sup>\***



**BOBCAT 23C**

Receive-O-Slide,  
Manual ANL, Automatic  
Modulation Control.

**Tears You Up**

**\$179<sup>95</sup>\***

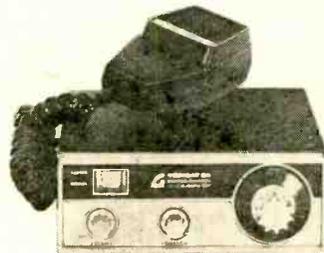


**PUMA 23B**

Big Meter that changes  
color, plug in mike and  
power leads, P.A.

**Sleek**

**\$159<sup>95</sup>\***



**TOMCAT 23**

23 Channels, S/RF meter,  
diode switching, crystal filter.

**The Untamed**

**\$129<sup>95</sup>\***

\*Suggested list price

Purr-fectness is expected from Pearce-Simpson and these grrreat new mobiles have it. Choose one of the Brand New Wild Bunch and cut through the CB jungle like a pussycat going through a saucer of warm milk.

**PEARCE-SIMPSON**  
DIVISION OF **GLADDING CORP.**  
P.O. BOX 520800 BISCAYNE ANNEX MIAMI, FLORIDA 33152

CANADIAN DISTRIBUTOR: SCOTTCOM RADIO, INC., 4643 LEVESQUE BLVD., CHOMEDY, LAVAL, QUEBEC, CANADA

CIRCLE NO. 17 ON PAGE 17 OR 103



# SUPER CB TALK POWER!

What gives Johnson CB two-way radios their "extra sock" 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 1-year parts and labor warranty with over 700 service centers nationwide.

PRICES START AT UNDER \$100!  
SEND COUPON FOR FREE CATALOG!



**E. F. Johnson Co.**  
Dept. EE Waseca, Minn. 56093

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
In Canada: A. C. Simmonds & Sons, Ltd.

CIRCLE NO. 33 ON PAGE 17 OR 103

The great new  
**Super Scanner**  
It scans 360° in milliseconds with 5.75 dB gain. Or beams an 8.75 dB gain signal where and when you want it—instantaneously. (Otherwise, it's just another beautiful ES base antenna.)

MODEL MS 119 Super Scanner electronic beam antenna with control console.



© Stripes of Quality

**the antenna specialists co.**

Division of ORION INDUSTRIES, INC.  
12435 Euclid Ave., Cleveland, Ohio 44106  
Export: 2200 Shames Dr.,  
Westbury, L.I., New York 11590  
Canada: A. C. Simmonds & Sons, Ltd.

CIRCLE NO. 20 ON PAGE 17 OR 103

## HEY, LOOK ME OVER

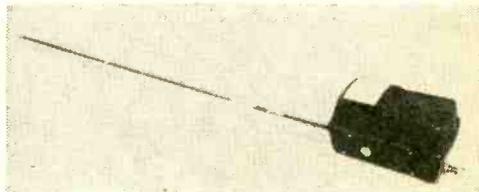


Circle No. 164 on Lit-Lib Coupon on page 86

If yes, then you need an efficient ferromagnetic filter that wipes out all the alternator and generator noise between 2.2 and 400 MHz. Gold Line alternator and generator filters are easy to install; no tuning is required at all. The 60-ampere unit, GLC-1076, sells for \$7.95. The 100-ampere unit, GLC-1080, goes for \$12.95. Sold nationally at CB outlets and independent distributors everywhere. For more information write to Gold Line, Muller Avenue, Norwalk, CT 06852.

### Open Sesame

The new Heathkit GD-3209 garage door opener system offers all the comfort and convenience needed with the reliability and safety necessary in a radio-controlled garage door opener. A touch of the button on the wireless transmitter will open the garage door and turn on the light inside the garage. After driving inside, another touch of the button closes the door securely, and the self-



Circle No. 1 on Reader Service Page 17 or 103

contained light stays on for 90 seconds before automatically shutting itself off. The GD-3209 provides convenience and safety the whole family will appreciate. The 8½-ft. self-lubricating screw mechanism, coupled with the powerful ⅓ hp motor, assures years of dependable, maintenance-free operation. A new dual-safety feature makes the door travel reverse, return to full open position, and stop if obstructed while closing. And an adjustable slip clutch is provided for opening safety. The built-in Snow Safety takes over a short distance from the floor to compensate for door reversal caused by ice and snow build-up. Price of the GD-3209A System with one transmitter is \$139.95 by mail or  
(Continued on page 22)

# ELEMENTARY

• The Editor of **ELEMENTARY ELECTRONICS** offers readers an easy way to get additional information about products and services advertised in this issue. Just follow the instructions below and the material you requested will be sent to you promptly and at no cost..

# ELECTRONICS

• The coupon below is designed for your convenience. Just circle the numbers that appear next to the advertisement that interests you. Then carefully print your name and address on the coupon. Cut out the coupon and mail to: **ELEMENTARY ELECTRONICS**, Box 886, Ansonia Station, New York, N.Y. 10023. Do it today! Coupon torn out? Then turn to page 103 for more!

## READER SERVICE PAGE

JULY-AUGUST, 1974

Void after **DECEMBER 20, 1974**

### ELEMENTARY ELECTRONICS

Box 886, Ansonia Station

New York, N.Y. 10023

Please send literature for the numbers I have circled. I understand this is a free service.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40

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 \_\_\_\_\_

State \_\_\_\_\_

Zip Code \_\_\_\_\_

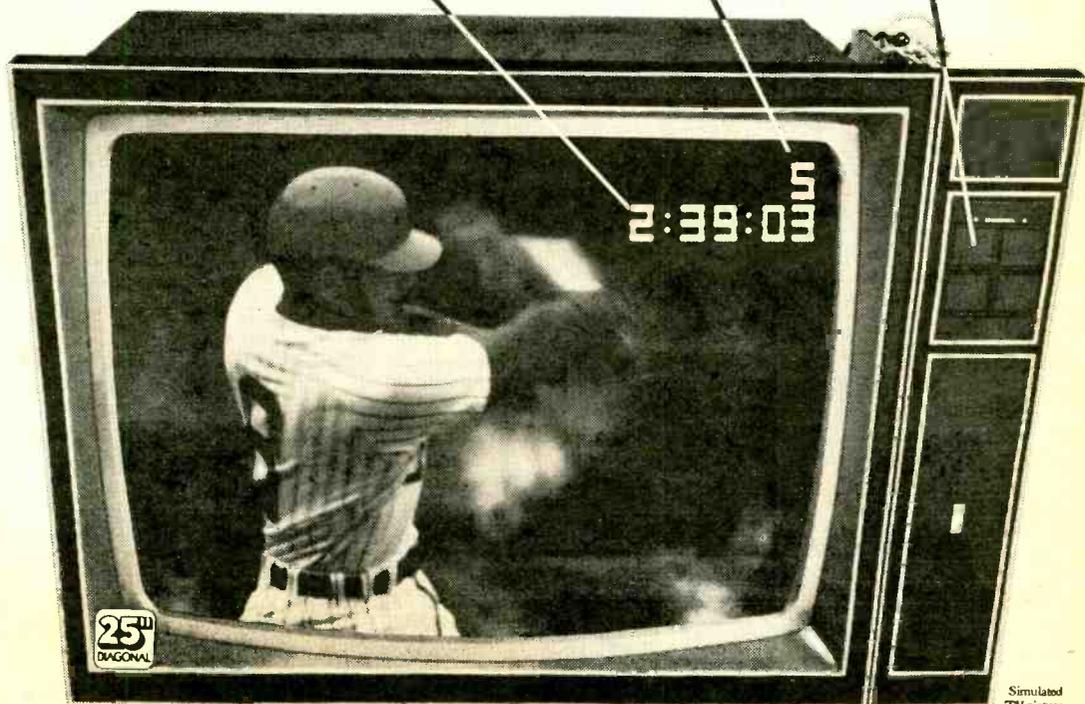
# Build it yourself!

Build this exciting color TV as part of Bell & Howell Schools' fascinating learn-at-home program employing digital electronics!

Digital clock that flashes on the screen!

Channel numbers that flash on the screen!

Automatic pre-set channel selector!



Simulated TV picture



"Electro-Lab" is a registered trademark of the Bell & Howell Company.

Simulated TV picture

## You get valuable "hands on" experience right from the very start . . . it makes learning faster and all the more enjoyable!

Digital electronics is a fascinating world to explore! It's an expanding technology that's changing not only our clocks, wristwatches and pocket calculators, but now, color TV!

By building Bell & Howell's new big-screen color TV with digital features, you'll learn about this exciting field first hand. And you'll take special pride in this remarkable TV because you built it yourself!

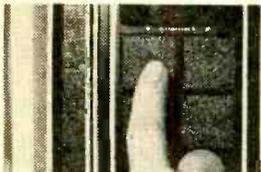
**You work with a color TV that's ahead of its time . . . and learn about these exciting features:**

### Digital channel numbers that flash on the screen



Press the instant-on button and the channel number flashes big and clear, right on the screen — and stays there as long as you want!

### Automatic pre-set channel selector



Just a push of the forward or reverse channel buttons and instantly the VHF and UHF channels come on in a pre-set sequence. All "dead" channels are skipped over.

### Digital clock that flashes on screen



With just the push of a button, this TV tells the correct time. The hours, minutes and seconds appear in clear, easy-to-read digital numbers.

**You need no prior electronics background . . . we help you every step of the way!**

We start you off with the basics and help you work your way

up, one step at a time.

With your first lesson, you'll receive a special Lab Starter Kit that aids your understanding of electronics fundamentals . . . gives you immediate "hands on" experience. If there's a "snag," call one of our expert instructors toll-free. You can also talk shop with instructors and fellow students at our "help-sessions" scheduled in 50 cities at various times throughout the year.

**Perform fascinating experiments with the exclusive Electro-Lab® electronics training system. It's yours to build.**



Your program includes professional testing equipment to give you valuable "hands on" experience. You'll build and use a digital multimeter, a solid-state oscilloscope with "triggered sweep," and a modular design console. You will have the most up-to-date tools of the trade, including instruments you can use professionally after you finish the program.

**The valuable skills you learn in digital electronics could lead to new income opportunities, full or part-time . . . perhaps a business of your own!**

Once you've completed this learn-at-home program, you'll have the skills to service color TV's, plus repair a variety of home electronics equipment.

While many of our students do not ask for employment assistance, it is available. Of course, no assurance of income opportunities can be offered. No better or more practical at-home training in electronics is available anywhere!

### Mail the postage-free card today!

This Bell & Howell Schools' program is approved by the state approval agency for Veterans' Benefits. Please check the appropriate box on the card for free information.

If card has been removed, write:  
An Electronics Home Study School  
DeVRV INSTITUTE OF TECHNOLOGY



ONE OF THE  
**BELL & HOWELL SCHOOLS**

4141 Belmont, Chicago, Illinois 60641

663

## HEY, LOOK ME OVER

(Continued from page 16)

der. For more information write to Heath Company, Benton Harbor, MI 49022.

### Fine Solder

A low melting point, thin solder in a convenient self-feed plastic dispenser has been introduced by GC Electronics. Especially designed for today's printed circuit needs, Fine Line Solder, Cat. No. 9132, is 60/40 rosin



Circle No. 15 on Reader Service Page 17 or 103

core type and .032 inches in diameter—excellent for kit construction and hundreds of other applications. The self-feed dispenser holds over 12 feet of solder and is made of clear plastic so that the amount of remaining solder can easily be seen. GC Electronics offers a complete selection of soldering equipment, printed circuit items and accessories, as well as chemicals, tools, and service aids for the technician, serviceman, and hobbyist alike. GC products are sold nationally at independent GC dealers.

### Smoke-Chek

A new sensitive early warning smoke and gas detector alarm is based on a new solid state N-type gas molecule detection principle. Called the Smoke-Chek Detector, it will warn of the presence of less than two parts in ten million toxic gases. It will detect within seconds and sound a loud alarm if minute quantities of carbon monoxide, smoke, cooking gas, gasoline, solvents, alcohol, or other gases are present in the air. The unit can sense products of spontaneous combustion before a resulting fire, and it is far more sensitive than a human or animal nose. Smoke-Chek plugs into any standard 115-volt outlet and requires no special installation or adjustments. Designed for years of con-

(Continued on page 90)

# SBE

## A SET FOR EVERY CB APPLICATION

### AM MOBILE

Capri II, sleek little work horse! Low cost, high utility. 5 xtl controlled channels (w/xtls for Chan. 9)—Dynamic mic w/coil cord. Bracket. 12VDC.



*Capri II*

### AM BASE

Complete 5W AM base station in handsome wood grain cabinet. 23 chans., no xtls to buy. 115VAC supply. Meter for output/VSWR/"S" units. Limiter, squelch, PA provision. Dynamic mic/cord/plug.



*Trinidad*

### AM MOBILE

Economical, book size, 23 channel station! No xtls to buy! Diode switching—no relays. King-size channel readout—Dynamic mic./coil cord. 12VDC.



*Catalina II*

### SSB/AM MOBILE

Final word, SSB/AM, 5W AM, 25W peak on SSB meets F.C.C. power boost! USB/LSB—23 channels, no xtls to buy—Solid state, no relays—Output/"S" units meter—Dynamic mic/plug. 12VDC.



*Sidebander II*

### AM MOBILE

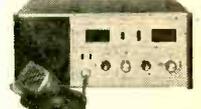
De luxe AM beauty! 23 chans., synthesized—meter for output/modulation/signal strength—Big 3-4W audio—full 4W power out. Dynamic mic/w/cord/plug—12VDC, positive and negative ground.



*Corley*

### SSB/AM BASE

Unequaled! 5W AM and 25W peak on SSB w/USB, LSB. 23 chans.—no xtls to buy. 115 VAC, shifts to external 12VDC if power fails. Squelch, ANL, panel multi-meter. PA provision. Dynamic mic/cord/plug.



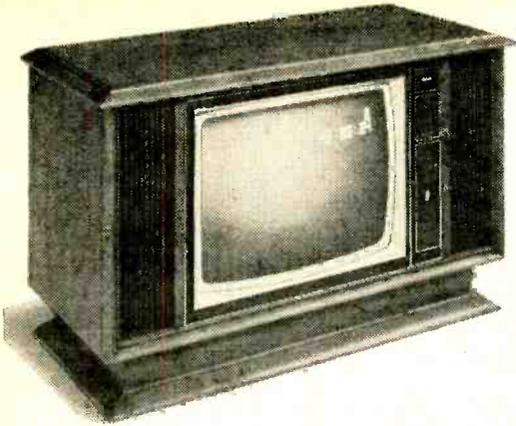
*Console II*

WRITE FOR FULL LINE BROCHURE

LINEAR SYSTEMS, INC. 220 Airport Blvd., Watsonville, CA 95076

CIRCLE NO. 22 ON PAGE 17 OR 103

# The editors' choice: Heathkit Digital Design Color TV!



At **ELEMENTARY ELECTRONICS** they said: "The fact is, today's Heathkit GR-2000 is the color TV the rest of the industry will be making tomorrow... there is no other TV available at any price which incorporates what Heath has built into their latest color TV."

The **FAMILY HANDYMAN** reviewer put it this way: "The picture quality of the GR-2000 is flawless, natural tints, excellent definition, and pictures are steady as a rock. It's better than any this writer has ever seen."

**POPULAR SCIENCE** pointed out "more linear IC's, improved vertical sweep, regulators that prevent power supply shorts, and an industry first: the permanently tuned I.F. filter."

The **RADIO-ELECTRONICS** editors said the Heathkit Digital TV has "features that are not to be found in any other production color TV being sold in the U.S.:

"On-screen electronic digital channel readout... numbers appear each time you switch channels or touch the RECALL button... On-screen electronic digital clock... an optional low cost feature... will display in 12- or 24-hour format... Silent all-electronic tuning. It's done with uhf and vhf varactor diode tuners... Touch-to-tune, reprogrammable, digital channel selection... up to 16 channels, uhf or vhf... in whatever order you wish... there's no need to ever tune to an unused channel. LC IF amplifier with fixed ten-section LC IF bandpass



filter in the IF strip... eliminates the need for critically adjusted traps for eliminating adjacent-channel and in-channel carrier beats. No IF alignment is needed ever. *Touch volume control*... when the remote control is used... touch switches raise or lower the volume in small steps."

**POPULAR ELECTRONICS** took a look at the 25-in. (diagonal) picture and said it "can only be described as superb. The Black (Negative) Matrix CRT, the tuner and IF strip, and the video amplifier provide a picture equal to that of many studio monitors..."

Furthermore, the Heathkit GR-2000 is an easier kit-form TV to build. **POPULAR ELECTRONICS** pointed out that "Each semiconductor has its own socket and there are 12 factory-fabricated interconnecting cables... The complete color adjustments can be performed in less than an hour."

To sum up, **POPULAR ELECTRONICS** concluded its study by stating, "In our view, the color TV of the future is here — and Heath's GR-2000 is it!"

Why not see what the experts have seen? The Heathkit Digital Design Color TV — without question the most remarkable TV available today.

Mail order price for chassis and tube, \$649.95. Remote Control, \$79.95 mail order. Clock, \$29.95 mail order. Cabinets start at \$139.95. (Retail prices slightly higher).



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CIRCLE NO. 18 ON PAGE 17 OR 103



**ASK HANK,  
HE KNOWS!**

### Cleared Up

My television set focus is poor at home, but in the TV repair shop it's perfect. I see this with my own eyes. Why?

—C.L.N., Richmond Hts., OH

Your antenna system has line reflections due to mismatching of antenna to the lead-in line to the TV receiver. This is not so at the TV repair shop because the pros there realize the importance of a good clean TV signal. Check your TV antenna system carefully. You may have to junk your TV antenna and lead-in wire. If so, install a sturdy unit and use coax cable with line matching transformers.

### Red Dust

I have an 8-track player that has been playing great for about a year now. Recently I have been having problems keeping the playback head clean. After about five minutes the head is covered with a dark red-brown coating. If I leave it alone the sound gets so dull it's hard to understand. What's wrong?

—C.R., Newark, NJ

Old tapes that tend to flake or new cheap ones can be the cause of the problem. If the problem occurs on a new quality tape, the head may be worn beyond use or some sharp edge in the mechanism is scraping the oxide free and the head is collecting it.

### Typical SWL Question

What is the address of Radio Nacional in Argentina?

—B.H., Reno, NV

Radio Nacional's address is Ayacucho 1556, Buenos Aires, Argentina. You can have all the

(Continued on page 89)

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. 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

# "We ran out of gas in the middle of nowhere, so I cranked up my Turner"

It takes more than a strong frequency carrier to get your message out. The other ingredient of a strong signal is a full, crisp modulation. You need both to punch out an understandable signal for any distance.

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Or, if engine, traffic and other background noises are the problem, get your hands on a NC350DM noise-cancelling mike. If you're not getting anywhere, ask for some help on the mike. See a Turner dealer and check out the advantages of mobile mikes built by Turner Microphones, 909 17th Street N.E., Cedar Rapids, Iowa 52402.

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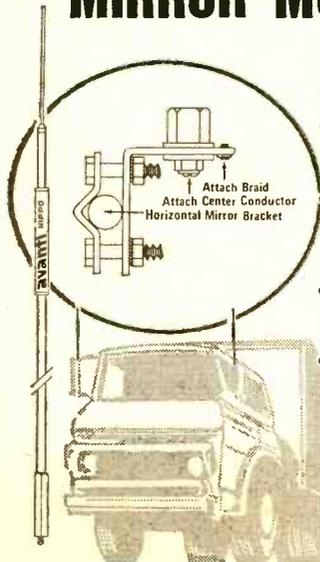
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CIRCLE NO. 4 ON PAGE 17 OR 103

**DX central  
reporting**

A world of SWL info!

BY DON JENSEN

□ What is a DX club? If you aren't a member of one of these organizations you may need a word of introduction, because these hobby clubs are really the backbone of DXing. DX clubs, and there are a number of them around the country, both large and small, are organizations of people just like you, people who enjoy the listening hobby.

Clubs give DXers the opportunity to get together, usually through the pages of their bulletins, through correspondence and, occasionally, in person, to share their interest in DXing. Bulletins, some printed, some mimeographed, provide current lists of stations others are hearing, useful how-to-do-it tips on listening and getting QSLs from stations heard, feature articles on broadcasters and technical topics, exchanges of members' ideas, and much more. Belonging to a club really is the best way of getting it all together in DXing.

Volunteer editors and publishers operate the clubs on a non-profit basis. Annual memberships vary from a couple of dollars to around \$15 a year, depending on the club and the type and frequency of its news bulletins. Most tend to operate quite informally. As a result, clubs come and go. Some flourish and die when the volunteer leaders tire of the work—and it is work—or find themselves too busy with other activities to continue. But some are as stable as the Rock of Gibraltar, having operated non-stop for up to 30 years or more!

To try to bring some stability to the club scene, back in 1964 an organization called the Association of North American Radio Clubs was founded. Not a club itself, it has served as a sort of club for clubs, loosely affiliating the individual hobby organizations. This year, ANARC celebrated its 10th anniversary. Al Reynolds, a veteran DXer from Nashville, serves as ANARC's executive secretary. Its prime function these days is to act as a clearing house for information about its affiliated clubs.

Holding full membership in ANARC are the National Radio Club, International Radio Club of America, North American SW Association,  
(Continued on page 28)

### GIANT NIXIE CLOCK KIT



For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

Giant Nixie Clock Kit ..... \$69.50

### 24 VOLT 5 AMP TRANSFORMER



We have just received a truckload of these high quality Computer specification transformers. The floors are groaning and we are selling them at a LOW-LOW price just to clear them out! Excellent for Power Supplies, Audio Amps.

24 Volt 5 Amp Transformer ..... \$3.95  
 5 for \$15.00, write for Prices of Mfg. quantities

### LIGHTED PUSH BUTTON SWITCHES WITH INSERT

These large lighted push button switches measure 1.7" x 1.4" inches, include clear plastic cap so that legend can be inserted inside. Includes two 12 volt bipin bulbs. Contacts are DPST. If cap is inserted upside down, switch section becomes inoperative, an excellent safeguard for burglar alarms, etc. for people who don't know the "trick".

Lighted push button switch ..... \$1.00 each  
 Write for product prices ..... 10 for \$7.50

### HEAVY DUTY DATA TERMINAL POWER SUPPLY



Originally manufactured for use in Data Terminals, these are rugged conservatively rated power supplies for continuous duty operation. The original cost of these supplies was \$278.00. All outputs are regulated to  $\pm 5\%$  by a constant voltage transformer, and in addition two of the outputs are regulated to 0.2% by solid state regulators. Circuits are protected by fuses and circuit breakers. Two types are available.

\*Type 'A' 24 VDC @ 1.6A  $\pm 0.2\%$ , 26.5V @ 1.25 A  $\pm 2\%$ , 18VDC @ 6.6A  $\pm 5\%$ , 14V @ 2.9A 0.2%, 12 VDC @ 1A  $\pm 5\%$  Price ..... \$29.50  
 \*Type 'B' Same as above except includes 5VDC @ 3.25 Amps, instead of 14V @ 2.9 AMPS ..... \$34.50  
 Shipping Weight—30 lbs either supply

### TELSA COIL KIT



Here's a truly basic kit for those who like to "roll their own". All the parts for an exciting adventure into high-frequency, high voltage. Add your own metal housing — a "smart chassis" or universal box is ideal. Tesla coils are patterned after the design of Nikola Tesla (1857-1943) an American electrical genius who built versions many feet tall. His dream was to light and power entire cities with energy radiated from such coils — but no luck!

Today's Tesla coils are popular with experimenters and students, and especially for science fair and educational demonstrations. Curt's is a high-frequency push-out oscillator coupled to a television flyback transformer, which steps up an external 12 VDC power supply to many thousand volts. SPECIAL NOTE: Although current output is relatively low, some hazard is inherent in all high voltage devices. This kit is intended for the experimenter who is mature enough to observe reasonable precaution in its use.

Telsa Coil Kit ..... \$7.50

### POWER SUPPLY KIT



This kit includes 24 Volt, 5 AMP heavy duty transformer, bridge rectifier, 8,000 MFD capacitor, 723 regulator, pair of 2N3055 transistors, D.C. voltmeter, plus all electrical circuit breaker parts to build a complete regulated laboratory supply.

Lab Supply Kit ..... \$19.75  
 Shipping Weight 20 lbs

### CLOSEOUT — CALCULATOR KIT



B and F was one of the first (if not the first) to introduce an under \$100.00 calculator. Now that all the giant corporations have introduced theirs, we feel it's time to move on to new kits and let the "Biggies" slug it out. We have enough parts for about 200 more calculators, which we are closing out at \$54.50 each. Floating point eight digit display, constant capability, sealed elastomer keyboard.

molded ABS case, uses (4) standard AA cells, 14 hour battery life.

Pocket Calculator Kit ..... \$39.50

### STEREO TAPE CARTRIDGE PLAYER



High quality tape cartridge player has built in preamps, and requires only 115V 60Hz for motor and 12 volts for electronics to operate. Four light indicators indicate channel selected. Output compatible with amplifier. "Auxiliary" inputs. Here is the inexpensive high fidelity way to play those tape cartridges for your car player in your home.

Stereo Tape Cartridge Player ..... \$15.00

### REVERBERATION UNIT & SPEAKER



Useful in conjunction with music synthesizers, organs, and to add "presence" to music. This complete reverberation unit requires only a source of 12 Volts to operate, might also be useful for other acoustic delay experiments. Includes high quality oval ceramic magnet speaker, brand new, originally made to sell for \$24.50, now at a price you would pay for the speaker alone.

Reverb Unit ..... \$6.95

### 1 MHz FREQUENCY STANDARD CRYSTAL

This is a 1,000,000 MHz Crystal  $\pm 5\text{Hz}$ ,  $-0\text{Hz}$ . Can be pulled to exactly 1 MHz  $\pm 0\text{Hz}$  with 5-30 PF trimmer. Excellent temperature coefficient, QD 4007 makes excellent Oscillator, buffer. Circuit included. Super LOW price while 2,000 PCs last.

1 MHz Crystal Standard ..... \$4.50

### QUARTZ CRYSTAL CHRONOMETER

Revolutionary! was the reaction of our customers when they saw this kit. Measuring only 2 1/2" x 2 1/2" x 2 3/8", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechanical clocks in cars, boats, and airplanes.

Fits into a standard 2 1/2" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e., replacing battery in car). This clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligible power drain. The low price is only possible because of a new one chip MOS clock. Operates from 12-24 Volts D.C. An accessory unit which mounts on the back adapts the unit to 2-28 volts for twin engine aircraft and larger boats using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.

Quartz Chronometer, Kit Form ..... \$69.50  
 Quartz Chronometer, Wired ..... \$99.50  
 24 Volt Adapter ..... \$10.00

### NICAD BATTERIES



No need to tell you the uses of these sealed Nickel-Cadmium batteries in all kinds of portable equipment. All brand new except the 0.5 ampere hour, which is removed from new equipment, guaranteed perfect.

Type	Volts	Amps	Price	Size
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<input type="checkbox"/> 1.25NCB06	1.25	0.6	1.00	Lg. AA
<input type="checkbox"/> 24NCB06	24	0.8	11.80	1 1/2" x 1 1/2" x 1 1/2"
<input type="checkbox"/> 8NCB06	8	0.6	5.00	5/8" diam x 1 1/2"
<input type="checkbox"/> 18NCB	18	0.5	7.50	3" x 3" x 4"

### LOUDSPEAKER SYSTEM COMPONENTS



We have made an excellent purchase of an excess inventory of a local manufacturer's speaker systems. Although we are not allowed to mention the mfg.'s name, the specs should make it self-evident.

The woofer is a 12" free-air (acoustic suspension) unit, with 2" voice coil and a No. 2 magnet. The mid-range is a 5" sealed back speaker and 3/4" flare dome tweeter for best high frequency dispersion. Crossover between woofer & mid-range is by an R-L-C network, while high frequency crossover is by an R-C network. Balance controls are provided for both mid-range and tweeter. Plans for a suitable enclosure are provided. The level controls provide frequency response to suit room acoustics, with realism that will delight even the most critical listener. Response — 25 to 250K + Hz., Power — 40 watts RMS. Impedance — 8 ohms. Sh. Wt. 12 lbs.

LSCS ..... \$42.50  
 2LSCS ..... 2 for \$75.00

### RESOLUTION TEST CHART



These 2" x 2" glass plate test charts are excellent for testing enlargers, microscopes, scanners, etc. Original cost to manufacture was over \$60.00. Complete plate is covered with test patterns. Several types available may vary slightly from illustration. A rare bargain.

Resolution Test Plate ..... \$2.50

### HERMETICALLY SEALED FIBERGLASS CARRYING CASES



13" x 30" x 30" brand new luggage type carrying cases were originally manufactured to ship delicate electronic equipment overseas. Excellent for storing, shipping and carrying photographic equipment, instruments, etc. Includes easily removable foam rubber inserts. Original cost to manufacture was \$160.00 would probably be even higher today because of plastic shortage.

Fiberglass carrying case ..... \$25.00

### RESETTABLE FOUR DIGIT COUNTERS



These counters have raised aluminum for print out thru fiber ribbon, but can be used as conventional counters also, reset by wheel on side. Coil is 12 volts D.C., may be operated on 115 VAC by diode-capacitor-resistor.

Resettable Four Digit Counter ..... \$2.50  
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Telephone KB ..... \$4.75

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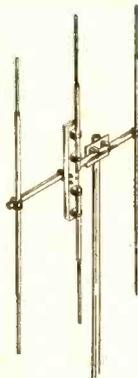
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CIRCLE NO. 19 ON PAGE 17 OR 103

## DX CENTRAL REPORTING

SPEEDX, American SWL Club, Canadian International DX Radio Club, and Worldwide TV FM DX Association. Younger clubs, more recently established, have won associate memberships in ANARC. They are the Minnesota DX Club, Rocky Mountain DXers Association, SWL International, Transworld DX Club, Triangle DX Club, Virginia DX Association, and Wingate SWL Club.

ANARC also holds an annual DX convention, at some centrally located spot in the U.S. All DXers, whether members of affiliated clubs or not, are welcome to attend. If you'd like information on the various ANARC clubs or this year's convention, drop a note to Al Reynolds at ANARC, Box 433, Peabody College Station, Nashville, TN 37203. Enclose a stamped self-addressed envelope for a reply.

**Information Please.** DXers are information-conscious. To keep up with all the many changes in the broadcasting world—necessary if you want to know how, when, and where to hunt in the radio spectrum for various stations—membership in a DX club is a smart move. There also are many books, booklets, and station lists available that will help you in your hobby. Here are a few of the publications you may want to add to your DXing library:

**World Radio and TV Handbook.** This annual book, published in Denmark but printed in English, is nicknamed "The DXer's Bible." It is probably the one indispensable volume for the SWL. It includes lists of shortwave stations around the world, their frequencies, schedules, addresses, and much, much more. The 1974 edition is priced at \$7.50 and is available from Watson-Guptil Publications Inc., 1 Astor Plaza, 1515 Broadway, New York, NY 10036; Gilfer Associates Inc., Box 239, Park Ridge NJ; and several of the DX clubs previously mentioned.

**Police Call Directories.** If you're one of the growing band of monitors who enjoy listening in on the VHF and UHF police frequencies, these lists may prove useful. For more information, write Hollins Radio Data, P.O. Box 35002, Los Angeles, CA 90035.

**World Utility DX Handbook.** This is probably the best single book available for the guy who is interested in those off-beat, non-broadcast type transmissions on shortwave. There is data on point-to-point communications, aeronautical, marine, weather, military, and many other communications services, including station names, addresses, and frequencies. Plus there are some very useful and interesting feature articles on these stations. It can be ordered for \$7.95 from SPEEDXTRAS, 2318 South Laurel, Port Angeles, WA 98362.

**NRC Domestic Log.** This is a list of medium wave stations in the U.S. and Canada. But besides calls and frequencies it includes data on licensed hours of operation, daytime and night-

(Continued on page 91)

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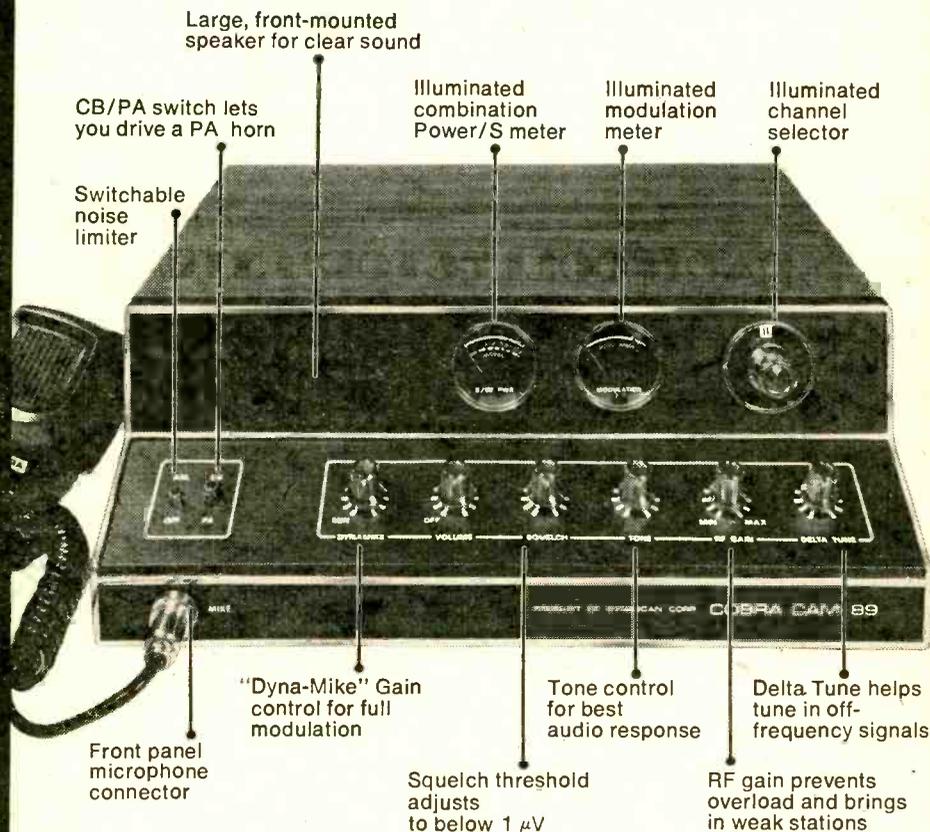
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CIRCLE NO. 11 ON PAGE 17 OR 103

# Hang an... **EXPANDED SCALE VOLTMETER From Your Dash**



by Martin W. Bajor

**P**ROFESSIONAL DRIVERS in big over-the-road rigs depend on an ammeter and a voltmeter to gauge electrical operating conditions in their vehicles. How about you?

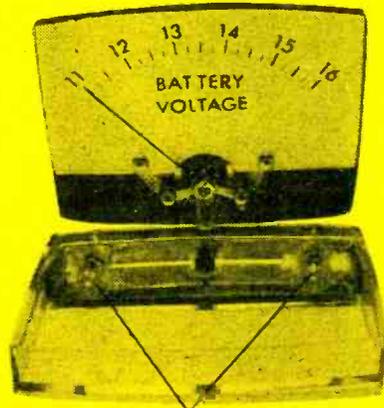
With this zener-regulated expanded scale voltmeter you can forget the idiot light and measure operational voltage fluctuations that can tell the real story.

Sure, an ammeter can be installed. After all, that's what most vehicular electrical gauges measure, if one is there at all, so why not install what manufacturers do?

Why? Because you don't have the problem of installing a meter in series with the primary power cable as with an ammeter. Just a simple tap to the ignition switch or even to an accessory power cable such as the radio or heater line will do for a voltmeter. And for a plus in performance, you have a new sensitivity to electrical system operation—battery, alternator, voltage regulator and more—that only an expanded scale voltmeter can conveniently provide.

**What Expanded Scale?** An expanded scale meter is one on which the lowest reading is not zero volts but the lowest voltage of interest to the user. A conventional voltmeter has a scale reading from

zero to a specified maximum voltage. On a typical meter with a full scale reading of 15 volts it would be difficult to read the difference of a few tenths of a volt that can be significant in the automotive electrical system. The range for this meter was chosen to be 11 to 16 volts. This covers the levels in which we are most interested.



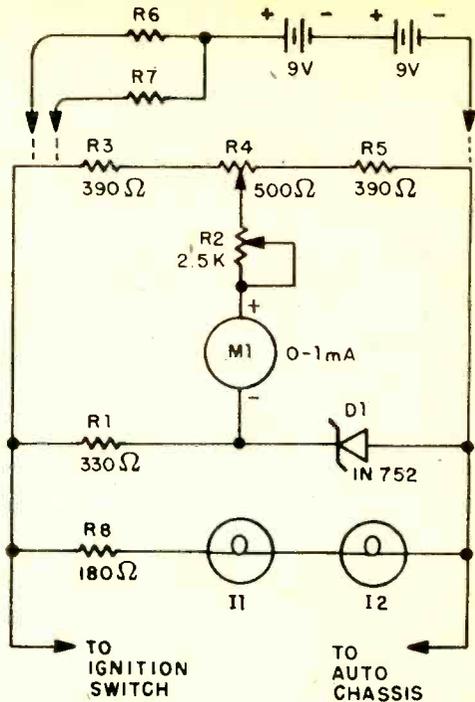
LAMPS FOR ILLUMINATION

**Drill two small holes for lamp wire, then cement, glue, or use selastic to secure a pair of series-connected 6-volt mini lamps.**

# e/a EXPANDED SCALE VM

## PARTS LIST FOR AN EXPANDED SCALE VOLTMETER

- D1—Zener diode, 5.6 volts, 1/2-watt, 1N752 (Motorola HEP-Z0212 or equiv.)
- I1, I2—Miniature lamps, 6 VDC, 25 mA (Radio Shack 272-1140 or equiv.)
- M1—Meter, 0 to 1 mA movement (Radio Shack 22-052 or equiv.)
- R1—330-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R2—2500-ohm potentiometer, PC-type (Radio Shack 271-228 or equiv.)
- R3, R5—390-ohm, 1/2-watt resistor, 5% (Radio Shack 525-228 or equiv.)
- R4—500-ohm potentiometer, PC-type, (Radio Shack 271-226 or equiv.)
- R6—820-ohm, 1/2-watt resistor, 5% (Radio Shack 525-347 or equiv.)
- R7—160-ohm, 1/2-watt resistors, 5% (Radio Shack 525-230 or equiv.)
- R8—180-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- Misc.—Case (3 x 3 1/4 x 2-in. deep), perf board, push-in clips, 2U6-type 9-volt batteries (for calibration, see text), wire, solder, hardware, etc.

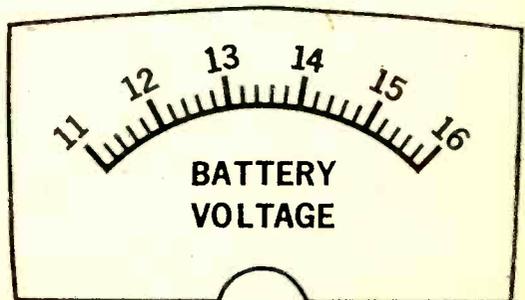


Look at the schematic. The negative terminal of the meter is connected to the junction of R1 and the zener diode, D1. Voltage at this point remains constant at 5.6 volts when the voltage across the circuit varies from 11 to 16. The positive meter terminal is connected through variable resistor R2 to the wiper of potentiometer R4. Network R3, R4, and R5 make up a voltage divider that is adjusted so 11 volts applied by the vehicle results in no current flow through R2 and the meter. Variable resistor R2 is set, when 16 volts is applied to the circuit, for a full scale meter deflection.

**Building It.** To insure accuracy only 5% tolerance (gold band) resistors should be used for R3, R5, and the calibrating resistors R6 and R7. If you can not obtain a 160-ohm resistor, two values totaling 160 may be connected in series—150 and 10 or 120 and 39. Be certain that the zener diode is installed in the proper direction. If a type other than the one in the parts list is substituted, the end with the band must go to the junction of the meter and R1. It must be a 500 milliwatt (1/2 watt) rating. A higher power rating will not properly regulate the voltage in this circuit. Provisions to conveniently disconnect the R3

end of the voltage divider for calibration should be made.

The meter face must be modified for meaningful readings. If you use the meter called for in the parts list cut out and cement in the pattern provided. Carefully pry the faceplate off the meter. The meter face can be removed by taking out the two screws; slide it out taking extreme care not to damage the pointer. If you use a different meter you can remove the unwanted numbers on the dial by gently rubbing them with a pencil eraser taking care only to erase the black lettering and not the white paint underneath. New numbers can be put on with dry transfer letters available from



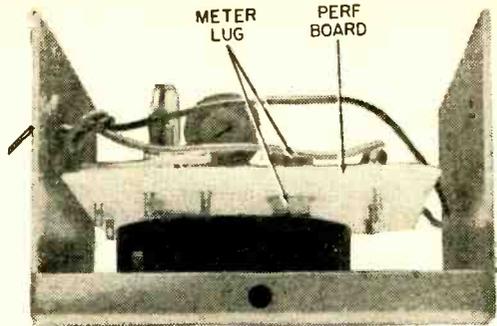
Copy or cut out this exact-size meter face.

art supply stores or electronic distributors.

If your installation requires lights, miniature bulbs can be built in behind the meter faceplate. While the faceplate is removed carefully drill a  $\frac{3}{32}$ -in. hole about  $\frac{1}{4}$ -in. in from each bottom corner. Drill two matching holes in the chassis so the wires can go through to the circuit board. Cement the bulbs in place with silicone adhesive. Connect the bulbs in series as shown in the schematic. The 180 ohm resistor is to drop the voltage slightly so lamp life is extended.

**Calibration.** If you have a variable power supply and an accurate voltmeter such as an automotive analyzer you may calibrate as follows. Apply 11 volts DC across the circuit and zero the meter with R4. Turn the supply to 16 volts and adjust the meter to full scale using R2. Repeat the procedure to be sure the settings are correct. Remember you must set R4 first then R2.

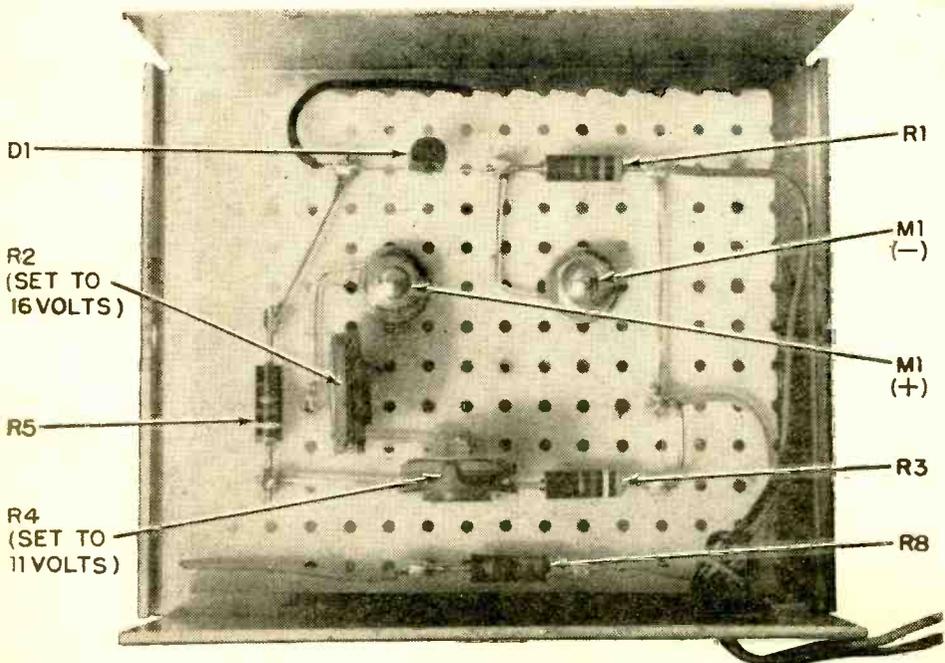
If you don't have a power supply use the following procedure. Disconnect the R3 end of the voltage divider. Connect R1 to the positive terminal of your car battery and the circuit ground to the negative terminal. Connect two 9-volt batteries in series with the negative end going to ground. Connect the positive end of this 18-volt battery through the 820-ohm resistor to the



**Pre-drill a pair of holes in the perf board; slip it over the meter lugs. The two nuts on each lug permit varying the mounting height.**

open end of R3. Adjust R4 to zero the meter; then connect the 18-volts through the 160-ohm resistor and set R2 to make the meter read full scale. Repeat to check settings. Using silicone adhesive or other suitable glue, cement the knobs of the potentiometers in place. Reconnect R3 to the circuit.

**Installation And Use.** Connect the positive lead of the meter circuit to a spare accessory terminal on the ignition switch. If this is not available, the lead to the radio will do. The ground lead goes to some con-



**Very simple layout uses push-in clips for stable mounting of the few parts used.**

venient chassis ground point; try under the head of a screw in the dash. When the key is turned to the accessory position (with none of the car's electrical equipment turned on) the meter will read the battery voltage. A fully charged battery will be above 12.5 volts. A reading of less than 11.5 volts (with no load) indicates a discharged battery.

Start the engine and run it for a few minutes at moderate to high idle. The meter reading under these conditions should be 13.5 to 14.4 volts for most cars. In colder temperatures the readings will be higher. A reading of over 15 volts indicates the regulator probably needs adjustment. Rapid fluctuations in the reading while driving could mean a loose alternator drive belt or an open stator winding or even an open diode.

A test of the battery's capacity can be performed as follows. Crank the engine with the starter for three seconds. If the engine starts turn it off immediately and turn the key to the accessory position. Turn the lights on low beam and watch the meter reading slowly drop. If, after one minute with the lights still on, the voltage drops below 11.7 the battery should be checked.

**Vehicle Maintenance.** Fan belt tension is critical with the alternator. Always make sure the belt is in good condition and ad-

justed to specification.

Following adjustment of the fan belt, turn your attention to the regulator. Make sure all connections at this unit are tight. Then check the battery terminals where high resistance could be causing the trouble. Remove the cables and clean the terminals and posts. Make sure the ground cable is clean and tight. Finally, check at the alternator for loose connections.

If trouble still persists, replace the brushes in the alternator since poor contact between brushes and slip rings is a major factor for a low charging rate. In some cars, the brushes can be removed from the alternator with the unit in the car. This is done by unscrewing the external cap screws to which the brushes are attached. In other cars, the unit must be removed from the car to reach the brushes, which can then be unscrewed.

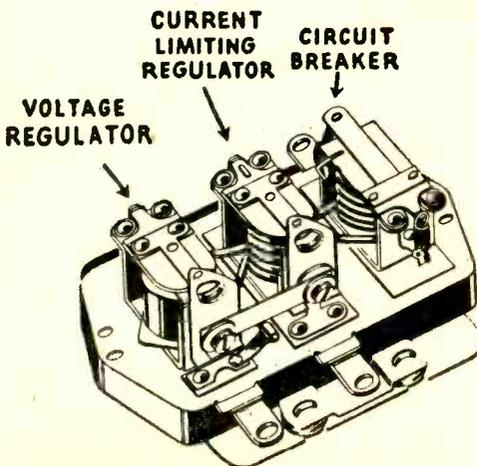
If you still have poor alternator performance remove the alternator from the car and check the stator. Open windings cause an unsteady, low charging rate. If it is necessary to take the unit apart, remove it from the car and split it open, separating the stator from the rotor. Test the rectifiers first. This can be done with a commercial diode tester, although you can also use any continuity tester, such as an ohmmeter or a test lamp.

If a diode is defective, it must be replaced. This requires special tools and should be left to a professional shop.

If the meter indicates low charge rate at all speeds and you get a run-down battery, which indicates low voltage output, hook the negative voltmeter lead to the battery's negative post and the positive to the positive post. Connect a jumper wire from the ignition terminal to the field terminal on the regulator and then start the engine. The voltmeter should read about 14 to 15 volts for a 12-volt charging system. If not, the regulator is faulty. If you have a mechanical regulator, try adjusting the regulator points; if that does not increase the voltage output, you probably need a new regulator.

But if the regulator does check out, go to the alternator and tighten all connections. The trouble could also be a shorted rectifier, or grounded or open stator, so check them as well.

I'm sure that when trade-in time for your car comes one of the first things removed will be the voltmeter. ■



Three-unit regulator used with a generator consists of sections that provide limiting of current and voltage, and circuit cutout.

# Peek -a- boo TV Eye



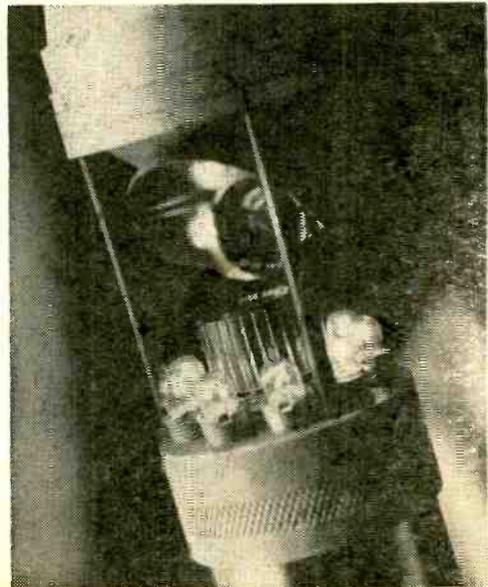
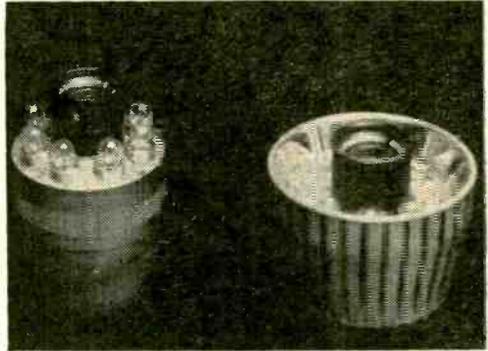
by Janus Kodrun

□ Look, here's the leak. A pin hole about 12 feet, 3 inches from the pipe entrance." An engineer just located the trouble that plagued his power plant for months, and it was done while the pipe was still inside a hot boiler with only a 2-inch bore in which to look. Impossible? Nope, it's very easy with a TV camera with only 1½-in. diameter.

The camera is designed to visually look inside objects that previously had to be dismantled for routine maintenance checks. It focuses from 0 to infinity and gives a truly remarkable definition on a television or video-tape screen. There are five basic lens attachments which can be fitted to the solid-state camera body. These lenses vary from special units designed to throw light back onto a subject between the light source and the lens and units which have rotating attachments allowing controlled 360 degree internal vision.

Attached to the camera and lens is a cable which can vary in length from 50 to 450 feet. The cable connects to a control unit, which is linked with the TV monitor. The system works  
*(Continued on page 98)*

**One in the eye for science. A young lady offers a close-up of her eye indicating possible surgical training to large audiences (top). The 360° rotating eye lens (bottom) permits pipe scanning continuously as camera is advanced into tube. And, illuminating heads (middle photo) offer correct lighting for the various lighting situations met.**



# NOW you can train at home building a NEW 25" DIAGONAL Solid State Color TV engineered by NRI for learning and trouble-shooting

*So much better for learning TV servicing than any hobby kit, because NRI designed and created it as an educational tool.*

Unlike hobby kits which are designed for creating a TV set as the end product, NRI built its exclusive 25" Diagonal Solid State Color TV kit as a real training kit. You can introduce and correct defects . . . for trouble-shooting and hands-on experience in circuitry and servicing. The kits include a wide-band oscilloscope, color bar crosshatch generator, transistorized volt-ohmmeter and other valuable equipment that can soon have you earning \$5 to \$7 an hour servicing color sets in your spare time.

**Handsome woodgrain cabinet, at no extra cost. (Offered only by NRI)**

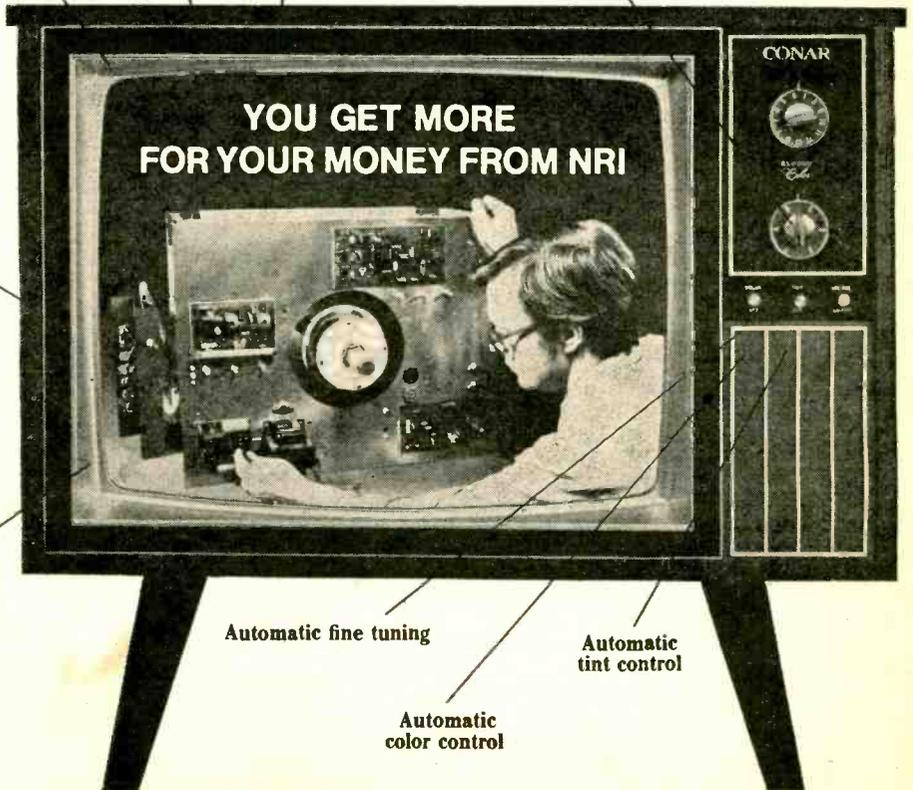
**New square-cornered Sylvania picture tube**

**100% solid state chassis**

**6-position detented UHF channel selector**



**Modular construction with plug-in circuit boards**



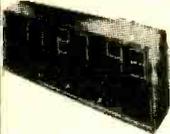
**Automatic degaussing**

**Automatic fine tuning**

**Automatic tint control**

**Automatic color control**

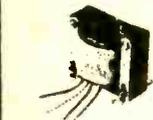
### GIANT NIXIE CLOCK KIT



For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

Giant Nixie Clock Kit ..... \$99.50

### 24 VOLT 5 AMP XFORMER



We have just received a truckload of these high quality computer specification transformers. The floors are groaning and we are selling them at a LOW-LOW price just to clear them out. Excellent for Power Supplies, Audio Amps.

24 Volt 5 Amp Xformer ..... \$3.95  
 5 for \$15.00, write for prices of Mfg. quantities

### LIGHTED PUSH BUTTON SWITCHES WITH INSERT



These large lighted push button switches measure 1.7" x 1.4" inches, include clear plastic cap so that legend can be inserted inside. Includes two 12 volt bipin bulbs. Contacts are DPST. If cap is inserted upside down, switch section becomes inoperative, an excellent safeguard for burglar alarms, etc. for people who don't know the "trick".

Lighted push button switch ..... \$1.00 each  
 Write for production prices ..... 10 for \$7.50

### HEAVY DUTY DATA TERMINAL POWER SUPPLY



Originally manufactured for use in Data Terminals, these are rugged conservatively rated power supplies for continuous duty operation. The original cost of these supplies was \$278.00. All outputs are regulated to  $\pm 5\%$  by a constant voltage transformer, and, in addition two of the outputs are regulated to 0.2% by solid state regulators. Circuits are protected by fuses and circuit breakers. Two types are available.

\*Type 'A' 24 VDC @ 1.6A  $\pm 0.2\%$ , 26.5V @ 3.25A  $\pm 2\%$ , 18VDC @ 6.6A  $\pm 5\%$ , 14V @ 2.9A 0.2%, 12VDC @ 1A  $\pm 5\%$ . Price ..... \$29.50

\*Type 'B' Same as above except includes 5VDC @ 3.25 Amps, instead of 14V @ 2.9 AMPS ..... \$34.50  
 Shipping Weight—30 lbs. either supply

### TESLA COIL KIT



Here's a truly basic kit for those who like to "roll their own". All the parts for an exciting adventure into high-frequency, high voltage. Add your own metal housing — a small chassis or universal box is ideal.

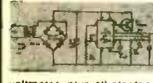
Tesla coils are patterned after the design of Nikola Tesla (1857-1943) an American electrical genius who built versions many feet tall. His dream was to light and power entire cities with energy radiated from such coils — but no luck!

Today's Tesla coils are popular with experimenters and students, and especially for science fair and educational demonstrations. Ours is a high-frequency push-pull oscillator coupled to a television flyback transformer, which steps up an external 12 VDC power supply to many thousand volts.

**SPECIAL NOTE:** Although current output is relatively low, some hazard is inherent in all high voltage devices. This kit is intended for the experimenter who is mature enough to observe reasonable precaution in its use.

TESLA COIL KIT ..... \$7.50

### POWER SUPPLY KIT



This kit includes 24 Volt, 5 AMP heavy duty transformer, Bridge rectifier, 8,000 MFD capacitor, 722 regulator, pair of 2N3055 transistors, D.C. voltmeter, plus all electrical circuit breaker parts to build a complete regulated laboratory supply

\*Lab Supply Kit ..... \$19.75  
 Shipping Weight 20 Lbs.

### CLOSEOUT — CALCULATOR KIT



B and F was one of the first (if not the first) to introduce an under \$100.00 calculator. Now that all the giant corporations have introduced theirs, we feel it's time to move on to new kits and let the "Biggies" slug it out. We have enough parts for about 200 more calculators, which we are closing out at \$54.50 each. Floating point eight digit display, constant capability, sealed elastomer keyboard,

molded ABS case, uses (4) standard AA cells, 14 hour battery life.  
 Pocket Calculator Kit ..... \$39.50

### STEREO TAPE CARTRIDGE PLAYER



High quality tape cartridge player has built in preamps, and requires only 115V 60Hz for motor and 12 volts for electronics to operate, four light indicators indicate channel selected. Output compatible with amplifier "Auxiliary" inputs. Here is the inexpensive high fidelity way to play those tape cartridges for your car player in your home.

Stereo Tape Cartridge Player ..... \$15.00

### REVERBERATION UNIT & SPEAKER



Useful in conjunction with music synthesizers, organs, and to add "presence" to music. This complete reverberation unit requires only a source of 12 Volts to operate, might also be useful for other acoustic delay experiments. Includes high quality oval ceramic magnet speaker, brand new, originally made to sell for \$24.50, now at a price you would pay for the speaker alone.

Reverb Unit ..... \$6.95

### 1 MHz FREQUENCY STANDARD CRYSTAL

This is a 1,000,000 MHz Crystal  $\pm 5$ Hz,  $\pm 0$ Hz. Can be pulled to exactly 1 MHz  $\pm 0$ Hz with 5-30 PF trimmer. Excellent temperature coefficient. OD 4007 makes excellent Oscillator, buffer. Circuit included. Super LOW price while 2,000 PCs last.

\*1 MHz Crystal Standard ..... \$4.50

### QUARTZ CRYSTAL CHRONOMETER

Revolutionary, was the reaction of our customers when they saw this kit. Measuring only 2 7/8" x 2 3/8", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechanical clocks in cars, boats, and airplanes.

Fits into a standard 2 7/8" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e., replacing battery in car). This clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligible power drain. The low price is only possible because of a new one chip MOS clock. Operates from 12-24 Volts D.C. An accessory unit which mounts on the back adapts the unit to 2-28 volts for twin engine aircraft and larger boats using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.

Quartz Chronometer, Kit Form ..... \$69.50  
 Quartz Chronometer, Wired ..... \$99.50  
 24 Volt Adapter ..... \$10.00

### NICAD BATTERIES



No need to tell you the uses of these sealed Nickel-Cadmium batteries in all kinds of portable equipment. All brand new except the 0.5 ampere hour, which is removed from new equipment, guaranteed perfect.

Type	Volts	Amps	Price	Size
<input type="checkbox"/> 1.25NCB0.5	1.25	0.5	.50	1 1/4" diam x 5/8"
<input type="checkbox"/> 1.25NCB0.6	1.25	0.6	1.00	Lg. AA
<input type="checkbox"/> 24NCB0.6	24	0.6	11.80	1 1/2" x 1 1/2" x 1 1/2"
<input type="checkbox"/> 8NCB0.6	8	0.6	5.00	5/8" diam x 1 1/2"
<input type="checkbox"/> 18NCB	18	0.5	7.50	3" x 3" x 4"

### LOUDSPEAKER SYSTEM COMPONENTS



We have made an excellent purchase of an excess inventory of a local manufacturer's speaker systems, although we are not allowed to mention (the mfg.'s name, the specs should make it self-evident.

The woofer is a 12" free-edge (acoustic suspension) unit, with 2" voice coil and a No. 2 magnet. The mid-range is a 5" sealed back-speaker and 3 1/2" flare dome tweeter for best high frequency dispersion. Crossover between woofer & mid-range is by an R-L-C network, while high frequency crossover is by an R-C network. Balance controls are provided for both mid-range and tweeter. Plans for a suitable enclosure are provided. The level controls provide frequency response to suit room acoustics, with realism that will delight even the most critical listener. Response — 25 to 250K + Hz., Power — 40 watts RMS. Impedance — 8 ohms. Sh. Wt. 12 lbs.

LSCS ..... \$42.50  
 2LSCS ..... 2 for \$75.00

### RESOLUTION TEST CHART



These 2" x 2" glass plate test charts are excellent for testing enlargers, microscopes, scanners, etc. Original cost to manufacture was over \$60.00. Complete plate is covered with test patterns. Several types available may vary slightly from illustration. A rare bargain.

Resolution Test Plate ..... \$2.50

### HERMETICALLY SEALED FIBERGLASS CARRYING CASES



13" x 30" x 30" brand new luggage type carrying cases were originally manufactured to ship delicate electronic equipment overseas. Excellent for storing, shipping and carrying photographic equipment, instruments, etc. Includes easily removable foam rubber inserts. Original cost to manufacture was \$160.00 would probably be even higher today because of plastics shortage.

Fiberglass carrying case ..... \$25.00

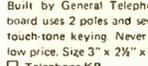
### RESETTABLE FOUR DIGIT COUNTERS



These counters have raised aluminum for print out thru fibrous ribbon, but can be used as conventional counters also. Reset by wheel on side. Coil is 12 volts D.C. may be operated on 115 VAC by diode-capacitor-resistor.

Resettable Four Digit Counter ..... \$2.50  
 Diode-Resistor-Cap for 115 VAC ..... \$5.00

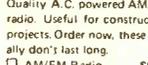
### TELEPHONE TOUCH-TONE KEYBOARD



Built by General Telephone, this keyboard uses 2 poles and seven buses, for touch-tone keying. Never before at this low price. Size 3" x 2 1/2" x 1".

Telephone KB ..... \$4.75

### AM/FM RADIO CHASSIS



Quality A.C. powered AM/FM radio. Useful for construction projects. Order now, these usually don't last long.

AM/FM Radio ..... \$5.75

Send in an order and get on our special customer Mailing List.

CATALOG: Check reader's card or write.

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119 Foster Street

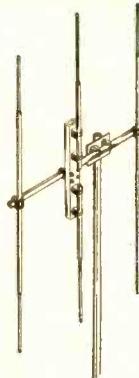
Peabody, Mass. 01960

CIRCLE NO. 26 ON PAGE 17 OR 103

# The CB Antenna With The Highest Gain Any 3-Element Beam Can Produce.

## The Mosley A-311

The renewed popularity of the deluxe A-311 is due in part to its endurance record. A record of ten years of reliable, trouble free performance. Heavy gauge, seamless aluminum tubing is pre-drilled and color-coded for fast, easy assembly. All hardware is 100% rust-proof. Illustrated instructions accompany each antenna. For complete specification and performance data, see your Mosley dealer or write; Dept. 216



**Mosley Electronics Inc.**  
4610 N. Lindbergh Blvd. Bridgeton, Missouri 63044

CIRCLE NO. 13 ON PAGE 17 OR 103



# FREE

## 1974 LAFAYETTE CATALOG 740

Ready Now!

### Your Complete Electronics Buying Guide

- Stereo/Hi-Fi Components • CB Transceivers & Walkie-talkies • PA Systems • Tools & Test Equipment
- Police/Fire Monitor Receivers • Antennas • Photography Equipment • Ham Gear • Books, Parts, and More!

Send Today!

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P.O. Box 10, Dept. 25074  
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CIRCLE NO. 19 ON PAGE 17 OR 103

## DX CENTRAL REPORTING

SPEEDX, American SWL Club, Canadian International DX Radio Club, and Worldwide TV FM DX Association. Younger clubs, more recently established, have won associate memberships in ANARC. They are the Minnesota DX Club, Rocky Mountain DXers Association, SWL International, Transworld DX Club, Triangle DX Club, Virginia DX Association, and Wingate SWL Club.

ANARC also holds an annual DX convention, at some centrally located spot in the U.S. All DXers, whether members of affiliated clubs or not, are welcome to attend. If you'd like information on the various ANARC clubs or this year's convention, drop a note to Al Reynolds at ANARC, Box 433, Peabody College Station, Nashville, TN 37203. Enclose a stamped self-addressed envelope for a reply.

**Information Please.** DXers are information-conscious. To keep up with all the many changes in the broadcasting world—necessary if you want to know how, when, and where to hunt in the radio spectrum for various stations—membership in a DX club is a smart move. There also are many books, booklets, and station lists available that will help you in your hobby. Here are a few of the publications you may want to add to your DXing library:

**World Radio and TV Handbook.** This annual book, published in Denmark but printed in English, is nicknamed "The DXer's Bible." It is probably the one indispensable volume for the SWL. It includes lists of shortwave stations around the world, their frequencies, schedules, addresses, and much, much more. The 1974 edition is priced at \$7.50 and is available from Watson-Guptil Publications Inc., 1 Astor Plaza, 1515 Broadway, New York, NY 10036; Gilfer Associates Inc., Box 239, Park Ridge NJ; and several of the DX clubs previously mentioned.

**Police Call Directories.** If you're one of the growing band of monitors who enjoy listening in on the VHF and UHF police frequencies, these lists may prove useful. For more information, write Hollins Radio Data, P.O. Box 35002, Los Angeles, CA 90035.

**World Utility DX Handbook.** This is probably the best single book available for the guy who is interested in those off-beat, non-broadcast type transmissions on shortwave. There is data on point-to-point communications, aeronautical, marine, weather, military, and many other communications services, including station names, addresses, and frequencies. Plus there are some very useful and interesting feature articles on these stations. It can be ordered for \$7.95 from SPEEDXTRAS, 2318 South Laurel, Port Angeles, WA 98362.

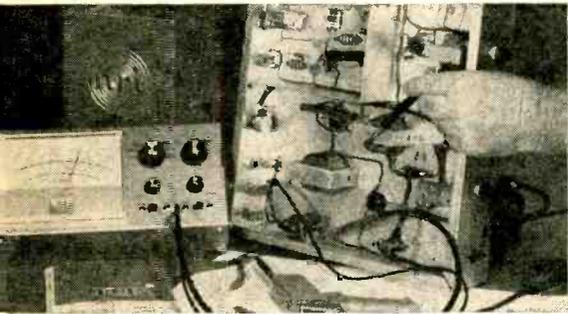
**NRC Domestic Log.** This is a list of medium wave stations in the U.S. and Canada. But besides calls and frequencies it includes data on licensed hours of operation, daytime and night-

(Continued on page 91)

# NRI FIRSTS make learning Electronics fast and fascinating—to give you priceless confidence



**FIRST** to give you a complete programmable digital computer, with memory, you build yourself . . . to learn organization, operation, trouble-shooting and programming. This remarkable computer is one of ten training kits you receive with the new NRI Complete Computer Electronics Course.



**FIRST** to give you true-to-life experiences as a Communications Technician. Every fascinating step you take in NRI Communications training, including circuit analysis of your own 15-watt, phone/cw transmitter, is engineered to help you prove theory and later apply it on the job. Studio equipment operation and trouble shooting became a matter of easily remembered logic.



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You start out with NRI's exclusive Achievement Kit, containing everything you need to get moving fast. Lessons have been specifically written so that experiments build upon one another like stepping stones. You can perform a hundred experiments, build hundreds of circuits . . . as you learn to use the professional test equipment provided, building radios and TV sets, transmitter or computer circuits. It's the priceless "third dimension" in NRI training . . . practical experience.

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Compare training kits, texts, techniques and overall training . . . and you'll find that you get more for your money from NRI. Whatever your reason for wanting more knowledge of Electronics, NRI has an instruction plan that will meet your needs. Choose from major programs in Advanced Color TV Servicing, Complete Computer Electronics, Industrial Electronics and the other special courses designed to meet specific needs. With NRI home training, you can learn new skills while you're still working at your present job . . . and turn yourself into the man in demand.

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a new crew for...

# PIRATE RADIO

**We are Musical Pirates, and very fine pirates are we.**

**We take a stand, the shortwave band we use illicitly, we use illicitly!**

**We are Broadcast Buccaneers, and very fine rock play we.**

**Our programs cool, against the rule, defy authority, defy authority!**

by **Don Jensen**

**A**POLOGIES to Gilbert and Sullivan, but if those Victorian worthies were alive today, thus might they musically describe a curious broadcasting phenomenon of the 1970's.

A few years back, Europe's state radio monopolies battled mightily against a rash of unlicensed commercial shipboard stations operating from international waters. Eventually, most closed down, following passage of the Treaty of Strasbourg by most of the

western European nations. Among other provisions, the pact threatened a crackdown on firms which advertised over the unlicensed stations. Recently, Holland became a signatory, apparently sealing the doom of the few remaining off-shore commercial pirates.

But just when the battle seemed won, a new challenge appeared, a new brand of illegal broadcaster. A musical pirate is the way one fellow describes his station. They

are also called hobby pirates, independent or free radios, bootleggers and other names, both proud and profane, depending on one's point of view.

**No Commercials.** Unlike the commercial pirate stations, the hobby-types are shore-based, though some pretend to be broadcasting from the high seas. They air no commercials so the real teeth in the Strasbourg pact, penalties for advertisers, leave nary a mark on these elusive little shortwave stations. With no need to reach a large audience of consumers, these stations can operate with erratic and abbreviated schedules, making them exceedingly hard to track down.

These hobby stations, it seems, broadcast mostly for the amusement of their own announcers and engineers; they transmit for *fun*, not *funds*.

Efforts by the various governments to stamp them out vary from desultory to vigorous. Aware of their precarious position outside the law, most of these broadcasters prefer anonymity.

"We have to be very careful over here as the fines are pretty large," worries Steven M., of the British pirate *Radio City*.

**From The Inside.** Without condoning their activities, but with the promise of confidentiality regarding names and locations, we persuaded a number of the radio pirate chiefs to open up and tell us the inside story. Most of our contacts were young, high school or college age, though a few were professional electronics men in their late 20's.

The *raison d'etre* for their stations? Part of it seems to be a widespread attraction of playing disc jockey. For the electronically-inclined there is the satisfaction of building and running a professional-sounding broadcasting station.

**Music, Music, Music.** There is a feeling

that the pop and avant-garde tastes in mood-ern music are not fully appreciated by the state-run radio networks. A few, but only a few, pirate broadcasters have political motivations. The phenomenon has also spread to the Soviet Union.

"Can't the authorities do something against the activities of radio hooligans whose number is catastrophically increasing?" wailed a writer in a Soviet newspaper recently.

In Moscow and southern Russia, illegal stations with names like Dragon, Ninochka, Radio Demon, Flying Skeleton and Parasite proliferate. American correspondent Murray Seeger has reported that in one Soviet region, 115 illegal broadcasts were heard in a five-hour period.

The Kremlin contends these stations wander about the shortwave spectrum, interfering with aero navigation signals, rail traffic transmissions and even the home service of Radio Moscow. A hard line approach has resulted in arrests, but as soon as one is silenced, another appears.

In defense of the radio hooligans, an anonymous youth complained to a Russian newspaper that the region's only radio club doesn't give young people access to transmitting gear.

"There is absolutely no chance to acquire proper radio habits. And for this reason, the boys do things they shouldn't, just out of boredom!"

**All Over.** Elsewhere in Europe, upward of 40 hobby pirates have been heard in recent months. Some are one-shot affairs while others have demonstrated some staying power. Some use medium-wave frequencies but a growing number favor a small segment of frequencies from about 6,220 to 6,320 kHz. European DXers have learned that Sunday morning, from about 1000 to 1200 GMT, is the time to tune these sta-

**Radio Gemini** QSL

50 Hempstead Road, Watford,  
Hertfordshire, England

We thank you for your reception of this transmission on

FOR INFORMATION ONLY

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QSL FROM DATE AS 11 73

**TOWER RADIO**

*Sample*

the sound of international  
broadcasting

FREQ. 6240 kHz      ADDR. 339, barley Road  
9790 kHz 15W.      Nottingham  
**POWER 220 KW.**      ENGLAND.

**Amateur shortwave broadcasters leave modulated-oscillators behind and step up to the not-so-legal world of Pirate Radio plus QSL cards. Look closely; that's a 220 watt power!**

## PIRATE RADIO

tions. Power-wise, most run about 30 to 60 watts, but a few claim to have 100 or 200 watts going for them. And watts was what got one of them, *World Music Radio*, in hot water last year.

*World Music Radio*, the undisputed granddaddy of all the hobby pirates, operated under various names from the Netherlands for a solid decade until its demise in August 1973. It is said that Dutch radio officials knew all about the station, including its location, but looked the other way. WMR's programming was never disturbed. Never, that is, until the British filed a complaint.

According to a WMR spokesman, a decision by the Dutch to close down the station was "the direct result of a so-called complaint from the BBC in the United Kingdom." WMR termed it "an extraordinary example of unjustified meddling in the affairs of another country by a powerful organization, apparently motivated by sheer prejudice against a young pioneer whose only 'crime' has been to bring fresh ideas into the shortwave radio profession."

The usual explanation for silencing unlicensed stations is that they cause interference to authorized communications on the same or adjoining frequencies. Admittedly this sometimes has been the case. But with *World Music Radio*, some insiders contend, it was an increase in the station's power to several hundred watts that prompted the British complaint.

Christopher E., an English pirate broadcaster, says, "I think they were silenced because their success encouraged other stations to take to the air."

*Island Troubles.* If so, the complaint may have come too late to accomplish the purpose. Today there are numerous radio pi-

rates in the British Isles. In recent months there have been reports of shortwave stations such as Radio Yorkshire, Radio Apollo International, Radio Atlantis North, Radio London International, Time Radio, Radio Lancashire, Radio Venus North and Liberty Radio, to name a few. Hobby pirates have also turned up in Holland, West Germany and Sweden.

Typical of British shortwave hobby broadcast stations, though perhaps more professional than most, is Tower Radio.

Like many, it is a two-man operation, one engineer, one deejay, Chris E. and Peter L., in this case.

Chris, a professional radio engineer, teamed up with Peter back in 1971, to put a 15 watt, 49-meter band transmitter on the air. It was called *Radio East Anglia*. When its tests drew only two listeners' letters, it left the air. The following year, the same duo initiated a factory-hospital closed-circuit broadcasting system called *Tower Radio*. After five months this too folded for lack of audience participation and a dispute with the factory management.

In 1973, *Tower Radio* turned up on a shortwave frequency of 6,225 kHz, and later on 6,240 and 6,260 kHz. It now operates with a 220-watt crystal-controlled transmitter. With good modulation and professional quality studio equipment, its "sound" is said to rival that of many small U.S. AM radio stations.

A smaller operation is *Radio City*, which broadcasts from somewhere near Birmingham. Steve M., the station's engineer, says the transmitter's power recently was upped to 65 watts on 6,240 or 6,260 kHz.

*There's More.* Two British college students are the powers behind another station, *Radio Gemini North*. One of them, Jim L., says his partner attends a different university so *Radio Gemini North* broadcasts on 6,240 kHz only when both return home for

(Continued on page 85)

radio gems! every Sunday

**Gemini**

SOUNDS OF SOLID GOLD  
on  
**49**  
metres

Pirates often stick together in a small part of the 49-meter band. Should, by chance, two stations use the same day to broadcast, one of them simply slips in an alternate crystal 10 or 20 kHz away. There is a surprising degree of informal cooperation among hobby radios.

# e/e checks out the...



## **B&K TRANSISTOR EQUIPMENT ANALYST**

**Multi-function device serves as Transistor Tester, Ohmmeter, Voltmeter, RF Signal Generator, Audio Oscillator, Milliammeter, and DC Power Supply with outputs to five amperes at fifteen volts.**

**W**E WOULD BE RICH if we had a dollar for every time someone said, "Sorry, but I can't service transistor radios." Or, "I'd like to help you out but I just don't have the right equipment to fix your pocket radio." It's no longer a joke when we're told it's cheaper to buy a new radio than pay someone to service solid-state equipment.

But that's all behind us now, for B & K's Model 970 Transistor Equipment Analyst makes troubleshooting any solid-state radio, FM receiver, or amplifier a snap. Whether you're a hobbyist, service technician, or run a school laboratory, the B & K 970 takes the troublesome time and effort out of servicing transistorized equipments.

The 970 combines several individual instruments specifically tailored for solid-state servicing into one cabinet. First, there is a switch-selected power supply of 1.5 to 15

volts DC at currents up to 5 amperes. A "bias" supply allows servicing equipment which utilizes a "tapped" (dual voltage) power source.

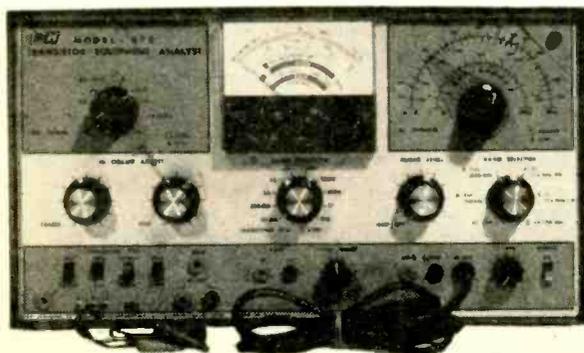
Next comes a VOM for up to 500 volts DC, 5 amps DC, and three ranges of resistance. The VOM also doubles as the indicator (readout) for a built in in-and-out-of-circuit transistor tester. The meter scale is calibrated to read directly in *Beta* without the need to fuss with calibration controls. Calibration is required only when testing a transistor in-circuit.

Finally, we come to the signal generator section—which accommodates AF (audio frequency), AM modulated RF, and FM modulated RF. The AF generator serves as a modulator for the RF and FM signal generators and can be modulated on unmodulated as needed by the user. The RF signal generator covers a frequency range of 250 to 2000 kHz, 10 to 11.4 MHz and 88 to 108 MHz in four bands. The output level is adjustable and can be used for signal in-

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The B&K Transistor Equipment Analyst Model 970 is from Dynascan Corporation, 1801 W. Belle Plaine, Chicago, IL 60613. Price is \$250.00.

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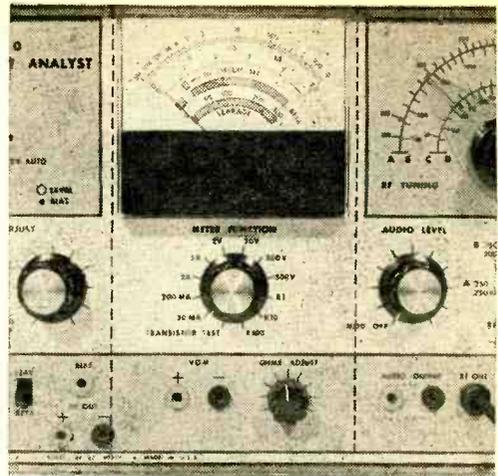


Front panel appears jam-packed with controls, but a closer look shows they are area grouped for individual circuit functions. Right side is used for the signal generators. It has AM for testing standard broadcast and shortwave radios, as well as FM for your use in testing FM radios. It even has a modulated FM IF test frequency (10.7 MHz) for signal tracing or audio output level alignment of standard FM sets. Circle 11 on Reader Service Page.

# e/e B & K 970 ANALYST

jection or RF and IF alignment. Two bands comprising the AM band (standard broadcast) and normal radio IF frequencies cover 250 to 2000 kHz AM modulated or unmodulated. The third band covers 10 to 11.4 MHz AM or FM modulated for checking and aligning shortwave radios or FM radio IF amplifiers. The final band covers 88 to 108 MHz FM modulated for checking and aligning FM receivers.

**Easy To Use.** What is surprising about the B & K 970 is not how much test circuitry is packaged in one cabinet, but rather how well the controls have been placed and designed. Each test circuit is broken down to its individual front panel layout so that the user can use each function as a separate item of test equipment. At the upper left of the front panel is the power supply selector providing ten calibrated test voltages. In actual fact, the calibrations are correct only when the power supply is delivering its rated current. When the current is substantially less than rated for the particular output voltage, the voltage at the output terminals is several volts higher than the calibration. In typical use the user would meter the output voltage (with the built in VOM) and bring up the selector switch from zero until the desired voltage was obtained. A small knob concentric with the voltage selector switch provides a continuously variable bias output



The entire center section of the Transistor Equipment Analyst is the high quality Volt-Ohm-Milliammeter (meter is D'Arsonval type).

voltage whose maximum value is equal to that of the switch-selected output voltage.

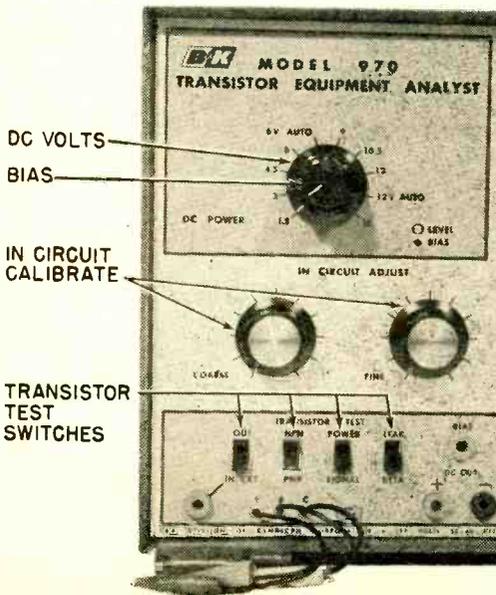
Directly below the power supply selector are two calibration controls for the in-circuit transistor test. Below these controls are the transistor NPN PNP selector and in-circuit/out-of-circuit transistor test switches. The transistor tester has attached clip leads and a test socket mounted on the panel.

The entire center of the front panel contains the VOM—the meter, range switch, ohms adjust and probe terminals. The meter scale has a good-bad transistor calibration as well as a direct readout in *Beta* (depending on the particular type of test you run).

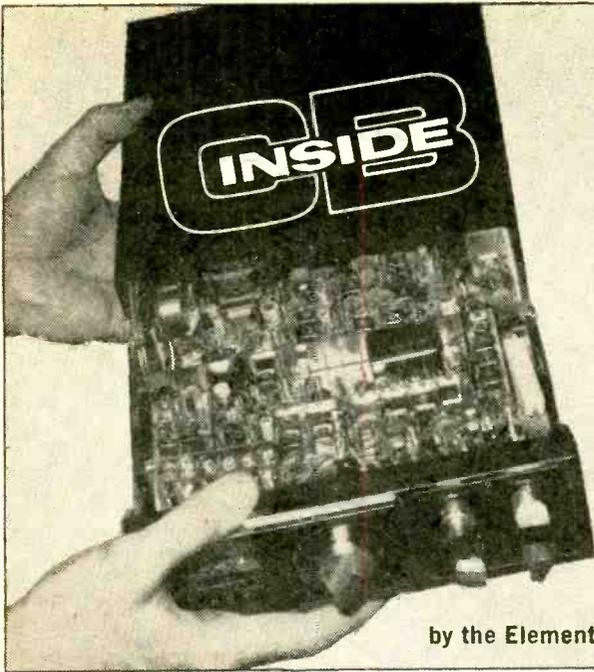
The right side of the front panel is for the signal generators. At the top is the vernier-tuned RF frequency dial calibrated in four bands. Directly under the dial are the controls for the audio signal level and the frequency/AM-FM modulation selector. Finally, along the right bottom edge are the audio signal output jacks, the RF output cable, the RF level control and the power switch.

What's nice about the instrument-group arrangement is that each function can be used independent of the others. For example, if you are using the signal generator you can also use the VOM, or the transistor tester at the same time. Or use the generator to check one radio or amplifier while the power

*(Continued on page 100)*



Text gives more details, but basic transistor test procedure gives "good" meter indication when probe is touched to transistor base lead.



# DISCOVER YOUR CB RECEIVER

We take a look  
inside your set  
to show what makes  
a good receiver tick!

by the Elementary Electronics Editorial Staff.

□ Of all the circuits that go into a CB transceiver—whether AM or SSB—it is those which make up the receiver section that most directly determines the final communications performance, for it is the receiver which determines if you can hear the other station—and if you can't hear 'em you can't work 'em.

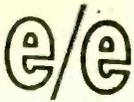
The receiver must perform two basic functions. First, it must receive the weakest signals possible, for the better the weak signal reception the greater the overall communications range; second, the receiver must be responsive only to the desired signal, rejecting all signals—such as atmospheric noise or radio transmissions—other than those appearing on the tuned channel.

Receiving the signal is primarily the job of those circuits we group as the *front end*, which consists of an RF preamplifier broadly-tuned for maximum gain at the CB frequencies, a mixer, and a crystal controlled oscillator. A typical front end block is shown in Fig. 1.

**Just What Happens?** The RF amplifier amplifies the weak received signal to a usable level, discriminating against those signals which lie outside the citizens band. Unfortunately, an amplifier tuned to 27 MHz isn't too effective at discriminating between CB signals and signals close to the citizen band; in fact, it has no discrimination at all against adjacent or alternate CB channels.

If an RF amplifier were used to provide all the receiver gain, the user would hear every signal on the band—all at the same time. So, it becomes necessary to convert the 27 MHz CB signal to a *lower* frequency signal, for the lower the frequency of a radio amplifier, the greater is its inherent discrimination against adjacent and alternate signals. If the tuned frequency of a radio frequency amplifier is made sufficiently low (or with the use of special filter devices) it is actually possible to completely separate two *adjacent* signals, such as from channels 9 and 10. The lower frequency amplifier which provides selectivity and gain is called the intermediate frequency, or IF, amplifier.

**How It's Done.** The front end components termed the *mixer* and *oscillator* convert the 27 MHz RF amplifier's output to the IF frequency. Assume the desired signal is 27.065 MHz (channel 9), and the IF frequency is 455 kHz. We would select a crystal for the oscillator that would produce an oscillator output frequency 455 kHz above 27.065 MHz (27.520 MHz). We could also use an oscillator frequency 455 kHz *below* channel 9; it wouldn't make any difference for this simple illustration. Now, both the RF amplifier output of 27.065 MHz and the 27.520 MHz oscillator are fed into the mixer where they beat together to produce new frequencies equal to the sum and difference



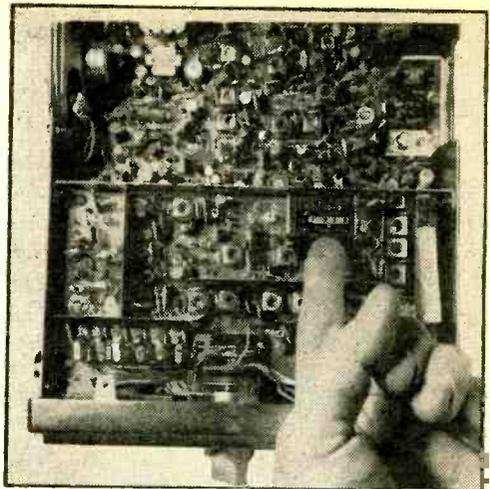
## YOUR CB RECEIVER

of the two input frequencies. The output of the mixer will consist primarily of four signals, the original 27.065 and 27.520 MHz, the sum of the two which is 54.585 MHz and the difference or the two which is 455 kHz. (Aha!). The mixer's output is then fed to a circuit *tuned* to 455 kHz. Of the four mixer output signals, only 455 kHz is passed by the tuned circuit; this is the signal which is fed to the IF amplifier.

**The IF Amplifier** provides most of the receiver's gain and all selectivity. IF amplifier systems used in CB equipment are either single or double conversion, though there have been a few models in the past which went so far as triple conversion. The important point to bear in mind about single vs. double conversion is that it really bears no relationship to receiver performance other than *image rejection*.

A simplified single conversion IF consists of an amplifier and a tuned circuit, as shown in Fig. 2. The input tuned circuit is really the same tuned circuit as used for the output of the front end. The IF amplifier's output tuned circuit feeds the detector, which separates the modulation from the radio frequency signal, passing the modulation on to audio amplifiers and finally, the loudspeaker.

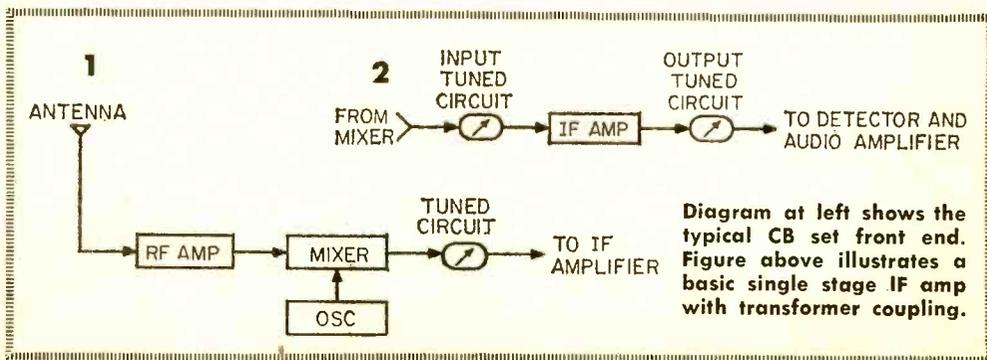
The selectivity of the IF amplifier is determined by the tuned circuits; greater selectivity is attained by using more tuned circuits. Additional tuned circuits are generally added in conjunction with more amplification, and a typical IF section from a moderate cost CB transceiver would more likely resemble Fig. 3—two IF amplifiers with three tuned circuits. This arrangement is commonly used, and provides some 20 to 25 dB adjacent channel rejection.



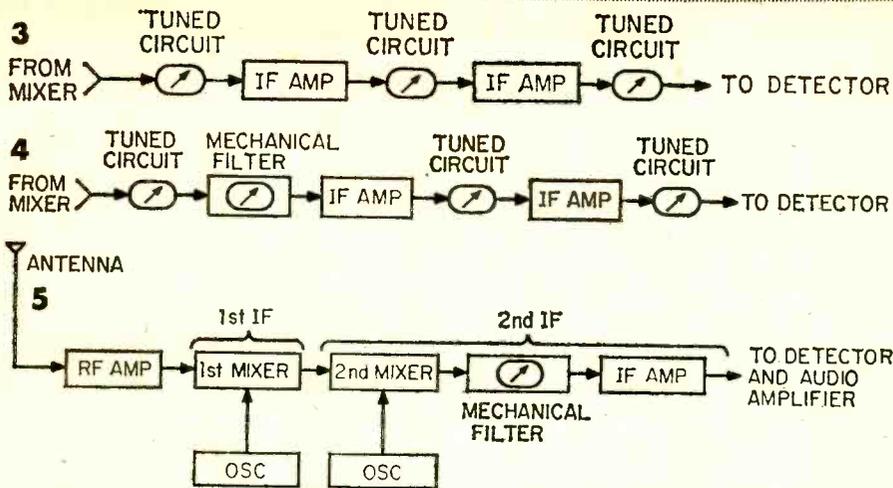
**Crystal filters like one in this Hy-Gain single sideband transceiver promote economy and excellent performance.**

To attain even greater selectivity requires more tuned circuits, of a type which are relatively expensive. Recent developments in mechanical and crystal filters (and ceramic tuned circuits) allows extra selectivity to be built into a receiver at substantially reduced cost and complexity compared to specially coupled tuned circuits. The most common super-selective device is the mechanical filter—which is found in everything from budget priced walkie-talkies to high performance base stations. As shown in Fig. 4, the mechanical filter can be “dropped” into an existing IF amplifier design, and though easily added to the design, the filter increases adjacent channel rejection from something like 25 dB to 45 dB or better.

In some CB transceivers the entire IF amplifier looks like not much more than a single transistor. This “transistor”, in fact, is an integrated circuit which represents not only all the IF amplification but the detector too. The only thing the IC doesn't have



**Diagram at left shows the typical CB set front end. Figure above illustrates a basic single stage IF amp with transformer coupling.**



Mechanical and crystal IF filters are added to basic tuned-circuit IF system

is tuned circuits for the necessary selectivity. The selectivity is almost always accomplished through a mechanical filter, so that the entire IF "strip" boils down to one small package for the mechanical filter and one for the IC. (That's a whopping savings on components.)

**Double Conversion.** The important justification for a double conversion IF strip is for the reduction of image interference. Double conversion means two IF frequencies; for example, the 27 MHz CB signal might be stepped down to 10 MHz and then to 455 kHz. Most of the amplification and almost all the selectivity is contributed by the second (low frequency) IF amplifier. Figure 5 shows a typical double conversion IF amplifier. Note that the first IF is simply a mixer—it is not even an amplifier; it functions as an intermediate step for the signal between the front end and the second IF.

Figure 6 shows how image interference

is created, and why double conversion is needed if the interference is to be effectively suppressed. As you recall, we said the IF frequency—the mixer's output—was created by beating together the desired signal coming from the RF amplifier and the output of the oscillator which is higher (or lower) in frequency. As shown in Fig. 6, if the desired signal is 27.065 MHz and the oscillator output is 27.520 MHz the difference frequency produced by beating the signals together in the mixer will be 455 kHz.

But, if a signal of 27.975 MHz also gets through the RF amplifier, it will also beat with the oscillator signal in the mixer, producing a 455 kHz output for the IF amplifier. The IF amplifier cannot tell which is the desired or interfering signal, so it amplifies both; and the receiver's output is a jumble of interfering signals. The interference signal of 27.975 MHz is called the image signal

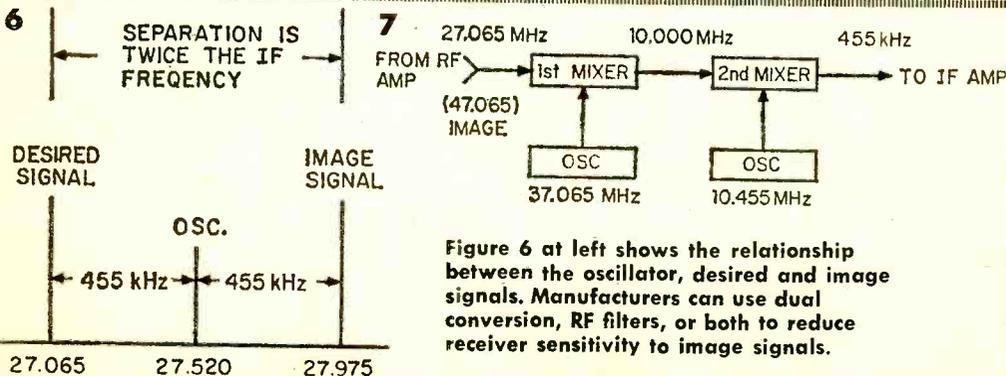


Figure 6 at left shows the relationship between the oscillator, desired and image signals. Manufacturers can use dual conversion, RF filters, or both to reduce receiver sensitivity to image signals.

# e/e YOUR CB RECEIVER

and is always separated from the desired signal by two-times the IF frequency.

The interfering image signal gets through the RF amplifier because the amplifier cannot effectively discriminate between two close frequencies—as we said, practically all of the receiver's selectivity comes from the IF amplifier.

To get around the problem of image interference we go to double conversion, and it works as shown in Fig. 7.

In Fig. 7, the input to the first mixer is 27.065 MHz; the oscillator is 37.065 MHz, producing an IF frequency of 10 MHz. Therefore, the image frequency must be

## There's More CB to Come!

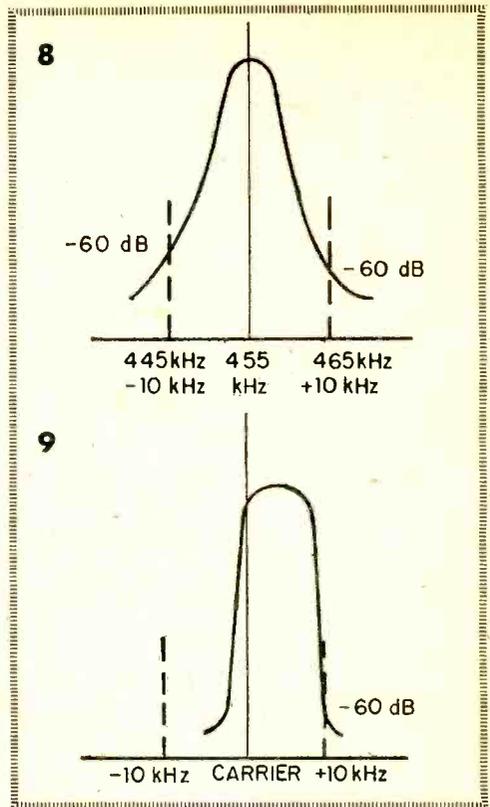
LOOK TO ELEMENTARY ELECTRONICS for the inside theory of Citizens Band Radio. Don't miss articles in this series of Inside CB in future issues. Here's what's in store for you:

**Transmitters.** What does more power mean in terms of signal? Facts about AM over SSB over AM and why each has its place on the airwaves. We show you what, when and how to tune your transmitter for maximum communications performance. And, plain talk on one much maligned mystery: The importance of a matched transmission and antenna system.

**Important Circuits.** What means "Modern" in today's CB transceivers? Find out how a full 23-channel CB of today does away with over 100 dollars worth of crystals—without any loss of frequency stability. Frequency synthesis is the answer; see how it works in transmitters and receivers for your benefit. Quiet is the word for modern sets; see how noise is limited and blanked out of existence for more reliable communications.

**Power Communicating.** What electronic techniques increase range? We show the smart CBER how to get his message through and across more miles without risking the wrath of Uncle and the FCC. Discover how easy it is to understand how clippers, compressors and other talk power boosters are used.

**Moving Out.** What makes a mobile run? This is one of the most important and often used techniques on the Citizens Band. Learn how you should use and install transceivers for maximum performance; how to utilize portable power packs and converters for maximum use in emergencies when line power is out.



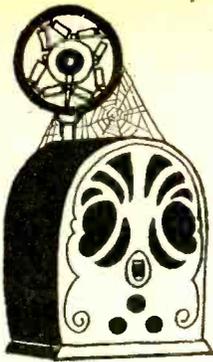
IF response curve for AM (Fig. 8) covers both sidebands. For SSB (Fig. 9) narrow curve shifts for upper (or lower) sideband.

47.065 MHz. Although an RF amplifier's signal rejection is not outstanding near the desired frequency (27.065 MHz) it can effectively reject an interfering signal 20 MHz higher in frequency (47.065 MHz). That part of the 47.065 MHz image frequency signal that *does* get through the RF amplifier is so sharply attenuated that it causes virtually no interference to the desired signal. (An example of typical image rejection performance specifications would be nominally 15 to 20 dB for single conversion IFs and 60 to 80 dB rejection for double conversion. You can see that double conversion IF systems offer considerable image rejection advantages.)

The first mixer's output signal of 10 MHz beat against an oscillator signal of 10.455 MHz in the 2nd mixer, producing the desired IF output of 455 kHz, which is fed to the IF amplifier.

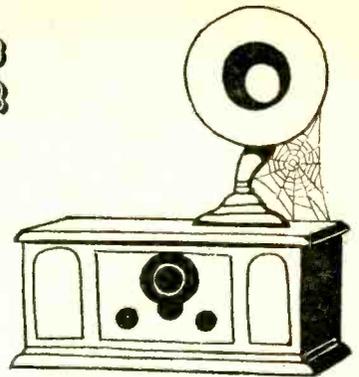
**Selectivity.** The receiver's adjacent channel rejection, known as *selectivity*, is determined, as previously stated, by the IF

(Continued on page 96)



# ANTIQUE RADIO CORNER

by James A. Fred



□ Hello out there in Radioland! We are back again to visit with you and talk about old radio and wireless equipment. I would like to hear from James Blyth. I am holding a Vintage Radio book for him and I need his address so I can send it to him. For those of you who are having a problem getting well-filtered 6 volts DC for your radio filaments you need only call at your local Olson Electronics store. If there is no store near you send for their catalog. They are selling a small 6-volt motorcycle battery that is ideal for this purpose. The price is right too: \$3.49 for one or (if you have a friend who's interested) you can get two for \$6.50. A simple half-wave rectifier and a transformer with about 7.5 volts output will keep the battery charged.

Morgan McMahan has introduced another book which will be of interest to collectors. It is a reprint of S. Gernsback's 1927 Radio Encyclopedia. It is a technical

reference on wireless and presents biographies of the giants of radio history. Its 175 pages cover a thousand subjects in words, pictures, and diagrams. I hope to have a copy to review by the time I write the next column. It will appear in two versions; a hard cover edition at \$12.95 and a soft cover edition at \$9.95. Copies may be purchased from Antique Radio Press, P.O. Box 42, Rossville, IN 46065. It will be shipped postpaid.

The IHRS will be the host for the AWA Summer Conference, on Saturday June 22, at the Stewart Center, Purdue University, West Lafayette, Indiana. A full day's program is planned, beginning at 8:30 AM. An old time receiver contest will be held, there will be a swap session and slide show, and the banquet in the evening will feature Bruce Kelly, Secretary of the AWA, as guest speaker.

*Old Radio Test Equipment* is our fea-

Stomp through your favorite antique radio sources keeping an eye out for period test equipment. You can spruce up your old-time radio gear using restored vintage equipment. Tube tester on left had no identification except the name "Readrite" on meter face. Author bought this Gillette, on right, tube tester for 50¢ and restored it to operation.

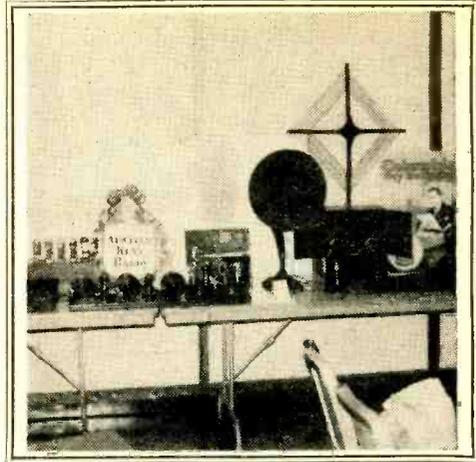


## e/e ANTIQUE RADIO CORNER

tured subject this time. There are two reasons for collecting test equipment. The first reason is because it is closely allied to radio collecting. The second reason is you can use it in trouble-shooting your own non-playing radios. In the earliest days of radio you could fix a radio with only a pocket voltmeter to check battery voltages. However as tubes began to wear out and sets became more complicated simple tube testers were designed and set analyzers came into use.

You can still find some of the real old testers in second-hand stores, flea markets, and antique stores. In one of the photographs you will see a tube tester I picked up in an antique store. There are eight sockets with the type tube each socket will accept stamped into the metal case. A transformer supplies filament voltages while a battery apparently supplied plate and grid voltages. Since there were no instructions with the tester I must assume that the millimeter would read an initial value, the test button was then pushed which applied another voltage to the grid which caused a change in plate current. There must have been a chart that told how much change in plate current a good tube would have. The only identification on the tester is the name "Readrite" on meter face. Since the Readrite Electrical Inst. Co. was in Bluffton, Ohio before and just after WW II, perhaps they made the whole tester.

Another old piece of test equipment shown in a photograph is a Gillette Condenser Tester, also with no address. I don't know if this is a company related to the Gillette Company that makes razors and blades or not. I picked this tester up at an auction sale at the home of a retired radio repairman. I paid 50¢ for it, and all I needed to do to make it work was to put in a neon bulb and to replace two very leaky condensers. It measures leakage at near rated voltage, but doesn't indicate values in microfarads. I compared it's leakage indications against those of a recently completed kit-type capacitor bridge and it was still fairly accurate. The condenser tester uses a 201A tube as a half wave rectifier and with a transformer supplies a test voltage up to 500 volts. If any reader has additional information concerning either of these testers I would appreciate a letter from him.



**Antique radio buffs gather at IHRS meeting and show Atwater-Kent radios, advertisement posters for Eveready and Columbia batteries.**

**The Yaxley Manufacturing Company** was one of the pioneer manufacturers of radio parts. Because I feel it is important for collectors to know the history behind the names they find on parts in their radios I am going to tell you about the Yaxley Mfg. Co. of Chicago. The Yaxley Company was founded in 1916 by Mr. Ernest E. Yaxley. Mr. Yaxley was active in the management of the company until he passed away in 1928. The sales of all the products they made were handled by the Sparrow Sales Co., also of Chicago. Later Mr. Ray Sparrow closed the sales company and became the executive vice-president of P. R. Mallory & Co., Inc.

The Yaxley Company consisted of two divisions when company management decided to sell the company. One division made relays and was sold to Mr. Frank Rowell. This operation is now known as the Guardian Electrical Mfg. Co. About this same time (1931) Mr. Ralph Hill, an employee of the Sparrow Sales Co., went to the Ohmmite Mfg. Co. Several years later Mr. Hill joined with Mr. Gray to form the Grayhill Company. The Grayhill Company makes terminals, test clips, and quality molded switches. Eventually Mr. Hill bought out Mr. Gray and he still operates Grayhill.

The other division of the Yaxley Company manufactured phone plugs, jacks, jack switches, radio convenience outlets, wire wound fixed resistors and potentiometers, shortwave multi-wafer switches, dial light assemblies, and other switches. P. R. Mallory & Co., Inc. purchased this division in No-

*(Continued on page 98)*

# e/e checks out 2-meter FM with...

## Heathkit's HW-202 Transceiver



**Amateur Radio lets you step up to VHF Action!**

**H**OW WOULD YOU LIKE a transceiver package that costs less than \$200, puts out 10 watts RF and delivers solid, legal DX contacts from 200 to 300 miles or more? No, it's not a new CB rig, it's Heathkit's HW-202 2-meter FM transceiver.

What's a 2-meter FM? It's shorthand for narrow-band FM modulation on the 2-meter amateur band, from 144 to 148 MHz. Fact is, 2-meter FM is the hottest thing going in hobby communications today. Because of new rules and new solid state devices it's now possible for a really pocket-size walkie-talkie to communicate reliably over distances almost undreamed of just a few years ago. And you don't hear too much about 2-meter FM because there's little in print outside the Ham publications—keep it small and you keep out the QRM. Yet anyone who has listened in on 2-meter FM gets the itch, and it isn't too long before they're working towards their amateur license so they can get with the action.

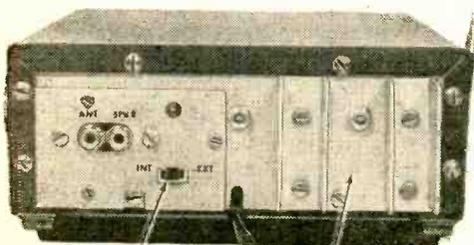
The two meter amateur band has been around a long, long time, and until recently it had about as much use as a rubber raft in

the desert. But in the past few years, thanks to low cost solid-state devices, our country has been covered by a network of repeater stations that have opened up two meters like a road house on Saturday night.

**Try That Again.** Just so you can follow what it's all about, let's take time out to explain a repeater. A repeater is an unattended receiver/transmitter placed atop high buildings, towers, mountains, and in one instance, a bridge. It can receive signals from flea powered transmitters from as far out as 150 miles, and then re-broadcast the signal, simultaneously on another frequency, in all directions for another 150 miles. Under emergency conditions it's even legal for repeaters to re-broadcast through other repeaters; and, in fact, Ham operators in New York use two "connected" repeaters to provide emergency communications for all of Long Island (about 150 miles). This means that a Ham with a flea power walkie-talkie can put in an S9 signal better than 100 miles away.

The repeater stations, which are automatic and unattended are built, installed and maintained by individual amateurs or repeater clubs which might charge a nominal fee of \$3 to \$15 a year for use of the repeater. Most repeaters are open to all, and if you use it you might get a letter for a small contribution (about \$3 per year) towards upkeep.

**Why FM?** The reason for success of the whole bit is the use of narrowband FM modulation—the most reliable in terms of lowest cost. It costs almost nothing to add NBFM to a basic transmitter in comparison to SSB and AM modulation, so equipment costs for a complete base-mobile installation, including antennas which can be a short



INT - EXT SPEAKER  
SELECTOR SWITCH

RF AMPLIFIER  
HEAT SINK

**Earn a Ham license and get on the VHF-High band with solid-state FM gear like this. Circle No. 1 on the Reader Service Page.**

## e/e 2-METER FM HEATHKIT

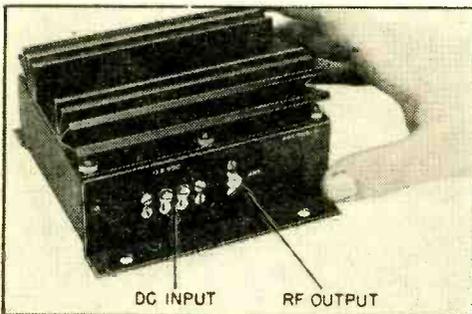
length of tubing, is often less than for any other electronic hobby.

The complete Heathkit 2-meter FM station is an example of the dollar value in 2-meter gear. The basic equipment is the HW-202 2-meter FM transceiver priced at \$179.95. Another \$24.95 gets you a Tone Burst encoder that fits into the transceiver, which is needed to automatically turn on the semi-closed repeater stations. (You pay your fee and you're given the tone frequencies!) If you have no need to work into a semi-closed repeater you don't need the tone burst encoder.

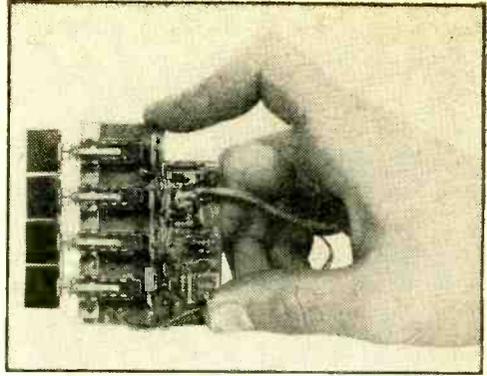
A regulated power supply for \$29.95 lets you use the transceiver in the house. While the transceiver has more than enough power for average 2-meter use because the antenna is usually high and in the clear, some operators like a little extra power in the mobile, and Heathkit has a 40 watt RF output bombshell that can fit right into your car's glove compartment, and it's powered directly by the 12 volt car battery; this powerhouse package tacks on \$69.95 in cost.

But if you want to get with the action without frills, all you need is the basic HW-202 for your car. The HW-202 provides independent selection of six transmit and receive crystal controlled frequencies. (The front panel is pre-drilled for the matching tone burst encoder). The crystal selection is so arranged that one button can select separate transmit and receiver frequencies—such as those used for repeater operation. The unit is normally supplied with one set of crystals for 146.94 MHz—the 2-meter National Calling Frequency.

**Inside Story.** The receiver section fea-



Hams enjoy a 1000-watt maximum power limit. This solid-state equivalent of a "linear" boosts power to about forty watts output.



Heath offers this optional tone generator to give access to semi-automatic repeaters which "open" for the correct "beep" only.

tures a dual-gate FET front end for strong signal overload immunity, a dual conversion IF with a crystal filter and a squelch. Because the modulation is FM, the receiver features the same limiting amplifier and noise reduction detector of the average FM receiver, so impulse noise is not a problem. Actually, the entire IF amplification and detection system is two integrated circuits—how's that for state-of-the-art?

The transmitter features an SWR-proof final amplifier; the transistors will not blow out even if the transmission line completely opens up. Though the transmitter uses 6 MHz crystals, they are, unfortunately, not standard in the sense they are used in other FM transceivers. While you can get the crystals from several sources you cannot get the cheapies, cheap because they are common to several different models. The receiver crystals however, are standard.

**Another Feature.** The narrow-band FM is actually attained by phase modulation of the oscillator through a vari-cap (variable capacity diode), the same technique used in the most modern FM two-way radios and broadcast stations. Though modulation is applied through a speech limiter to insure the greatest degree of talk-power, the HW-202 also employs a pre-emphasis/de-emphasis filter around the limiting amplifier to insure maximum modulation of the intelligence-carrying mid-frequencies. This trick delivers about four times the punch of conventional limiting and is generally found only in the most expensive and sophisticated equipment.

Both the receiver and transmitter crystal sockets have individual trimmer adjustments to "rubber" the crystal frequencies to the

precise center frequency. Because of the very high receiver selectivity found in transceivers such as the HW-202, these adjustments must be made by the user to insure optimum reception at both ends of the contact.

Power is applied to the HW-202 through a built in hash filter (to suppress ignition system interference) and voltage regulator, the regulator insuring that varying battery/charging voltage does not affect the oscillators.

The optional base station power supply provides a regulated and filtered 13.8 VDC for the transceiver. One quick push of the power plug is all it takes to switch from mobile to base operation.

The mobile power amplifier is rated for a maximum of 50 watts output, providing 40 watts when driven by the HW-202. It has a quasi-broadband tuning, similar to the transceiver, and will handle a rather large spread of operating frequencies without need for retuning (a 1.5 MHz band segment). It features RF controlled electronic switching. When receiving, the signal passes from the antenna directly to the receiver. When transmitting, the power amplifier senses the RF output from the transmitter and automatically switches itself into the transmission line.

**Putting It All Together.** The transceiver is best described as a five evening project, and you can't watch TV while putting it together. There are many components and it takes

concentration to get it together correctly (this is not a first-project kit). The transceiver has four basic modules: two large printed circuit assemblies for the receiver and transmitter, a small voltage regulator, and the RF power amplifier. You almost need a shoe horn to get it all into the cabinet, so take extra care to cut each lead to the exact length specified. Even if Heath's photographs of the wiring appears sloppy do it their way—it insures proper operation and assembly.

If you intend to use the tone burst encoder at some future date so you can get into a repeater, we suggest you install the unit while building the transceiver. While the HW-202 has been designed for upgrading at a later date, it's a lot easier to add the encoder while the transceiver is being assembled.

The power supply is a rather easy one-evening project, as is the mobile amplifier.

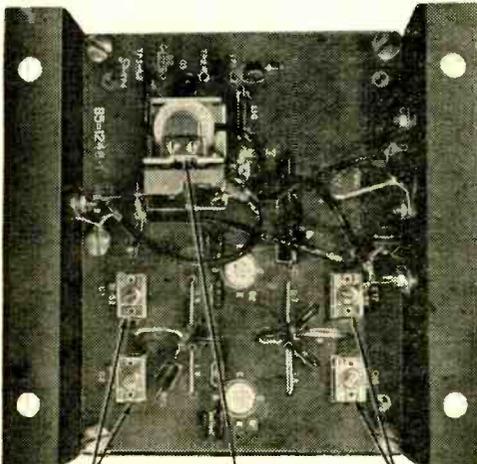
The transceiver alignment is somewhat complex; it can be done either with or without instruments by using the special connections Heath provides for the S-meter, which doubles as a service meter for check-out and alignment.

**Performance Plus.** The entire 2-meter FM station checked out as a real winner. Every aspect of performance checked out to Heath's *minimum* level; somewhat unusual, as virtually every non-instrument aligned project we've tested previously always fell off in at least one performance specification. Of interest, the transmission line we connected to the HW-202 had a dead short (the cable was brand new), which the output transistors took in stride. On-the-air checks were outstanding; the HW-202's signal is all talk power, and we could easily tell when another station was using the same rig. When working the rig into a rooftop halo, we could raise a repeater 50 miles away, and used the repeater to work out another 100 miles or so.

The receiver, which checked out with a sensitivity less than 0.5  $\mu$ V (the limit of our test gear) often picked up stations other locals could not even hear.

**Summing Up.** All in all, the complete Heathkit 2-meter FM package, or just the HW-202 alone, is an outstanding value—from the viewpoints of both price and performance. Both are gateways to a whole new world of hobby communications.

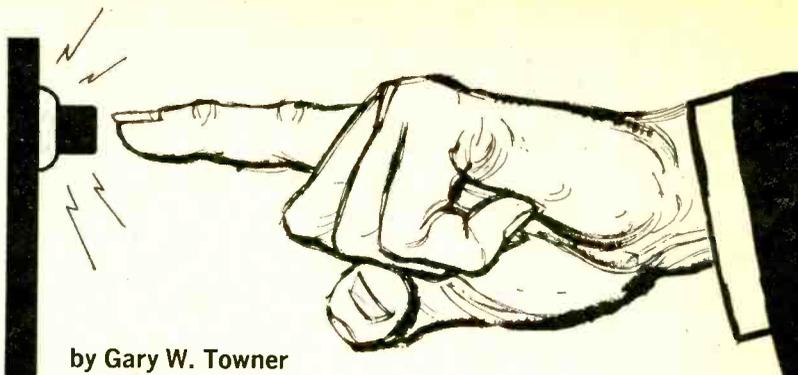
For additional information circle No. 1 on the Reader Service page. ■



TUNING CAPACITORS T/R RELAY TUNING CAPACITORS

Inside the auxiliary RF power amplifier, a transmit/receive relay will automatically switch to transmit when the mike is keyed.

# Pushie Button



by Gary W. Towner

□ *To play this dueling game* two players sit opposite each other with the box in between. To start the game, the on-off-reset switch is closed and each player puts his hands in his lap. At the count of three each player hits his button. The first one to do so is the winner of the round as indicated by the lamp opposite his button. After each round, S3 must be turned off, then on to reset the lamps.

**How It Works.** Refer to the schematic diagram; each of the two lamps is returned to the negative of the battery through a silicon controlled rectifier (SCR). Such rectifiers are special in that a positive voltage between gate to cathode must exist before current can flow from the anode to the cathode. One other feature of the SCR is that once anode-to-cathode current flows it continues to flow no matter what is done to the gate voltage.

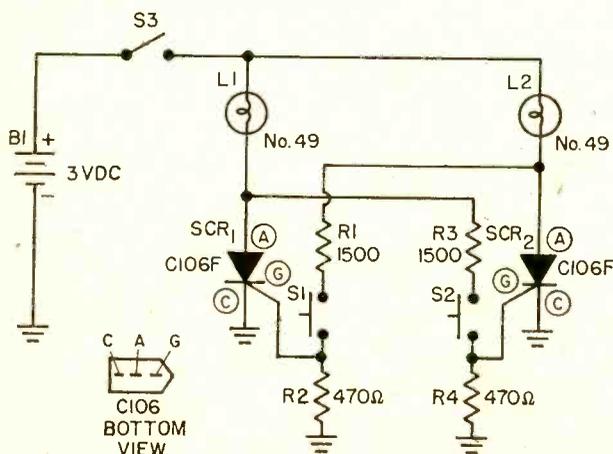
Suppose S2 is pressed. Current will flow through L1, R3, and R4. While this current is far too low to light L1, it is sufficient to develop a voltage drop across R4. With SCR-2 turned

on in this way, L2 will light.

If S1 is now pressed, very little current can flow through R1 and R2 because SCR-2 is turned on and represents, for all practical purposes, a short to ground. Therefore, not enough positive voltage can be developed between gate and cathode to turn on SCR-1. Of course, if S1 had been pressed first, L1 would be on and L2 off.

**Construction Details.** The wiring layout is not at all critical. You can use perf board or not, as you wish. Remember, the smaller the box, the more sporting the game. Dress up the metal front panel with self-adhesive shelf paper for good looks.

It's an exciting pushbutton gadget you can build for players of all ages. With a handful of parts and a few hours work anyone can construct this electronic game. By the way, the first player to achieve a ten-round win is the winner of the series and becomes eligible to participate in the annual Boardinghouse-Reach "grab-the-spuds" contest. ■



## PARTS LIST FOR PUSHIE-BUTTON

- B1—3-volt battery (two D-cells in battery holder such as the Radio Shack 270-1439)
- L1, L2—Low power #49 lamps (Radio Shack 272-1111 or equiv.)
- R1, R3—1500-ohm, ½-watt resistor (Radio Shack 276-000 or equiv.)
- R2, R4—470-ohm, ½-watt resistor (Radio Shack 276-000 or equiv.)
- SCR1, SCR2—Silicon controlled rectifier (General Electric C106F2 or equiv.)
- S1, S2—Normally open pushbutton switch (Radio Shack 275-609 or equiv.)
- S3—Spst slide switch (Radio Shack 275-401 or equiv.)
- Misc.—Utility box, lamp holders such as Radio Shack 272-318, wire, solder, etc.



by Kathi Martin KAI0614

# KATHI'S CB CAROUSEL

**W**ITH GIANTS OF INDUSTRY conspiring to ripoff the public for the absolute necessities of life such as heating oil, electricity, food and clothing, there's not much, if anything, left in the weekly paycheck to cover the not-so-absolute necessities such as education, family vacations and CB gear.

Because much CB gear is manufactured overseas in countries hard hit by the footsie being played by oil companies and leaders of a few cockamamie oil producing countries, the average CB'er finds that "gold plated special" he's been saving for is now priced out of reach.

But if we look inward, to equipment manufactured right here in the U.S.A., we can still find outstanding buys in CB equipment, such as the Pace 223 full-23 mobile transceiver. Would you believe full 23 channel coverage with *all* crystals, quick-release (locking) mobile bracket, 50 dB of adjacent channel rejection and a 1.0  $\mu$ V sensitivity for only \$139.95?

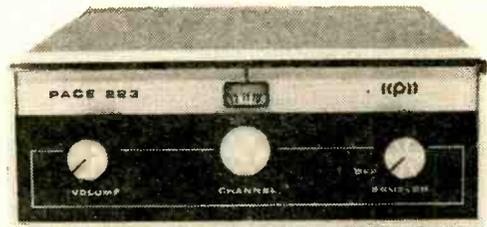
**How Does Pace Do It?** By eliminating the fancy frills, features many of you don't need, and using a Plain-Jane utility cabinet (did you know that a fancy cabinet and chromed knobs can represent \$25 or more of the total transceiver price?).

The Pace 223 has only the features needed for reliable all-channel CB communications. The front panel has a *channel selector*, *volume control* and a *squelch/power-switch control*. The microphone is attached to the rig by a "Koil-Kord." The rear apron has only a connected 12-volt DC (negative ground) power wire and an antenna jack.

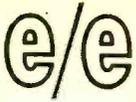
The Pace 223 Citizens Band 2-way radio is from Pace division of Pathcom, Inc., 24049 South Frampton Avenue, Harbor City, CA 90710. Price is \$139.95.

That's the whole bit! No S-meter, no external speaker or P.A. output jacks, no noise limiter switch—nothing but the hardware needed for reliable two-way radio communications. The only frill—if you'd call it a frill—is a quick release mobile bracket with a ring for a padlock. To remove the rig—say, for protection from night-crawlers with two legs—the user simply releases the power-wire fuse holder and the thumb latch on the mobile bracket. The bracket springs open and the rig pops out into your hand. For moderate protection you can insert a small padlock through a ring in the thumb latch.

**Down To Basics.** The receiver section is double conversion with a simplified bandpass filter which provides a relatively high degree of selectivity. Our own lab tests showed a receiver sensitivity of 1.0  $\mu$ V for a 10 dB signal plus noise to noise ratio (S+N/N); selectivity was 50 dB; image rejection was 38 dB; AGC action was 9 dB—meaning a signal input range of 80 dB produced an output signal variation of 9 dB. While 9 dB AGC action is considerably more than the nominal 3 dB common to most solid state receivers, it is about the value for the better



With prices going up and up it's nice to know Pace still provides a good buy in CB with equipment made in the United States. More info? Circle number 6 on Reader Service Page.



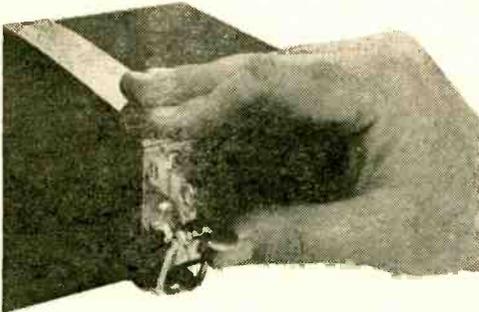
## KATHI'S CB CAROUSEL

quality tube transceivers and is quite satisfactory.

The transmitter delivered 2.5 watts RF output into a 50-ohm dummy load. The microphone input sensitivity for 100 percent modulation was -38 dB, which is about 10 dB more sensitive than the average transceiver. Full modulation can be attained with a voice level little more than a whisper (the transmitter is not limited to 100% negative peak modulation).

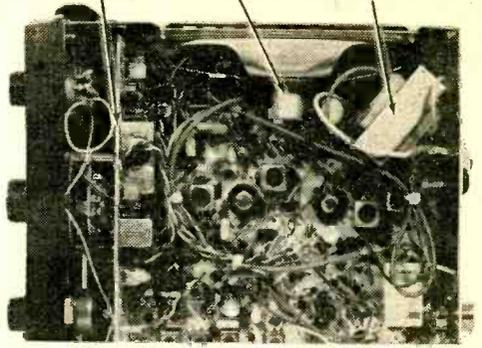
The overall transmit sound quality was good. The received sound quality was similar to that of an intercom—a lot of midrange and virtually no bass (which, of course, is good).

**More Economy Facts.** The rather high level of performance at a notably low price is attained through several circuit short-cuts which lower the overall cost *without* degrading final performance. For example, unlike most other CB transceivers which utilize a Class B modulator for low idling current, the Pace 223 uses a Class A amplifier to eliminate one power transistor. While a Class A amplifier has what could be termed a substantial idling current (at full power output and modulation the total current draw is just under 2 amperes) it's certainly no strain for a mobile installation. Though 2 amperes would be a strain for a battery pack made up of "D" size flashlight batteries, the rig isn't intended as a portable to begin with (actually, the total 2-ampere draw of the Pace 223 is only about 0.5 to 1 ampere higher than a "portable" transceiver, so it *could* be battery powered in a pinch).



Burley hand of lab tech flips open mobile quick-release bracket latch. Bet you think operating and testing gear is a lab tech's delight. You bet! Big Herb the lab boss is not about to let anyone forget it, either!

OSCILLATOR PC BOARD    LARGE SPEAKER    MODULATION TRANSFORMER



The fine transmit audio (modulation) is due in no small part to a modulation transformer with a lot of iron. The speaker, which is a 2-in. x 6-in. oval job, is mounted on the driver's side so the received signal heads toward the driver rather than to the floor.

In a similar manner, the tuned-circuits used to provide extra selectivity in the Pace 223 perform as well as a mechanical filter, so savings are again passed along to the consumer.

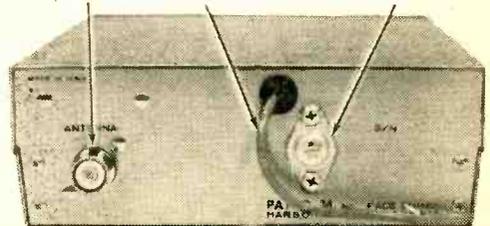
As far as overall construction is concerned, the Pace 223 uses the same U-type main-frame common to most other mobile transceivers; savings are realized through unadorned lightweight covers and a straightforward front panel—neither of which have the least significance as far as performance is concerned.

**Summing Up.** With inflation driving the price of everything sky-high, the Pace 223 shapes up as forerunner of things to come in CB—good performance at low cost—by eliminating unneeded features, frills and decorator-designed cabinets.

For more information on the Pace 223 circle No. 6 on the Reader Service Coupon.

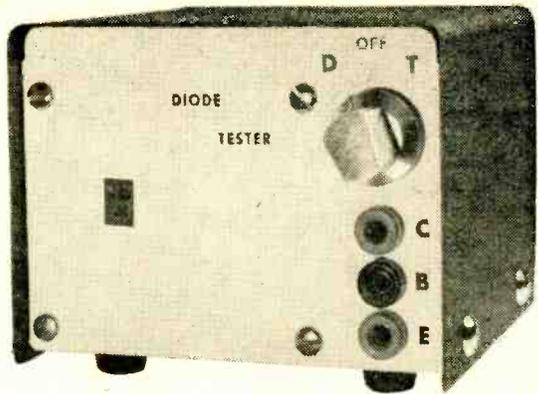
In the uncluttered no-frills tradition of Pace's 223 CB transceiver, you find only a single audio power transistor that uses the chassis as a heat sink, and a coax antenna jack.

ANTENNA OUTPUT CONNECTOR    +12 VDC POWER CORD    CLASS "A" AUDIO POWER OUTPUT TRANSISTOR



stamp out  
semiconductor  
bugs with our...

# ELECTRONIC DDT



This Digital Diode Tester spots  
NPN and PNP transistors, too!

by Charles Rakes

□ JUST HOW MANY bullet diodes, miniature glass diodes, epoxy encapsulated diodes, unmarked diodes, gunn diodes, 10-for-a-buck diodes, unbanded diodes and stripped-from-equipment diodes have you run into? If you wanted to use any of these don't-know or not-sure-what-they-are diode types, you've had to drag out the ohmmeter for a front-to-back resistance check. Nothing wrong with that, of course. But here's an easy-to-build and inexpensive digital IC gadget that blinks an **A** or **C** in a little window to tell you if the end of the diode you've selected is the *anode* or the *cathode*.

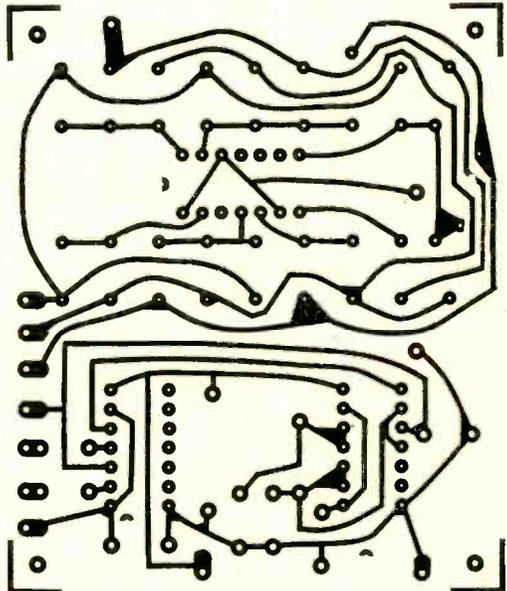
And if that's not enough for you, plug in an unknown transistor and the same window will come up with an **N** or a **P**—you guessed it—to tell you what type you have: NPN or PNP! If you try to fool this gadget with an open transistor, it pops up an **A** (for throw it away?) in the window for as long as you keep it there. (If an open diode is tested, the readout doesn't budge from its normal 8. A shorted diode blanks the display window for as long as the diode is connected.)

So, if you have ever wished for a simple gadget that would indicate the type of transistor, either PNP or NPN, if it has gain, and what lead of a diode is connected to the test terminal, wish no more, for this DDT will test almost every type of transistor made including germanium, silicon, low, medium, and high power devices. As we said, if the transistor under test is good, the readout will indicate a **P** for PNP transistor, and an **N** for a NPN transistor. The readout will

indicate an **A** for an open transistor, and will distinguish for a shorted transistor.

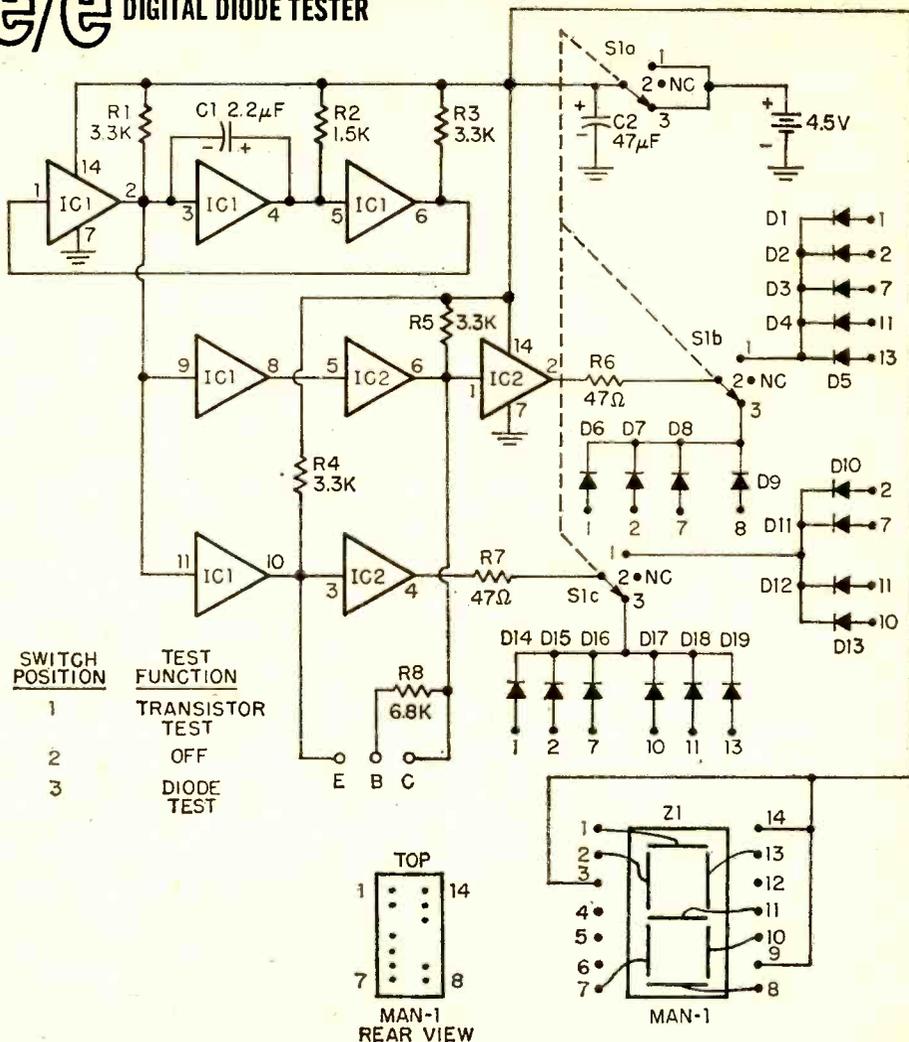
You can turn your white elephant collection of goodies into useable items by spending less than \$20.00 and about four hours building an all-digital diode tester of your own. We believe you will agree that this tester is the most valuable transistor and diode tester available for twice the money.

*How The Circuit Operates.* One-half of



This actual-size printed circuit board is available pre-etched and pre-drilled. See the parts list for source and order info.

# e/e DIGITAL DIODE TESTER



## PARTS LIST FOR AN ALL-DIGITAL DIODE TESTER

- B1—4.5-volt battery (three AA cells in series)
- C1—2.2  $\mu$ F tantalum dip-coated capacitor, 6 VDC or better (Sprague 196D225X0025HA1 or equivalent will fit circuit board. Use any convenient size for point-to-point wiring.)
- C2—4.7 or 5  $\mu$ F electrolytic capacitor, 6 VDC to 50 VDC, (Radio Shack 272-1001 or equiv.)
- D1 to D19—Silicon diode, 1N914 or equiv. (Radio Shack 276-612 for a package of 10 untested diodes. Check F/B ratio with ohmmeter before using.)
- IC1, IC2—TTL hex inverter, open collector, type 7405
- R1, R3 to R5—3300-ohm,  $\frac{1}{2}$ -watt resistor (Radio Shack 271-000 or equiv.)
- R2—1500-ohm,  $\frac{1}{2}$ -watt resistor (Radio Shack 271-000 or equiv.)
- R6, R7—47-ohm,  $\frac{1}{2}$ -watt resistor (Radio Shack 271-000 or equiv.)
- R8—6800-ohm,  $\frac{1}{2}$ -watt resistor (Radio Shack 271-000 or equiv.)
- S1—Rotary switch, 3-pole 3-position, non-shorting
- Z1—Readout, 7-segment LED type (Opcoa SLA-1, Monsanto MAN-1 or equiv.)
- Misc.—Cabinet  $\frac{1}{4}$ -in. x  $\frac{3}{8}$ -in. x 4-in deep, hardware, 14-pin IC sockets (Radio Shack 276-027 or equiv.), battery holder (Radio Shack 270-1434 or equiv.), knob, banana plugs (Radio Shack 274-721 or equiv.), banana jacks (Radio Shack 274-725 or equiv.), wire, solder, etc.

An etched and drilled printed circuit board for this project is available for \$3.75 postpaid from Krystal Kits, 2202 S.E. 14th Street, Bentonville, AK 72712. Canadian orders, add \$1.00 extra. No foreign orders, please. Speedy service offered when postal money order accompanies order. Otherwise, allow 6 to 8 weeks for delivery.

IC-1 operates as a ring oscillator. The output of the oscillator drives two sets of inverter stages.

A test terminal marked C is driven through two inverter stages, while the E terminal is driven with only one inverter. This makes the voltage present at terminal C always opposite to the voltage at the E test terminal. When a diode is connected (with the anode at the C test terminal) the output of the inverter, IC2 pin 4, is low pulling the six segments to battery negative. These six segments form the letter A for anode. The same is true when the cathode of the diode is connected to test terminal C, but the output of another inverter, IC2 pin 2, goes low making the letter C appear. At the same time the other inverter that produced letter A goes high turning off the segments relating to that letter only.

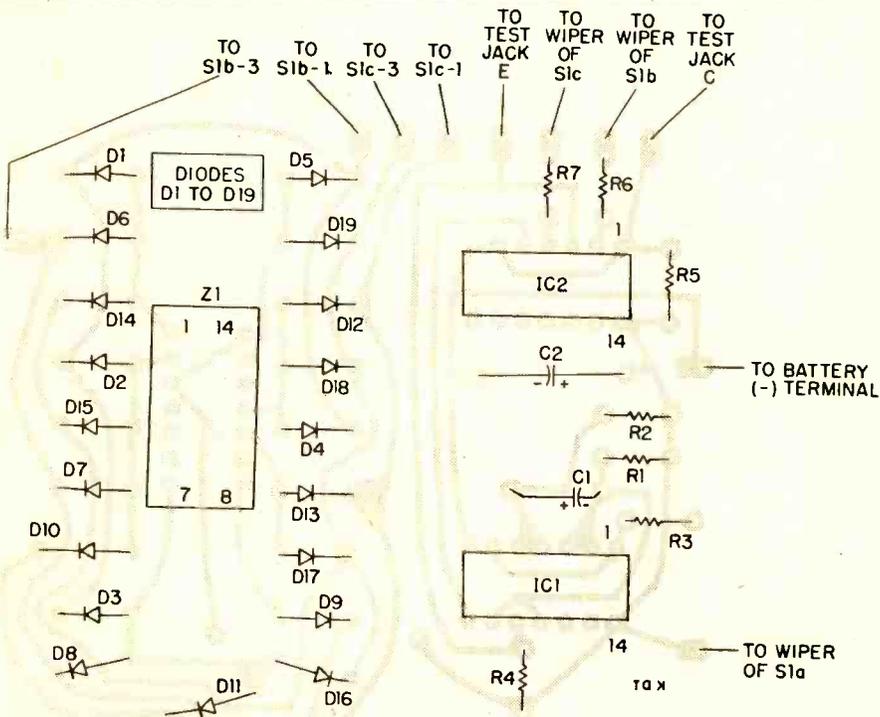
Transistors are checked in a similar way when S1 is in the transistor test position, but the base is included by biasing it from the collector test terminal through current limiting resistor R8. This allows the NPN transistor to conduct only when its collector

is positive, and a PNP transistor when the collector is negative. The inverters are connected to the proper diodes (through S1) to cause the letter P to light on the readout for a PNP transistor, and the letter N for NPN transistors. The tester is powered by three 1½-volt penlight cells.

**Building Your Own.** The circuit is a simple one and can be constructed on perfboard or printed circuit board; the choice is yours because the layout isn't critical and the circuit will work in most any configuration.

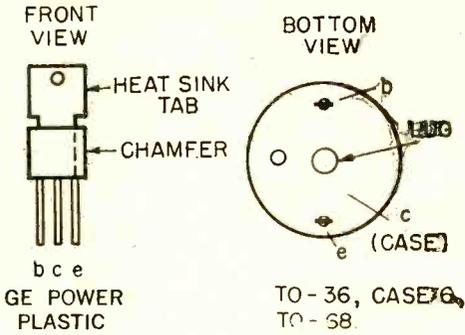
If a printed circuit board is used and the author's model copied, a metal or plastic cabinet about 4¼ x 3½ x 4-in. in size should do fine for an enclosure for the tester. If the kit of parts is used, just follow the layout of the author's model, and be very careful when soldering the semiconductors in place (if you are not using IC sockets) to avoid heat damage.

A printed circuit or perfboard is mounted to the front of the cabinet with a rectangle hole cut out on the LED readout (use a nibbler tool). This hole can be cut out and filed to a neat window for the readout. The

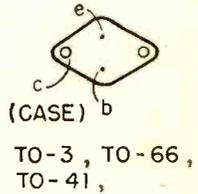
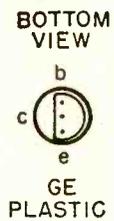
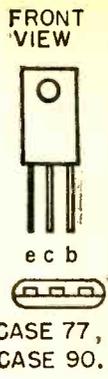
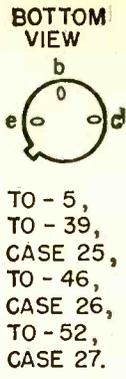


This is the component (top) of your printed circuit board with an X-ray view of the copper pattern. In addition to components illustrated above, be sure to supply battery power to the LED readout by including a jumper wire between the two empty pads shown.

# e/e DIGITAL DIODE TESTER



To be sure you have the correct transistor leads connected to your tester, here are some of the more common transistor base pin configurations. Get more base diagram data from the Motorola HEP Cross-Reference and Archer Transistor Substitution Guide.



three penlight batteries are located near the back of the bottom of the cabinet. The selector switch may be mounted in any convenient location.

**Initial Checkout.** With the batteries in place, switch the selector switch to the "D" position (diode test) and connect a good diode to the C and E test terminals.

The readout should present the letter A or C to correspond to the lead that is connected to the C test terminal. If the test leads are shorted together, the readout

should go dark, and with the leads open the readout should display an eight.

The only precaution to take when testing transistors is to be certain that it is connected to the proper test leads or the test results will be misleading. A group of the most common transistor base diagrams is shown. If the transistor to be tested falls into one of categories, no difficulty will be had in determining the type of transistor and its condition. Put those nameless functions to work for you now!

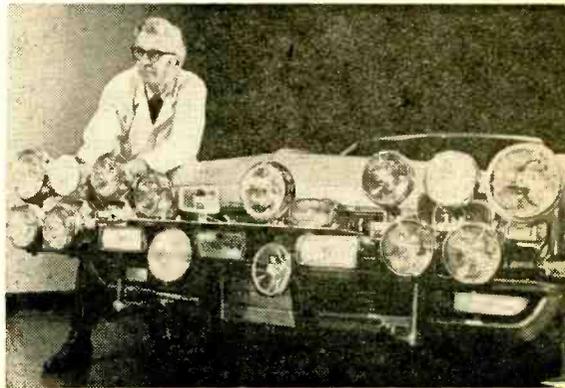
## You Should See It Come Down the Pike!

A car with 19 additional headlamps is holding the key to future car light safety standards. At the Guide Lamp Division plant of General Motors in Anderson, Indiana stands a car with 19 auxiliary headlamps fitted to it. The car is not some bizarre futuristic product, nor is it a racing car; rather, it is a test-bed which may well prove to have a bearing on all headlamp design of the future.

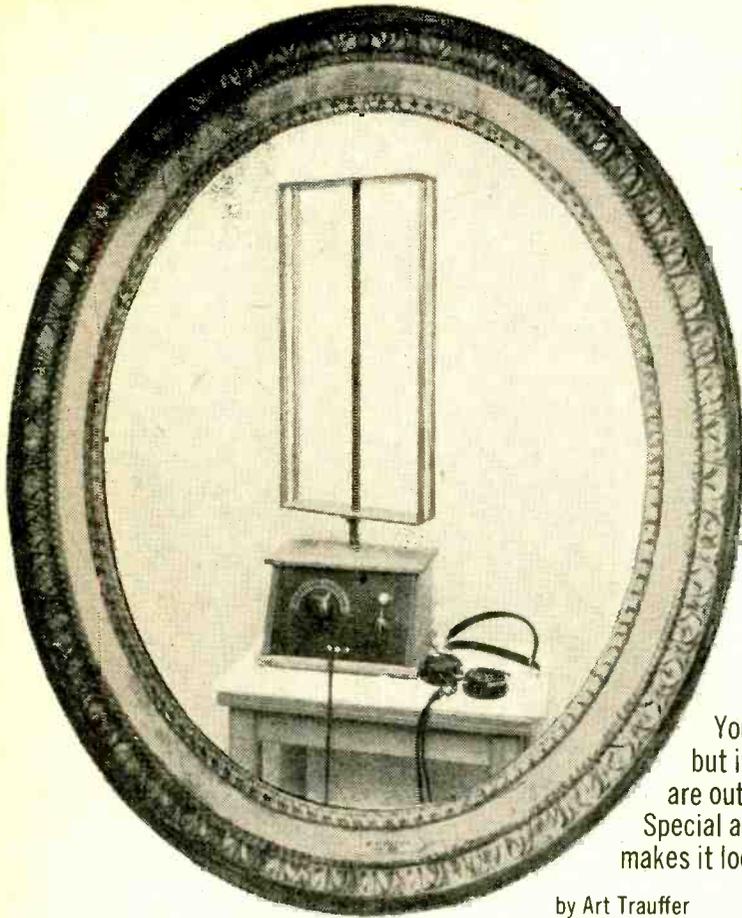
Each of the 19 beams is set up and angled with different intensity lights to try to find the best combination of light power and location which will be needed to cope with tomorrow's traffic and atmospheric problems. It has already been decided that as of 1975 the legal maximum of 75,000 candlepower for headlamp lighting in the U.S. will be raised to a new maximum of 200,000 candlepower.

Other notable changes developed with the multi-light vehicle include a three-beam head-

light and a system of steerable headlamps which follow the direction of the wheels.



# OLD-TIME FLAVOR CRYSTAL RADIO



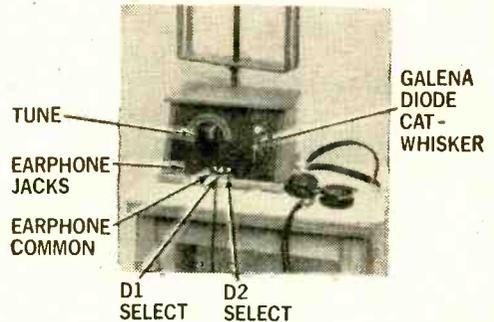
You build this radio with new parts, but its circuit and operation are out of the past. Special attention to cabinetry makes it look the part, too!

by Art Trauffer

**H**ERE'S a crystal radio that needs neither a long wire antenna, nor a wire to the water pipe for a ground. A large coil of wire on top of the radio doubles as both a tuning coil and an antenna. This radio is quite selective because the loop antenna is center-tapped and directional—you can aim the loop at the desired station, thus reducing interference from some of the other stations. This radio looks as though it was made in the early 1920s and is quite a conversation piece; and, it will fit nicely in your home or your school museum. As for performance, I have no trouble separating the six Council Bluffs and Omaha stations. Using a sensitive crystal and a pair of sensitive high-impedance earphones, I can even hear station KMA, Shenandoah, about 45 airline miles from my home—not bad for a crystal radio having no conventional antenna and ground!

**Remember the Loop?** Simply stated, when the loop lies in the *same* plane as the incoming signal wave, that is, pointing to-

ward the radio station, maximum induction takes place in the loop. The current induced by the electrical field in the side of the loop pointing toward the station is *ahead* of the current induced on the opposite side of the loop; thus, a current will flow around the loop as a result of the two induced signals.



**This showpiece project actually works!** Tune in to the AM broadcast band in an authentic twenties style. Two diodes make tuning easy.

# e/e CRYSTAL RADIO

When the plane of the loop is at *right angles* to the station, all points of the loop will be reached by the wave at the same instant, so the induced voltages on both sides of the loop will be equal but opposite in direction and therefore will neutralize, or cancel out.

The loop has less static pickup than a long wire antenna, and there is no lightning worry. The loop is highly directional, and thus more selective, and it lets you tune out interfering stations located at right angles to the desired station, even when both stations are on the same wavelength or nearly so.

**Who Invented the Loop?** No one man can be given credit for inventing the loop antenna. Here's how it happened. Many early "wireless" experimenters noticed that they could faintly hear signals from near-by wireless stations even with the antenna and ground disconnected, and that the signals were loudest when the tuning coil in the receiver was positioned so that the turns of wire in the coil were in the direction of the station. So they figured that the coil itself was picking up RF energy from the station, and if they made the coil larger in diameter, the pickup would be increased. Thus the coil would act as both an antenna and a tuning coil. It wasn't practical to wind coils on large tubular coil forms, so they built large wood frames to wind their coils. So that's how the loop antenna came to be!

## Bill of Materials for Crystal Radio

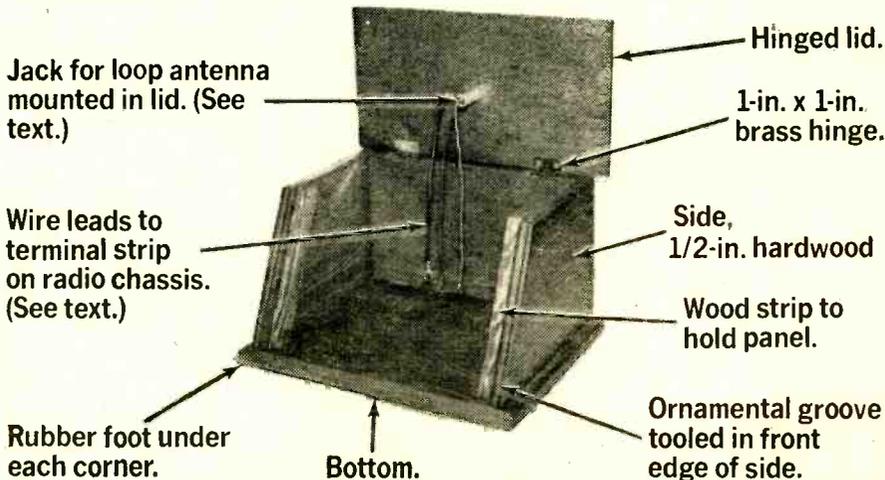
### Material for Cabinet

- Top**—9 $\frac{3}{4}$ -in. x 5 $\frac{1}{4}$ -in. x  $\frac{1}{2}$ -in. walnut, mahogany, or oak.
- Bottom**—9 $\frac{3}{4}$ -in. x 7 $\frac{1}{4}$ -in. x  $\frac{1}{2}$ -in. hardwood.
- Sides**— $\frac{1}{2}$ -in. hardwood about 4 $\frac{7}{8}$ -in. high x 4 $\frac{7}{8}$ -in. at top sloping to 7-in. at bottom. 2-pieces required.
- Back**—8-in. x 4 $\frac{7}{8}$ -in. x  $\frac{1}{2}$ -in. hardwood.
- Front**—8-in. x 5 $\frac{1}{4}$ -in. x  $\frac{1}{8}$ -in. black non-metallic panel (Plexiglas, Formica, hard rubber, Bakelite, or composition board covered with black contact paper.)
- Strips**—12-in. length of  $\frac{1}{2}$ -in. hardwood.
- Misc.**—Nails, screws, wood glue, sandpaper, wood stain, etc.

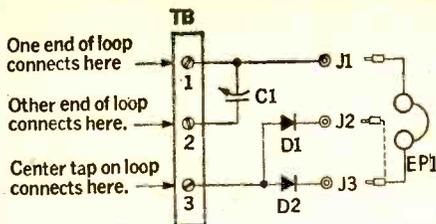
### Material for Loop

- One** 22-in. length of  $\frac{1}{2}$ -in. diameter wood dowel for loop upright
- One** 3-conductor  $\frac{1}{4}$ -in. stereo phone plug (Radio Shack 274-139 or equiv.)
- One** 3-conductor  $\frac{1}{4}$ -in. stereo phone jack (Radio Shack 274-141 or equiv.)
- Two** pieces 9  $\frac{1}{2}$ -in. x 2 $\frac{3}{4}$ -in. x  $\frac{1}{4}$ -in. hardwood to match cabinet wood, if possible, for loop cross-pieces.
- One** 5-in. x  $\frac{1}{2}$ -in. x  $\frac{1}{16}$ -in. brass strap for making U-bracket.
- Misc.**—Hook-up wire, solder, wire for loop antenna (Author used about 100-feet of AC-DC Radio Antenna Wire made by White Electric Cable Co., Haverstraw, NY, or he also suggests Belden 8014 Indoor Antenna Wire.)

**Constructional Details.** A photo gives details for the wood cabinet which features a hinged lid and a slant front, like many cabinets in the early days. I used  $\frac{1}{2}$ -in. mahogany, and after the pieces were cut to size



You who know an auger from a brace-and-bit can duplicate the fine hand-crafted workmanship shown in the author's model. This matching of woodworking and electronics gives you a "period piece" suitable for home display.

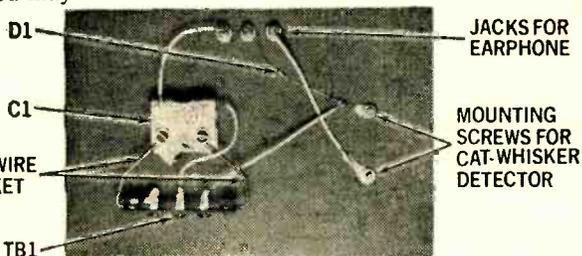
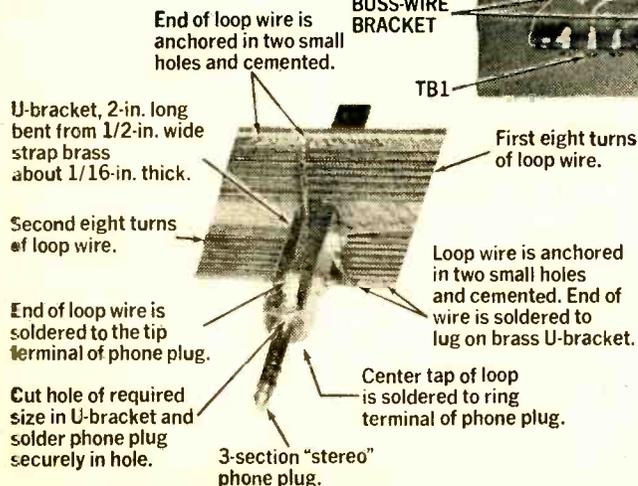


### PARTS LIST FOR OLD-TIME CRYSTAL RADIO

- C1**—365  $\mu$ F variable capacitor (Radio Shack 272-1344 or equiv.)  
**D1**—Germanium diode, 1N34 (Radio Shack 276-821 or equiv.)  
**D2**—Detector diode, galena-and-cat-whisker-type and stand. (Modern Radio Labs type K/D 9-14 stand and 9-1 crystal: Modern Radio Labs, 1477-G, Garden Grove, CA, 92642)  
**EP1**—2000-ohm earphones (Radio Shack 33-180 or equiv.)  
**J1, J2, J3**—Standard phone-tip jack (Radio Shack 274-724 or equiv.)  
**TB1**—Terminal strip with 3 screw-type terminals (Radio Shack 274-664 or equiv.)  
**Misc.**—Wire, solder, lugs, hardware, dial scale and tuning knob (Black fluted tuning knob used by author is Burstein-Applebee 12A34. Author can supply a photo reproduction of an old-time, 0-180 dial scale used in this project for 75¢ and a self addressed stamped envelope; one scale to a customer, please. Send to Art Trauffer, 120 Fourth Street, Council Bluffs, IA, 51501.)

they were sanded smooth and put together using wood screws and small nails and Sears Hide Glue. I used walnut satin, but you may prefer mahogany stain.

**Below**— Phone plug serves as both a swivel-point and three circuit electrical connector.



**Above**—The schematic diagram at the top of the page is so simple you can't go wrong unless you really try! Photo of wiring on back of front panel is above. Fixed detector diode D1 eliminates hunting for that "sensitive" spot on the galena crystal, but sensitivity with fixed diodes is usually lower.

Photographs give most details for the simple receiver; all parts are mounted right on the panel. The black non-metallic panel (like the early days) can be 1/8-in. Plexiglas, Formica, hard rubber, or Bakelite. If you have trouble getting any of the above, use 1/8-in. composition board and cover the front side with black contact paper.

If your variable capacitor (C1) has no mounting hole on the front side of the frame, you will have to drill and thread a hole for a 6-32 x 1/4-in. flat-head screw, or simply glue the capacitor to the back of the panel using a good all-purpose cement.

As stated in the materials list, you can get your galena-and-cat-whisker crystal detector stand from MRL in Garden Grove, California, and also a steel galena crystal. Black fluted tuning knobs are still available and these look much like the knobs of the old days. Make a metal pointer and cement it to the underside of the knob, as shown. The curved metal panel-mounted dial scale, calibrated 0 to 180, is no longer being made, so I made photo reproductions printed on double-weight paper which can be cut out with a pair of scissors and cemented onto the panel. If you want a scale check the parts list for more information.

Note that three phone tip jacks are provided on the panel. When you get tired of hunting for a sensitive spot on the crystal you simply plug one of the phone cord tips  
*(Continued on page 94)*

# THE REASON I CALLED

If you're holding a business conference in London, do



A delegate (above) makes use of his microphone to speak with the chairman of the conference, whom he can see close-up.



□ A new hotel, situated within the confines of London's Heathrow Airport, offers the world's businessmen the most comprehensive and probably the best in-hotel conference facilities in the world. With 66 foreign airlines using Heathrow it is still the busiest international airport in the world. Besides the vast number of tourists who pass into and out of England every day comes a deluge of businessmen who are very often on their way to conferences held in sometimes—by their standards—antiquated facilities. But the wide-ranging use of the latest in electronics gear and closed-circuit TV is changing all this.

Now a hotel, aptly called *The Heathrow*, has opened within the perimeter of the airport itself. The Heathrow has under its roof the answer to those unfortunate conference facilities. A businessman can fly in, stay at the hotel, have his conference there, and fly out—all without ever leaving the airport.

The main conference hall, called the *York Theatre*, seats 262 delegates in plush, ample-leg-room seats. The seats face a 35-foot wide movie screen which is used to transmit pre-recorded information, live interviews, even outside broadcasts. A small panel facing the seat opens out to make a writing surface and reveals the delegate's personal conference console. This



Inside the 250 square foot studio televised interviews are made. These can either be pre-recorded or transmitted live.

# THIS MEETING... ■ By Janus Kodrun

we have the place for you—an electronic palace, yet!



The "York Theatre" can comfortably seat 262 delegates at the same time, each with his own elaborate conference console.

Gustaaf Thies, the Conference Service Manager, is in the producer's chair in the York Theatre control room (above).

consists of a 9-inch television monitor to the right of which is the delegate's response unit, so that he can communicate with the lecturer or chairman of the meeting if he wishes. He can even address the meeting as a whole by pressing a button. Then, standing up as he talks, an automatic TV camera shows the speaker to the other delegates. Simultaneous translations into four languages at a time can be made for those who don't speak English. This, of course, is almost never available as a part of regular conference facilities; it is similar to the simultaneous translation facilities at the U.N. in New York.

An interview or conference can also take place in a side studio involving only a few people. This can be linked into the main hall so that all 262 delegates can listen in and take part.

At all times the big screen and the little screens can be used to show diagrams, figures, or illustrations, all controlled from the control room.

All this is available for the businessman who wishes to get things done quickly and efficiently. And modern electronics makes it all possible. ■

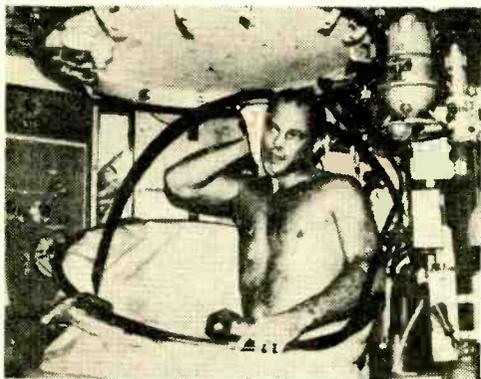


If a delegate wishes to address the conference he can be picked up by one of the three special overhead TV cameras.



## BOOKMARK BY BOOKWÖRM

**Up With Science.** Current studies in laboratories and research centers far from your home may affect the future quality of your health, your diet, your education, your environment, and other aspects of your life. These investigations and discoveries, and their actual or potential application, in the sciences and related fields are examined and explained in Time-Life Books' *Nature/Science Annual 1974 Edition*. The 1974 Edition explores the thinking of en-



Enjoying an unearthly hot bath, Skylab II astronaut Jack Lousma soaps himself in an ingenious shower stall. Because water floats in zero-gravity, the shower curtain must be pulled up for suds to be sprayed off. Photograph from *Nature/Science Annual 1974 Edition*.

vironmentalists who have stopped looking at trash as something to be gotten rid of and started regarding it as a valuable resource. Using in-depth reports and photographic essays, the book probes and interprets current thinking on a wide range of subjects. Included is a discussion of the charting of life in space by the



Hard cover  
192 pages  
\$5.95

noted scientist and writer Arthur C. Clarke; archeological studies of the ancient city of Cahokia—just east of present-day St. Louis—that demolishes the myth of the savage Indian and replaces it with a picture of an inventive, sophisticated culture; the use of an eye-in-the-sky satellite which monitors crop growth and water pollution, and locates mineral deposits; and the gradual "legitimatization" of investigation into such psychic phenomena as ESP and clairvoyance. Throughout, the text is clarified and illustrated with drawings, photographs, charts, and diagrams. The book is fully indexed for easy reference. Published by Time-Life Books, 541 No. Fairbanks Court, Chicago, IL 60611.

**Ship Ahoy.** The FCC Rules governing marine radio operation have been changing for several years and will continue to change in accordance with the Commission's Master Plan. *Marine Electronics Handbook* by Leo G. Sands cites the changes, tells whom they affect, and offers information that will help mariners use them to their fullest advantage. Written for both the marine radio technician and the radio user, the Handbook covers high-band FM, single-sideband, and low-band AM marine radiotelephones, and includes information about antennas, power sources, sound systems and



Soft cover  
192 pages  
\$4.95

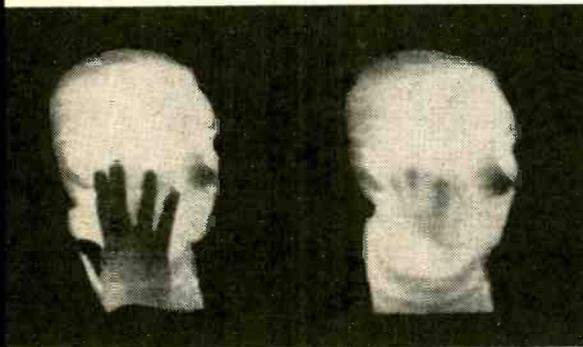
intercoms, radio direction finders, and ship-to-ship pagers. In addition, this all-in-one handbook summarizes the latest FCC Rules and includes comments, interpretations, and suggested operating practices. Published by Tab Books, Blue Ridge Summit, PA 17214.

**For Getting Ahead.** If you are seeking an amateur or a commercial FCC license, then *Electronics For Modern Communications* by George J. Angerbauer is essential to your study. Easy to understand, easy to use, the book presents all of the material in a step-by-step method progressing solidly from the basic simple concepts to the more complex. This approach establishes a valuable continuity from one element to the next. Many special features are designed to give you reliable help in comprehending fully all of the required material: Material on transistors and other solid-state devices reflects the latest FCC type questions; FCC type questions following most chapters

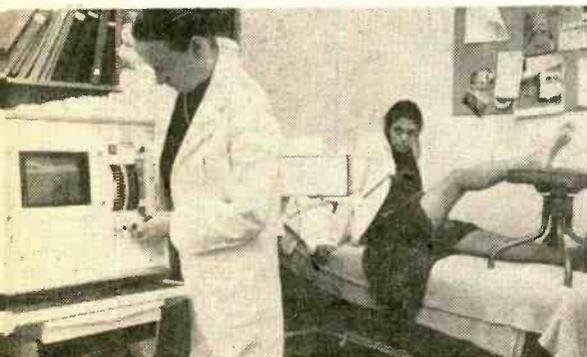
(Continued on page 90)

# Hot Pictures Spot Strokes

The heat's on for predicting strokes and blood circulatory disorders



Left image shows a cold hand held against face. Right image shows cool area on face three minutes later.



Here a Thermograph is being taken of a woman's leg. Doctor is looking for extent of patient's varicose veins.

□ Taking *heat pictures* (infrared thermography) is not a new idea. Originally, it was a method used for defense purposes during the second world war. In 1956, thermography was used in Canada for trying to locate possible breast cancer. The main development of scanners for medical purposes took place in Sweden and in the U.S.A. In the early 70's, Britain produced a scanner with a digital print-out facility thus preventing possibly misinterpretations.

The scanner works by focussing infrared onto a very sensitive thermocouple (Indium-Antinimide) cooled with liquid nitrogen to between minus 200 to 400 degrees which increases its sensitivity to infrared emissions. The infrared is picked up by an optical system which scans the patient and directs the infrared onto the thermocouple. The signal is then amplified and made visual on a grey scale basis and can be seen on the instrument's cathode-ray-tube. Black represents cold, and white represents hot.

The result is a *heat picture*. In cases of stroke prevention, one focusses on the face. The warning sign would be a relative coolness over one, or both, eyebrows.

The scanner offers a useful initial screening test for a person who has complained of weakness, dizziness, one-sided headaches and transient blurring of vision. These can be the warning symptoms that a stroke is on the way. Most strokes are triggered by a partial blockage of one of the two major blood vessels which feed the brain. The blockage, sometimes in an accessible place in the neck, can give off clots, which when swept upwards towards the brain cause a stroke. The aim is to discover and operate on the initial blockage before the stroke can occur.

(Continued on page 102)

# YOUR BLOOD PROFILE



The SMA 12/60 (above) can perform twelve different chemical analyses at the rate of sixty per hour. A technician is pouring a new blood-plasma sample into the machine.



Pam Farren, a secretary, has a 10 ml blood sample drawn for analysis. Her blood profile will be ready in only an hour or so.



The Autoanalyzer is used to run tests on the heart and arteries. The graph print-out indicates the results of the tests.

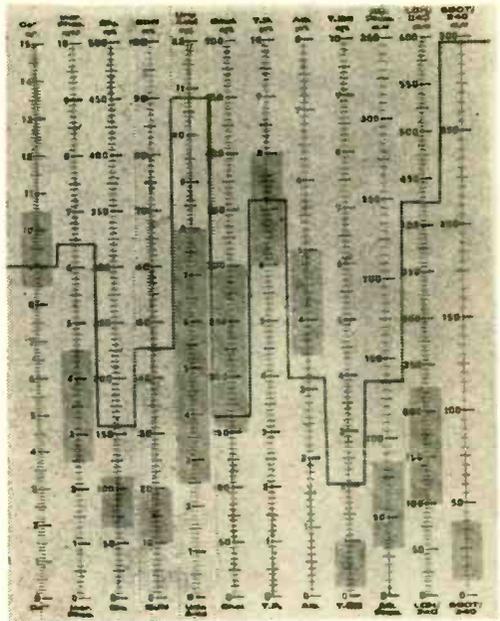
# COMPUT-O-MATED

□ A medical laboratory in England has been established to automatically check and forecast impending illnesses in Britain's work force. By instantly analyzing a blood sample, machines at the lab can graphically show doctors if a patient is ill without knowing it. As one relieved London executive put it: "I gave a blood sample for blood-profiling and less than two hours later was informed that my cholesterol level was over 300 mg percent!" He was relieved because his likelihood of a heart attack in the near future had been spotted in time to do something about it.

The two electronic "wizards" that make these health predictions possible are the *Autoanalyzer*, a two-channel chemical analysis unit, and the *SMA 12/60*, a unit which carries out six times as many tests as the *Autoanalyzer*. With each unit the results of the different analyses are recorded on a graph print-out sheet. The combination of results from all the tests gives a complete blood-profile on the medical condition of the patient. In the hands of an expert technician or doctor these graphs can be instantly interpreted into medical facts and figures about the present and future condition of the patient. All this electronics-aided analyzing takes only an hour or so to perform; it would take weeks to do it by hand! The lab is set up so that they can analyze blood samples from some 250 peo-

ple a day.

The age of the all-computer doctor is not with us, and may never be; but in the meantime electronics has lent a helping hand again in predicting, and perhaps preventing, fatal illness. ■



The graph print-out shown above would indicate to a doctor that congestive heart failure is a distinct possibility.



With the SMA 12/60 the results of a blood profile can be read on the graph even as it is being printed out.



With her profiling completed, Pam Farren talks with her G.P., who can tell by the chart whether something is wrong or not.

# newscan

## Electronics in the News!

### Ding-A-Ling

Let us now praise un-ding-a-lings. Your phone rings "ding-a-ling" for two seconds, followed by four silent seconds of un-ding-a-ling. This on-again, off-again process continues until you answer or your caller hangs up.

But, why the un-ding-a-ling? Why not a steady "ding-a-ling-a-ling-a-ling?" The difference is made by little devices that automatically interrupt the signal that tells the phones to ring. They're called, naturally, "interrupters."

Interrupters operate much like music box mechanisms. A little metal contact arm with a tiny roller on its tip rides on the side of a revolving plastic cylinder with a raised ridge. Every time the contact is raised by the ridge the result is a "ding-a-ling" in phones being called at that moment. Otherwise, all is silent. Interrupters come in various sizes and can handle from five to 50 "ding-a-lings." Other kinds of interrupters take the "biz" out of busy signals.



Western Electric senior engineer Joe Colman examines an interrupter used in Bell Telephone company central offices to break up the "ding-a-ling" ring in customers' telephones. Behind him is the interrupter test set he developed.

Though durable, interrupters can get dirty or worn and require repair or replacement. So every year, out of the more than 3-million interrupters in the Bell Telephone network, about 100,000 requires servicing. Until recently, many man-hours were spent just trying to find out what was wrong with the used devices. Now, because of a new interrupter test set, Western Electric service centers can do almost all the repair work themselves, returning very few to manufacturers.

Developed by Joe Colman, a senior engineer, the new test set performs up to 20 different checks simultaneously; in less than 50 seconds a repairman gets a complete reading on defects. Using this information the repairman can devote his time to repairing interrupters instead of merely trying to figure out what's wrong with them.

So next time your phone rings "ding-a-ling" be thankful for the little interrupter in your central office that gives you un-ding-a-ling, and not a steady "ding-a-ling-a-ling-a-ling." Don't you feel like a ding-a-ling reading this?

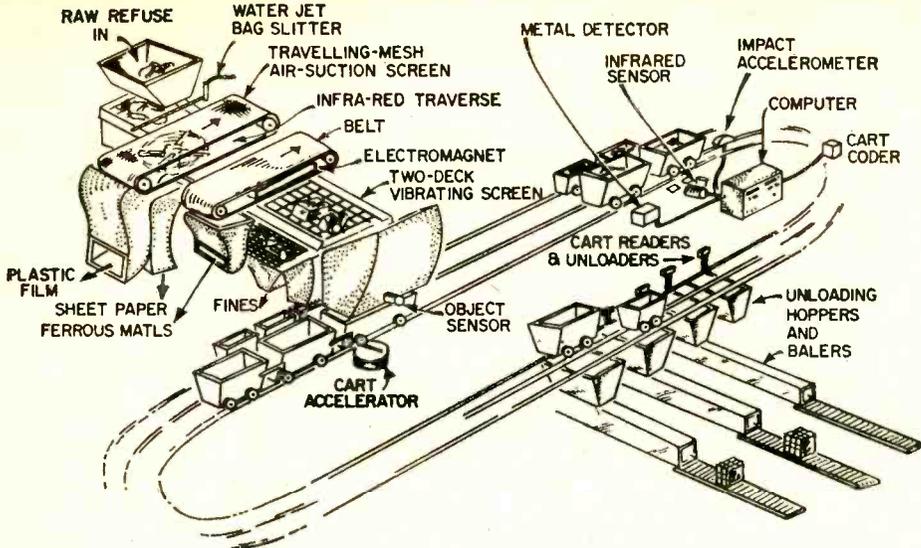
### Garbage for Ecology

As the steady decline in minicomputer prices tends to open up broader, more mundane areas of application, some minicomputers are beginning to wind up in the garbage dump—but not as refuse. What the minis are doing is helping to perform an important ecological role in balancing community waste disposal by controlling a garbage-sorting system designed to aid communities in screening out recyclable solid waste from useless rubbish.

Professors at Massachusetts Institute of Technology have packaged a minicomputer into an electrical/mechanical system that takes pure, unadulterated trash and quickly and accurately sorts it into different categories, immediately identifying waste for disposal or recycling. As a result, the MIT group sees a broad potential for computer driven trash sorters in communities throughout the nation, particularly those which are very short of disposal sites.

In the words of Dr. Stephen D. Senturia, "We couldn't have conceived of building the system if an inexpensive minicomputer hadn't been available. We have to take many sensor inputs from a wide variety of trash and make classification decisions in 1/10th of a second. The minicomputer was obviously our only answer."

In the MIT trash sorting system, trash and refuse are loaded onto a wire mesh vibrating screen which shakes out objects by size into small buggies moving along an oval conveyor, which begins the sorting of the main trash stream into several independent streams of categorized trash. The buggies each measure approximately 18 inches long. The objects are then moved along in their carts, passing a simple metal detector like those being used to screen



The MIT garbage sorting system is drawn for easy system-operation understanding. The heart of the system is a minicomputer spared from the garbage heap.

airline passengers. An infrared spectrometer identifies and sorts objects by category, such as cellulose, plastic, glass, and a variety of metals. An impact sensor with an accelerometer and a small hammer distinguishes the difference between such materials as wood and paper.

The ALPHA 16, a minicomputer made by Computer Automation, Inc., keeps track of which set of data goes with which buggy and processes the data to control unloading switches that cause the classified garbage to be dumped into separate bins. Items which defy classification are automatically rejected. The minicomputer monitors four carts simultaneously as they pass through the sensor station and performs calculations to classify the contents of each one at the rate of three per second.

The MIT scientists have built sections of a preliminary prototype system which they are currently perfecting. The sensors in the system have successfully separated sample refuse materials into five or six categories, although separation into many more categories will soon be possible.

There are a lot of solid economic reasons for this system. It would cost less than a new incinerator, and a trash sorting system would make an existing incinerator that much more efficient. In addition, landfill areas would have a considerably longer life and many objects could be reclaimed, earning a credit against other costs of solid waste management, not to mention the ecological advantages of such a system.

## Computerized Production

Computer controlled machines which automatically select electronic components, put them

in proper sequence, and insert them onto printed circuit cards at rates of up to 7,000 per hour are in operation at Sanders Data Systems' manufacturing facilities here. This is news? Not really, actually, it's news only because it's becoming so common.

The automated equipment at Sanders, used to manufacture computer display terminals, is expected to increase production substantially. The production equipment, all controlled by a computer that stores 800 blocks of program in its memory, includes a "sequencer" machine  
(Continued on page 90)



Electronic components for computer display terminals are checked by Sue Graves of Sanders next to a computer-driven sequencing machine that automatically selects the required component and places it in programmed order on a new reel.

# IRON BARS

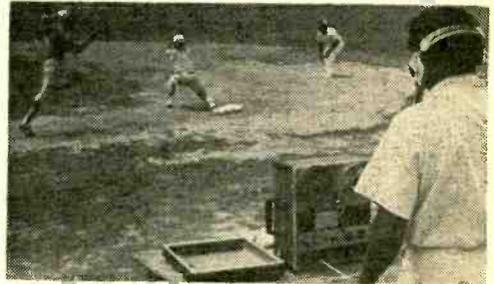
# Do a Good Ground Make



**Radio Three is the first inmate radio station operated by prisoners in prison in competition with outside stations!**  
by Joe Gronk

□ Radio GDCC, the idea of a former inmate of Georgia State Prison (known as the Georgia Diagnostic & Classification Center) of Jackson, Georgia is "on the air" seven days a week from late afternoon till late at night. The former inmate, Don Duckworth, is now one of the announcers for an Atlanta, Georgia, radio station. To the thousands of inmates it reaches, Radio GDCC speaks to them with one of the loudest voices they hear and in a language they readily understand.

In a dark cell, without the distractions of the daytime routine, a man alone with his thoughts is easily inclined to imagine himself forgotten by everyone. Then he hears the sound of his own name over the radio. It's an acknowledgement of something he has asked for, or a re-



**Prison softball game is taped by inmate for evening broadcast on Station GDCC.**

minder that other people are, in fact, thinking about him. Either way, he knows that he is not forgotten and he is aware that hundreds of other inmates listening know this—also.

The station began operating late 1971 after Don (an experienced broadcaster and radio manager for years who found himself in prison one day) had been able to sell the new, progressive administration of the prison on the value of his idea. The idea was accepted, but it became apparent that the cost of good equipment was prohibitive. Don didn't give in and got permission to write to broadcasters, manufacturers of broadcast equipment and record producers, outlining his idea for an inmate radio station and asking them if they would be interested in donating new or used equipment. He was even invited to address the Georgia Association of  
*(Continued on page 102)*



**Disc Jockey Wayne Meeks controls Radio Three under the alias "Country Cousin." Top pop albums are inmates frequent requests.**

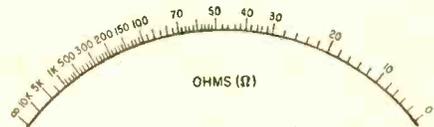
# e/e's

## ALL NEW BASIC COURSE in ELECTRICITY & ELECTRONICS



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

# RESISTORS FOR CIRCUITS



**W**hat you will learn. Voltage, current, and resistance are closely related within a circuit. Where you find one, you find the other two. Current cannot flow unless there is voltage. How much will flow is determined by how much voltage and how much resistance are present in the circuit. You will learn what resistance is, what it does, and how it is used.



## WHAT LIMITS CURRENT FLOW?

You have learned that voltage is a pressure which forces current to flow through a circuit. You also have learned that current has the ability to heat a lamp filament white-hot and thus produce light. But have you ever wondered why a 40-watt lamp produces less light than one rated at 100 watts? After all, the amount of voltage pushing current through both lamps is the same. The answer, of course, is the individual characteristic of each lamp which limits the amount of current that will flow.

The 100-watt lamp glows more brightly because more current is allowed to pass through the filament, heating it to a higher degree, thus causing it to give off more light. Less current is allowed to flow through the 40-watt filament. The reason for the different amount of current through each of the two lamps is an electrical characteristic called *resistance*. Resistance *limits* or *controls* the flow of current.

## WHAT IS RESISTANCE?

Resistance is a physical property of all materials and is directly responsible for the amount of current which will flow through a material with a given voltage applied.

### Atomic Structure

All matter is made up of invisible particles called *atoms*. There are over 100 different atoms, or *elements*, as the physicist calls them. One of the features that makes one atom different from another is the number of *electrons* each contains. A hydrogen atom has one electron, an oxygen atom has eight, and a uranium atom has 92.

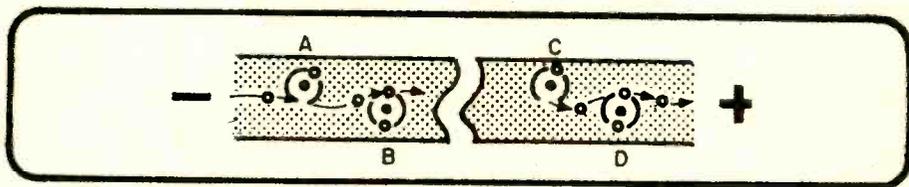
You know that current is a flow of electrons and that electrons are made to move by a voltage. This does not mean that an electron leaves the negative pole of a battery and speeds around the circuit to the positive terminal. Instead, there is a general movement or drift of electrons throughout the complete circuit.

The illustration shows a greatly magnified and exaggerated depiction of a length of wire with four atoms—A, B, C, and D. Actually, in the shortest possible length of a very thin wire there are many millions of atoms.

### Electron Flow

As shown in the illustration, electrons orbit about the center of an atom. At the instant voltage is applied, two things happen simultaneously—negative voltage at one end of the wire pushes against the electrons, and positive voltage at the other end of the wire pulls

ELECTRON MOVEMENT IN A WIRE



them toward that end. In moving, electrons strike other electrons. One electron is bumped out of atom, A, and it in turn pushes another out of atom B. At the positive end, an electron is pulled from atom D and another leaves atom C to replace it. The atoms of some materials give up their electrons more easily than the atoms of other materials.

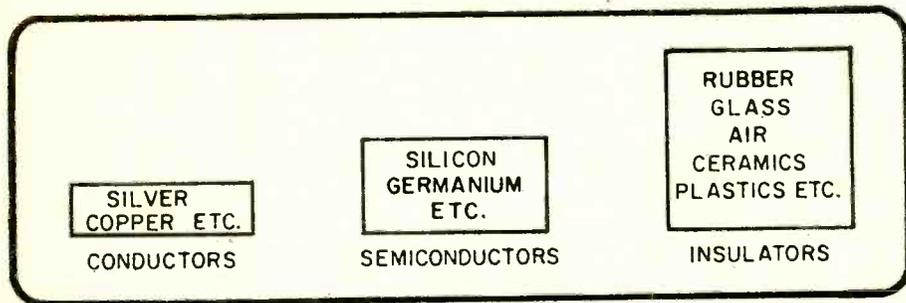
### Resistance of Materials

There is no perfect conductor. Even the best conductors, such as those having silver or copper atoms, resist the pressure to release electrons. On the other hand, the best insulators

have atoms which, under conditions of sufficiently high voltage, give up some electrons. The resistance of a material, then, is *determined by its atomic structure*.

The size of the columns in the illustration shows the comparative resistance of certain materials. Keep in mind that no material is a perfect conductor or a perfect insulator.

### RESISTANCE OF MATERIALS



Most metals contain atoms that release electrons very easily. These materials, therefore, offer the least resistance to current flow. Insulators have the greatest resistance because their atoms resist the release of electrons. The in-between materials are neither good conductors nor insulators. Among these semi-conductors are the materials from which *transistors* are manufactured.

### Unit of Measurement

Resistance is measured in *ohms*; the device for conducting such measurement is called an *ohmmeter*. The resistance of a 1.5-volt lamp, for example, is approximately 6 ohms. In other words, the lamp offers 6 ohms of resistance to the electrical pressure of a 1.5-volt cell, and the result is a current flow of 0.25 amp.

### QUESTIONS

- Q1. What is the difference between a conductor and an insulator?  
 Q2. The resistance of a material is determined by its ----- structure.

### ANSWERS

- A1. Conductor atoms give up their electrons more easily than insulator atoms.  
 A2. The resistance of a material is determined by its atomic structure.

### Volts, Ohms, and Amperes

Since resistance limits the amount of current that flows and voltage forces an amount to flow, there must be some numerical relationship between them.

You would see current decrease to half its former amount when a second lamp is added in series with the lamp circuit just mentioned. Current is divided by two when resistance is multiplied by two. Mathematicians say, then, that current is inversely proportional to resistance. In other words, *current decreases* by the same amount that *resistance increases*.

You can also discover, by experimenting, what happens to current when voltage increases. You will find they increase together (they are directly proportional to each other). This makes sense because the pressure of voltage causes current to flow. If the pressure increases, flow increases.

These relationships of voltage and resistance to current can be expressed in an arithmetic statement as:

$$\text{Current in a circuit} = \frac{\text{voltage applied to a circuit}}{\text{resistance of a circuit}}$$

Using mathematical symbols, this statement becomes:  $I = \frac{E}{R}$



where,  $I$  is the current in amperes,  
 $E$  is the voltage in volts,  
 $R$  is the resistance in ohms.

If voltage ( $E$ ) is increased, current ( $I$ ) will increase. When  $E$  decreases,  $I$  also decreases. The relationship between  $I$  and  $R$  is just the reverse. A decrease in  $R$  causes  $I$  to increase. The larger  $R$  becomes, the smaller  $I$  will be. The formula above is known as *Ohm's law*.

## RESISTORS

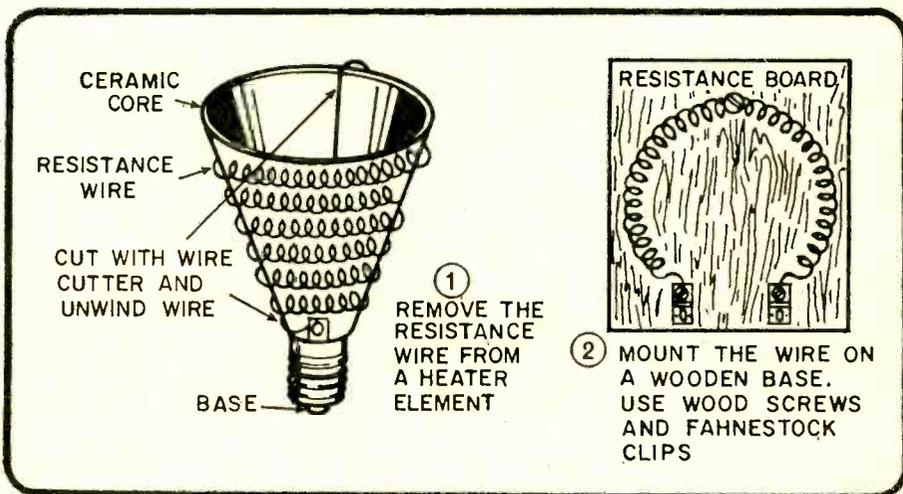
Now that you know what resistance is, let's look into the device that presents resistance to a circuit—the *resistor*.

### What Is a Resistor?

A resistor not only offers resistance to current flow but also has a specific value of resistance. A resistor has many uses, but its main purpose is to control current.

Since you know that all materials have some resistance, you should be able to make a resistor having a desired value. The wire from a heating element is an economical material to use.

### MAKING A SIMPLE RESISTOR



The element with its wire can be purchased from hardware or most variety stores. Unstretched lengths of the coiled wire can be obtained at an appliance repair shop. Replacement wire for heating elements is tightly coiled and looks very much like a spring. If you make the resistance board shown below using the tightly coiled wire, cut off a 2- or 3-inch length. Grasp the last turn on each end with pliers and gently stretch the coil until it is a foot long.

### QUESTIONS

- Q3. The unit used in measuring resistance is the ---.
- Q4. When resistance remains the same, current will (increase, decrease) when voltage decreases.
- Q5. With  $E$  constant,  $I$  will (increase, decrease) if  $R$  decreases.

### ANSWERS

- A3. The unit used in measuring resistance is the ohm.
- A4. When resistance remains the same, current will decrease when voltage decreases.
- A5. With  $E$  constant,  $I$  will increase if  $R$  decreases.

Q6. Fifty volts is applied across 100 ohms. How much current will flow through the resistance?

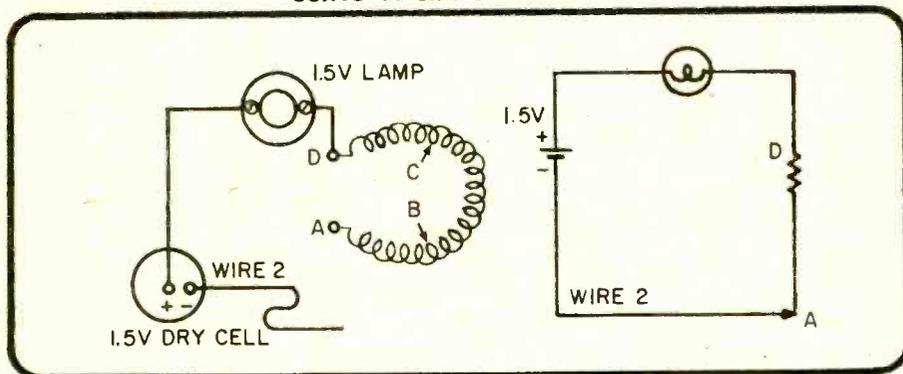
A6. Fifty volts is applied across 100 ohms. The current that will flow is:

$$I = \frac{E}{R} = \frac{50 \text{ volts}}{100 \text{ ohms}} = 0.5 \text{ amp}$$

The resistance board can be used as a means of controlling current in the familiar lamp circuit. Note the schematic symbol for resistance.

A device that can be adjusted to provide a desired amount of resistance is called a rheostat. It has a moving contact that performs the function of moving wire 2 across the resistance from point A to D.

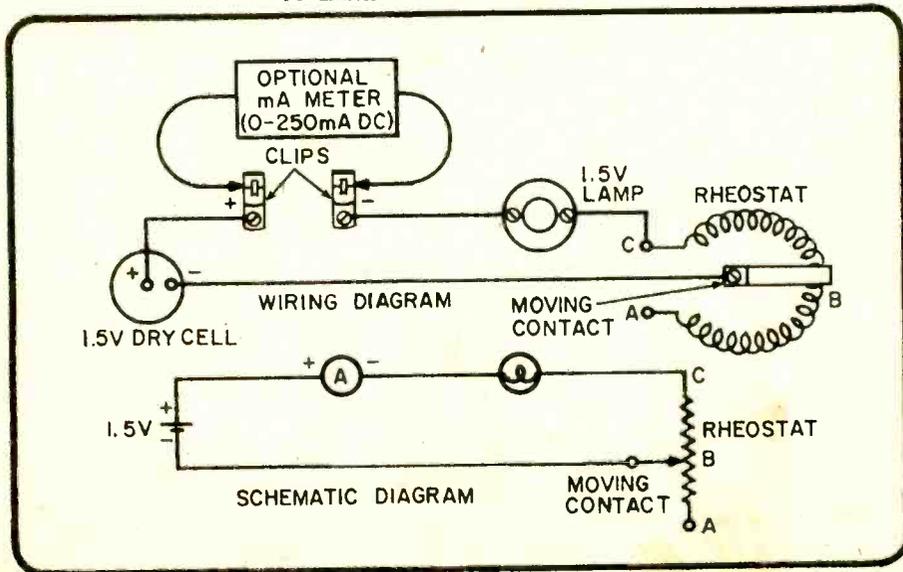
### USING A SIMPLE RESISTOR



The diagram shows how the simple resistor would look if it were converted into a rheostat. By inserting the rheostat into a circuit with one wire connected to the rotating arm and the other to one of the terminals, a desired value of resistance can be selected.

As you can see, the schematic symbol for a rheostat (variable resistor) is a combination of switch and resistor symbols. The arrow indicates that the value of resistance can be varied.

### A LAMP CONTROL CIRCUIT





## MEASURING RESISTANCE

Like voltage and current, resistance can be measured with a meter. In fact, you have already learned that an ohmmeter is part of a multimeter.

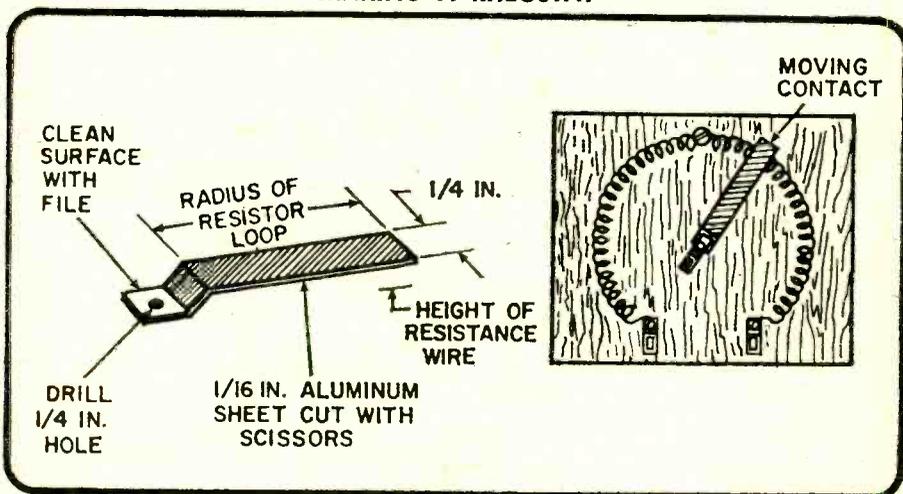
### QUESTIONS

- Q7. A rheostat is a ----- resistor. For the remaining questions, use this information.
- (a) The lamp and rheostat are the circuit load.
  - (b) Lamp resistance is 6 ohms; rheostat, 12 ohms.
  - (c) The resistance from point B to point C (see illustration) is half the rheostat resistance.
- Q8. What is the total resistance of the load?
- Q9. Circuit current will be minimum when the moving contact is at point (A,B,C).
- Q10. The lamp will glow brightest when the contact is at point (A,B,C).
- Q11. How much current will be registered by the ammeter when the contact is at point B?

### ANSWERS

- A7. A rheostat is a variable resistor.
- A8. The total resistance of the load is 18 ohms. Six ohms (lamp) in series with 12 ohms (rheostat) equals 18 ohms.
- A9. Circuit current will be minimum when the moving contact is at point A. (The entire resistance of the rheostat becomes part of the load.)
- A10. The lamp will glow brightest when the contact is at point C. (The rheostat is no longer in the circuit and therefore offers no resistance.)
- A11. 0.125 amp, or 125 milliamps. (The contact selects six ohms of rheostat resistance which, when added to the six ohms of the lamp, produces a total load resistance of 12 ohms. 1.5 volts divided by 12 ohms equals the answer.)

### MAKING A RHEOSTAT



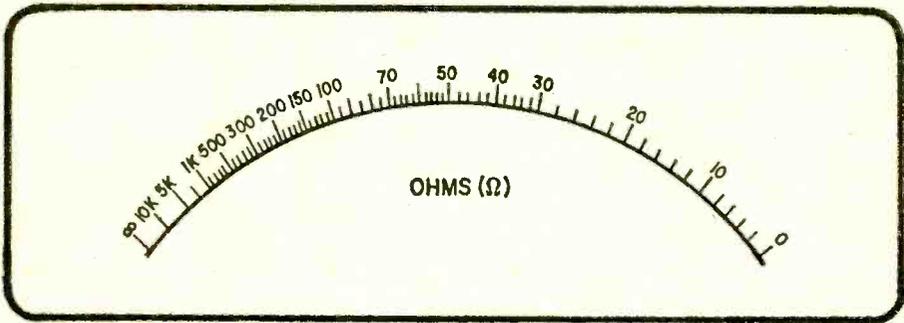
### The Ohmmeter Scale

An ohmmeter scale is labeled either OHMS or with the Greek letter omega ( $\Omega$ ). Instead of writing the word "ohm" after the numerical value of a resistance, the omega symbol is often used. A typical OHMS scale is shown.

The meter scale reads from zero to infinity, as indicated by the symbol  $\infty$ . Because it is so great, infinity has no numerical value. The "K" on the scale stands for 1,000; therefore, 5K equals 5,000 ohms.

Zero is on the right of the scale instead of the left as it is for voltmeter and ammeter readings. As you remember, the meter pointer moves across the dial a distance that is proportional to the amount of current flowing through the meter. If there is zero current when

### AN OHMMETER SCALE



taking a current or voltage measurement, the pointer remains at the left on 0. Maximum voltage or current readings cause the pointer to rest on the right end of the respective scales.

The ohmmeter measures the value of a resistance by passing current through the resistance. The amount is measured by the meter. The smallest resistance allows the most current to flow. Therefore, zero ohms is at the maximum position of pointer swing—at the right. Maximum resistance permits the least meter current to flow. Therefore  $\infty$  is on the left.

*Note:* As mentioned previously, there are no resistances that are perfect insulators or perfect conductors. Zero and  $\infty$  have been selected arbitrarily as the two extreme scale markings. Each scale must have a maximum and a minimum point. These points are 0 to  $\infty$ .

The ohmmeter scale is read in the same manner as the voltage and current scales. If the pointer stops on a numbered division, that number represents the value in ohms. Between numbers, you determine the value of each division mark. Multiply this by the number of marks to the pointer and add to the lower number. For example, there are five divisions between 40 and 50. The pointer rests on the third division past 40. The entire distance is 10, so each division is worth 2. Three 2's are 6 which, when added to 40, provide a meter reading of 46 ohms. Near the left (upper) end of the scale, numbers are close together. A reading here can only be an estimate.

#### QUESTION

**Q12.** The pointer rests on the second of five divisions between 500 and 1K. What is the value of resistance?

#### ANSWER

**A12.** The resistance is 700 ohms. The value between the numbers is 500 (1000 — 500). Each of the five divisions is therefore worth 100. Two divisions of 100 each added to the lower number (500) equals 700.

### Calibrating the Ohmmeter

The ohmmeter must be calibrated, or "zeroed," before accurate resistance measurements can be made.

The zeroing procedure is as follows. Set the function selector to  $R \times 1$ . Touch the meter probes together. The pointer will rest close to, but not at 0 on the scale. Then, slowly vary the OHMS ADJ control until the pointer rests on 0.

The ohmmeter is now zeroed and a resistance measurement can be made. The pointer should swing back to infinity when the meter is not in use and the probes are not touching each other.



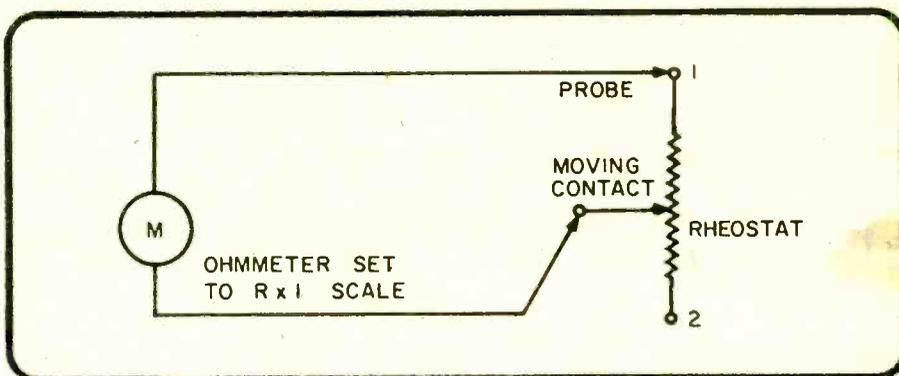
## Ohmmeter Use

Resistance measurements are made by touching the meter probes to the terminals of the unit to be measured. Never make a resistance measurement when the circuit under test is operating. Current from the operating circuit will enter the test leads and damage the meter.

The schematic diagram shows how an ohmmeter is used to measure the resistance of a rheostat.

If the rheostat contact is at terminal 1 and the meter has been properly zeroed, the resistance reading should be zero ohms. Leaving the probes connected, the meter will show

### MEASURING RHEOSTAT RESISTANCE



the gradual increase of resistance as the contact is moved toward terminal 2. At terminal 2 the total resistance of the rheostat will be read on the meter scale.

If this experiment is conducted with a properly designed rheostat,  $\frac{1}{4}$  of the total resistance will be read when the contact travels  $\frac{1}{4}$  of its total rotation,  $\frac{1}{2}$  at the halfway point, and so on. This shows that resistance is proportional to the length of the material. If a 12-inch length of wire measures 12 ohms, a 1-inch piece of the same wire will measure one ohm.

### QUESTIONS

- Q13. Before making a resistance measurement in a circuit, what should you determine first about the circuit?
- Q14. One yard of wire measures two ohms. How many ohms will 10 yards of the wire measure?

### ANSWERS

- A13. Check the circuit to be sure that it is not operating. If it is, turn it off or disconnect it from the voltage source.
- A14. If one yard of wire measures two ohms, 10 yards will measure 20 ohms.

## TYPES OF RESISTORS

Resistors are classified in two ways: in terms of their construction (wire-wound and composition); in terms of their type or function (fixed, adjustable, variable).

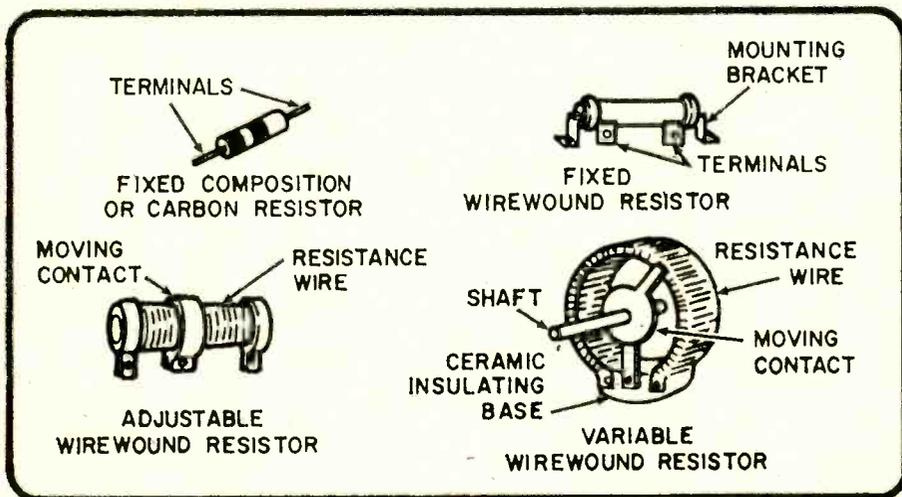
Wirewound resistors are made by wrapping resistance wire around a ceramic or other high-insulation cylinder. The assembly is then covered with enamel glaze and baked. The wire has a known value of ohms per inch. The resistance value desired is then merely a matter of wrapping on the required length of wire.

### Composition or Carbon Resistors

Composition or carbon resistors are molded from a paste consisting of carbon (a con-

ducting material) and a filler. Terminal wires (sometimes called *pigtails*) are inserted into the paste before it hardens. The resistor is then covered with a plastic coating. The resistance of a composition resistor is determined by the ingredients (percentage of carbon) and its diameter and length.

### RESISTORS COME IN DIFFERENT SHAPES



### Fixed Resistors

A fixed resistor has only one nonvariable ohmic value.

### Adjustable Resistors

Adjustable resistors provide a range of resistance within the limits of their total value. When placed in a circuit, the sliding contact can be positioned and secured to accurately provide the required resistance value. This type of resistor is not designed to be continuously variable.

### Variable Resistors

Variable resistors are designed for continuous adjustment. A shaft to control the resistance value is usually connected to a knob on the front panel of an electrical or electronic device. The volume control of your radio or TV set is an example.

A rheostat is a variable resistor. The material that the moving contact presses against may be either resistance wire or a carbon mixture.

Typical applications for each kind of resistor are presented below.

### QUESTIONS

- Q15. Composition resistors are made from a ..... and ..... mixture.
- Q16. The control that dims the dashboard lights in an automobile is a(an) ..... resistor.
- Q17. .... and ..... resistors are not designed to be continuously variable.

### ANSWERS

- A15. Composition resistors are made from a carbon and filler mixture.
- A16. The control that dims the dashboard lights in an automobile is a variable resistor.
- A17. Fixed and adjustable resistors are not designed to be continuously variable.



## Resistor Applications

Type	Applications
Composition or Carbon	Composition resistors are the least expensive of the types discussed. They are, therefore, the type most widely used. However, composition resistors have certain limitations. They cannot handle large currents, and their measured values may vary as much as 20% from their rated resistance.
Wirewound	Wirewound resistors are more expensive to manufacture. They are used in circuits which carry large currents or in circuits where accurate resistance values are required. Wirewound resistors can be made to better than 99.9% of the desired value.

## RESISTOR POWER RATINGS

As you already know, current passing through a resistor generates heat. If too much heat is generated, the resistor will be damaged. Wire in the wound resistor will melt and become open, or some of the carbon in the composition resistor will burn away.

The current-carrying capacity of a resistor is rated according to the amount of heat it can safely release in a given period of time. A resistor cannot be used in a circuit where current causes heat to build up faster than the resistor can dissipate it. When such a condition exists, the resistor may become so hot that it will be destroyed. Even if the resistor doesn't melt and become open, the excessive heat may cause a permanent change in its resistance value. In addition, heat from the overloaded resistor may damage other components that are near by.

Since heat is a form of energy, the heat-releasing rate of a resistor is measured in energy units. The unit is a *watt*. A 100-watt lamp dissipates 100 watts of heat. In the process, the lamp also gives off light.

Heat energy depends on the amount of current flowing through a resistor. The arithmetic involved is:

$$\text{Heat energy in watts} = (\text{current in amps})^2 \times (\text{resistance})$$

This means that the number of watts dissipated by a resistor can be found by multiplying the resistance in ohms times the square (a number multiplied by itself) of the current in amperes. The electrical term for heat energy is *power*.

For example, a 10-ohm resistor has three amps flowing through it. What must be its power rating in watts?

$$\text{Power} = (\text{amps})^2 \times (\text{ohms}) = (3)^2 \times (10) = 90 \text{ watts}$$

Composition resistors usually come in power ratings of  $\frac{1}{4}$  watt,  $\frac{1}{2}$  watt, 1 watt, and 2 watts. If larger power ratings are required, wirewound resistors are used.

A design engineer determines the value of resistance needed and the amount of current that will flow through it. He then specifies the resistor wattage that must be used. If the value falls between two of the ratings mentioned above, he selects the higher rating.

### QUESTIONS

**Q18.** Which of the standard composition-resistor ratings would you select for a resistor of 10 ohms through which 1/10 of an amp flows?

### ANSWERS

$$\begin{aligned} \text{A18. Power} &= \left(\frac{1}{10}\right)^2 \times 10 \\ &= \frac{1}{100} \times 10 = \frac{1}{10} \text{ watt} \end{aligned}$$

the next standard rating is  $\frac{1}{4}$  watt.

O19. A 1-watt wirewound resistor (will, will not) safely carry more current than a 2-watt composition resistor of the same resistance.

A19. A 1-watt wirewound resistor will not safely carry more current than a 2-watt composition resistor of the same resistance.

## RESISTOR TOLERANCE

As mentioned previously, a resistor will rarely measure the exact number of ohms specified by its label. The amount it will vary is called *tolerance*. Every resistor has a tolerance rating.

Resistor tolerance is given as a *percentage value* which indicates the amount that a resistor may vary above or below its labeled value. Standard tolerances for composition resistors are 5%, 10%, and 20%. Wirewound resistors may have tolerances as low as 1 or 2 percent.

Try a 1000-ohm, 10% tolerance resistor as an example. Ten percent of 1000 is 100 ohms. The tolerance factor thus indicates this resistor will measure somewhere between 100 ohms above and 100 ohms below the labeled value of 1000 ohms. This is a range from 900 to 1100 ohms. The same resistor with a 20% tolerance will have a true ohmic value somewhere between 800 and 1200 ohms.

If you have trouble working with percentages, here is another way of computing tolerance:

$$\text{Resistance variation} = \frac{\text{resistance} \times \text{tolerance}}{100}$$

The answer will be the number of ohms the resistor may vary above and below its labeled value. For example:

$$\text{Resistance variations} = \frac{2000 \text{ ohms} \times 10}{100} = \frac{20,000}{100} = 200 \text{ ohms}$$

A 2000-ohm resistor with a 10% tolerance may vary as much as 200 ohms above or below—1800 to 2200 ohms.

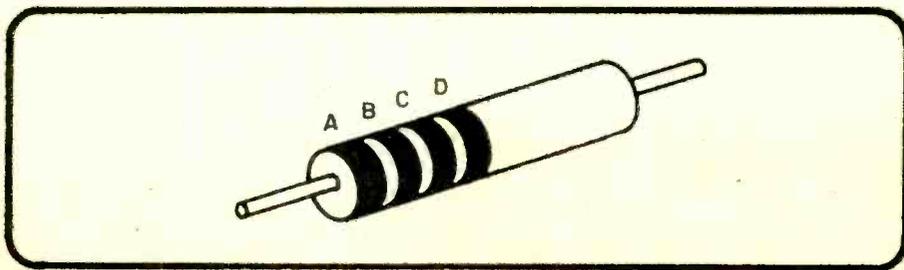
Resistor tolerance is not an indication of poor manufacturing. Closer tolerances can be achieved, but at greater expense. As you will discover, for a given ohmic value a 20% tolerance resistor costs less than one rated at 10%. And a 10% tolerance resistor is less expensive than one rated at 5%.

Required resistor tolerance depends on circuit design. If current flow must be controlled within very close limits, the engineer specifies a 1% resistor. On the other hand, a 20% tolerance is satisfactory for circuits which have less critical operating requirements. Your radio or television set, for example, has more 20% resistors than all the other tolerances combined.

## RESISTOR COLOR CODES

Wirewound resistors normally have their value in ohms and tolerance in percent stamped on them. For carbon or composition resistors a *color code* is used.

### COLORS SHOW THE RESISTANCE





For several years, resistance values have been coded by three colored bands painted around the body of the resistor. If the tolerance is either 5% or 10%, a fourth color band is added. Position of the band is shown in the drawing.

Each of the colors represents one of the ten digits—0 through 9.

### Resistor Color Code

Color	Number	Color	Number
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

The order of reading the bands is from the end of the resistor toward the middle.

The first two colors (A and B in the illustration) indicate the first two digits in the resistance value. The third band (C) indicates the number of zeroes that follow the first two digits. Sometimes a fourth band (D) is present. This band indicates tolerance and will be either gold or silver. A gold band denotes 5% tolerance, silver 10%, no fourth band, 20%.

### WHAT YOU HAVE LEARNED

1. Resistance is a property of all materials which limits the flow of current.
2. Conductors have a low resistance; insulators have a high resistance.
3. Since voltage causes a certain amount of current to flow and resistance limits the amount that will flow, there is a special relationship between current, voltage, and resistance. This relationship is expressed by the following:

$$I = \frac{E}{R}, \text{ or current} = \frac{\text{voltage}}{\text{resistance}}$$

$$R = \frac{E}{I}, \text{ or resistance} = \frac{\text{voltage}}{\text{current}}$$

$$E = IR, \text{ or voltage} = \text{current} \times \text{resistance}$$

4. The unit of resistance is the ohm. The value of resistance in ohms can be measured with an ohmmeter.
5. Current flowing through a resistance generates heat.
6. Resistors are designated by construction (wirewound or composition) and by intended use (fixed, adjustable, or variable).
7. Resistances are rated by their heat-dissipating capability in terms of watts.
8. Resistor tolerance is given as a percentage value which indicates the amount a resistor may vary above or below the labeled value.
9. Four characteristics of any resistor are type, value, tolerance, and power rating.
10. Wirewound resistors have their value and tolerance stamped on the body. Composition resistors are read by decoding colored bands painted around the body of the resistors.

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.

## Pirate Radio

Continued from page 42

the school holidays.

Their station, incidentally, should not be confused with plain old *Radio Gemini*, another British hobby-type that claims, with doubtful accuracy, to broadcast "sounds of solid gold every Sunday". Engineer Edwin D. says Gemini runs a shortwave power of somewhere between 150 and 250 watts.

Another sometimes occupant of 6,260 kHz is *Radio North Atlantic*, something of a newcomer to the game. The station, says Brian S., chief engineer, feeds a 22-foot-high half-wave dipole antenna with between 40 and 60 watts.

**The Irish, Too!** Across the Irish Sea, a couple of young fellows recently had the distinction of broadcasting the first shortwave programs from the Republic of Ireland in many a year. The official government shortwave outlet at Athlone ceased operation long ago. Public recognition they'll never get though, since their station, *Radio Valleri* is completely illegal.

Whence the name? From the station's theme song, "Valleri", by the once-popular Monkees group, replies *Radio Valleri's* Michael T. The station, located near Dublin, transmits on a frequency that wanders in the neighborhood of 6,317 kHz.

One of our contacts, a globetrotting DX spy, who will remain nameless, prowling Dublin in search of pirate information, managed to hook up with a subterranean group in a fly-specked Hungarian restaurant. There he learned of plans to reactivate a weird little pirate station with an even weirder name, the *Gnomes of Ulster*.

The *Gnomes*, a group of anarchist students in Belfast, Northern Ireland, formerly operated one of the few politically oriented pirate stations. They also, it has been reported, broadcasted on short-wave by using a metal chimney pipe as an antenna!

Most of the British stations and a few elsewhere in Europe belong to one or the other of two pirate radio organizations, the *Sussex Independent Radio Association* (SIRA), and the *Brighton Independent Radio Movement* (BIRM). One of the most important services offered by SIRA and BIRM is to provide the stations with a confidential address. Listeners to the various stations are advised on the air that they may send their letters and reception reports

in care of a confidential box number at SIRA (91 Park Street, Horsham, Sussex) or at BIRM (63 Gleton Avenue, Hove, Sussex). Many of the stations have attractive QSL (verification) cards printed, which are sent in reply to correct reception reports.

**Reception Nil.** North American listeners undoubtedly will want to know if they can receive the English and European shortwave hobby stations. Frankly, the odds are small, though two New Englanders managed to log *World Music Radio* a year or so ago. Working against such trans-atlantic receptions are the stations' normal schedules and their extremely low power. Several test broadcasts last winter at times more favorable for U.S. and Canadian reception failed to produce results. But, theoretically, under optimum conditions, future test transmissions might be heard Stateside.

**U.S. Stations.** Yes, we do have our own hobby pirate stations on this side of the "pond". But they are not, it seems, as well organized or operated as their Anglo-European counterparts. And, relatively few broadcast on shortwave frequencies.

A few years ago there was *Radio Free Harlem*, which made the newspaper headlines. It briefly set up shop in the midst of a crowded amateur radio band. The press erroneously assumed it to be a protest station with political connotations. There was, in fact, more spoof than spark to the programs, the work of some experienced radio technicians. If ever that entire story can be told it will make for fascinating reading!

There have been other U.S. shortwave pirates, but most have broadcast only a time or two, a fact probably attributable to the efforts of the Federal Communications Commission monitors.

One of the most recent of the one-shot broadcasts was that of a station calling itself WNIX, *Radio Clandestine*, which was heard in the 49-meter band by listeners from the east coast to the midwest last December. With the avowed purpose of providing "irrelevant commentary on today's contemporary social institutions," it lampooned a number of prominent personages.

Both here and abroad, the broadcasting efforts of these illicit stations are applauded by some, condemned by others. They operate illegally and we offer no defense for them. But as a minor broadcasting phenomenon of our era they probably will continue to make their weak and sometimes poorly modulated voices heard. ■



# 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 1974 lineup of CB transceivers & VHF/UHF receivers (public service/business bands—police, fire, etc.)

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 CB (base and mobile) equipment, and marine transceivers and accessories are illustrated in a new 4-color 24-page folder. There's also a separate 8-page, 4-color flyer on scanners.

112. EDI (Electronic Distributors) has a catalog with an index of manufacturers' items 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. Olson Electronics' 244-page fully-illustrated 1974 catalog carries leading national brand products in all electronics categories.

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).

118. Burstein-Applebee's 1974 catalog has 276 pages of radio/TV electronics bargains. Selling for \$2, it is offered free to our readers.

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 1974 catalog for electronics enthusiasts has 180 pages, colorfully illustrated—a complete range (kits & wired) of hi-fi, CB, SWL equipment and parts.

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. Avanti antennas (mobile and base for CB and VHF/UHF) are fully described and illustrated in new 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 1974 full-color catalog is a shopper's dream—chockful of gadgets and goodies everyone would want to own.

Elementary Electronics  
Box 886  
Ansonia Station  
New York, N.Y. 10023

Please arrange to have this literature whose numbers I have circled at right sent to me as soon as possible. I am enclosing 50¢ to cover handling. (No stamps, please).

Indicate total number of booklets requested.

Sorry, only 10 circled items maximum.

J/A74

101 102 103 104 105 106 107 108 109 110  
111 112 113 114 115 116 117 118 119 120  
121 122 123 124 125 126 127 128 129 130  
131 132 133 134 135 136 137 138 139 140  
141 142 143 144 145 146 147 148 149 150  
151 152 153 154 155 156 157 158 159 160  
161 162 163 164 165 166 167 168 169 170

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

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ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_ ZIP \_\_\_\_\_

Not Valid After December 20, 1974

## Ask Hank, He Knows!

Continued from page 24

DX addresses you need by picking up a copy of *World Radio and TV Handbook 1974* from Gilfer Associates, Inc., Box 239, Park Ridge, NJ 07656 for only \$7.50. And, when the DX questions get tough, I send them to Don Jensen, our Shortwave Editor—he's the expert.

### From an Old Timer

I believe that you should warn your readers that the Varactor tuned receiver described in the January/February 1974 issue of *ELEMENTARY ELECTRONICS* is a signal radiator and illegal to operate. When this receiver is tuned with the whistle as instructed, the whistle will also be heard in every receiver tuned to the same station within a radius of several blocks. We made receivers similar to this back in the 20s. Of course, we used variable coupling instead of variable resistance for the regeneration control, and a variable condenser for tuning a tube instead of a transistor. The old single circuit regenerative unit can also be

used as a transmitter with only minor modification. A key inserted in the tickler circuit makes it a code transmitter. We also used it for phone, accomplishing the modulation in a number of ways. It was fun until we were caught. The radiation problem of the Varactor receiver can be eliminated by adding a TRF stage on the front end. With careful alignment it should be possible to tune with a single bias voltage.

—W.B.O., Westernport, MD

Gee, thanks! Actually the editors believed many builders would make it for the novelty aspect, and few would operate it, if at all. So, readers, start planning to add on a TRF stage.

### Bell Blows Power

I have a Regency scanner monitor that works perfectly except when I try to monitor the Illinois Bell radiotelephone frequency. When I install the crystal with the frequency of 152.51 it will scan to this station and lock there even though no one is talking. Is there a way that I can monitor this frequency and scan the others too?

—J.L.K., Danville, IL

Nope, it seems that the station in question is

131. E. F. Johnson's 1974 full line of CB transceivers and accessories equipment is featured in a new 16-page brochure. A 4-color folder on monitor scanner line is also offered.

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

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* (a new name in electronics manufacturing) is a 16-page catalog for CB'ers. See their base and mobile transceivers, accessories and test instruments.

143. A set of Abraxas/4 speakers long contains a rugged 12-inch 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. *American Trading Corp.* offers you two catalogs in 4-color. One features their *Electronics 2000/Contact 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. Get the most out of your CB rig or scanner receiver with *ASCOM* accessories. An 8-page brochure illustrates antenna matcher, antenna switch, modulation bridge, monitor/scanner, preamps, translators, and other equipment performance helpmates.

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

152. Operating two (or more) TV sets plus your FM stereo receiver from one outdoor antenna? Find out how to improve your reception with a *Finco* multiple-set amplifier in this booklet of detailed specs of five models.

153. A full-color brochure on *Ten-tec'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!

broadcasting a dead, wasteful carrier that hangs up the scanner. Quit this frequency.

### Tricky Trap

Hank, I got this Admiral LKS6511M with good color on all channels except channel 2. I suspect a trap. If I am right, which one is it?

—R.D., New York, NY

Two things can be wrong. One could be that the tuner is at fault. The other could be your TV antenna system. Check your lead-in wire, move it about and see if it changes the picture on channel 2.

### It's a Copy

I just saw an ad for an antique radio for only \$39.95 in a major mail order catalog. Who is kidding who?

—T.B., St. Louis, MO

You are kidding yourself. The ad in question has the following in big type, "New! Authentically styled reproduction. . . ." No one can catalog the real antiques, only copies. The mail order house took great pains to be honest and clear. You read your dreams into the ad.

### Loves CB

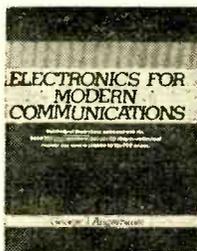
How do I join REACT? I love CB, spend all my time on it.

—H.B., Tuscumbia, AL

I don't think REACT will love you. REACT is basically a program to provide organized citizens with two-way radio communications in local emergencies. Chit-chatting is out. However, if you have the urge to help other people and are willing to accept and adhere to good CB practices, send a letter to Henry B. Kreer, National Director, REACT, 111 E. Wacker Drive, Chicago, IL 60601 and tell him Hank sent you.

## Bookmark

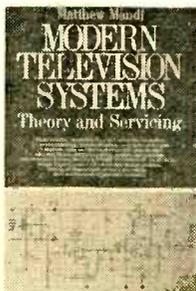
*Continued from page 66*



Hard cover  
662 pages  
\$15.95

have been compiled in full accordance with the latest FCC Study Guide Revisions; and new circuits have been included, wherever possible, to show the changing nature of electronics communication. Published by Prentice-Hall, Inc., Englewood, NJ 07632.

**For Serious TV Technicians.** Including a unique and field-proven Master Index to Common Television Troubles, *Modern Television Systems, Theory and Servicing* by Matthew Mandl is the most up-to-date and essential working tool for any professional involved in television servicing. It covers every aspect of



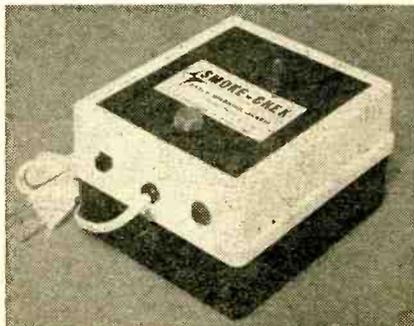
Hard cover  
463 pages  
\$15.95

modern television receivers—both black-and-white and color—and provides the most profusely illustrated explanations available anywhere in the existing literature. An outstanding feature of this remarkable manual is its illustrated coverage of trouble symptoms as they appear on a television receiver screen together with detailed explanations probing the cause these symptoms reveal. Scope patterns and many other photographic illustrations also provide keys to identifying other trouble symptoms in in television reception. Published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. ■

## Hey, Look Me Over

*Continued from page 22*

tinuous economical operation, the solid state sensor requires no periodic servicing, and automatically resets itself following clearing of the air. Suggested retail price: \$49.95. For more information write to Delcor Industries, Box 113, Centuck Station, Yonkers, NY 10710.



Circle No. 165 on Lit-Lib Coupon on page 86

## NewsScan

Continued from page 71

that can hold up to 40 reels of components such as diodes, resistors, and capacitors.

The sequencing machine automatically selects the required component and places it in programmed order on a new reel. The pro-



The world's most sensitive solid state television camera, capable of taking pictures by candlelight, produced the detailed image seen below.

grammed reel is placed into an insertion machine which attaches the components in their proper locations on the printed circuit cards. The cards are then fed into an automatic wave solder machine which solders the components to the boards. The assembled boards are automatically tested to isolate any faults in the production sequence. With production computerized at Sanders and at many other companies, the price of electronic equipment will become more competitive with foreign products.

### Flat and Small

The world's most sensitive solid state television camera, capable of taking pictures by the glow of a candle, is wallet-sized and weighs less than a pound. The new camera can be adapted for use with an ordinary television set to produce exceptionally crisp images even when light levels are extremely low.

The heart of GE's new camera, developed by GE scientists, is a charge-injection solid state imager—a quarter-inch-square metal-oxide-semiconductor chip. Covered with 10,000 pairs of miniature capacitors, the light-sensing chip performs the same job as the camera tube in conventional television cameras: It converts a visual image into an electronic video signal.

To process the electrical charge into a tele-

vision picture each pair of capacitors is individually addressed by scanning circuits to release its charge, "injecting" it into the base of the chip. Electronic circuits process the charge to reproduce the image on a television screen. The imager can be scanned at speeds compatible with ordinary television sets. The charge-injection principle offers several important advantages. Since no special structures are needed for transporting the signal charge, almost the entire chip can be photo-sensitive, giving the GE TV camera by far the highest sensitivity yet achieved by a solid state imager. Future models are expected to approach and possibly equal commercial TV camera picture quality. ■

## DX Central Reporting

Continued from page 28

time station powers, network affiliations, addresses, and schedules. Now in its third edition, it is available from the National Radio Club, P.O. Box 127, Boonton, NJ 07005.

**SWL Address Book.** Here is a handy source for shortwave station addresses. But that's not all: Along with the addresses is information on the verification policies, whether a broadcaster replies with QSL card or letter, and roughly how long it takes to get a response from the station. It is published and sold by Gilfer Associates, Inc., address above.

**FM Station Atlas.** For the FM DXer, here is a state-by-state presentation, in map and text form, of the FM broadcasting stations in the U.S. and Canada. There also are tips for the FM DXer on how to log distant stations on the 88-108 MHz FM broadcast band. For additional info on this book, write to FM Station Atlas, P.O. Box 24, Adolph, MN 55701.

**SW Transmissions to North America.** When and where should you tune to receive English language shortwave broadcasts to North America from overseas stations? This list will give you the inside dope. Frequently updated, it is published by the North American SW Association (NASWA), P.O. Box 8452, South Charleston, WV 25303. Best thing about it is that it is free for a large self-addressed stamped envelope.

This is, of course, only a partial list of interesting and useful books and other literature for the DXer. From time to time I'll review other publications you may want for your DX library.

**BANDSWEEP.** (Frequencies in kHz, times in GMT) 665—*Emissora Nacional*, the Portuguese government's 135-kilowatt powerhouse has been called the best Trans-Atlantic MW signal of last season. It is reported with "super signals" at times . . . 3240—A special selection for Latin lovers, er, lovers of Latin Amer-

(Continued on page 94)

# CLASSIFIED Market Place

FOR BIGGER PROFITS! NEW CAREER OPPORTUNITIES!  
READ AND REPLY TO THESE CLASSIFIED ADS

Classified Ads 95¢ per word, each insertion, minimum 15 words, payable in advance.  
For information on Classified ads—to be included in our next **ELEMENTARY ELECTRONICS**  
—write to R. S. Wayner, Classified Ad Manager, 229 Park Ave. South, N. Y. 10003.

## ADDITIONAL INCOME

**AEROSOL FIRE EXTINGUISHERS** \$2.98 AND \$3.98. Distributors quantity price \$7 1/2¢ ANI 90% Sample of each \$4.50. Trial Case Of Each \$32.50 Postpaid. Warren, 6922 Congress, Detroit 48207.

**BEAT THE ODDS IN STATE LOTTERIES.** Irish Sweepstakes with our winning system! Works. Many Winners! Don't buy tickets at random. How to participate in Government Lotteries from Anywhere. Necaca, Box 851-S, Philadelphia, PA. 19105.

**NEW REPORT:** Cash for photographs. Specific buyers listed. PAYS your travel \$1.00. Alexander Enterprises, 1295 Beacon, Brookline, Massachusetts 02146.

**WIN \$1,000,000.00—\$500,000.00 in Olympic Lottery Canada.** \$12,125,000.00 cash, tax-free each draw. Second drawing July 16, 1974. (Six more coming) Government approved. Legal. Full information to enter send airmail for \$3.00. **ADVERTISERS-MAILERS:** ask for our **SPECIAL OFFER** with your order. Guaranteed. No obligation. **GMO Distribution, 1805 Poullin 22A, Quebec, Canada G1E 3S6.**

## ANTIQUES, ARTS & CURIOS

**OFFICIAL ANTIQUE BUYING GUIDE.** Full 224 pages, thousands of prices, hundreds of illustrations. Know what you own. \$1.95 plus 50¢ postage. Charmglow Gifts, 3554 Parallel Rd., Dept. 5, Dayton, Ohio 45470.

## ATHLETIC EQUIPMENT & BODY BUILDING

**WORLD Famous Royal Canadian Air Force 5BX Physical Fitness Programme.** \$2. Etcco, Box 741 "A", Montreal

## AUTO PARTS & ACCESSORIES

**AIRMASTER Gas Saver.** Fits All Cars. \$14.95. Airmaster, Lenora, Kansas 67645.

**SAVE Money.** End expensive repairs. Do job yourself. Auto repair book \$1.95 Mailway Sales, 639 Ninth Avenue, Kirkland, Washington 98033.

**ALTERNATOR Generator Rebuilder's course;** includes Tooling & Test Equipment. Write: Hedelund Engineering, P.O. Box 5777, Las Vegas, NV 89102.

## AUTOMOBILES & MIDGET CARS

**SAVE On Insurance.** Get The Facts. Box 3185, Albuquerque, N. M. 87110.

## BLUEPRINTS, PATTERNS & PLANS

**NEW CRAFT PRINT CATALOG—**choose from over 100 great easy-to-build plans. Send \$1.25 (completely refunded with your first order). **BOAT BUILDER**, (CP Div.) —229 Park Avenue South, New York, N.Y. 10003.

## BOOKS & PERIODICALS

**WIRETAPPING Expose! Your Privacy Invaaded.** Details \$1.00 (Refundable). Don-Q, Box 548, Seattle, Washington 98111.

## BUSINESS OPPORTUNITIES

**I made \$40,000.00 Year by Mailorder!** Help others make money! Start with \$15.00—Free Proof! Torrey, Box 318-T, Ypsilanti, Michigan 48197.

**MAKE Magnetic Signs.** Big profits. Details. Universal, Lenora, Kansas 67645.

**FREE Secret Book "2042 Unique, Proven Enterprises."** Fabulous "Little Knowns" Work home! **HAYLINGS-E14,** Carlsbad, California 92008.

**1000% PROFIT Bronzing Baby Shoes In Your Home.** Free Honest Facts. **NBC-DG, Gower, Missouri 64454.**

**1000% PROFIT Preserving Baby Shoes in Chinakote or Bronze.** Free Literature. **NBC-DG, Coral Springs, Florida 33065.**

**HERBALISM!** The home gold mine! Free minicourse. **Herbalism Institute-D, Box 968, Glendora, Ca. 91740.**

**HOW To Make Money Addressing, Mailing Envelopes.** Offer Details 10¢. **Lindbloom Services, 3636 Peterson, Chicago 60659.**

**MAIL Baby Catalogs imprinted with your address to New Mothers for Big Profits!** Details 25¢. **Volz-EE, Ypsilanti, Michigan 48197.**

**HOW MUCH** does being your own boss or making \$25,000.00 per year interest you? The Warner breakthrough in the Engraving field could be your future. Write: **Warner, Room EC-107-DJ, 1512 Jarvis, Chicago, Ill. 60626.**

**DO Simple Addressing-Mailing.** Receive \$12.95 orders. Keep \$8.00 profit. Details Free! Quality, **Box 9-DC, East Rockaway, New York 11518.**

**ADDRESS Envelopes, \$150.00 Weekly Possible.** Details Send \$1.00. Stamped Addressed Envelope. **KeenJ, Box 9995DC, San Diego CA 92109.**

**NEW STUFF Envelopes \$24.95 Hundred.** Complete Kit \$1. (Refundable). Trade. **1C82, 3047 University, San Diego, Calif. 92104.**

**\$178.00 WEEKLY.** Work one hour daily. Free brochure. **FAS, Box 13703, San Antonio, TX. 78213.**

**\$30.00 HUNDRED Stuffing Envelopes.** Immediate Earnings. **Beginners Kit \$1.00 (Refundable) Colossi, 1433 D 61st Street, Brooklyn, N. Y. 11218.**

## BUSINESS OPPORTUNITIES—Cont'd

**AUTOMOBILE SIXTY SECOND TIRE FIXER.** No Tools, No Jack—Dealers Invited. Sample and Details, \$3.98. Trial Case \$30.00 Postpaid. Warren, 6922 Congress, Detroit 48207.

**BECOME WEALTHY** using financial manipulation. Information 8¢ stamp. **BIRDEN, Box 8846-D, Pine Bluff, Arkansas 71601.**

**HOW TO RAISE \$100.00 to \$1,000,000.00!** Capital-EE, Dawsonville, Georgia 30534.

**MAILORDER Millionaire** helps beginners make \$500 weekly. Free Report reveals secret plan! Executive I67, 333 North Michigan, Chicago 60601.

**DON'T Envy success.** Be it. Any age, sex, location. Part, full time. Phenomenal "999" Small, Unique, little known, proven. Businesses. Huge profits, little, no investment. **Lynn-2, Box 508, Sullivan, Missouri 63080.**

**ASK For Money (never repay)** International, 2148 Lawrence Drive, Benton Harbor, Michigan 49022.

**PHOTO Button Machines, Sample Button.** Brochure \$1.00. **Coffman, 1973H, Glenhaven, Ablene, Texas 79603.**

**EARN Stuffing envelopes, clip newspaper items, \$5.00-\$35.00 each.** Rush \$1.00. **Minock, 311 Chew Road, Hammon, N. J. 08037.**

**BECOME our Mail Order Distributor** with \$150 investment. Free brochure. **Audit Controls, 30 Brookside Av., Fair Lawn, NJ 07410.**

**FREE COLLECTION AGENCY Details!!** \$1000.00 Monthly Possible. **Master-EE, Dawsonville, Georgia 30534.**

**FANTASTIC Opportunity** mail baby catalogs. Your name address imprinted. Big profit, details 25¢. **Cook-IO, 431 Wicks Road, Brentwood, New York 11717.**

**CLAIM ABANDONED SILVER—\$20,000 secret revealed!** Free information: **Silverman 38-B, Box 548, Woodville, Texas 75979.**

**ESTABLISH Your own profitable mail-order business!** Everything supplied. **Michael, Box 573, Lenox Hill Station, Dept. SM7, New York 10021.**

**\$100 WEEKLY possible!** Mailing circulars for advertisers. Details. **Rush stamped envelope. Service, Box 721-BC, Lynbrook, NY 11563.**

## BUY IT WHOLESALE

**MEERSCHAUM PIPES.** Free catalog. **Conner Imports, Box 9574-D7, San Jose, CA. 95157.**

# CLASSIFIED MARKET PLACE

(Continued from page 92)

## BUY IT WHOLESALE

**BARGAIN DIRECTORY** Lists sources of low cost items. \$1.00. Winchester Enterprises. 2807EE Hargrave Street, Philadelphia, Penna. 19136.

## DO-IT-YOURSELF

**BURGLAR Alarm.** Build, install yourself. Send \$2.00 for information, Birchette, 3022-48th Place, Des Moines, Iowa 50310.

**DISCOVER** how to avoid calling the serviceman. Save by servicing home equipment yourself. Send \$1.25 for magazine. **RADIO-TV REPAIR**—229 Park Avenue South, New York, New York 10003.

## EDUCATION & INSTRUCTION

"**LOGIC** newsletter, design and construction, sample copy, \$1.00. Logic Newsletter. POB 252, Waldwick, N.J. 07463."

**ACUPUNCTURE TRAINING** Home Study Course! Tsang, Box 219W, Toronto, Canada M6M 4Z2.

**BIG profits** in publishing. Learn how. Details free. Stevenson Enterprises, 4808 Santa Monica Ave., San Diego, CA. 92107.

**USED Courses!** Books! List 10¢. Smith's, 124 Marlborough, Salem, Mass. 01970.

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Continued on page 95

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ican DX, that is, is Lima, Peru's *Radio America*. Give it a try around 0200 . . . **3339**—Signals have improved lately from *Radio Tanzania's* outlet on the island of Zanzibar. Arabic type chanting is often the fare around 0330 . . . **3425**—*Radio Nepal* has become considerably easier to hear since it moved its high powered transmitter to this out-of-the-way frequency where interference is minimal. Tune in about dawn . . . **4719**—It used to be called Makassar but now this Indonesian city is known as Ujung Padang. Regardless of the name, this station is one of the best bets among the home service outlets of *Radio Republik Indonesia* around 1230 . . . **4832**—One of the best bets among Spanish-speaking short-wave outlets is Costa Rica's *Radio Capital*. You should have little trouble hearing this one . . . **4865**—Tough for West Coasters, only moderately difficult for those east of the Mississippi, is *Emissora Regional* at Ponta Delgada, Azores. This mid-Atlantic island station is on afternoons until 2300 . . . **6170**—A new addition to the 49-meter band is *La Voz de la Selva*, that's Spanish for the Voice of the Jungle, located in Florencia, Colombia. It can be heard during the evening, but mornings around 1030 may be better . . . **9535**—Here is a beginners' special, the *Swiss Broadcasting Corporation's* shortwave outlet at Berne. Listen for English programs to North America at 0130 . . . **11810**—Readers write that they are having trouble logging India. All right, a tip for you is *All India Radio*, in English at 1330 . . . **15245**—Widely reported lately is *La Voix du Zaire*, a French-speaking African station heard at various times between 1600 and 2100. (Credits: Jeff Falconer, Ont., Canada; Gerry Dexter, Wis.; Bill Sparks, Cal.; Kent Corson, Iowa; Larry Yamron, Pa.; Eric Falkenhan, Md.; Jim Davis, Cal.; National Radio Club, Box 127, Boonton, NJ 07005; North American SW Association, Box 8452, South Charleston, WV 25303.)

**Backtalk.** Time for a quick dip into the mailbox to see what you readers have on your



minds. Wisconsin DXer Mike Witkowski writes that he's strictly a ham band listener—some call it amateur radio monitoring—and has verified 263 out of 271 countries logged. That tally is enough to identify Mike as a pro's pro. Right on!

A complaint from Edward Wray, Oakland, Cal. Ed says he wrote complete reception reports on two loggings of the *Canadian Broadcasting Corporation's Northern Service* on 9625 kHz. Both reports, sent last year, failed to bring QSLs. "Is this the policy of the CBC?" he asks. Ed, the CBC is usually a very good and prompt verifier. But slip-ups do occur. Try again and I bet you'll succeed.

"I would like to know where I would send a reception report of listening to the *American Forces Radio and TV Service*?" asks George Willis of Collingwood, Ontario. Reports of AFRTS go to 1117 North 19th Street, Arlington, VA 22209. Short question, short answer, George.

James Incoronato, Winnipeg, reports hearing a station on 17 MHz announcing a transmission for identification and receiver adjustment. This utility-type transmission was from "Radio Station WOO, Whiskey, Oscar, Oscar, Ocean Gate Radio." "Please tell me what it was," requests James. OK, James, what you heard was the American Telephone and Telegraph's coastal radio station. The station's address is P.O. Box 558, Beach Avenue, Manahawkins, NJ 08050. ■

## Crystal Radio

*Continued from page 63*

in the germanium diode jack. The germanium diode is the only modern feature used in this old-time radio.

**Making Your Loop.** Photos give most details for making the plug-in type loop antenna. Note in the illustrations that one end of the loop wire goes to the frame of the 3-conductor stereo plug, which goes to the frame of the 3-conductor stereo jack, which goes to the frame of the variable capacitor (C1). The other end of the loop wire goes to one of the other lugs on the phone plug, and the center tap on the loop goes to the remaining lug on the phone plug. It is then an easy matter to get your leads right, going from the phone jack to the three-terminal strip by experiment.

The wood frame of the loop can be stained to match the cabinet, or you might like to paint the wood dowel upright black to match the black radio panel as I did.

For winding the loop antenna I used  
(Continued on page 96)

# CLASSIFIED MARKET PLACE

(Continued from page 93)

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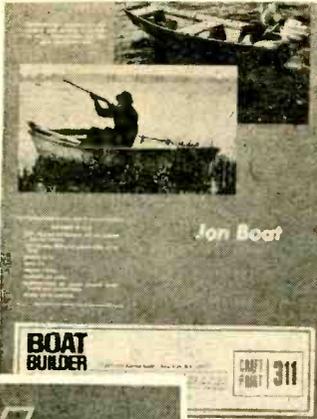
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For best results from this radio use the most sensitive germanium diode and galena crystal, and the best high-impedance magnetic earphones you can get. ■

### Discover Your CB Receiver

*Continued from page 48*

amplifier; the exact degree of selectivity is determined by the number and type of tuned circuits, mechanical or crystal filters, etc. In a typical AM receiver the carrier signal, which is the modulated IF output from the mixer, is positioned in the center of the IF selectivity passband so the adjacent channel on each side of the desired signal receives the same degree of attenuation. See Fig. 8 for the selectivity curve of a typical high-performance receiver. Note that reception of signal  $\pm 10$  kHz from the center (IF) frequency are attenuated 60 dB. In a receiver without some form of high selectivity device such as a mechanical filter, the signals from adjacent channels might be attenuated only 20 to 30 dB.

Single sideband (SSB) receivers might use the type of carrier position in the center of the IF selectivity curve (passband), but they more likely will position the carrier to either side, using the entire passband for just the one used sideband, as shown in Fig. 9. Note that in Fig. 9 the interference from the higher adjacent channel has 60 dB attenuation while the interference from the lower adjacent channel isn't even in the IF passband. (The position of the SSB carrier signal—on the high or low side of the passband—depends on whether the received signal is using the upper or lower sideband.)

Because the IF passband accommodates only the sideband representing carrier modulation, it is possible for another station using the same center frequency to transmit on the opposite sideband, producing little interference. For example, assume the desired signal is transmitting with the upper sideband as shown in Fig. 9. You will note

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that the entire sideband (modulation) fills the IF passband, while virtually no passband is left for a lower sideband. If another station using the lower sideband comes on the channel, very little of the lower sideband modulation gets through the IF passband. Another receiver tuned to the lower sideband will receive this second signal; similarly, it would not receive the upper sideband signal.

*Next Issue—How your transmitter works!*

**Antique Radio Corner**  
*Continued from page 50*

vention, 1931. It was moved to the Mallory plant in Indianapolis, Indiana in mid-February 1932. In 1951 the remaining product lines, namely, switches, jacks, plugs, and wire wound resistors, were moved to the Mallory Controls Company plant in Frankfort, Indiana.

It has been my good fortune to be associated with three of the men who made the move from Yaxley to Chicago, to Mallory's in Indianapolis, and then to Frankfort, Indiana. These three men have a combined total of over 125 years working time with Yaxley and Mallory. We are indebted to Mr. George Puerner of the Mallory Controls Company for the history presented here.

Next time we will have a review of a reprint of Sidney Gernsback's 1927 Radio Encyclopedia, some technical tips on how to restore radios, and we will answer some of the more interesting letters we have received from you, our readers. So long until then. ■

**Peek-a-Boo TV Eye**  
*Continued from page 35*

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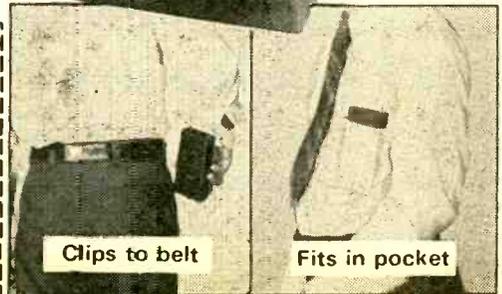
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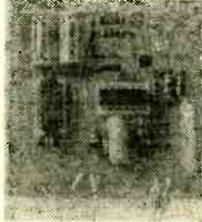
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## B & K 970 Analyst

*Continued from page 44*

supply is used for some other purpose. Since no control or switch does double-duty at no time does the use of one test unit interfere with another.

**Works Well.** All functions worked well. In particular, the signal generator was surprisingly stable, even on the FM band, and the modulation was clean; clean enough, in fact, to be used to determine where distortion was being generated: in the radio or amplifier.

Best of all was the transistor checker. All we had to do was plug in the transistor and flip the leakage switch. If the meter didn't rise we simply flipped to test and read the gain directly off the meter scale—no calibration, no setting of current, no extra procedures. Admittedly, this is not the most accurate of transistor checks, but it's good enough for troubleshooting most radios and amplifiers.

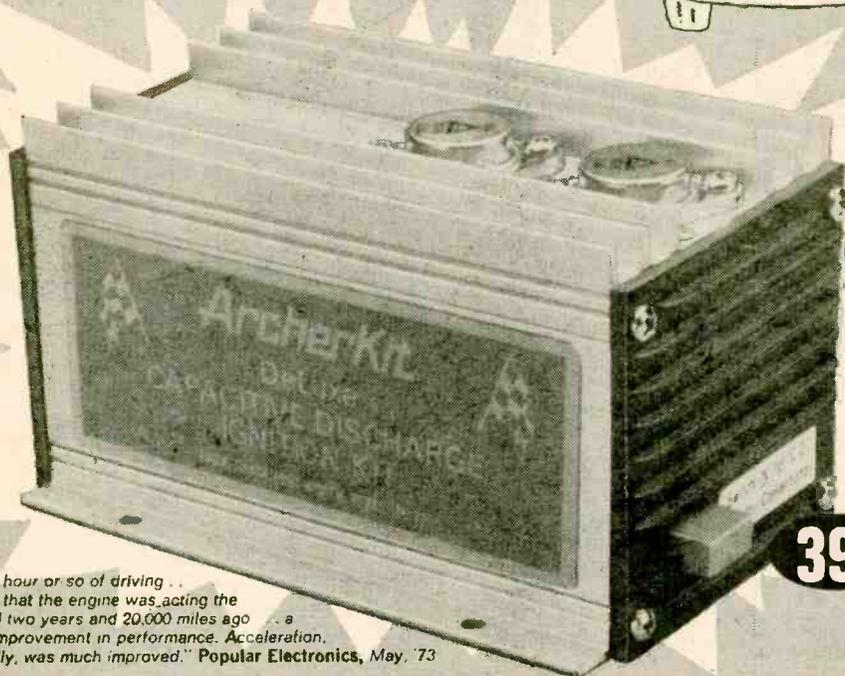
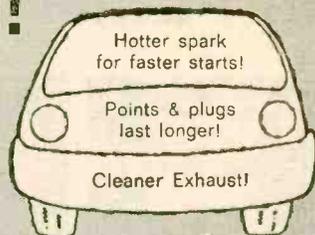
The in-circuit transistor test is interesting and unusual—B & K calls it Dyna Trace. If the radio is powered by the analyst (and only if so powered), it is only necessary to touch a test probe to the transistor's base (after calibrating the meter to indicate "In Circuit Set"). As long as the meter moves off the "set" mark upscale, the stage is operating and the transistor's DC circuitry is okay. If the meter pointer does *not* move upscale, the defective stage or transistor has been located. The two out-of-circuit calibration controls labeled coarse and fine are only used to set the meter pointer to the "set" mark.

To see just how well the B & K 970 would perform under actual service condition we dug out a few AM and AM/FM pocket radios which had long since been thrown in a drawer—they were either too difficult or too time-consuming to work on. We got three of those "dogs" working in less than an hour. The fourth, for which we had no schematic, turned up three defective transistors in about 15 minutes, but we still didn't have it working 15-minutes later, so we quit (we didn't have proper replacement transistors). If we had had the correct replacements, we feel certain we could have repaired the fourth radio using the B & K transistor equipment analyst. (Actually, it

*(Continued on page 102)*

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CIRCLE NO. 7 ON PAGE 17 OR 103

looked as though someone connected this 6 volt radio to a 12 volt auto cigarette lighter output and zapped half the transistors.) Still, three out of four is a good average for two hours work, particularly in view of the fact that we don't stock an assortment of universal replacement transistors.

**Summing Up.** The B & K Model 970 Transistor Equipment Analyzer is the instrument we've needed for many years. While its list price of \$250.00 isn't exactly in the hobbyist range, it certainly is a must-have for service shops and schools, for it puts to rest the excuse that transistor servicing is too difficult—it's not difficult at all if you use the B & K 970.

For additional information circle No. 11 on the Reader Service Coupon. ■

## Iron Bars . . .

*Continued from page 72*

Broadcasters at their Convention in Atlanta on November, 1971 and explain his plans and ideas to the members attending from a six state area. The broadcasters enthusiastically supported the project and as a result Radio GDCC now has around 1,000 record albums, over 700 singles, tapes, excellent equipment all of which is presently valued at around \$35,000.

Duckworth is now released and doing well. He was succeeded by Curt Alford, a former Atlanta musician, who was trained by Don prior to his leaving and Alford has now two trainees himself. There are plans to introduce a news show in the future mainly for the benefit of transient prisoners, which will wrap up national, state and local news as well as news of the prison and the prison system.

Mr. B Hatch, Executive Director of the Georgia Association of Broadcasters, who has helped a great deal to get things started, got from the team here the first *Good Guy Award* and was made, together with Mr. C Murphy of Stations WBMK and WCJM-FM in West Point, Georgia an "Honorary Convict" with a lifetime tenure as Trusty." ■

## Hot Pictures Spot Strokes

*Continued from page 67*

Heat pictures are also showing promise as a useful tool in screening for breast cancer and for locating operating sites for varicose veins. Due to the fact that the thermograph reads temperatures of the skin, body tumors can be readily seen as hot areas (white areas) against cold areas (black). ■

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# ELEMENTARY ELECTRONICS

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To find out more about these coupons, turn to page 17.

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*Bill Alfring often quits work early to catch a salmon in the Sacramento River that runs through his back yard. (see left) (Photo: Charles Weckler)*



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