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# elementary Electronics

**INTRODUCTION  
TO  
ELECTRICITY**  
OUR BASIC COURSE

Including Electronics Digest<sup>®</sup>

## Kathi tunes in to... Inside CB

An all-new Citizens  
Band technical theory  
series on how CB  
transceivers work—  
beginning in this issue!

1282

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Martin  
KGK3916  
CB Editor

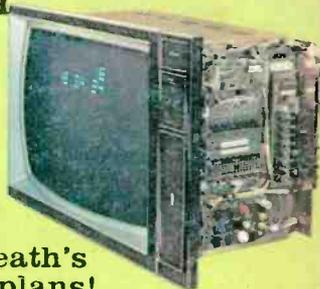
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simple  
plans!



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**Straight from our Test Lab—**

**E. F. Johnson  
Messenger 130 CB Rig** →

**Marantz 4230 4-Channel  
Dolby Receiver**

**Hustler 5M5 AM/FM/  
VHF/UHF Monitor Match**

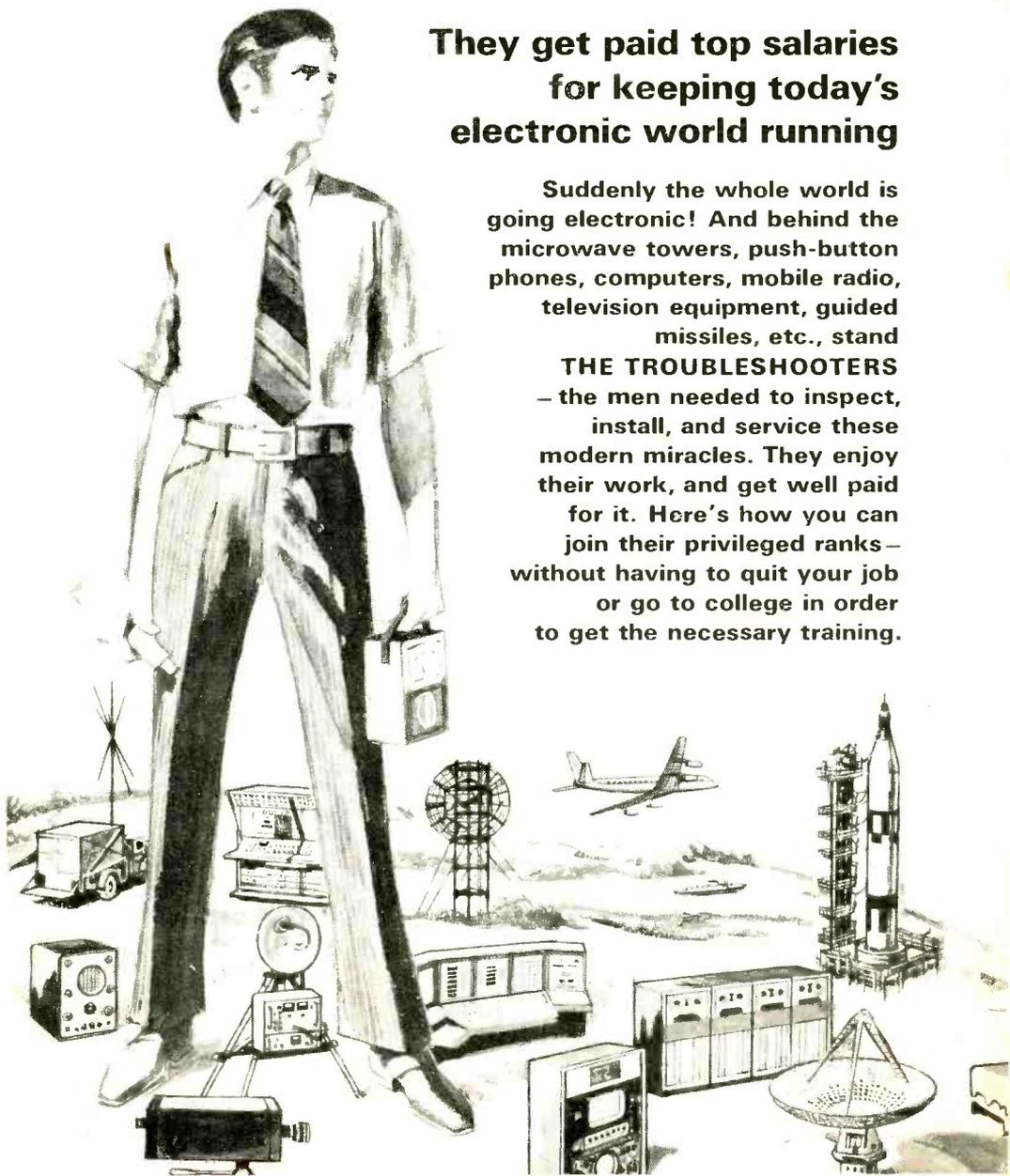


# Join "THE TROUBLESHOOTERS"

**They get paid top salaries  
for keeping today's  
electronic world running**

Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand

**THE TROUBLESHOOTERS**  
– the men needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks – without having to quit your job or go to college in order to get the necessary training.



Just think how much in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter... keep a whole assembly line moving by fixing automated production controls... prevent a bank, an airline, or your government from making serious mistakes by servicing a computer.

Today, whole industries depend on Electronics. When breakdowns or emergencies occur, someone has got to move in, take over, and keep things running. That calls for one of a new breed of technicians — The Troubleshooters.

Because they prevent expensive mistakes or delays, they get top pay — and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of The Troubleshooters? You might think you need a college degree, but you don't. What you need is know-how—the kind a good TV service technician has—only lots more.

### Learn at Home . . . In Your Spare Time

As one of The Troubleshooters, you'll have to be ready to tackle a wide variety of electronic problems. You may not be able to dismantle what you're working on — you must be able to take it apart "in your head." You'll have to know enough Electronics to understand the engineering specs, read the wiring diagrams, and calculate how the circuits should test at any given point.

Learning all this can be much simpler than you think. In fact, you can master it without setting foot in a classroom . . . and without giving up your job!

For over 37 years, the Cleveland Institute of Electronics has specialized in teaching Electronics at home. We've developed special techniques that make learning easy, even if you've had trouble studying before. Our AUTO-PROGRAMMED® Lessons build your knowledge as easily and solidly as you'd build a brick wall — one brick at a time. And our instruction is personal. Your teacher not only grades your work, he analyzes it to make sure you are thinking correctly. And he returns it the same way it is received, while everything is fresh in your mind.

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# elementary Electronics

Dedicated to America's Electronics Hobbyists

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☆  
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## AUTHORS IN THIS ISSUE

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## and Electronics Circuits

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#### PROGRESSIVE TEACHING METHOD

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

#### THE "EDU-KIT" IS COMPLETE

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

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

Training Electronics Technicians Since 1946

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- CERTIFICATE OF MERIT
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- HIGH FIDELITY GUIDE + QUIZZES
- TELEVISION BOOK - RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE + FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

#### SERVICING LESSONS

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

#### FROM OUR MAIL BAG

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

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

#### PRINTED CIRCUITRY

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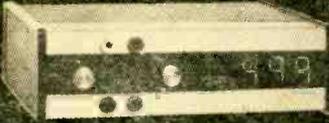
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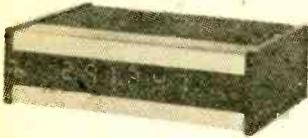


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# elementary Electronics

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Dedicated to America's Electronics Hobbyists

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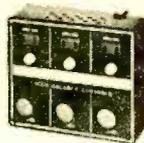
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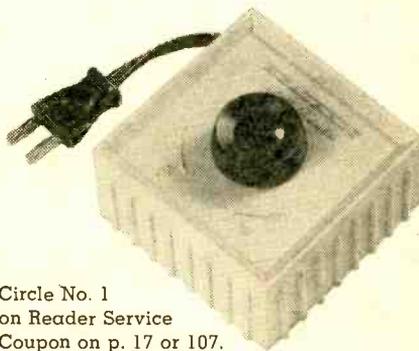
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# Hey, look me over

## Showcase of New Products

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on Reader Service  
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burned-out elements in 3-way bulbs. The GD-1018 is a phase-controlled switch, utilizing a Triac and Diac solid-state switching element. It is designed for resistive loads only and will not work on motors or fluorescent lamps. The kit can easily be assembled in one evening and costs only \$7.95 mail order.

### Energy Conservation

Specially designed labels which urge "Help Conserve Energy" are now available. In their conspicuous position on each electrical switch in the home or on the job, they are a constant and immediate reminder to *turn off* the switch. Label No. 124 reads, "Help Conserve Energy. Please . . . Turn Off Lights!" Label No. 120 is used primarily on switch



For the name of your nearest SILTRONIX dealer, write to Lorelei c/o SILTRONIX,  
221 Via El Centro, Oceanside, CA 92054 — or call (714) 757-8860

# IT'S TIME TO MAKE

# YOUR

# MOVE



## UP TO SILTRONIX

Now is the perfect time to begin enjoying the CB game. And you can, with a SSB Citizen Band transceiver from SILTRONIX. There will be more action to join in, during 1974, than ever before. CB enthusiasts throughout the nation are realizing that it's time to "get it all together". Be sure you have what it takes, and that begins with the equipment you use.

Old fashioned AM equipment is too much of a hassle on crowded channels, it just doesn't have the power to be a winner. You won't waste energy if you use single sideband communications. By choosing equipment bearing the SILTRONIX label, you're assured of quality in design and workmanship. After all, quality is the name of the game when you want performance.

Check with your authorized SILTRONIX dealer for the full scoop on our line-up of 1974 products . . . there's a lot to choose from.

**Choose a winner — Choose SILTRONIX!**



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

CIRCLE NO. 20 ON PAGE 17 OR 103

**PACE**  
makes  
another  
**BREAKTHROUGH**



**23 CHANNEL CB TRANSCEIVER**

- ALL crystals supplied
- 5 Watts of Transmit
- Pace plus modulation
- Ceramic microphone
- Locking latch rack

**Pace Model 223**



**\$129.95**

From the PACE U. S. Engineering Team that introduced the first all transistor CB transceiver, the Model 223 offers another breakthrough in both Price and Quality. Taking advantage of U.S. mass production techniques and engineering knowhow, the PACE Model 223 provides the truly great bargain for today's CB operator who wants performance and price with the quality guarantee of a U.S. manufacturing firm. With a NO compromise design approach the PACE engineers built a double conversion receiver with a full 6 section tuned filter network for maximum receiver performance even under adverse conditions - we can guarantee performance for 2 years because we shake every one in the roughest QC test procedure ever designed for 2 way radios.

If you compare before you buy you'll join the Proud Pace owner's club!

**((p)) PACE COMMUNICATIONS**

Division of PATHCOM INC. 24049 South Frampton Ave.  
Harbor City, California 90710 • (213) 325-1290  
Export: 2200 Shames Drive, Westbury, New York 11590

**CIRCLE NO. 12 ON PAGE 17 OR 103**

**HEY, LOOK ME OVER**

plates for homes. It reads "Please Turn Off Lights, Heating, Television and Air Conditioning." The face of each label is covered by a protective layer of clear transparent mylar, making the labels mar-proof, and insuring that they will remain permanently legible. Get the facts by writing directly to Seton Name Plate Corp., 592 Boulevard, New Haven, CN 06519.

**4-Channel Pocket Scanner**

Teaberry has introduced its new 4-channel VHF-FM pocket scanner, the "T" Scan. The new unit is a completely solid state, double conversion, narrow band VHF-FM portable receiver, capable of automatically switching four crystal controlled channels. The carrier-delay feature holds any channel locked for two seconds after the signal stops so the listener can hear the replying station. A bypass channel is provided so the operator can lock out a busy frequency from the scanning sequence. The "T" Scan comes complete with belt clip and collapsible



Circle No. 38  
Coupon on p. 17 or 107.

antenna for convenient portability. Write to Teaberry Electronics Corporation, 3401 No. Shadeland, Indianapolis, IN 46226.

**CB Phone Patch**

The GLC 1083 Phone Patch allows an operator to reach anywhere in the world from his car. A simple installation connects the phone to a CB rig. It can be used with 3- to 16-ohm speakers and high impedance mike inputs.



Circle No. 168 on Lit-Lib Coupon on p. 100

**if you've been wondering what the  
next great step in CB will be...  
you're off the hook.**

Messenger 130... so radically new in design and performance that citizens band radio will never be the same again. Inside this prestigious "radiotelephone" package is a unique all solid-state chassis that provides unparalleled operating advantages. From handset reception clarity... to automatic speaker silencing for private listening... this is truly an innovation in CB mobile radio performance. An innovation that's available only from your E. F. Johnson dealer.

## Messenger® 130

*CB mobile radio will never be the same again.*

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PRIVATE LISTENING OPTION



POWERFUL ALL SOLID-STATE  
13-CHANNEL CIRCUITRY



BUILT-IN PA FUNCTION...  
EXTERNAL SPEAKER FUNCTION  
LETS YOU HEAR CALL  
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Circle No. 33 On Reader Service

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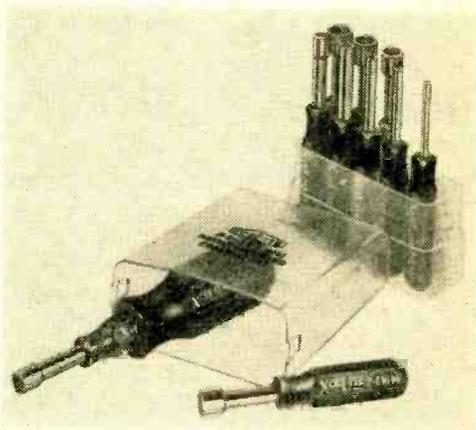
7707 Records Street, Indianapolis, Indiana 46226  
CIRCLE NO. 24 ON PAGE 17 OR 103

**HEY, LOOK ME OVER**

The modulation gain control compensates for varying line levels. An on/off switch disconnects the patch when not in use. Price, \$15.95. Gold Line Connector, Inc., Muller Avenue, Norwalk, CN 06852 will send you all the facts if you write.

**It's The Nuts**

A new, compact, convertible nutdriver set with precise metric dimensions, said to be particularly useful and often essential in assembling and servicing foreign-made equipment, is now available from Xcelite. Designated PS-121 MM, the set consists of ten pocket-size nutdrivers plus Xcelite's original "piggyback" torque amplifier handle that



Circle No. 39 on Reader Service Coupon

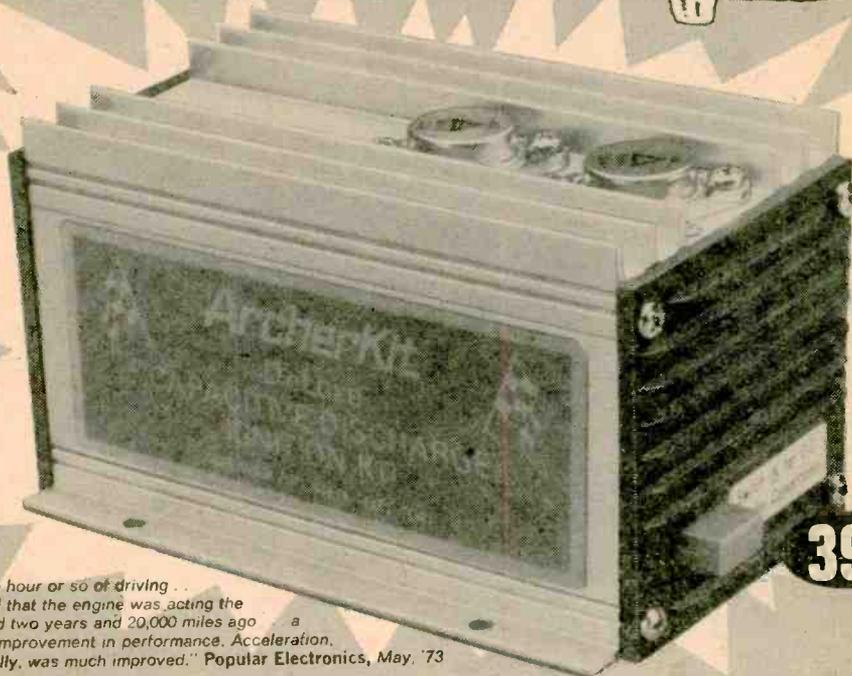
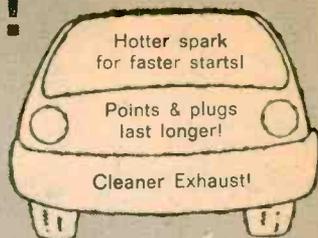
slips over the top of the midget tools to provide longer reach and greater driving power whenever needed. Precision formed sockets of the 3½-in. long drivers have hex openings ranging from 3 mm to 10 mm. The drivers and the 1¼-in x 3½-in. auxiliary handle are housed in a convenient, flexible plastic, see-thru, stand-up case with a snap-lock cover. Nutdriver shafts are finished in bright nickel chrome and securely embedded in black plastic handles. Complete specifications and price information on the PS-121 MM Nutdriver Set may be obtained by writing for new, illustrated Bulletin 1073 available from Xcelite, a Division of Cooper Industries, Orchard Park, NY 14127.

**Auto-Audio**

Dynamount speakers by Jensen are made for surface mounting in cars, boats, and recreational vehicles and are available in ready-to-install stereo kits. Each kit contains two 5¼-in., 20-oz. magnet high-fidelity speakers, with enclosures, metal mounting rings, black padded grills, attaching hardware, wiring

# Improve your gas mileage!

## With an Archerkit<sup>TM</sup> from Radio Shack



**39<sup>95</sup>**

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

Radio Shack's Deluxe Capacitive Discharge Ignition puts more "Go" in every gallon! It delivers 50% more spark power for faster acceleration and more complete combustion. That means you get better gas mileage, and your points and plugs will last 3 to 10 times longer. An in/out button lets you make instant performance comparisons with your old ignition. And it makes tuneups easier. The thorough step-by-step manual makes it easy for even a first-time kit builder to assemble and install—no wires to cut. Improves any 12-volt negative ground vehicle. #28-3203.

### Deluxe, high-intensity timing light kit



Tune-up aid for any engine. For full power & economy. Bright flash is visible even in daylight! #28-4016.

**1995** With All Cables



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CIRCLE NO. 32 ON PAGE 17 OR 103

MAY-JUNE, 1974

13

# Kits

Printed Circuit Materials

FOR THE HOBBYIST & PROFESSIONAL

**FREE!**  
Printed Circuit Handbook  
when you take this ad to  
your electronic supplier.



**GC ELECTRONICS**

DIVISION OF HYDROMETALS, INC.  
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CIRCLE NO. 10 ON PAGE 17 OR 103

## HEY, LOOK ME OVER

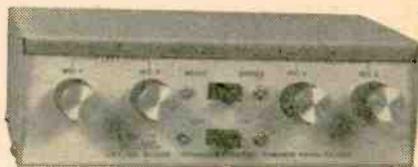


Circle No. 167 on Lit-Lib on p. 100

cable, and installation instructions. Dyna-mount Speaker Systems retail at \$59.95. Get more facts and other auto-audio product data from Jensen Sound Laboratories, 4310 Trans World Road, Schiller Park, IL 60176.

### Four to One

Increase the number of microphone inputs to your tape recorder or amplifier with the new Stereo Mike Mixer from Audiotex. The Mike Mixer (No. 30-2320) feeds up to four high impedance signals to a single high imped-



Circle No. 10 on Reader Service Coupon

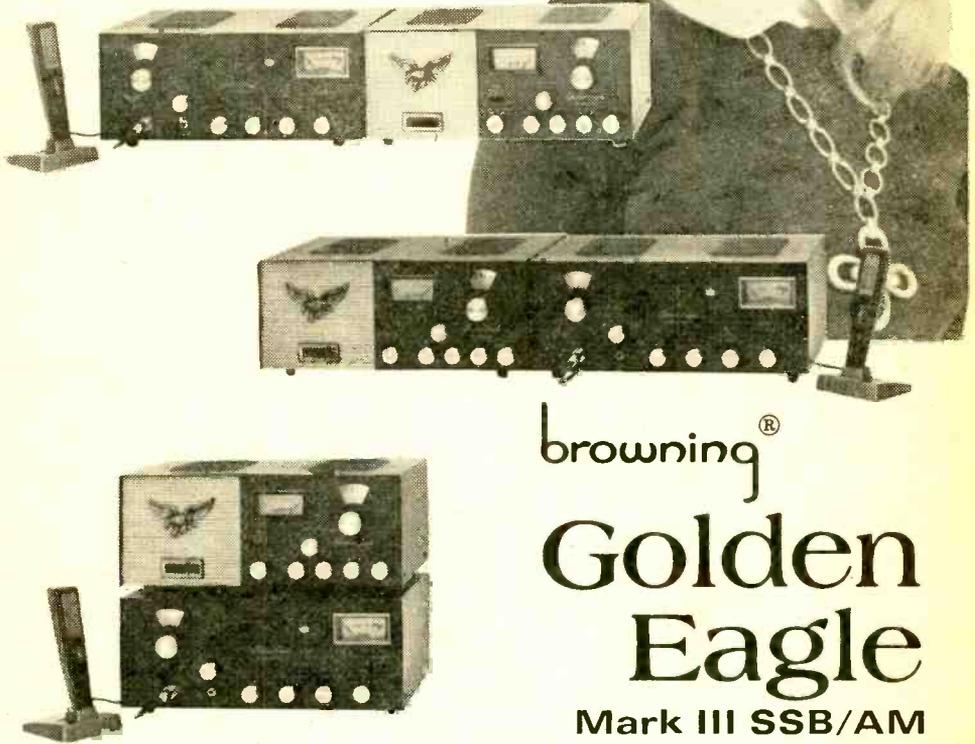
ance input. With its separate volume controls, it is possible to increase the volume of any channel, while feeding or holding the other channels. Ideal for recording or general purpose P.A. uses, the Mike Mixer features transistorized circuitry, Stereo/Mono and On/Off switches, standard 1/4-in. phone jack inputs and phono jack outputs and is 9-volt battery operated. For more information, write to Audiotex Division, GC Electronics, 400 South Wyman Street, Rockford, IL 61101.

### Tune In Your Brain

With the ever increasing interest in biofeedback monitoring (listening to one's alpha and theta brainwaves) it was inevitable that a popular priced "starter" unit would be made available to the public. So there is now a fully portable, self-contained biofeedback

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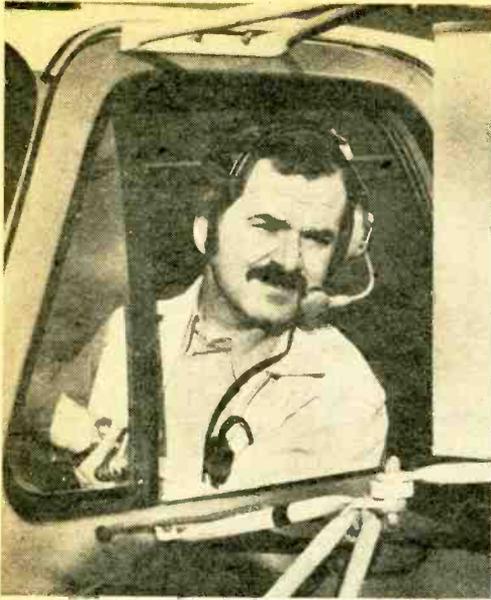
In a recent coast-to-coast survey we discovered that over 60% of Golden Eagle Mark III owners located their transmitter to the left, while about 20% liked the right—and still another 20% preferred to stack their units. Left, right or stacked, these CB'ers all agreed their Golden Eagle Mark III's gave them the ultimate in base station performance!

Plan a visit to your local Browning distributor today. Examine for yourself Golden Eagle's precision craftsmanship. A word of caution, however—one look at a Golden Eagle Mark III in action and *you'll never be satisfied with any other base station!*

**browning<sup>®</sup> laboratories inc.**

1269 UNION AVENUE  
LACONIA, NEW HAMPSHIRE 03246  
TELEPHONE (603) 524-5454

CIRCLE NO. 3 ON PAGE 17 OR 103



# Telex CB headphones... they keep you in touch.

For people who keep two hands on the wheel, two eyes on the road and an ear for the dispatcher, Telex has the citizens' band headsets that provide the ultimate in hands free mobility and convenience.

Features include a fully adjustable boom mic that limits surrounding noise pick-up, an easy to reach inline push-to-talk switch and a clear, distraction free signal at your ear.

For information write Telex Communications, Inc., 9600 Aldrich Avenue South, Minneapolis, Minnesota 55420.

PRODUCTS OF SOUND RESEARCH  
**TELEX**  
COMMUNICATIONS, INC.

CANADA: Double Diamond Electronics Ltd.,  
Scarborough, Ontario

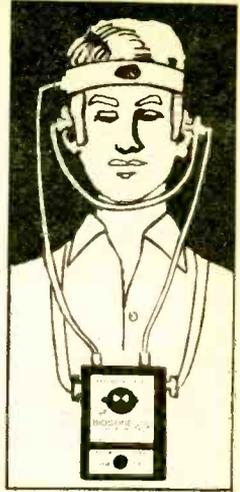
INTERNATIONAL: Telex Export Dept., 9600 Aldrich Avenue South,  
Minneapolis, Minn 55420 U.S.A.

7313

CIRCLE NO. 18 ON PAGE 17 OR 103

## HEY, LOOK ME OVER

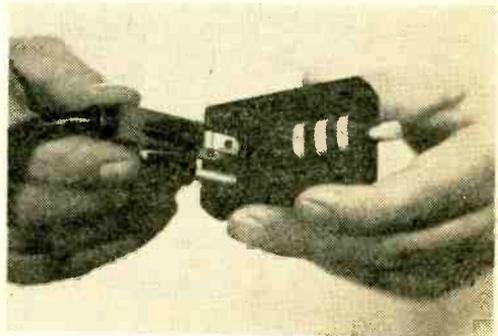
system priced at under fifty dollars. It picks up alpha and theta brainwaves and provides an audio signal so their increase and decrease (depending on mental state) can be monitored, which is a great aid to relaxation and concentration. The Edmund Biosone (Stock No. 71,809—\$49.95) contains narrow band filters that isolate alpha and theta; and a high-grain low-noise amplifier that provides 5-microvolt sensitivity. It includes stethoscope earphones, a headband with permanent electrodes, a neckband that eliminates the need to hold the unit, electrode cream, complete instructions and a 1-year warranty. The Biosone is available by mail from Edmund Scientific Co., 380 Edsorp Bldg., Barrington, NJ 08007. As with all Edmund products, it is sold with a 30-day money-back guarantee.



Circle No. 6 on  
Reader Service  
Coupon on p. 17

### Plug Lock

When you can't lock it away, lock it up! That's what Plug Lock can do for your electrical tools. Smaller than a pack of cigarettes, Plug Lock contains a plug receptacle and three numbered dials. Simply insert the plug into Plug Lock, twirl the dials and the equip-



ment is inoperative. To remove Plug Lock the owner just dials the three number combination. Hand saws, power drills, lawn mowers, edgers, stereo equipment, sewing machines, etc. can be locked up in seconds. Plug Lock fits both two and three prong 110-

(Continued on page 104)

# 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

MAY-JUNE, 1974

Void after SEPTEMBER 30, 1974

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

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

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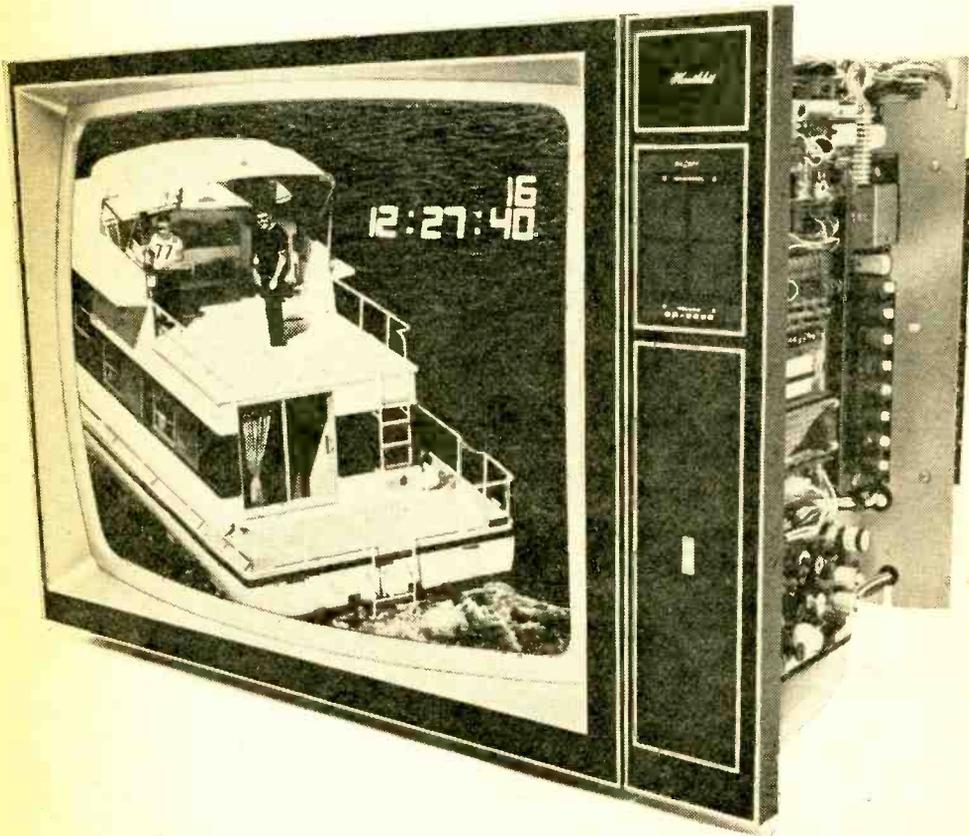
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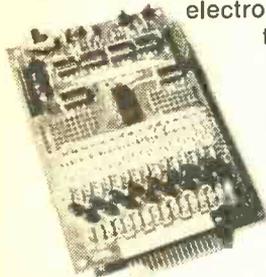
# Heathkit® Digital Color TV...

Digital technology comes to TV with the new Heathkit GR-2000 Color TV. It has on-screen channel numbers and a digital clock . . . programmable digital channel selection, all electronic varactor tuning, and an IF that never needs alignment! So advanced, it's like nothing you've ever seen before.



# tomorrow's TV design today!

The Heathkit GR-2000 Digital Color TV has electronic on-screen readout



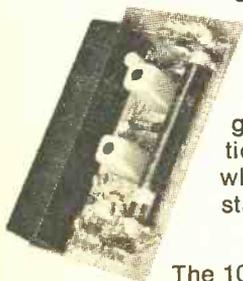
that puts channel number and an optional digital clock into the picture. Change channels, or touch the "recall" button and you have instant, highly visible station identification.

Digital logic circuitry selects channels. You program up to 16 stations, in any sequence, for automatic recall — intermix UHF with VHF, even repeat a station in the cycle. You'll never switch through a "dead" channel again.



A solid-state UHF-VHF varactor tuner takes the place of the noisy mechanical "thunker", corroding contacts, humming motors and mechanical linkages. It's completely silent and never needs cleaning.

Yet another "first" is the unique fixed-filter IF amplifier that never needs instrument alignment! The picture retains its brilliance



and clarity year after year, without periodic IF servicing. And you get truly superior reception, even in urban areas where the high density of stations causes adjacent channel interference.

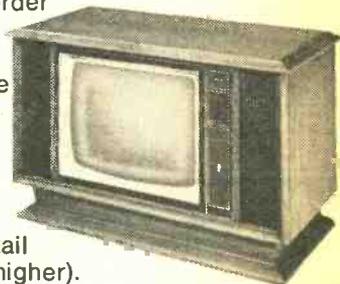
The 100% solid-state chassis uses more integrated circuits than any other TV around. The 25" (diagonal) matrix picture tube is the most advanced available. There's even a volume controlled hi-fi output jack, so you can reproduce TV audio through your separate amplifier.

Plus, the Heathkit Digital Color TV comes with a complete complement of self-service

instruments. And a service manual that shows you how to use them all.

The Heathkit GR-2000 Digital TV is also an easier kit-form TV to build. More modular circuit boards, plus more prefabricated wiring harnesses and cables, hold point-to-point connections to a minimum. It may well be the most rewarding kit-building experience of your life.

You can order the Heathkit GR-2000 Digital Color TV with the optional on-screen digital clock (it can be set for 4- or 6-digit readout), ultrasonic digital remote control, and any of four beautiful factory assembled and finished cabinets. Mail order

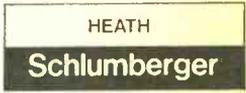


price for chassis and tube, \$649.95. Remote Control, \$79.95 mail order. Clock, \$29.95 mail order. Cabinets start at \$139.95. (Retail prices slightly higher).

Send the attached card for your FREE HEATHKIT CATALOG describing the amazing new Heathkit Digital Color TV in detail. If



card has been removed, write: Heath Company, Dept. 139-5, Benton Harbor, Mich. 49022.



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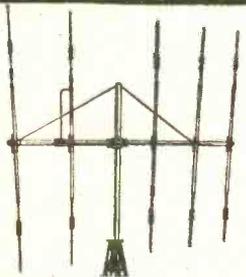
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CIRCLE NO. 16 ON PAGE 17 OR 103

**NEW 5-ELEMENT**

**CB MINI-BEAM**  
 Model GA-5D



**9.5db Gain .... 500Watt Power Rating**

The secret of success in this five-element miniature beam is in its coils. Ten High "Q" coils molded on each element-extension limit the mechanical size of the GA-5D without limiting its electrical capability. These coils are built to take a powerful beating----in fact, the same coils are used in the construction of 10-meter amateur antennas. The GA-5D is lightweight. Erect on TV antenna mount and turn with an inexpensive TV rotor. Get all the facts: see your Dealer or write factory direct, Dept. 211-RTV

**Mosley Electronics, Inc.**  
 4610 N. LINDBERGH BLVD., BRIDGETON MO. 63044

CIRCLE NO. 22 ON PAGE 17 OR 103



**ASK HANK, HE KNOWS!**

**Ugh!**

My science teacher uses a cat's fur to rub glass rods to generate static electricity. I think this is disgusting, do you?

—D.B., Gary, IN

I'm with you. See if you can help the cat escape! However, if only the fur remains, and the rest of the cat has gone to where deceased cats go, there's nothing much you can do for it. Classically, the ancient scientists performed the same static experiments using the same materials. If you would like your teacher to switch over to a fur cut from your mother's coat, check with Mom first.

**Older Than This Column**

Where can I buy the instruction manual for my Paco S-50 push-pull oscilloscope?

—J.M.S., Industry, PA

The PACO products were manufactured by a company that ceased making these products about ten years ago. In fact, I don't know if they are in business today. I think it's time for a new scope.

**Who Needs It**

How important is an S-meter on a CB set?

—C.M., Staplehurst NE

Never knew why S-Meters were ever wired into CB sets. If you can hear the station you want, great. If not, tuff! My ears can tell me what I hear, why resort to an S-Meter that's (often as not) not calibrated.

**Holy Halography**

I realize that halography is still in the infant stage. However, I have seen on TV and in the movies halographic projection systems which

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  
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MAY-JUNE, 1974

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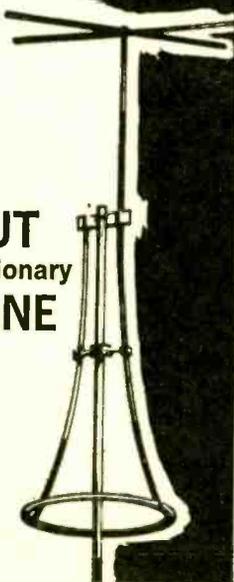
CIRCLE NO. 21 ON PAGE 17 OR 103

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## MOONRAKER

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## ASK HANK, HE KNOWS!

I believe are a reality. Can you verify this and do you know of any plans available for the building of such a system?

—P.L.W., Houston TX

Halography exists and is well! I suggest you write to *Scientific American* magazine. Some time ago they published a terrific article on this subject with plans for the amateur scientist.

### Save Two Bucks

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

—T.K., Ft. Worth TX

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

### A Four Alarmer

I happened to be in a burning building and could not get my walkie-talkie CB rig to work. Can the plasma gases of the fire do this to radio communications?

—F.H., Detroit MI

I was once in a burlesque house when it was raided and I couldn't hear the band. Everybody has problems. As for yours, I can't answer it, but I advise you to be more selective in the future about the site you transmit from. The first thing people in a burning building should do is get the H—I out, and fast. By the way, do you play with matches?

### Switcheroo!

I modernized my home's electrical system by inserting screw-in circuit breakers in place of the ordinary "one-blow" fuses. My neighbor said I am breaking the law. Is he right?

—J.J.A., Paxton, MA

No, because the circuit breakers you installed are perfectly acceptable provided they are of the correct rating for your home's wiring. However, you are wrong in saying that you modernized. You haven't increased the load capacity of your home's wiring at all. I suggest that you consult your local power company. They will be happy to advise you—and it's free.

### Can't Pull It In

I can't get my transistor radio to work in the attic. What gives, Hank?

—D.L., Macon, GA

I can't get my son to clean the basement; we both have problems. But yours is easy to explain. Many homes have aluminum foil laid under the roof tile, the foil acting as a large shield preventing radio signals from coming through. Also, interior insulation packaged in foil is often placed in the rafters effectively reducing, if not practically eliminating, radio waves. The lower levels of the house have gaps in the walls called windows and doors that per-

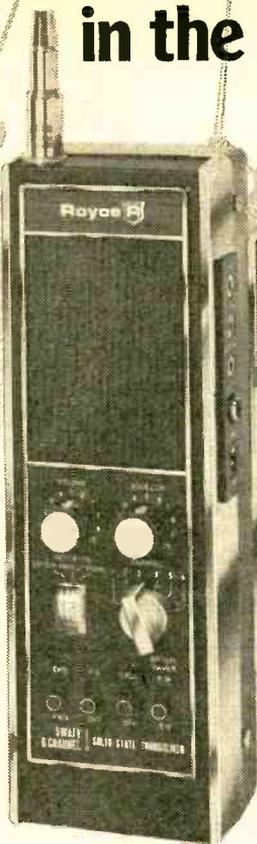
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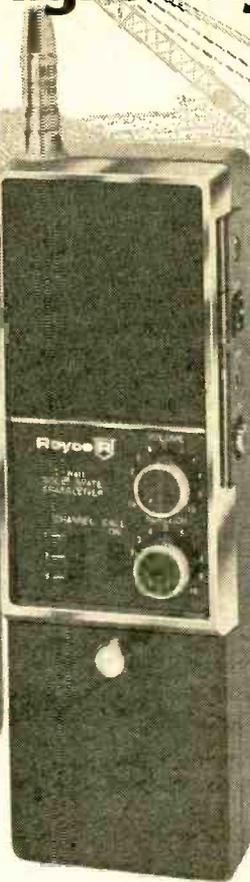
**New, lightweight construction!**

Model 1-408 is light in weight, with power to spare. Choice of 5-watt or 2-watt power input—use only the power you need and increase battery life. 3-way meter monitors battery level, power output, incoming signal strength. P.A. switch. 6-channel versatility (Channel 11 crystals supplied). Heavy-duty carrying case. Plus so much more. See this lightweight wonder at your CB dealer soon!



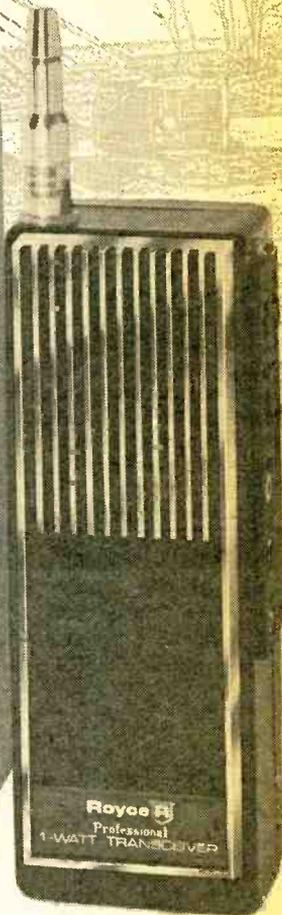
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CIRCLE NO. 23 ON PAGE 17 OR 103

## ASK HANK, HE KNOWS!

mit passage of radio waves. The wall insulation does limit the radio signals requiring external radio and FM antennas for otherwise weak signals that are now totally lost.

### 6SN7, 6K6, 6AL5, etc.

I have some old radio tubes from about 1950. Can I sell them?

—F.T., Bloomington, IN

Sure you can if you can find a buyer. The tubes of that period are not valuable, and many of the types you listed at the bottom of your letter are still available brand new! Visit a flea market—never can tell!

### Typical CCB Question

How long should a long-wire antenna be?

—D.N., Scottsdale, AZ

As long as is reasonably possible. For example, if you own your own house on a 40-foot by 150-foot plot in the suburbs, try to plan for an L-shaped job 190 feet long. If you live in the city, you may be lucky enough to string 20 feet out of doors. One reader had a 40-foot antenna on his apartment house roof, but his lead-in wire was 10 feet longer. Beg, borrow, or steal what you can, but it may not help if the electrostatic noise level near your apartment house is high. If you are in the woods out

of sight of other chimneys, you got it made in the green. Another reader emptied a few power transformer windings and hooked up a tree-to-tree long wire almost one-half mile long set north to south, enabling him to pull in east and west coast stations.

### Up With Coax—Sometimes

Why do they still sell that worthless 300-ohm antenna lead-in wire? I would think coax could have taken over the marketplace.

—V.F., Seattle, WA

I know someone who owns a laundry basket woven from 300-ohm lead-in wire. So you see, it's not worthless. Properly installed on simple installations, 300-ohm lead-in is as good as coax cable for antenna to TV receiver hookup. In most cases, signal loss is not as important as "ghosts." That's why coax is preferred in difficult situations. Of course, 300-ohm-to-75-ohm line matching transformers are necessary, raising the cost of coax installations.

### Real Thin

Can you settle an argument? Is there a special solder for printed circuit boards?

—D.M., Galveston, TX

Solder intended for point-to-point wiring in electronic circuits can be used for printed circuit board assembly. However, it may be too  
(Continued on page 104)

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This is an updated version of our popular low price clock kit. In addition to the former features which were a decorator walnut case, six digit blue-green display, the clock now features 12/30/31 day calendar, 28/24 hour clock

and 24 hour alarm, snooze alarm, 50/60 Hz Operation, setting any counter (time, alarm, calendar, and clock radio) is quite easy, since a separate control of the hour and minutes digits has been provided. The setting of any counter does not affect the contents of any other counter.

New Clock/Alarm/Calendar Clock Kit. Available Jan. 1974. Send \$10.00 deposit to insure early shipment. Will be shipped C.O.D. for balance of \$59.50 to make up full purchase price of \$69.50.

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This new kit has so many features and applications, we hardly know where to start. To summarize the applications:

\*The unit can be used as a conventional clock, either from internal batteries, or from the AC adapter. Makes an alarm clock.

\*The alarm feature can be set at any time, and will generate a tone with an external speaker.

\*The unit can be used as a stopwatch, either registering hours, minutes, or seconds, up to 23:59:59, or minutes, seconds, and 1/60 seconds up to 24 minutes, to an accuracy of 1/60 second.

\*The unit can be used as a timer, to trigger an external device at a preset time.

This unit will be available as a complete kit in Jan. 1974. To get one of the first, and take advantage of our lower pre-issue price, send \$10.00 deposit, will be sent C.O.D. for balance. Total kit price will be \$69.50 including pillow speaker as shown. AC power adapter \$4.75 additional.

Available now, all parts, but no circuit board or detailed instructions. \$59.50

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7001 Chip - Features 28/30/31 day calendar, 12/24 hour clock, 24 hour clock, 24 hour alarm, snooze alarm, 6 digit display, direct drive to luminescent anode tubes or LED segments, single transistor interface with Sperry displays. Segment and digital outputs can be "wire or D" to share calculator displays. \$14.75

MM5314 Chip - Features 6 digit seven segment output, operates from 50 or 60 Hz input, use for Minitrans LED's, Luminescent or Sperry display. \$9.75

MM5311 Chip - Same as 5314 but with additional BCD outputs, ceramic pkg. \$12.50

**FUNCTION GENERATOR CHIP, TYPE 4038**

This chip gives simultaneous sine, square, sawtooth, and triangular outputs. Great for music synthesizers, or voltage controlled function generators and oscillators.

Function Generator Chip. \$7.75

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7SD-1705 READOUT \$1.70  
6 for \$8.50  
10 for \$14.00



one of the world's largest manufacturers, has sold us his surplus of multiple digit clusters with one bad digit per cluster. They were for use in the calculator, DVM, and other products. The remaining digits are guaranteed perfect in all respects and are intensely graded (marked on the back with letters A thru F) and matched, so that several strips can be combined and still result in a perfect match. These monolithic GaAsP displays require as little as 7 mV per digit, are highly readable at arm's length, and lend themselves well to hand-held portable applications.

Applications include hand-held calculators, digital thermometers, stopwatches, darkroom timers, DVM's, clocks and watches, or any other product requiring low cost, low power, long life time indicators.

The unit is common cathode, set up for multiplexed operation. Two decimal point styles are available: center decimal for PN 7804/05, and right decimal for PN 7814/15, as illustrated. The following configurations are available, where "8" represents a perfect digit, "X" a non-functioning digit:

- X8888 7405-1 or 7415-1, X888 7414-1
- 8X888 7405-2 or 7415-2, 8X88 7414-2
- 88X88 7405-3 or 7415-3, 88X8 7414-3
- 888X8 7405-4 or 7415-4, 888X 7414-4
- 8888X 7405-5 or 7415-5, X88X 7556-1

All products are available at the following price rate:

- 1 - 24 digits ... \$1.875/digit
- 25 - 99 digits ... \$1.50/digit
- 100 - 499 digits ... \$1.25/digit

Higher quantity price on request.

For the following applications we recommend the following configurations:

Pocket calculators: 7405-1 & 7405-5, which results in X88888888X, eight consecutive perfect digits @ \$1.875 = \$15.00.

Recommended Calculator chips:  
Nortec 4204 @ \$19.75 (\$15.00 when ordered with display),  
Caltex 5005 @ \$9.75 (\$7.50 when ordered with display).

Clocks: 7405-3 & 7556-1, which results in 88X88X88X, six perfect digits at \$1.875 = \$11.25.

Recommended clock chips:  
National MM5314 @ \$9.75 (\$7.50 ordered with display),  
National MM5316 @ \$19.75, includes alarm. (\$15.00 ordered with display).

For only hours and minutes, order 7405-3 only.

Digital thermometers, DVM's, stopwatches, darkroom timers, frequency counters, etc., order 7415-1 or 7415-5 for four digits (\$7.50) or 7414-1 or 7414-4 for three digits (\$5.60). Use Soltron CM 4102AE 3 1/2 digit counter decoder @ \$19.00, (\$15.00 ordered with display).

Schematics for calculators, clocks and counters using these components free with order.



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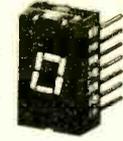
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- 4011AE Quad 2 Input NAND ..... \$ .99



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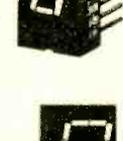
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Vary your display colors for coding or variety.

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This is one of the largest LED Displays made. Used in applications where the displays must be read at greater than average distances, or for commercial and advertising purposes.

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# TAB BOOKS

BLUE RIDGE SUMMIT, PA. 17214

CIRCLE NO. 7 ON PAGE 17 OR 103

# DX central reporting

## A world of SWL info!

BY DON JENSEN

With headlines bannering shortages, real or imagined, of many consumer products from gasoline to bathroom tissue, one wonders, what next? Unhappily for SWLs, the answer may be a shortage of shortwave communications receivers.

Already old familiar names such as Hammarlund and Hallicrafters have faded from the shortwave scene. National Radio Company, whose receivers have graced many a DX shack, now turns out only a couple of high-priced models designed more for specialized communications work than DX listening. And Radio Shack's noble experiment, the SX-190, generally rated a good mid-priced communications receiver, has been closed out at the firm's stores across the nation.

SWLs in the market for a receiver once could count on a spinoff from the amateur radio hobby. Most DX receivers were designed originally for the ham operator. But the continuing trend to single sideband transceivers has changed all that. The R.L. Drake Company, thankfully a hold-out in the field, reportedly is working double shifts to turn out its R-4-C and popular SPR-4 receiver lines. But dealers tell of back orders and delivery delays due to the demand.

Where there once were a number of communications receivers in the popular price range between \$100 and \$200, Radio Shack's successful DX-150B now stands virtually alone.

For the kit-builder, Heath still offers three models, from the SB-313 down to the SW-717, which except for the inexpensive Japanese-made portables—not really DX machines at all—is the only choice left for the budget-minded shortwave listener.

For U.S. manufacturers of radios, not just the communications types, the picture reportedly is not bright. Though the total radio market is expected to grow to 45 million units by next year, most will be built in such places as Japan, Hong Kong, Taiwan and Korea. Can we then look to the Orient to provide the next generation of shortwave communications receivers? Despite periodic rumors to that effect, knowledgeable insiders say it is unlikely that it is in the cards for the immediate future. It is said that a U.S.

firm which sells by mail order and through a network of local stores will import a mid-priced Japanese-made communications receiver by year's end. But aside from that one bright spot, there's darkness at the end of the tunnel.

What does this mean to SWLs? It probably means that now is the time to buy that new receiver if you can. It means a good used set may be a better bargain now than it will be later when an anticipated shortage of new models drives prices upward. And it means that if you already own a good SW receiver, take good care of it. It may have to last you a while.

**Tip Topper.** Many international broadcasters are opting for higher and higher transmitting powers these days. And many DXers are viewing the situation with alarm. For it is inevitable that the proliferation of 250-, 300-, and 500-kilowatt transmitters causes increased interference on the SW bands, making it harder and harder to hear the weaker DX stations.

If there is a bright side to the situation, it is the fact that some of the big broadcasters are installing their powerful transmitters at relay locations in out-of-the-way corners of the world, thus opening up new countries to be heard by the SWL. This happened nearly a decade ago, when the West Germans built a high-powered relay station at Kigali, capital of the tiny central African country of Rwanda. Beginning in 1963, *Deutsche Welle* began

tests using a 500-watt transmitter, but by 1965, the first of a pair of 250-kilowatt giants was in operation. Since that time, thousands of DXers have been able to log and QSL this remote country. Using a directional antenna system, two "curtain arrays" separated by a pair of two-band quadrant antennas, DW's Kigali relay is widely heard by SW listeners.

Except for local identifications, the programs are produced in DW's German studios. They are fed by point-to-point facilities at Bockhagen, Germany, using highly directional rhombic antennas. At Kigali they are received by an automatic listening station and are fed to the shortwave transmitters for rebroadcast.

At this writing, *Deutsche Welle's* station in Rwanda could be heard after 2030 GMT on 11965 kHz. But DW does change frequencies with the season, so you may have to hunt a bit for this one. Or, better yet, a current schedule of all DW broadcasts, including the Kigali station's, can be yours free by writing *Deutsche Welle*, Postfach 10-04-44, D-5, Kohn 1, Federal Republic of Germany. And when you do hear the station, a correct reception report to the same address will get you an attractive and colorful QSL card.

**Bandsweep.** (Frequencies in kHz, times in GMT) **860**—Those of you who prowl the medium wave frequencies for foreign signals  
(Continued on page 101)



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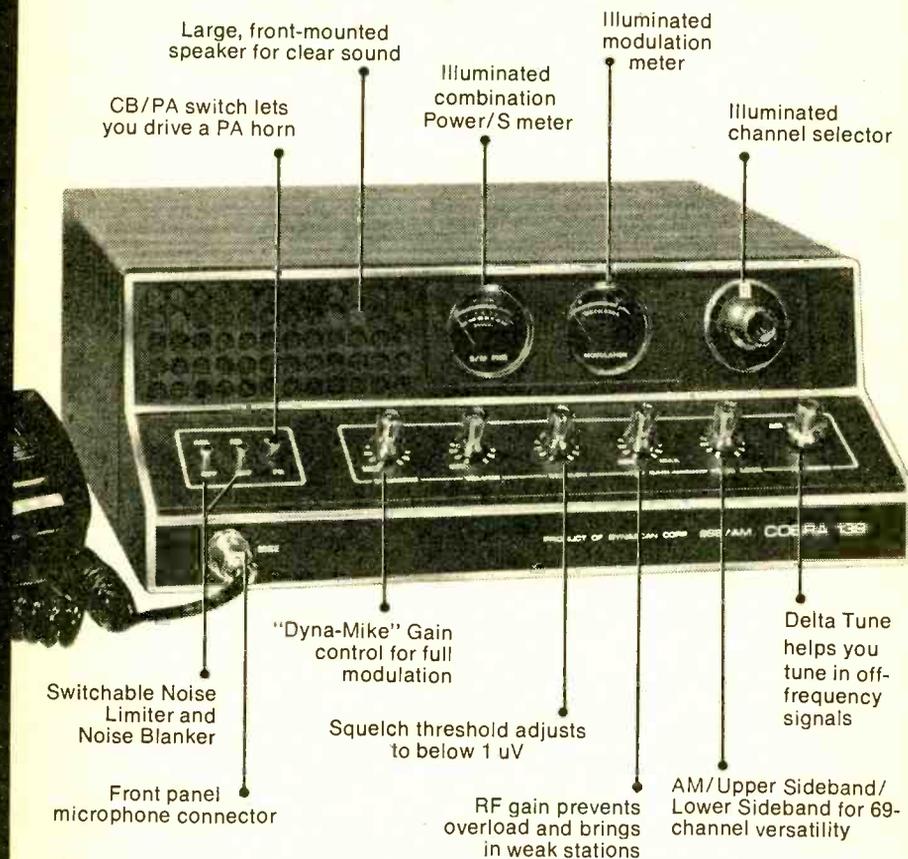
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CIRCLE NO. 9 ON PAGE 17 OR 103

Do you guys really do all that stuff? One of the many questions experimenter-hobbyists ask the editors is whether or not they test projects in e/e. You bet we do. And we don't stop there, either. This editor takes a vacation and gets a chance to put in full time on his own projects. Here's a report on...

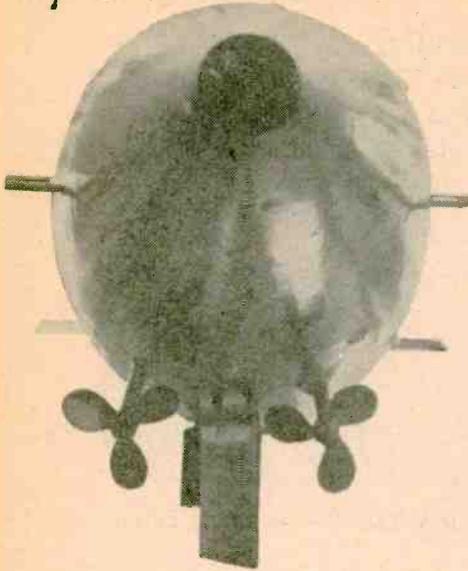
## CAN A RADIO CONTROLLED SUBMARINE OPERATE UNDERWATER?

by Peter L. Dexas WA3LOQ—Technical Editor



It had been fully a year and a half since bringing my new baby home from the hobby shop. Inside a yard-long box lay freshly turned cylinders of wood, brass plates, foam rubber strips, screws, nuts, propellers, and fifty other bits and pieces. Many hours of work were ahead, but finally she was ready for her first "sea" trials. With twin Aristocrat No. 35 electric engines mounted and tested in the bright yellow hull a year before, she was freshly packed to the yardarms with a full complement of radio gear, rechargeable batteries, servos, push-pull control rods, drive shafts, couplings, and lots more. A clear plexiglass top, shaped to the lower hull and fitted with a water-sealing T-shaped strip of foam rubber, was pressed water-tight to the glossy epoxy paint with a dozen screws. A flexible white antenna wire had been fitted through the upper wood cover, looped around a spring-steel

# e/e RADIO CONTROLLED SUB

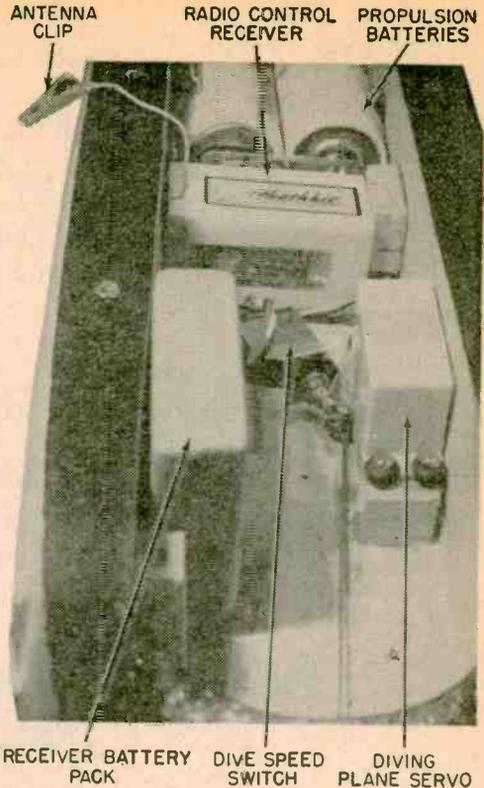


Counter-revolving propeller system cancels gyroscopic (twisting) effect from spinning motor armatures. Thrust from the downward slanted propellers aids the diving action.

rod and back to an eyelet at the rear of the sub for maximum control signal reception.

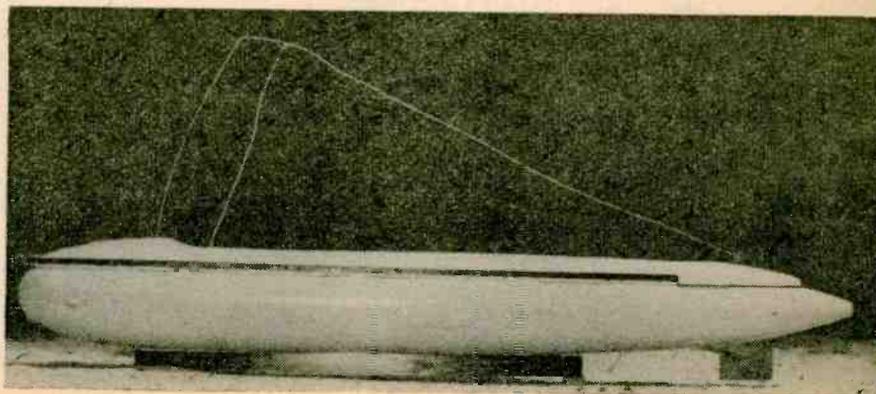
**Splash!** Launching took place on a cloudy, wet day in August into the fresh clear water of a Maine lake. Success? Well, not quite yet. Yes, she does respond well to left and right rudder, fast, slow, forward and reverse speeds. She's bone-dry inside even though waves wash over her whale-like body. The cruising range with a pair of 4 ampere-hour ni-cad batteries is nearly *two* miles on the surface, and actual control range of the 53.2 MHz system is far be-

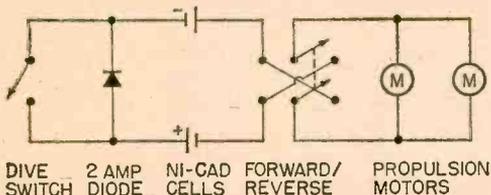
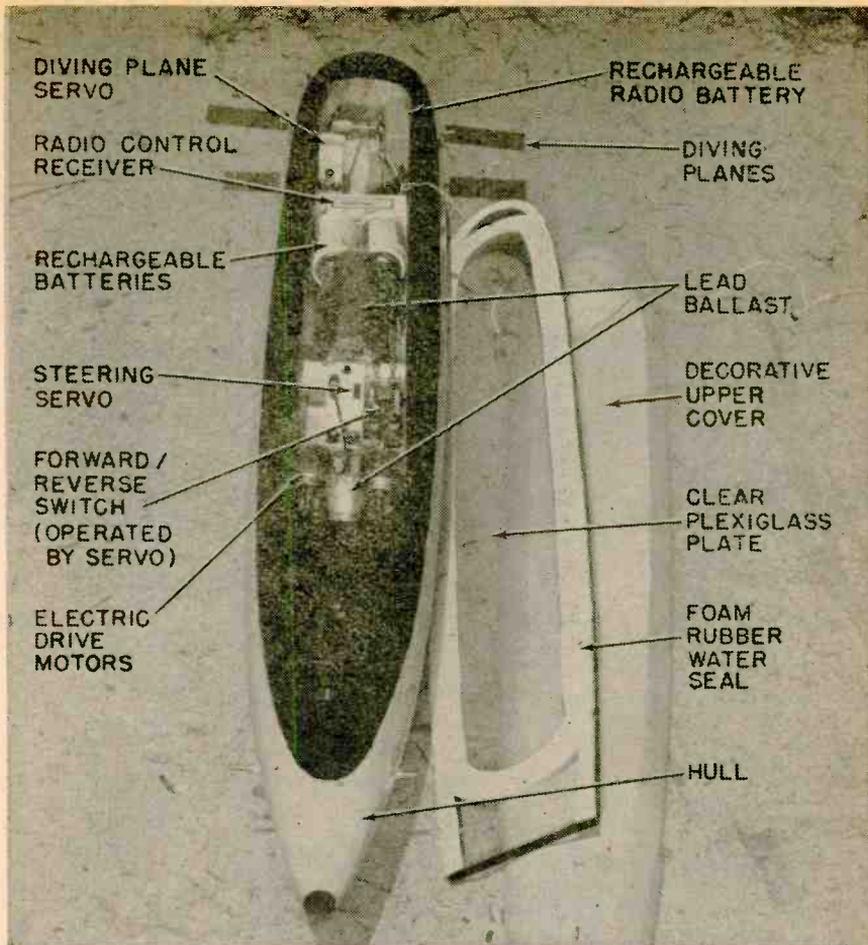
On the beach showing heavy steel keel. Radio control system is the Heath model GD-57—a three channel digital proportional kit available for the two Class C RC bands and the six meter amateur band. Antenna wire passes through a water-tight seal.



yond your ability to see and control accurately. Rechargeable batteries power the radios for at least four hours.

Almost everything is right. "Almost everything" because there's not a bit of response when a control stick for the special R/C (radio control) diving plane channel is tilted forward. True, a special *dive speed* switch trips the propulsion engines to full power. The diving planes tilt downward towards Davey Jones' locker. But still it isn't enough to dunk the twenty-pound sub underwater.





Simple sub wiring uses diode in series with batteries to lower motor voltage. Activating diving planes closes switch to short out diode for full motor power. Battery power is applied to motors thru a servo-operated forward-reverse switch.

And anyway, if it *does* go underwater, what will happen to the radio control? As the tip of the antenna dips under the surface, will control be lost? How far will six-meter signals from a ½-watt transmitter reach underwater?

**Another Tack.** To answer these questions and, hopefully, to feel the thrill of “flying” the sub underwater, we went to the office of the *Camden Herald*, a once-a-week local newspaper where a rickety linotype machine (a forerunner of the ones used to set this magazine) molds letters from a pot of molten lead-alloy bars called “pigs.” Well, a ten-pound piece of triangular “pig” cut to fit

the sub’s available interior space turned the tide! In the water she just broke the surface as wavelets splashed over her observation bubble. Her buoyancy was slightly positive, meaning she would float, but just barely. So, when full-ahead dive is commanded, she slips under the surface with the kind of quietness that gave the real submarine corps its nickname—the “silent service.”

Yes, the sub could be controlled underwater. I made dives as deep as five feet and, at a 2-foot depth, from as far away as forty. When you are watching from a few feet above the water’s surface, it becomes diffi-

(Continued on page 94)

# ELECTRONICS GIVES MENDING BONES A BREAK



□ It's Sunday, late afternoon. Somewhere high up in the Bavarian Alps a number of ski enthusiasts are ready for the last trip down. These last trips are the ones during which most accidents happen. People have become a little too tired, and perhaps a little too confident as well. An added hazard is the fact that the composition of the snow will have changed during the day, and the skier descends rather faster than anticipated.

It's the same way on the roads. Cars are faster than they used to be, accelerate faster, and more accidents are caused. One thing however hasn't changed: the fracture resistance of the human body.

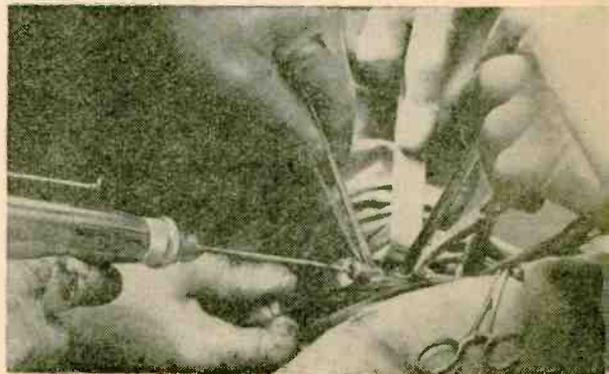
As a result, doctors have to deal with many more complicated "open" fractures than ever before, fractures involving serious damage to skin and muscles, as well as to bones; and with all this there is the greater danger of infection of the damaged parts of the body.

When dealing with compound fractures the normal method followed is that a metal plate is fixed to the fractured bone and to a nearby joint with the aid of special screws. This helps the bone fragments to mend together properly by holding them in place, but an obvious disadvantage is that the living bone does not get much of a chance to become flexible again. Often, more than one operation is necessary; or the patient has to use a cane for the rest of his life; or even, sometimes, the dam-

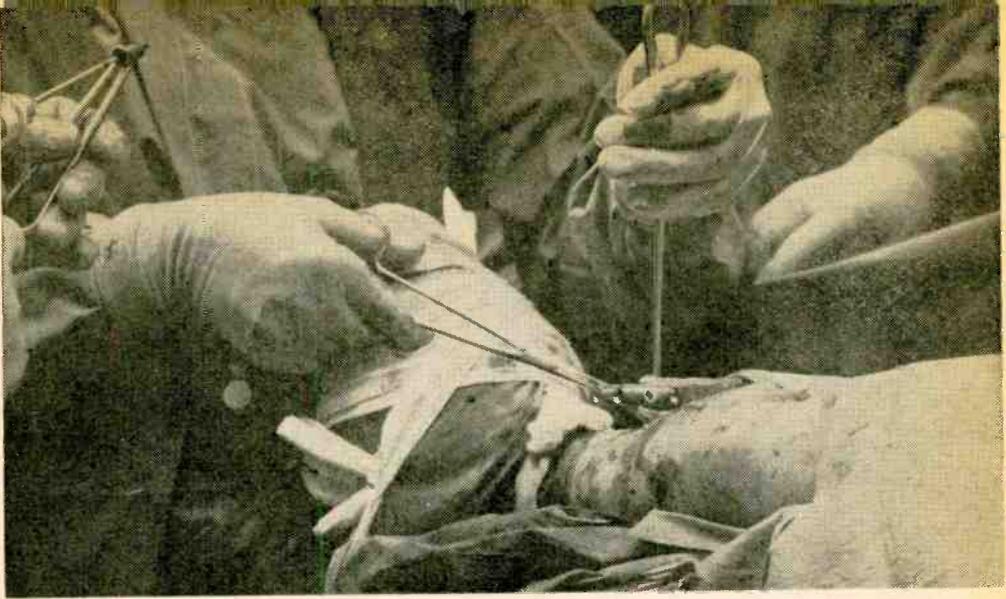
aged limb has to be amputated.

But now, at the County Hospital of Garmisch-Partenkirchen, a German ski resort, a fascinating new method for curing bone fractures has been developed and put into practice. They use induction—electrical current.

The background for this breakthrough was the discovery in the mid-1950s that certain kinds of electrical currents travel through the human body. If there's an interruption of the normal flow of current—for instance, if you break your leg—the electricity can't travel properly anymore. Werner Kraus, a Munich physicist, had developed a theory that if the proper flow of current in the body could be restored it would be very beneficial. Then he met Dr. Fritz Lechner, the General Director of the Garmisch-Partenkirchen hospital, and the



Treatment going on (top of page). Not only is it not painful, says this patient, it feels good! Above, we see the screwing through metal and bone in progress.



two of them began putting the theory into practice.

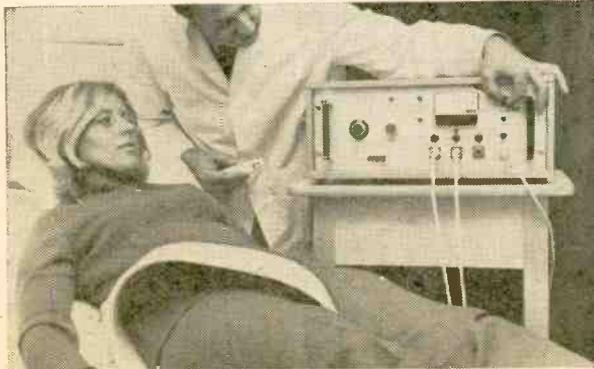
This is how it's done: two screws on either side of the break are electrically insulated from the metal brace with plastic inserts that do not react with the body's chemicals. The screws serve as electrodes that receive electrical energy from a small coil connected to the screws during the surgery when the leg bone was re-assembled with the implanted metal brace. The coil itself does not generate electricity; however, when placed in a magnetic field it is inductively coupled to a power source. Thus the entire limb is inserted into an external coil that supplies the power.

The external coil and the implanted internal coil function together as an air core transformer that is very inefficient. Very little power, however, is necessary to pro-

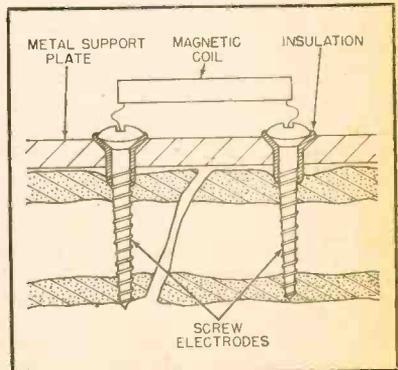
**Operation on a severely fractured leg is on the way (above). A metal plate is screwed to the bone, and a magnetic coil attached.**

mote healing. The power from the implanted coil passes through one screw through the damaged bone and flesh to the other screw. These electrical impulses promote healing of damaged blood vessels, skin, muscle, and bone. The energy required is less than 1/100,000 of that required to light up a 25-watt bulb.

The new treatment has proved to work very well. Says Dr. Lechner, "We have already used this method on over 300 patients, and we cured them. We believe that we have found a new way of promoting health in the general sense of the word. We also have reason to believe that this method will prove increasingly effective when fighting different tumor types." ■



**This young lady suffered a nasty fracture, but she's almost cured now. Soon she'll be back on the slopes!**



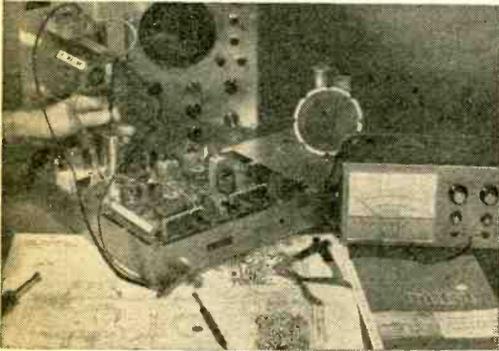
**The drawing above illustrates the principle of the new treatment.**



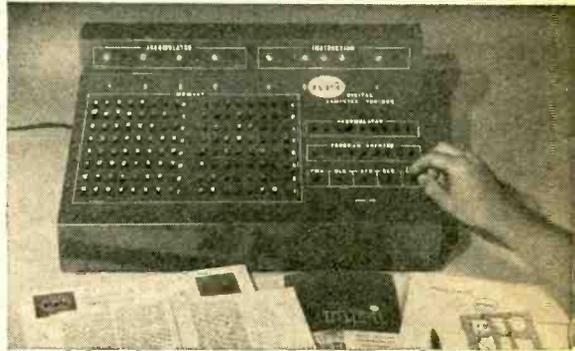
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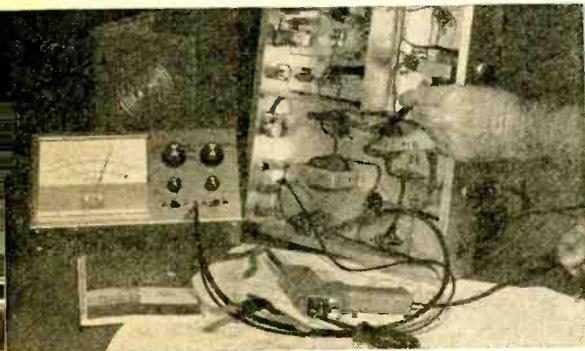
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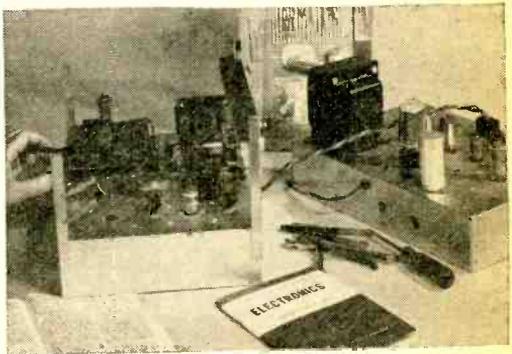
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# KLAXON FIRE ALARM



## The next "Wheep, wheep" you hear

□ A fire in your home can mean more than just a monetary loss or the loss of irreplaceable family heirlooms; if the fire breaks out at night while your family is sleeping it can mean the loss of life. Yet a fire alarm is one of the least expensive and easiest to install of all home protection systems.

Basically, a fire alarm consists of one or more low-cost normally-open heat detectors, a 6-volt battery, and an alarm horn or bell. When heat in the room becomes excessive the detector's contacts close, thereby completing a circuit, and the alarm-horn sounds. Even if there is an outdoor alarm bell, a horn should be positioned in the sleeping area to wake the occupants in time to get out safely. Unfortunately, any continuous noise (such as a steady tone from a horn) is not likely to wake a sound sleeper. What's needed is a horn that *pul-*

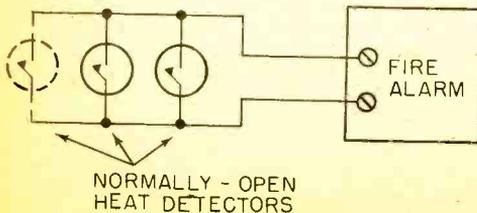
*sates*—similar to the warning horns and klaxons used on boats.

The Klaxon Fire Alarm project is just such a device. When triggered by a heat detector, the horn produces a raucous *wheep, wheep, wheep*, and keeps producing the sound until heat is removed from the detector.

The basic alarm consists of the alarm horn and pulsation relay, which is mounted on a scrap of plastic or wood (not metal) approximately 3 x 4 inches. The power supply is a 6-volt lantern battery which has a shelf life of at least one year. The alarm requires no standby current.

The alarm and the battery can be mounted in any suitable enclosure—metal, wood, or plastic. Since the alarm should be mounted in the general sleeping area, or perhaps directly at a child's bedside (several alarms can be connected in parallel), you might prefer an enclosure that blends in with the general decor. Our alarm is shown in an attractive speaker enclosure purchased locally for \$2.

**For More Noise.** If you wish to add an outdoor alarm bell, or additional horns (up



**Yes, you can also connect normally open smoke detectors to this alarm system.**



# FOR YOUR HOME

by Herb Friedman

## will save your life and maybe your home!

to three total), simply connect them across the horn (BU1) at points A and B. However, if you add any additional horns or bells you must substitute a relay for RY1 with contacts rated at least one ampere. Any 6-VDC general purpose relay can be used, such as the Potter & Brumfield KA5DY (Allied Radio 886-0389).

Horn BU1 requires a 1 $\frac{5}{8}$  in. mounting hole. It is cemented to the board with epoxy or one of the "miracle" adhesives such as *Permabond*. Relay RY1 is supplied in a plastic case which should not be removed. Position RY1 in relation to the horn as shown in the photo and cement the case to the board. Position RY1 so its leads stick out from the top.

The 5-terminal strip is cut down from a larger strip, or you can use two smaller terminal strips—the important thing is to have five terminals. Capacitor C1 is required; C2 might not be needed and there's no need to purchase it in advance.

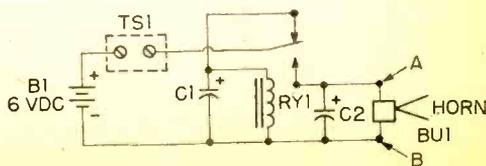
To avoid shorts between RY1's leads, place insulation on every wire from RY1. The wire leads are extra-thin, so you can use the insulation stripped from ordinary

"radio" hook-up wire.

Horn BU1 is supplied with only one terminal wire; the metal case is the other terminal. Using a soldering iron or gun rated at least 100 watts, "tin" a small area on the horn's case with solder—using a non-corrosive soldering paste. Then solder a 2-in. wire to the case. This wire must connect to C1's negative terminal.

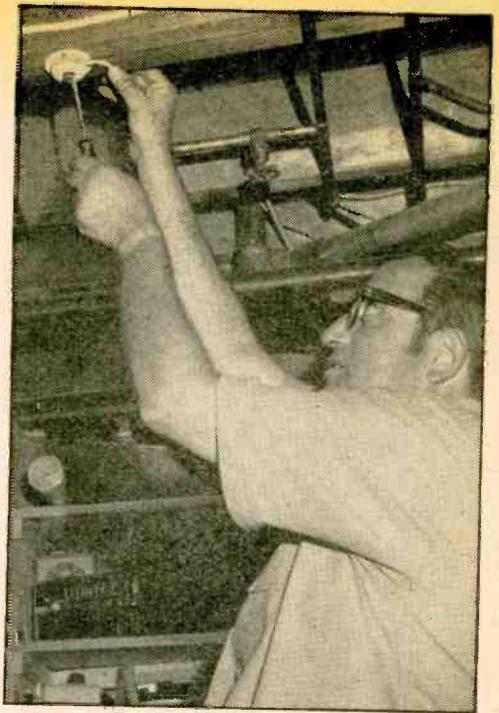
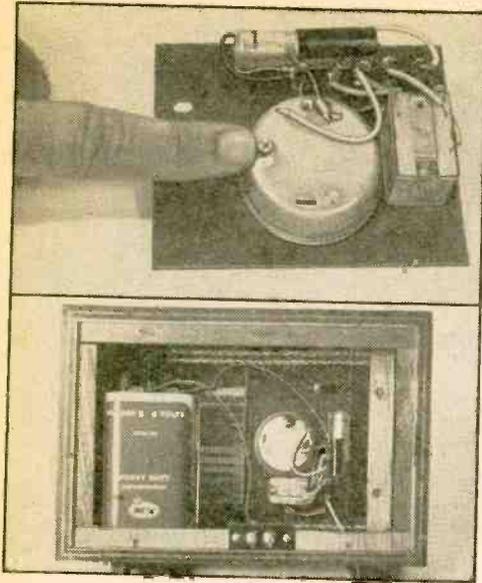
The terminal wire supplied with the horn is very delicate and almost impossible to shorten without damage, so use it full length.

**Checkout Before Installation.** Connect a wire from the terminal to which C1's negative lead connects to a 6-volt battery's negative terminal. Connect a wire from the terminal with RY1's wiper contact to the battery's positive terminal. This should cause the horn to sound. If it doesn't sound, rotate the small screw sticking out the back of the horn until the horn sounds. Then carefully adjust the screw until the sound is as



**Note the very simple schematic. Normally open detectors, left, connect to TS1, right.**

# e/e KLAXON FIRE ALARM



A complete alarm circuit is easily put together on a small plastic or wood board. A finger points to the loudness-adjust screw. Place the entire circuit in any convenient enclosure such as this surplus speaker box.

loud as possible. The horn should pulsate as it sounds. If the sound pulsates but the horn sounds as if it is sticking—barely getting enough energy to sound loudly—install capacitor C2. The negative terminal of C2 connects to the same point as C1's negative terminal.

**Completing the Fire Alarm.** Install the horn assembly in the enclosure, making certain you leave enough room for battery B1.

## PARTS LIST FOR KLAXON FIRE ALARM

- B1—6-volt lantern battery (Radio Shack 23-066 or equiv.)
- BUI—6-volt alarm buzzer (horn) (Radio Shack 273-049 or equiv.)
- C1—500  $\mu$ F, 15 VDC electrolytic capacitor (Radio Shack 272-1007 or equiv.)
- C2—100  $\mu$ F, 15 VDC electrolytic capacitor, see text (Radio Shack 272-1005 or equiv.)
- RY1—SPST, 6-volt DC relay (Radio Shack 275-004 or equiv.)
- TS1—2-terminal, screw-type terminal strip (Radio Shack 274-663 or equiv.)

Note: Heat detectors are available for \$3.50 each from Custom Components, Box 153, Malverne, N.Y. 11565. Specify either 130° F. or 190° F. heat rating. Add \$1 postage and handling to total order. N.Y. State residents must add sales tax. No foreign orders.

Keep in mind that heat rises. You must not install fire detectors near, of course, the floor. In the furnace room, secure a heat detector directly above the furnace. Look to the parts list for detector availability.

Install a 2-terminal screw-type strip at the back of the cabinet and then install the battery, securing it with a metal, string, or wire strap.

Connect the battery's positive terminal to one screw terminal on the strip. Connect the remaining strip terminal to the alarm. Connect the battery's negative terminal to the alarm. The system is ready for use.

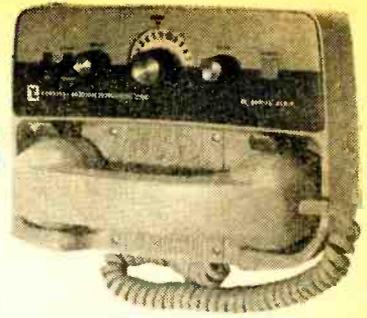
The heat detectors must be the normally-open type, where the contacts are open until excessive heat causes them to close. Any number of heat detectors can be used—they are all connected in parallel. Two wires (lamp cord or equivalent) can be run from any of the heat detectors to the fire alarm terminals.

Standard heat detectors will protect an area up to 20 x 20 feet (400 sq. feet). They can be positioned in the center of a ceiling, or even near a corner with the walls. If installed near a corner keep in mind that protection does not extend beyond 20 feet. If necessary, use two detectors in opposite corners.

Heat detectors used for the general living area should be rated 135° F. Detectors  
(Continued on page 94)



# KATHI'S CB CAROUSEL



**I** FLIPPED, and almost blew my mind the first time I saw the Johnson Messenger 130 CB transceiver. After years of staring at black boxes whose only condescension to modern styling and convenience was chromium plated knobs, there was a transceiver which looked as if it came right out of some Hollywood space flick—the type of gear I don't mind putting in my fireball-orange Vega.

The folks at Johnson just didn't put a CB transceiver into a case that looks like it came from a NASA workshop and call it quits, for the heart of the 130 is a telephone handset, a gadget I consider one of the most important mobile features. How often I've wished for some way to stick the signal right in my ear when road noise obliterated the sound from my rig's speaker!

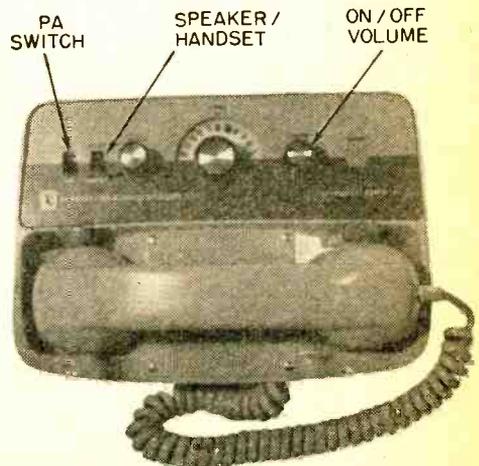
As you can see from the photographs, the Messenger 130 looks like a Princess-Radiophone; something the telephone company would sock you for an extra \$10 a month if they could make their phones look as good as the 130. Across the top half are a 23 channel selector, *volume* control, *squelch* control, *PA* switch, a *speaker/handset* switch and a red-light transmit indicator.

The bottom half of the case is a molded cradle for the handset. Two spring-loaded clamps secure the handset by forcing it down firmly into the side of the cradle.

A speaker is positioned under the handset. A small push button switch, forced down by the handset, controls the operation of the

speaker, which I'll explain carefully because this is the feature I dig the most.

When the handset is in the cradle all received signals are heard through the speaker. If the speaker/handset switch is set to *speaker* the signals will still be heard from the speaker even if the handset is lifted from the cradle. But if the speaker/handset switch is set to *handset*, the small push button, which is released when the handset is lifted, switches the signal from the speaker to the handset, bringing the signal right into my ear. Normally, I prefer the big sound of a speaker; but when road noise gets so bad I have to run the speaker volume almost to the threshold of pain to make sense out of the transmission, I simply switch to the handset monitor and the signal purrs into my ear—well in the clear of the interfering road noise.



---

The Messenger 130 Citizens Band radio is from the E. F. Johnson Company, Waseca, MN 56093, and sells for \$199.00. For more information, circle No. 33 on Reader Service Coupon on page 17 or 103.

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**Congratulations to E. F. Johnson for a most attractive mobile package that gets my vote for best design innovation yet in AM CB.**

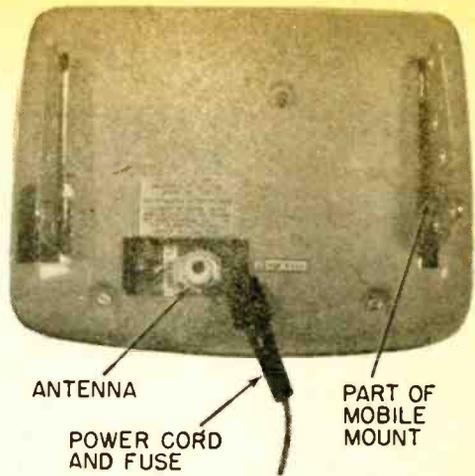
## e/e KATHI'S CB CAROUSEL

The back of the Messenger 130 has the coax antenna jack, a PA/external speaker mini-jack and a direct-connected positive battery wire. The two steel brackets on the rear are part of the mobile mount and provide the negative battery connection from the car's frame.

**Back To Basics.** The Messenger 130 is strictly a communications device—there are no frills such as S-meters, RF-output meters, modulation indicators, etc. The receiver is single conversion, and full 23-channel coverage is provided through a frequency synthesizer. For additional selectivity a bandpass filter is used in the IF amplifier. The transmitter is more or less straightforward with a pre-tuned (at the factory) pi-net output.

**Getting Results.** The receiver checked out with a sensitivity of 1.0  $\mu\text{V}$  for a 10 dB S+N/N ratio (signal-plus-noise to noise). Selectivity measured 49 dB adjacent channel rejection while image rejection was 16 dB. Though the image rejection is nowhere near the usual figure for double-conversion receivers, 16 dB is typical of the better single conversion receivers. The AGC action for signals ranging from 2  $\mu\text{V}$  to 10,000  $\mu\text{V}$  was only 7 dB, the type of performance needed when monitoring through an ear-phone; in plain terms it means that switching from a very weak to a strong station will not cause the volume to suddenly blast the speaker out of the rig or the phone from your ear.

The transmitter delivered 3.4 watts RF



Set must be grounded at mounting brackets. A mini-jack in the antenna connector well serves for both PA and remote speaker out.

output to a 50-ohm load. The microphone sensitivity for 85 percent modulation measured -12 dB, an excellent value for the close-talking handset. The modulation was limited to 100 percent.

Performance aside, the feature I like the most is the mobile mount, which is shaped to fit the curve in the car's driveline hump—as well as serving as a dashboard mount. Those cute U-brackets that come with most transceivers are great for installation under the dash of a Detroit battleship, but they're zilch in a gas-saving mini-car. The 130's bracket, however, is extra sturdy for a hump installation and makes installation a breeze. For more information about the E. F. Johnson Messenger 130, Circle No. 33 on the Reader Service page. ■

## LOOKING AT COLOR TV ENERGY WASTE

□ Now that the "out of gas" signs limit pleasure driving, more people are looking to their color TV sets as a source of enjoyment, with a second color set moving into more and more homes. TV viewing certainly beats travel by car, when it's a question of saving gas. But what about the electrical energy a color set consumes?

Recent tests showed that the all-tube chassis of one color TV set had a power rating of about 325 watts, while the hybrid chassis of another model used power at the rate of 260 watts. In contrast, the all solid-state chassis of a third color set needed only 176 watts.

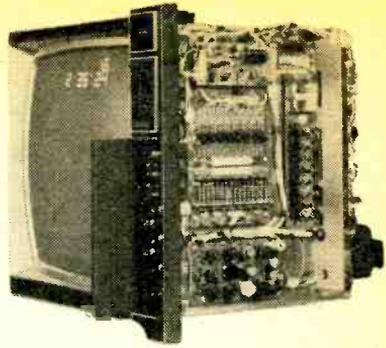
An "instant-on" feature wastes power round the clock and should be wired out of the set. If your set has automatic brightness control, which compensates for room light, you are saving power, sometimes up to 15 watts. Yes, you can save energy. ■



Magnavox Videomatic brightness and contrast circuit

e/e checks out  
the Heathkit...

Circle  
No. 1  
on Reader  
Service  
Page



# DIGITAL-DESIGN COLOR TV KIT

New features like varactor tuning, digital dialing and channel/time video readout!

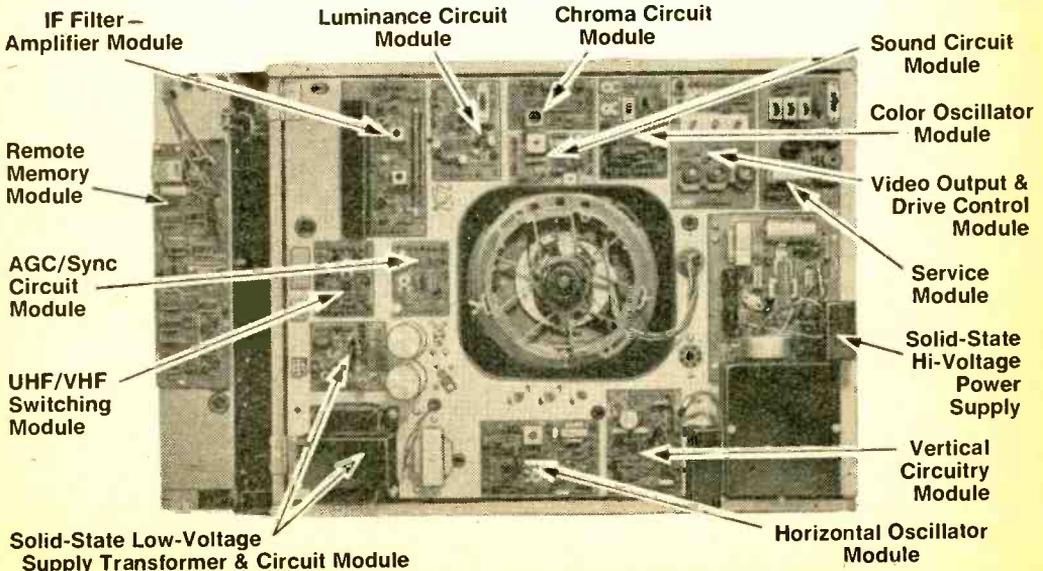
ALTHOUGH color TV manufacturers like to speak in terms of "state of the art," the plain fact is that it has taken most of them something like seven years to just approximate—let alone equal—the picture quality of a Heathkit color TV. And while these same manufacturers talk of transistors, or all solid state circuitry, it is nevertheless true that the solid state circuits are generally straight replacements for tubes, with little that's new in actual "state of the art." Many tuners still use the trouble-prone mechanical switching, and most sets have complex tuning and trap adjustments. The limited attempts at modular snap-in circuits still require the attention of an expensive service technician; they help the technician get the circuits free, but do little towards shaving your service bills.

But with the introduction of the Heathkit

GR-2000 Color TV we really enter the age of modern electronic technology as far as color TV is concerned, with all its advantages in the way of performance, reliability, and rock-bottom service problems. The fact is, today's Heathkit GR-2000 is the color TV the rest of the industry will be making tomorrow.

**New Throughout.** Everything about the GR-2000 is so new and advanced it's difficult to know where to start, so we'll begin with two of the highlight features.

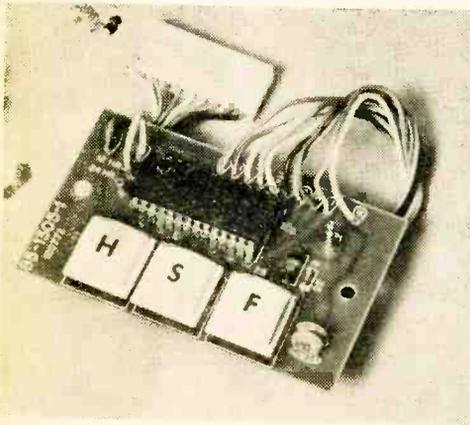
Firstly, the GR-2000 is *all solid-state*. Except for the deep color saturation Black Matrix color tube, all circuits use solid state devices, including the high voltage power supply. Unlike other solid state TVs, however, the transistors and ICs in the GR-2000 are not mere replacements for tubes; the complementary circuitry is as advanced



Plug-in modules can be serviced by Heath at stores or main plant.

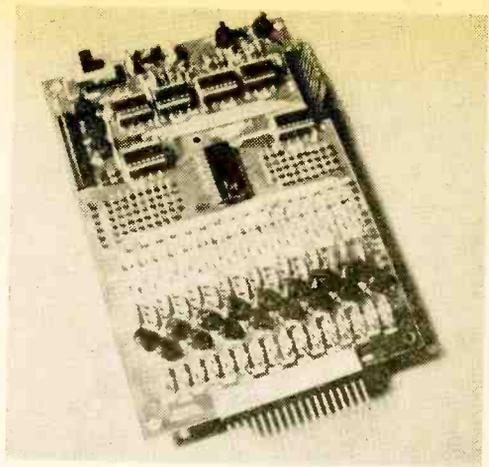
as the solid state devices. For example, the IF amplifiers do not use the common, drift-prone sound and picture traps to keep "garbage" out of the picture. In the GR-2000 the IF amplifier has a fix-tuned bandpass filter whose characteristics place the picture and sound carrier, and the chroma, exactly where they belong without need for *precision* adjustment; in fact, the bandpass filter takes no adjustment. Other circuits, as we'll show, use the same high degree of advanced technology.

The second big plus is the varactor-tuned front end with its associated digital channel readout which appears directly on the screen. Varactors are diodes whose capacitance is determined by an applied voltage. Tuning of the Heathkit color TV is accomplished through these diodes, with no intermediate mechanical devices. Simply touching a front panel button causes the channel selector to electronically switch (count) up or down. Up to 16 pre-selected VHF and/or UHF channels can be programmed into the electronic tuning "switch"; as each channel is tuned in its number appears in the upper right corner of the screen. (Electronic feedback insures that each channel is locked to *precise tuning*—so important for proper color reception.) The length of time the



An optional digital readout clock assembly indicates time to the second on the scope face whenever the channel number appears.

From up to 20 feet away from the GR-2000 you can change channel (up or down), color and tint adjustments, and volume.

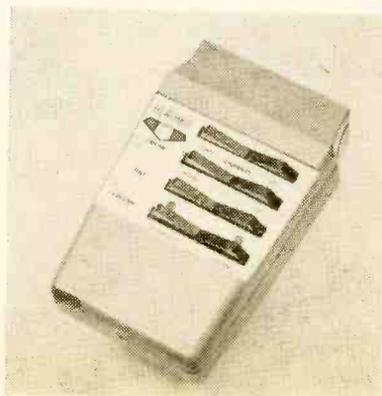


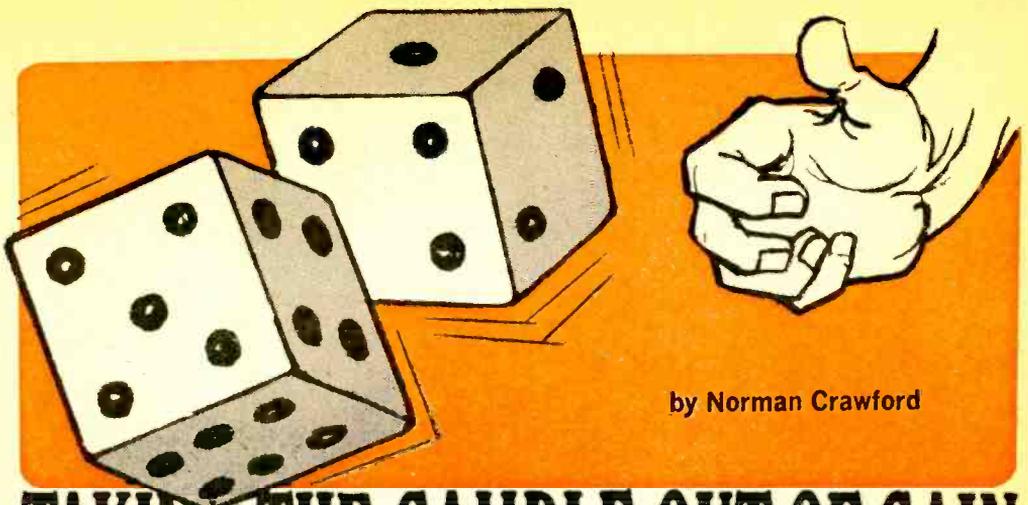
Unlike conventional tuners with switches, the GR-2000 front end is programmed to tune in only those VHF and UHF stations near you!

channel number is displayed on the screen is determined by the user's programming of the channel selector. An optional digital clock assembly, which mounts in the TV, will display the precise time in hours, minutes and seconds in conjunction with the channel number.

The tuner's output feeds the bandpass IF amplifier and then branches out to several small functional modules, each of which snaps into matching connectors in the main frame. Each module provides an essentially independent function, so that in the event of a component breakdown the difficulty can be easily isolated. Unlike other TVs with so-called "modular construction," when you pull a module on the GR-2000 you don't wind up disabling half a dozen circuits, which makes troubleshooting next to impossible.

**Service, Made Easier.** To assist the build-  
(Continued on page 96)





by Norman Crawford

# TAKING THE GAMBLE OUT OF GAIN

**G**AMBLERS and amplifiers have one thing in common: Their goal is to get more *out* than is put *in*. But, while successful gambling requires the smiles of Lady Luck, amplification is not a matter which should be left to chance. All too often, however, amplifier circuits are used whose actual gain is a complete unknown until the circuit is actually built and tested.

And gain is not the whole story. The bias, or DC operating point, must also be known and predictable, or the amplifier may clip and distort the signal it is passing. In extreme cases, it will fail to pass a signal at all. Again, we often see amplifier circuits whose DC operating points are left to chance, or are "tweaked" into place only after the circuit is built and fails to operate correctly.

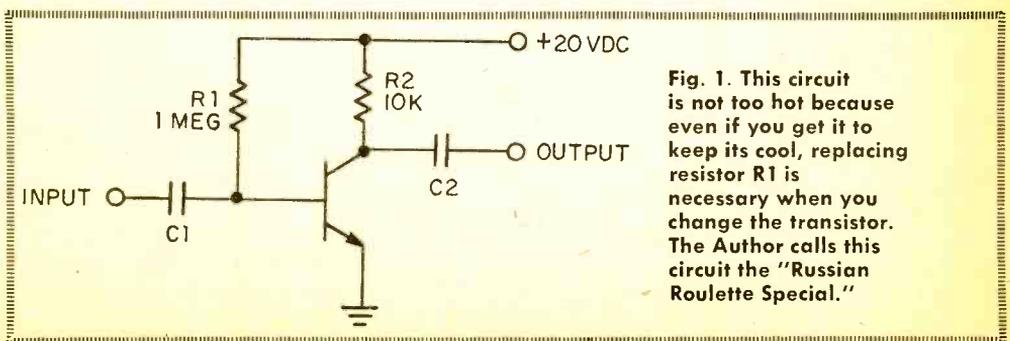
Such gambling with gain and bias is unnecessary. Very simple and straightforward methods can be used to predict the gain and DC operating conditions of an amplifier, making its behavior a matter of logic, not luck. These techniques succeed because they make the gain and DC operating points depend upon resistor values, which are predictable, instead of de-

pending upon transistors and ICs, which are notoriously unpredictable, even at the present state of the art.

In the following paragraphs, we shall give examples of both *long shots* and *sure things* in the amplifier world, and show how to convert a long-shot risk into a much more reliable amplifier.

**Russian Roulette Special.** If you like to gamble, the circuit of Fig. 1 will give you a *lot* of gain—if it works at all! But even if you get it working, the first hot day may send it into raspy distortion as the hot transistor shifts its DC operating point, brutally destroying your clean hi-fi signals. And even if you can get it to keep its cool, you will find that the resistor values shown won't work if you change transistors, or if you try to build another identical circuit. In brief, this circuit requires, first, that you hand-tailor it to fit each and every transistor, and second, that you keep the circuit's transistor cool.

So in spite of the high gain available from this circuit, it represents a bad gamble—a real long shot—because it may not work at all, or



**Fig. 1.** This circuit is not too hot because even if you get it to keep its cool, replacing resistor R1 is necessary when you change the transistor. The Author calls this circuit the "Russian Roulette Special."



## GAIN WITHOUT GAMBLE

it may work one day and not the next, or it may work with one transistor and not another. Even if Lady Luck smiles on you and the circuit works, you cannot readily predict how high the gain will be.

**A Better Gamble.** If you don't like long shots, you can add one resistor to the *Russian Roulette Special* and improve its reliability considerably. But, as in most gambling operations, the payoff—in this case, the gain—goes down.

Take a look at Fig. 2 and you will see that it is just the *Russian Roulette Special* with a resistor added in the emitter circuit.

The gain of this circuit is, for all practical purposes, completely independent of the transistor. In fact, the gain is simply the value of the collector resistor, R2, 10,000 ohms, divided by the value of the emitter resistor, 2,000 ohms. Therefore, the gain is  $10,000/2,000 = 5$ . A one-volt signal applied to this circuit can be relied upon to produce a five-volt output signal, every time.

The new emitter resistor also does nice things for the DC operating point, by making it more predictable and less susceptible to high temperature difficulties. Although this circuit is still not the best we can do, it is a much better bet than the *Russian Roulette Special* shown in Fig. 1.

**The Sure Thing.** Adding yet another resistor, R4, to the circuit of Fig. 2 gives us Fig. 3, which is a real *sure thing* in the amplifier world.

Just as for the circuit of Fig. 2, the gain of this circuit is  $R2/R3$ . Since the value of R2 has to drop a little for this circuit—for reasons explained below—the gain of this circuit is  $9,100/2,000 = 4.55$ . Note that, just as in Fig. 2, the transistor has nothing to do with this value of gain. Only the fixed resistors determine the gain, which is just the way we like it.

The DC operating point of this circuit is extremely stable and predictable—far better,

even, than the circuit of Fig. 2—and is determined by the resistor values only.

**Putting It Together.** If you're a compulsive gambler, or for some reason like to play *Russian Roulette* with your amplifier designs, you may opt for the simple but unreliable circuit of Fig. 1. In such a case, you can reduce your risk somewhat by following the step-by-step design arrangement given below:

1. Choose your power supply voltage. In Fig. 1, we chose 20 volts, a good round number. For most transistors, values below 2 volts will make for a difficult design. In no case should the voltage chosen be greater than the value given in the transistor data for  $BV_{ce0}$  (Breakdown Voltage; Collector-to-Emitter, with the remaining electrode (base) Open).

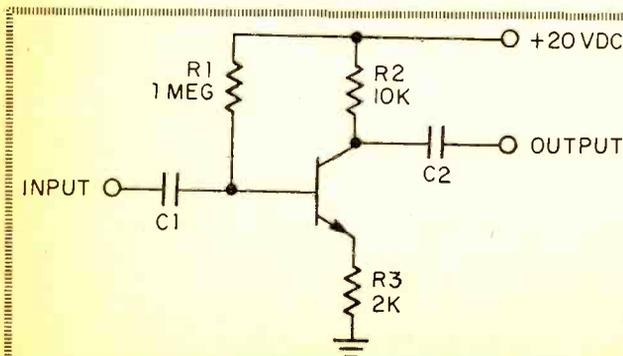
2. Second, choose the current desired in the transistor. For economy, especially for battery operation, this should be as small as possible. However, many small transistors do not operate well below 0.5 milliampere; often the transistor databook will indirectly recommend a current by saying something like "Beta (or  $h_{fe}$ ) is 35 at  $I_c = 2$  mA." This is a broad hint that the particular transistor type you're considering has been manufactured to work best at 2 mA. Under no circumstances should you choose the current value given under "Maximum Ratings." This is the red-line, never-exceed value of current; one increment beyond this value and the transistor may vanish in a puff of silicon smoke! If in doubt, 1 or 2 mA is a reasonable value for small transistors. In our example, we chose 1 mA.

3. Having chosen the current, calculate R2, the collector resistor, with the formula

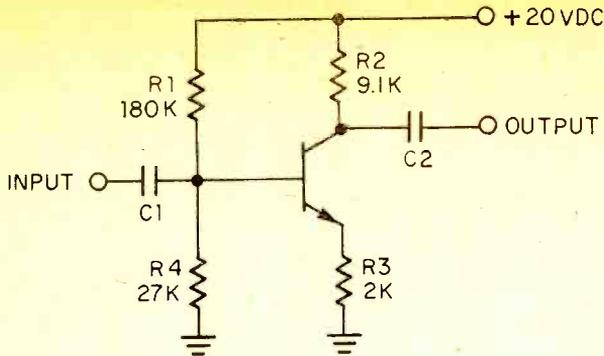
$$R2 = \frac{500 \times E}{I_c \text{ (mA)}}$$

$$R2 = \frac{500 \times 20}{1} = 10,000 \text{ ohms}$$

4. For the next steps, you need a voltmeter, an ohmmeter, a 2-megohm po-



**Fig. 2.** This circuit amplifies the input signal, and the amount of gain is not a function of the transistor, but the ratio of resistances R2 and R3. In this case, gain is 5.



**Fig. 3. Stability is the name of the game played with gain. The addition of R4 removes the circuit's tendency to self destruct like the one shown in Fig. 1. Gain is still the ratio of R2/R3, but notice value is lower, with a loss of some gain,**

tentiometer, and a resistor somewhere between 10,000 and 100,000 ohms. Put the circuit together with the pot, resistor, and voltmeter as shown in Fig. 4.

5. Adjust the potentiometer in Fig. 4 until the voltmeter reads one-half the supply voltage—10 volts, in this case.

6. Without disturbing the potentiometer setting in Fig. 4, remove the pot and its associated resistor and measure their combined value with the ohmmeter.

7. Use the value obtained in step 6 for the R1 of Fig. 1.

To complete the design, C1 and C2 should be chosen to have values in the 100  $\mu$ F region for most audio work, with voltage ratings equal to or greater than the power supply voltage.

If you ever have to replace the transistor, you will probably have to repeat steps 4, 5, 6, and 7.

The above effort, which includes all that playing around with meters and pots, yields you an amplifier of unpredictable gain and doubtful reliability. The circuit of Fig. 2, though better, offers not enough real improvement to warrant a detailed discussion. Fig. 3 is the circuit that removes us from the ranks of risk-takers, so we should next see how this superior circuit may be designed, step-by-step.

**No-Gamble Gain:** Here's the step by step procedure that is foolproof.

A. Select the supply voltage and transistor current just as in steps 1 and 2, above.

B. Select a DC voltage, smaller than the

supply voltage, which you want to appear at the emitter. In the example in Fig. 3, we chose 2 volts. If this voltage is chosen too small (less than 1/20th the supply voltage), gain predictability and bias predictability will be poor. If chosen too large (more than half the supply voltage), then so much of the available voltage is "used up" on the emitter that there's very little left to produce signal output. So, it's a trade-off between good stability and a large output. A good rule of thumb is to let about one-fifth to one-tenth of the supply voltage appear at the emitter.

C. Calculate the emitter resistor, R3, by the formula

$$R3 = \frac{1,000 \times E(\text{emitter})}{I_e (\text{mA})}$$

$$R3 = \frac{1,000 \times 2}{1} = 2,000 \text{ ohms}$$

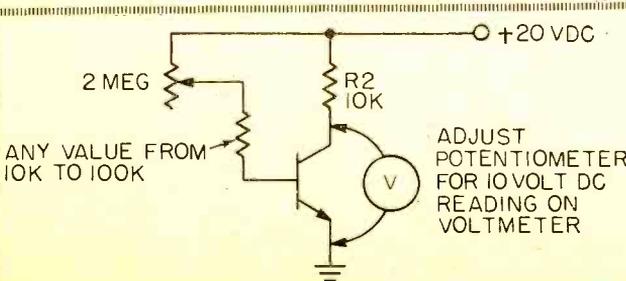
D. Add 0.6 volt to the emitter voltage, to obtain the base voltage:

$$E(\text{base}) = E(\text{emitter}) + 0.6 \\ = 2 + 0.6 = 2.6 \text{ volts}$$

(Note: Use 0.6 volt for silicon transistors; use 0.2 volt for germanium transistors)

E. Calculate R4 by the formula

$$R4 = \frac{10,000 \times E(\text{base})}{I_e \text{ mA}}$$



**Fig. 4. Adjusting pot until voltage across transistor is one half of power supply is a sure way of discovering value of R1 in Fig. 1. Be sure potentiometer resistance is maximum and decrease slowly, never exceeding one-half collector voltage.**

# E/G GAIN WITHOUT GAMBLE

$$R4 = \frac{10,000 \times 2.6}{1} = 26,000 \text{ ohms}$$

(use EIA value, 27,000 ohms)

F. Calculate R1 by the formula

$$R1 = \frac{10,000 \times [E(\text{supply}) - E(\text{base})]}{I_c \text{ mA}}$$

$$R1 = \frac{10,000 \times (20 - 2.6)}{1}$$

R1 = 174,000 ohms (Use EIA value, 180,000 ohms)

G. Calculate R2 by the formula

$$R2 = \frac{500 \times [E(\text{supply}) - E(\text{emitter})]}{I_c \text{ (mA)}}$$

$$R2 = \frac{500 \times (20 - 2)}{1}$$

R2 = 9,000 ohms (use EIA value, 9100 ohms).

Notice that using up two volts on the emitter caused us to have only 18 volts left for output. The mathematics then forces us to drop the 10,000-ohm collector resistor to 18/20ths of 10,000 ohms, which is 9,000 ohms. This causes some loss of gain (from a gain of 5 for the circuit of Fig. 2, to a gain of 4.55 for this circuit) which is the price paid for stabilizing the amplifier. Again, it's just like gambling—when the risk goes down, so does the return.

Can we hedge our bets? That is, can we keep the DC operating point stable, and still get more gain? Indeed, we can. The circuit of Fig. 5 shows how this is done:

In this circuit, a 300-ohm resistor, R5, has been added in parallel with the 2,000-ohm emitter resistor, R3, but with a capacitor C3 in series with the new resistor. Since the capaci-

tor is an open circuit to DC, the DC stabilizing effect of R3 is unchanged—it's just as though R5 weren't there, as far as DC is concerned. However, for the signal, which is AC, the capacitor looks like a short circuit—it looks exactly as though R5 were soldered directly across the emitter resistor.

So, for the signal, the total resistance in the emitter circuit is effectively the parallel combination of R3 and R5:

$$R = \frac{R3 \times R5}{R3 + R5} = \frac{2,000 \times 300}{2,300}$$

$$R = 261 \text{ ohms}$$

And, since the gain is given by R2/R3, the addition of R5 in parallel with R3 has changed the gain thus:

Before R5 and C3 were added:

$$\text{Gain} = (9,100)/(2,000) = 4.55$$

After R5 and C3 were added:

$$\text{Gain} = (9,100)/(261) = 34.9$$

The addition of R5, then, gave us nearly eight times as much gain, and did so without disturbing the excellent DC-operating-point stability of the basic circuit. What price do we pay for this improvement—that is, beyond the money cost of the resistor and capacitor? And, if dropping in a 300-ohm resistor yields eight times the gain, would a 30-ohm resistor give 80 times the gain?

Obviously, the smaller we make R5, the more gain we get, until finally, when R5 = 0, we get the most gain we can obtain from this transistor. At this point—with R5 shorted out, and the capacitor C3 therefore directly across the 2,000-ohm resistor, R3—the gain is identical to the gain obtained from the *Russian Roulette Special* circuit of Fig. 1. It is just as large, and just as unpredictable. Such a circuit, with R5 shorted out and C3 directly across R3, is sometimes used to obtain the most AC

(Continued on page 95)

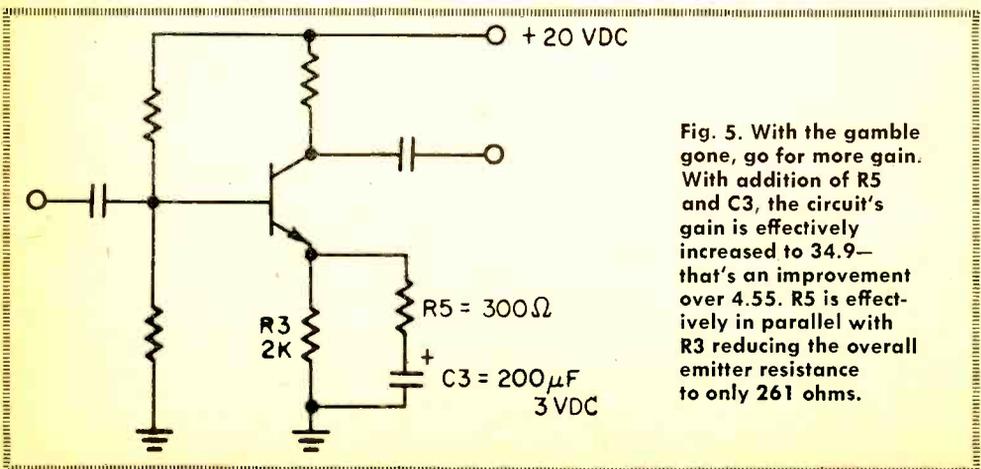


Fig. 5. With the gamble gone, go for more gain. With addition of R5 and C3, the circuit's gain is effectively increased to 34.9—that's an improvement over 4.55. R5 is effectively in parallel with R3 reducing the overall emitter resistance to only 261 ohms.

# INSIDE

The beginning of e/e's continuing look inside and around your 2-way Citizens Band transceiver!

by the Elementary Electronics Editorial Staff

□ The CB transceiver is truly an amazing device. Dollar for dollar it is the best value in consumer-type electronic equipment. Organized around two basic design systems—amplitude modulation and single sideband—the modern CB transceiver can be specifically tailored to a given level of performance or operating convenience by adding a dollar or so of parts here, fifty cent worth of hardware there. No other consumer device can be so easily expanded to meet the need of the user. Whether you are a hobbyist, or business-only CB'er, that black box called a transceiver can do exactly what you want it to do when you want it.

The CB transceiver can provide general, or blanket, communications over a general area, provide pin-point line-of-sight communications, keep you informed of emergency situations, record messages while unattended, substitute for a telephone across impenetrable mountains, function as a pocket-fone, and . . . well, anything you can think of in the way of personal communications can probably be handled by the modern CB transceiver. In short, the CB transceiver is a sort of universal "communicator" in that it can be made to meet any operating needs.

The exact facilities delivered by your present CB transceivers, or models you might be considering adding to your CB station, depends on the performance and features of small, individual "modules" which the manufacturer has plugged together at the factory. Using more or less basic circuits he can build upward from a three-control black box (channel selector, volume and squelch) to one of those gold plated specials with everything except running water.

In this series we're going to look into those "modules," for by having an understanding of how CB transceivers work, you'll be able to purchase a CB transceiver having *all the features and performance needed for all your applications*. As a side benefit, by knowing the in and outs of your CB transceiver, you'll be able to handle operating and minor repair problems which might come your way.

**Two CB Systems.** There are presently two distinct and separate type of transmission systems in use: AM, or amplitude modulation,

and SSB, or single-sideband. They are incompatible with each other, meaning an AM station cannot "work" a sideband station and vice versa. Only if the individual transceivers have *both* AM and SSB can they work all CB stations.

In the amplitude modulation system the voice energy, termed modulation, is impressed on the radio frequency carrier generated by the transmitter. In the process of combining the audio modulation and RF carrier, new frequencies called *sidebands* are generated. These sidebands are equal in frequency to: the RF carrier *plus* the modulating frequencies, and the RF carrier frequency *minus* the modulation frequencies.

The maximum amount of *undistorted* modulation that can be impressed on the RF carrier is one-half of the carrier power input, which, of course, also means one-half the carrier power output. If the CB transmitter takes 5 watts input, the maximum amount of modulation is 2.5 watts. If the transmitter has 80% efficiency—actual output power divided by input power—there will be 4 watts carrier output power and 2 watts of modulation divided between two sidebands, so that each sideband has only 1 watt of modulation power.

**One Does The Job.** The AM receiver responds only to the energy in one sideband; it requires the carrier and other sideband for restoration of the signal back to audio, but only one sideband conveys intelligence. (The other sideband can be eliminated at the transmitter with very little audio loss at the receiver.) Therefore, of the entire 7.5 watts of energy put into the transmitter, at most, 1 watt of RF output power is converted back to an audio signal at the receiver.

The advantage of the AM system lies primarily in the fact that circuits are relatively simple, and it is quite easy to build a good communications system at a rather low price—as evidenced by some rather noteworthy CB transceivers in the \$100 price range. It is the easiest system to use, requires no adjustments other than selecting the desired channel, and will generally give years of trouble-free operation even under the most severe handling.

Disadvantages to the AM system are exces-

sive channel bandwidth and susceptibility to interference. Though only one sideband is needed to transmit intelligence, the AM signal has two sidebands, one sideband taking up space that could be used by another station. Though this is really no concern to the average user, the citizens band is fast becoming saturated with stations fighting for the available channels; if the second, unneeded, sideband were eliminated, the citizens band could accommodate twice the number of interference-free signals. As far as interference is concerned, an AM receiver is particularly susceptible to heterodyne interference, the whistle caused when two stations try to use the same frequency simultaneously. The interfering station's signal strength need be only 1/100 that of the desired station to cause objectionable interference.

**A Solution?**—Single Sideband, or SSB as it is termed, utilizes the principle that only one sideband is required for transmitting intelligence. By eliminating the carrier and second sideband at the transmitter, all the intelligence-carrying energy goes into the entire signal transmitted by the station. This means that the transmitter input power allowed by the F.C.C., 5 watts average DC power, goes into the modulation energy. This is four times greater than the 1.25 watts of power input for one sideband of an AM signal.

To digress for a moment, you'll often find SSB transceivers rated at 10 watts P.E.P, or 15 watts P.E.P. This does not mean 10 or 15 watts power input. The P.E.P. stand for Peak

Envelope power, which when integrated over the complete cycle comes out as 5 watts average power input, which is the same thing the F.C.C. means when they specify 5 watts DC power input.

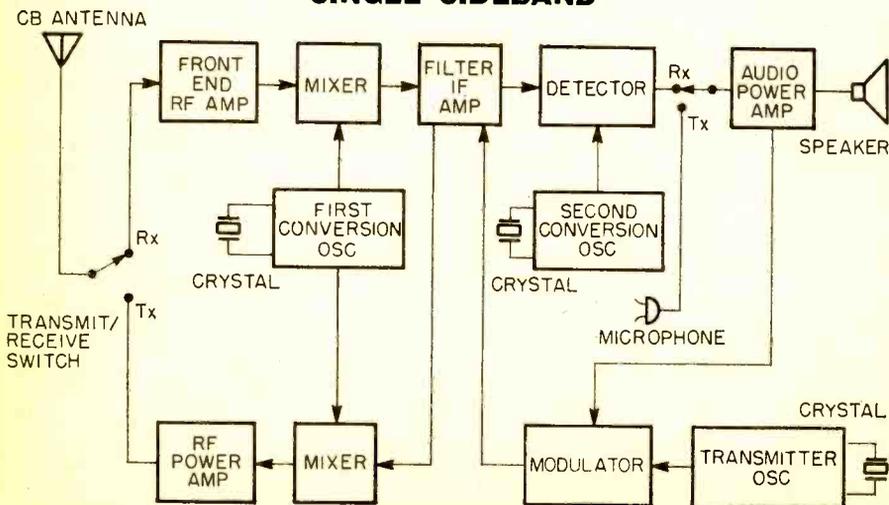
All the RF energy radiated from the SSB transmitter is sideband energy, and since the power input of the sideband energy is four times that of the AM sideband input, the signal at the receiving station is four times stronger than that of an AM transmitter. Only problem is the receiver hears the sideband signal as monkey chatter or Donald Duck; completely, but completely unintelligible.

As we said, a carrier is necessary at the receiver for converting the signal back to audio. With a sideband receiver, the carrier is reinserted at the receiver by a separate oscillator which is part of the receiver's detector. (The detector doesn't care where the carrier comes from as long as one is there.)

**23 times SSB=46.** If we backtrack, we see SSB signal uses only the radio frequencies that are needed for one AM sideband—it could be the upper or lower sideband frequencies. This frees the frequencies needed by the unused AM sideband for another SSB station, and, in fact, two SSB stations can share the same channel without interference, one using the upper sideband frequencies, the other the lower sideband frequencies. If all CB stations were SSB the present 23 channels could provide 46 communication channels.

Single Sideband offers several advantages over AM. First, there's the matter of *working range*. The intelligence-carrying part of the signal is four times stronger than AM; added to signal enhancement by the process of SSB detection in the receiver, an SSB signal is the

### SINGLE SIDEBAND



This block diagram of a modern single sideband transceiver clearly shows the additional circuitry required. To lower complexity,

## 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:

**Receivers.** What makes the big difference? Explore the famous dual conversion receiver. Learn why single conversion has its place in today's CB transceivers—and why it will stay. Look for full information in the easy to read e/e format about IF filters: tuned, crystal, mechanical and ceramic.

**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.

equivalent of 8 to 10 dB more effective than an AM signal. The effect at the receiver is as if an AM station were running almost 50 watts input power. Also, there is no carrier, so there is no heterodyne "whistle" interference if all stations using a channel are SSB. The interference between SSB signals sounds like chatter, which is not as annoying as a constant background whistle.

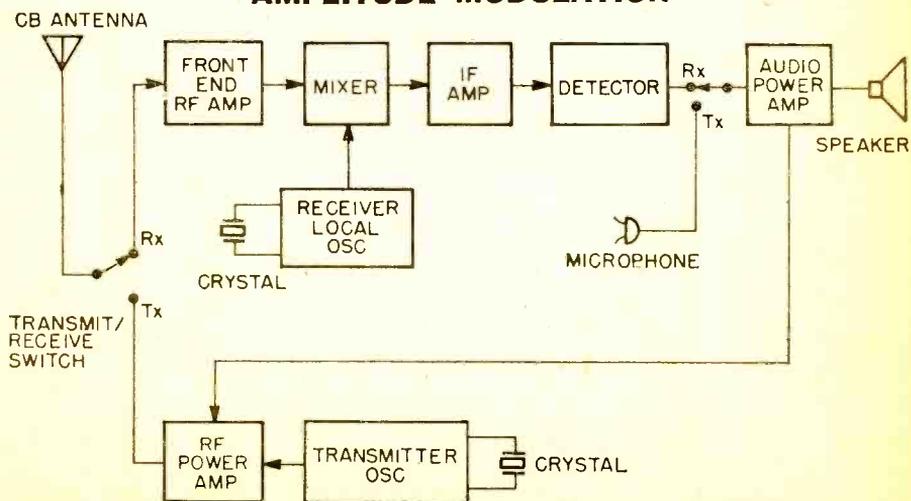
Since highly selective filter circuits are required for the generation of an SSB signal, these same filter circuits are sitting there, available for receiving, so you'll find that SSB

transceivers feature high selectivity (adjacent channel interference rejection).

Since SSB requires considerable precision circuitry, as you'd expect, SSB rigs are not cheap. Unlike AM transceivers, which can be stripped of circuits to the bare bone and still deliver excellent overall performance, SSB requires sophisticated circuits for both budget and higher priced models—the differences in price generally reflected operating convenience features rather than performance.

The figure gives a good illustration of the  
*(Continued on page 94)*

## AMPLITUDE MODULATION



manufacturers double-up wherever possible by using the same circuit during both transmit and receive. SSB sets usually include the AM mode.

# DIGITAL COLOR

**Bell & Howell Schools announces an exciting new at-home learning program that includes this advanced color TV with digital features... you build it yourself!**

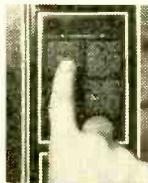
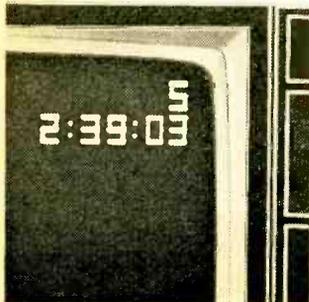
**You learn valuable skills in electronics through experiments and testing as you build a color television that's ahead of its time!**

You've seen TV's that swivel, TV's with radios built in. TV's small enough to stuff in a suitcase and TV's that have remote control.

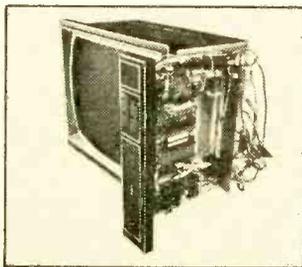
But now comes a color television with features you've never seen before. Features now possible as a result of the new applications of digital electronics --- features that make Bell & Howell's new 25-inch diagonal color TV ahead of its time! You learn about...

Channel numbers that flash big and clear right on the screen. An on-screen digital clock that flashes the time in hours, minutes and seconds with just the push of a button. An automatic channel selector that you pre-set to skip over "dead" channels and go directly to the channels of your choice.

And to insure highest quality performance, this new TV has silent, all-



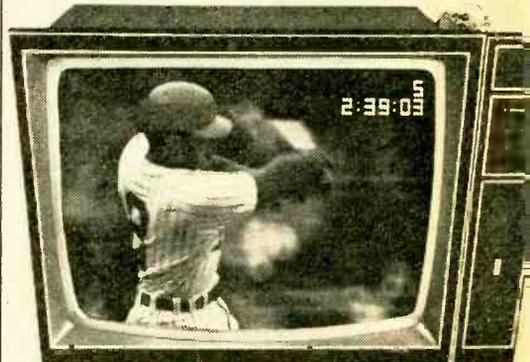
electronic tuning, "state-of-the-art" integrated circuitry, Black Matrix picture tube for a brighter, sharper picture and 100% solid-state chassis for longer life and dependability.



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

Designed exclusively for our students, this new Bell & Howell Electro-

Simulated TV picture.



**You build and keep this revolutionary new Bell & Howell 25" diagonal color TV with amazing digital features! Mail the postage-free card today for complete details, free!**

Lab® gives you up-to-date "tools of the trade", including instruments you can use professionally after you finish the program.

A new digital multimeter that measures voltage, current and resistance and displays its findings in big, clear numbers. Far more accurate and readable than conventional "needle pointer"



meters that require guesswork and interpretation.

The solid-state "triggered sweep" oscilloscope is a "must" for accurate analysis of digital circuitry. Includes DC wide-band vertical amplifier and "triggered sweep" feature to lock in signals for easier observation.

The design console is a valuable device for setting up and examining circuits without soldering! Features patented modular connectors, AC power supply and transistorized dual range DC power supply.

# R TV IS HERE!

## Build it yourself... the perfect way to discover the exciting field of digital electronics!

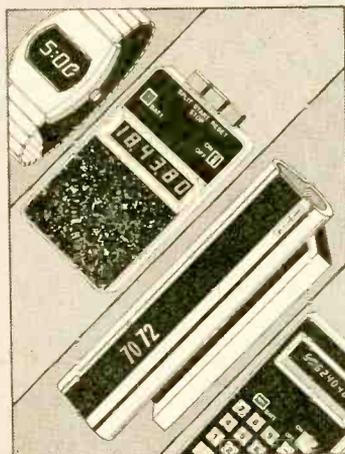
It's part of a complete learn-at-home program!

Imagine spending your spare time actually building your own 25-inch diagonal color TV! It's a project you can work on right in your home. You'll enjoy the challenge...exploring the new systems of digital circuitry and performing experiments to test what you learn.

There's no travelling to classes, no lectures to attend, and you don't have to give up your job or paycheck just because you want to get ahead. When you finish this new Bell & Howell Schools program you'll have learned new skills, plus you'll have a great color TV to look and enjoy for years!

**You need no prior electronics background!**

We start you off with the basics.



## Digital electronics is changing our lives!

There's a lot more to digital electronics than just the numbers! True, that's what you see on more and more products like digital calculators, clocks and watches. But behind the numbers lies a fantastic technology that's creating higher standards of accuracy and dependability. The versatility of digital electronics has begun another industrial revolution. Its growth and applications are giving us new and better ways of doing things and spectacular products like this new Bell & Howell color TV with digital features!

You'll receive a special Lab Starter Kit with your first lesson so that you can get immediate "hands on" experience to help you better understand newly-learned electronics principles. Later, you'll use your new knowledge and learn valuable skills as you build the color TV. You can take advantage of our toll-free phone-in assistance service throughout the program and also our in person "help sessions" held in major cities throughout the year where you can "talk shop" with your instructors and fellow students.

**Pick up valuable skills in electronics that could lead to extra income, full or part time... perhaps a business of your own!**

Once you complete this new learn-at-home program from Bell & Howell Schools, you'll have the specialized skills to service color TV's plus the knowledge that you can apply to repair a variety of home electronics equipment. No better or more practical at-home training in electronics is available anywhere!

These skills could open up new income opportunities for you full or part time. While many of our students do not ask for employment assistance, it is available. Of course, no assurance of income opportunities can be offered. Get the complete story on this exciting, learn-at-home program... the world's first color TV course employing digital electronics technology!

**Mail card today for full details, free!**

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

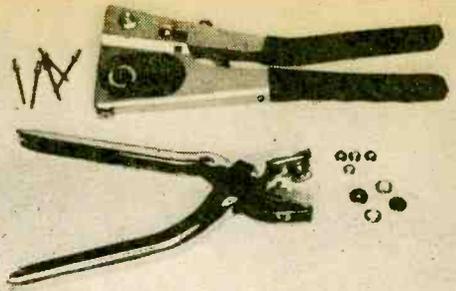
**BELL & HOWELL SCHOOLS**  
4141 Belmont, Chicago, Illinois 60641

Electro-1 lab is a registered trademark of the Bell & Howell Company.

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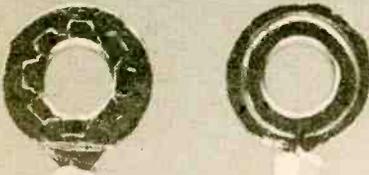
# Eyelet-Popping Connectors

by Jorma Hyypia



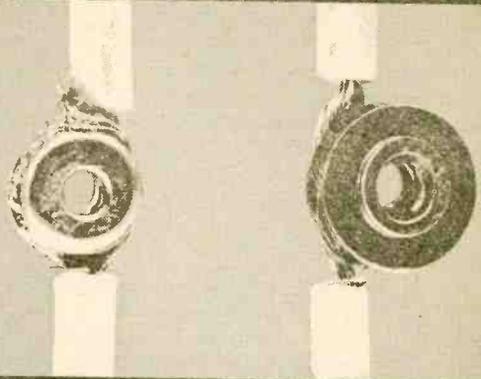
□ Here are several handy ways to use a "pop" rivet tool and an eyelet tool to make solderless connections when building electronic gadgets and when repairing home appliances. Obtain several sizes of rivets and a stock of washers that will slip neatly over the rivet shanks. If a rivet is too long for a particular job, slide it off the long pin and file or hack saw to the desired length. Your eyelet fastening tool will be doubly

useful if you obtain one that is also capable of setting snap fasteners. Although these are basically solderless joints, you can add solder to obtain better electrical connection between joined wires. However, remember that you cannot solder to the eyelets which are of aluminum, and that you should **not** use colored eyelets which would not conduct electricity. If in doubt, check conductivity with an ohmmeter.

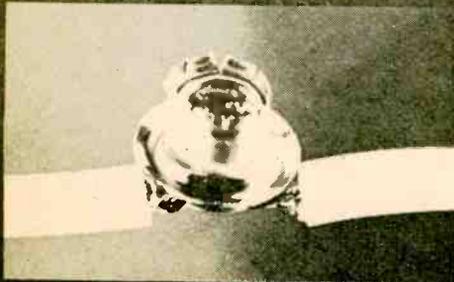


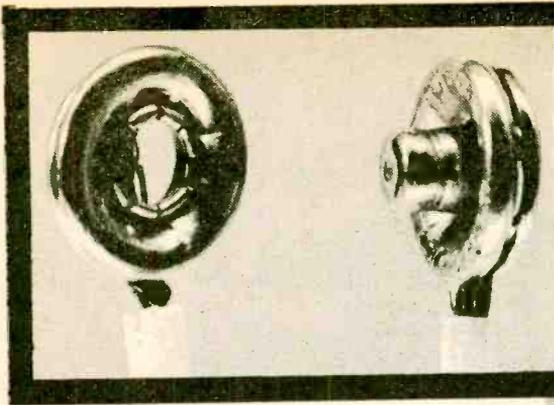
**Wire-End Eyelet.** Divide the conductor strands in the wire into halves and wrap around two sides of the eyelet shank. Twist the wire ends together to keep tight fit. Set eyelet with tool to lock in wire, trim off-excess wire strands. The eyelet is a perfect fit on terminal bolts. For a rugged terminal eyelet sandwich the wire strands between two washers that fit snugly on the eyelet shank. Set eyelet and trim off excess wire.

**Rivet Wire Connectors.** To join two wires quickly without soldering, wrap the bared wire ends around the shank of a "pop" rivet, add a small washer, and set the rivet with the rivet tool. For a stronger connection, or when using heavier gauge wire, sandwich the wire ends between two washers that just fit the rivet shank. The handiest rivet size for most applications is  $\frac{1}{8}$ " diameter with a  $\frac{1}{8}$ " work thickness rating. This is a handy way to connect a line cord to iron wires found in older appliances. Note that the "pop" rivet has a hole in the center through which you can insert a screw, bolt or nail to mount the connector to a panel.



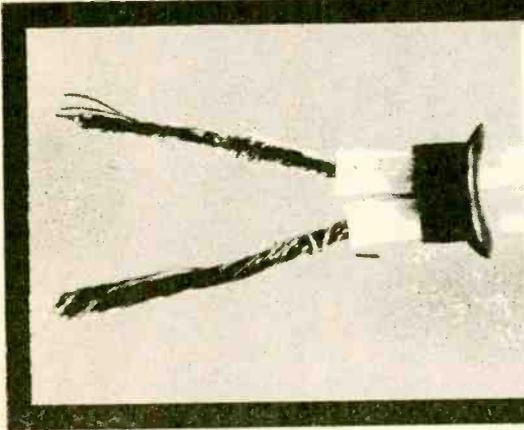
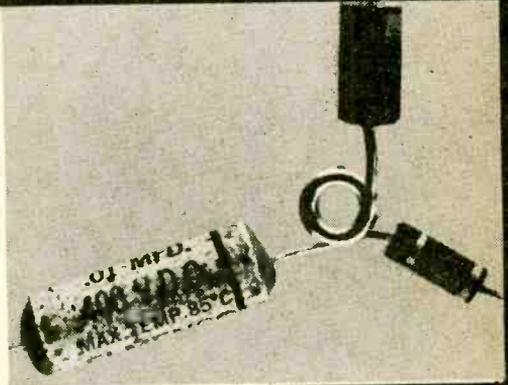
**Rivet-Eyelet Connector.** Insert the bared wire ends into an eyelet from the flange side, then add a  $\frac{1}{8}$ " x  $\frac{1}{8}$ " "pop" rivet from the same side. Set the rivet with the rivet tool. The wire ends are thus pinched between the rivet and inside of the eyelet for a tight fit. Note that this connector provides a stand-off shank with a hole through the middle that can be used to mount the wire joint a fraction of an inch off the assembly panel on which it is used.





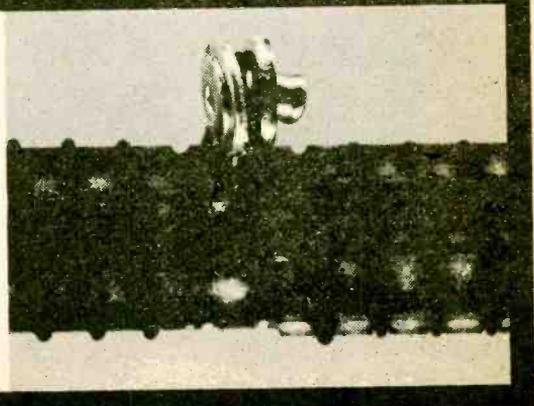
**Take-Apart Connector.** Where you anticipate the need to disconnect joined wires, try this trick. Just attach the bared wire ends to the two halves of a clothing snap fastener using an eyelet setting tool having this capability. For example, place the socket portion and its mating prong ring into the tool jaws, run the bared wire strands (flatten the bundle) completely across the prong ring, and mate the socket and prong ring by squeezing the tool. Attach the other wire to the stud section in the same manner. A handy connector for breadboarding or wherever the connection needs to be taken apart frequently.

**Components Joiner.** Want to join several resistors, capacitors or other electronic components together in a jiffy? Just wrap each lead a full turn around the shank of an eyelet, and pinch the eyelet shut with the tool. This provides a good mechanical joining of the wires, but you can run in some solder if you like. The eyelet ring is handy for mounting the assembly on a bolt or other support.



**Wire Clamp and Strain Relief.** An easy way to bind two separate insulated wires together is to slip them through an eyelet and pinch the eyelet shank with pliers. To fashion a strain relief that will keep a wire from being pulled through a chassis hole, use two eyelets with their flanges facing each other and a washer between them. Lock the washer in place by pinching the shanks of both eyelets.

**Hot-Wire Connector.** The burned-apart ends of a heating coil in a space heater or other appliance obviously cannot be soldered together. For an emergency repair, try this: form loops on the ends of the wires that just fit the shank of a "pop" rivet and place the loops between two washers slipped on the rivet. Set the rivet to make a really tight physical connection. To ensure good electrical contact, be sure to brighten the heater wire loops with sandpaper or light filing.



e/e checks out...

# HUSTLER MONITOR MATCH 5M5



Your car aerial becomes an all-band Action Radio antenna

□ ONCE YOU START adding radio monitor equipment to your car, the roof and fenders quickly become an antenna farm; for without an external, antenna few signals make it through the car-body steel and into the radio. While a slew of antennas might give your wheels the gung-ho look, they also announce to every hood in sight, "Hey, look here, Detroit Iron loaded with nice expensive equipment." And when it comes time to trade in the heap the "trade estimator" is so impressed he knocks off up to \$75 per antenna hole.

But now there's no need to worry about the local delinquents spotting your equipment through multiple antennas, or "Honest Stan—the trade-in man" reducing your trade-in allowance, for New-Tronics, a name long familiar with quality mobile antenna equipment, has introduced a gadget that lets the car's usual AM or AM/FM antenna do triple duty for AM, FM and VHF/UHF monitor radios.

The device that pulls off this multi-connection trick is the *Hustler Monitor Match 5M5*. Before we get into what the Monitor Match does and how it does it, let's take a look at the reason you ordinarily can't con-

nect two different radios to the same antenna.

Let's suppose your car has a built in AM radio and you install a VHF hi-band monitor. The VHF monitor radio's RF input consists of an antenna coil with a one or two turn primary. If you connect the monitor radio across the car antenna, in parallel with the AM radio, the AM radio signals will see the 2-turn primary in the VHF monitor as a direct short to ground, and the AM radio will appear "dead."

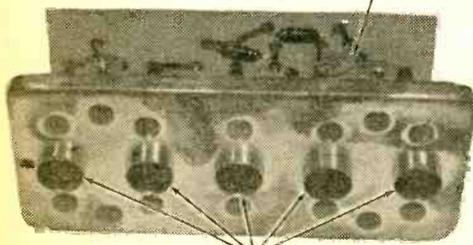
**Alternately.** An AM radio with a highly capacitive antenna input will short circuit the VHF signals to ground, and the more radios you connect across the single antenna the more interaction there is causing signal losses.

Now that you've seen the problem, we'll examine the Hustler Monitor Match 5M5. The 5M5 brings in the antenna signals through a series of passive filters and routes the individual signals to four output jacks. One jack is for the AM/FM car radio, one for a 25-50 MHz VHF monitor, one for a 140-175 MHz VHF monitor and one for a 300-500 MHz UHF monitor. Each output jack is electrically isolated from the other output jacks in such a manner that the antenna signal can only travel to appropriate jacks; for example, a 153 MHz signal can only travel to the 25-50 MHz and 140-175 MHz jacks; filters prevent it from going to other output jacks where the signals could be shorted to ground by the radio's antenna input. In a similar manner, the filters isolate each output, so one radio input cannot affect any other.

Because of the isolated inputs it is possible to receive, all at the same time, AM,

*(Continued on page 95)*

FILTER NETWORKS ON  
PRINTED CIRCUIT BOARD



ANTENNA CONNECTIONS

Isolation filters that prevent interaction between various radio connections are all mounted behind the jacks on a circuit board.

The Hustler Monitor Match model 5M5 is from the New-Tronics Corporation, Brook Park, Ohio 44142 and has a \$14.95 price tag. Circle No. 14 on the Reader Service Page.

**mechanical  
electrical  
transistor**  
and now the fourth generation!



## IC METRONOME

It's stable, portable, economical and is the only *simple* metronome we found that keeps its beat for wide voltage and temperature changes.

by C. R. Lewart

**W**HAT, ANOTHER METRONOME PROJECT? They've been around for years, you say. Why another one then? Well, as far as we're concerned, currently popular versions of the electronic metronome—a unijunction relaxation circuit—simply aren't in the picture anymore.

With this project, you can have a metronome that will run on a single 9-volt transistor radio battery for *thirty to fifty* hours and keep the beat accurate throughout the useful battery life, even under wide temperature variations.

Unijunction transistors are extremely dependent upon supply voltage. So either you power the unit with 117 VAC (which means it's tied to a not-always-convenient outlet), or you regulate the battery voltage—

a practice that is expensive both in parts and battery power. You either suffer a change in tempo in step with battery aging, or tie yourself to a power socket.

In addition to battery voltage and temperature independence, the sound this metronome makes is a dry *snap* or *click* much like the mechanical variety. The sound of the click does not change as you vary the beat frequency, and the dial is not squeezed at either end. An optional light-emitting diode (LED) flashes with each click to give a visual beat indication.

When we went to press the 556 IC was new, so you may not be able to obtain it through the regular hobby channels. You can, however, use two individual 555-type IC timers which are much easier to find.

# e/e IC METRONOME

The only disadvantage to using two 555 ICs compared to a single 556 is a slightly higher battery drain with its associated, slightly lower, battery life. Check the table for equivalent pin connections if you use the two 555s.

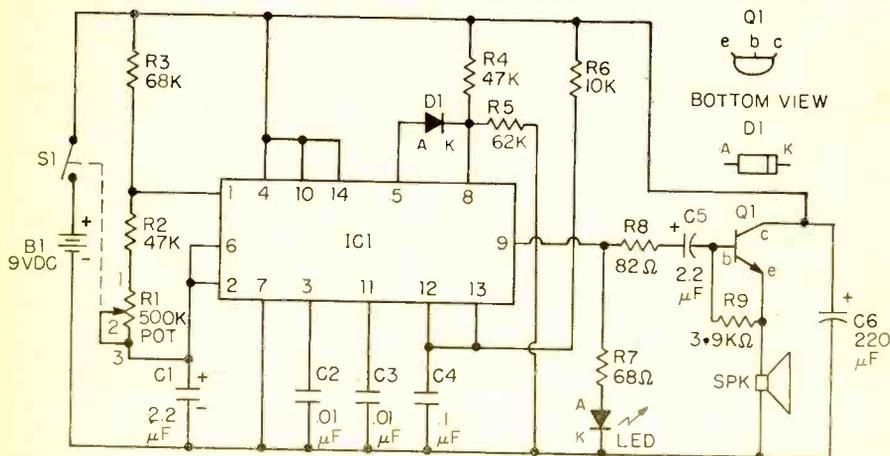
**Why It's Better.** The first IC, a 555-type timer, is connected as an astable multi-vibrator, which is something like an automatic switch that turns itself on-off-on-off.

This generates the basic metronome beat frequency, which is determined by C1, R1, R2, and R3. Variable resistor R1 determines the time necessary to charge

capacitor C1 to approximately two-thirds the battery voltage. By specifying R1 with an audio taper, you have a fairly uniform beat frequency scale without crowding at the high end.

Each on-off cycle of the first IC triggers the second IC (an identical 555-type unit) for a short, fixed on-off cycle. It is the output of the second IC that produces the waveform ultimately used to drive the speaker. This "click" stage lights the LED and, with additional amplification by transistor Q1, drives the speaker.

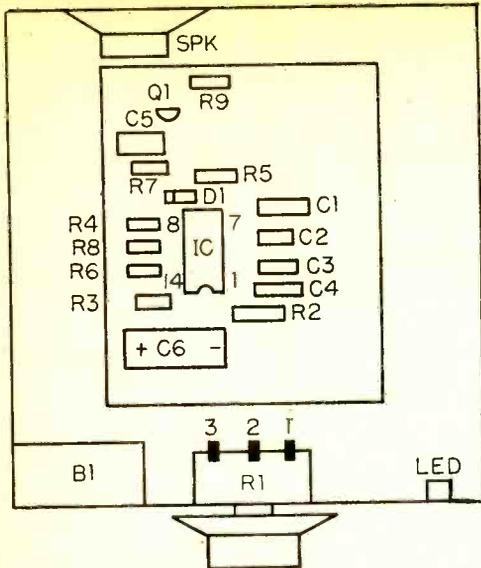
A critical component in the circuit is C1, which determines the beat frequency. A ceramic or mylar capacitor would be best here. Though an electrolytic will also work, it will make you lose some of the inherent



## PARTS LIST FOR AN IC METRONOME

- B1**—9-volt transistor radio battery (Radio Shack 23-464 or equiv.)
- C1**—2.2 uF capacitor, ceramic or mylar, Centralab UK225  
Note: Electrolytic capacitors such as the Radio Shack 272-1040 may be used with some loss of temperature and frequency stability.
- C2, C3**—0.01uF capacitor (Radio Shack 272-1065 or equiv.)
- C4**—0.1 uF capacitor (Radio Shack 272-1069 or equiv.)
- C5**—2.2 uF electrolytic capacitor (Radio Shack 272-1040 or equiv.)
- C6**—220 uF electrolytic capacitor (Radio Shack 272-1006 or equiv.)
- D1**—Silicon diode, 1-amp, 50 PIV or better (Radio Shack 276-1101 or equiv.)
- IC1**—Dual IC timer, Signetics or Raytheon type 556  
Note: You can use two 555-type IC timers (Radio Shack 276-1722 or equiv.) in place of the 556, see text.
- LED**—Light emitting diode, 20 mA (Radio Shack 276-042 or equiv.)

- Q1**—npn transistor, Motorola HEP735 or Radio Shack 276-2013
- R1**—500,000-ohm potentiometer, audio taper w/SPST switch (Radio Shack 271-1728 or equiv.)
- R2, R4**—47,000-ohm, 1/2-watt resistor (Radio Shack 271-000)
- R3**—68,000-ohm, 1/2-watt resistor (Radio Shack 271-000)
- R5**—62,000-ohm, 1/2-watt resistor (Radio Shack 271-000)
- R6**—10,000-ohm, 1/2-watt resistor (Radio Shack 271-000)
- R7**—68-ohm, 1/2-watt resistor (Radio Shack 271-000)
- R8**—82-ohm, 1/2-watt resistor (Radio Shack 271-000)
- R9**—3900-ohm, 1/2-watt resistor (Radio Shack 271-000)
- SPK**—Small 3.2 to 8-ohm speaker; salvage from discarded transistor radio
- Misc.**—Wire, solder, 3 x 4 x 5-in. cabinet, perf-board, knob, etc.



Tempo-set potentiometer R1 drawn in birds eye view above, shows solder lugs facing up. It can be wired as indicated on the schematic so clockwise rotation will decrease tempo, or by moving the lug no. 2 connection from 3 to 1, for increasing tempo.

IC	PIN EQUIVALENTS													
556	1	2	3	4	5	6	7	8	9	10	11	12	13	14
555 (NO.1)	7	6	5	4	3	2	1							8
555 (NO.2)							1	2	3	4	5	6	7	8

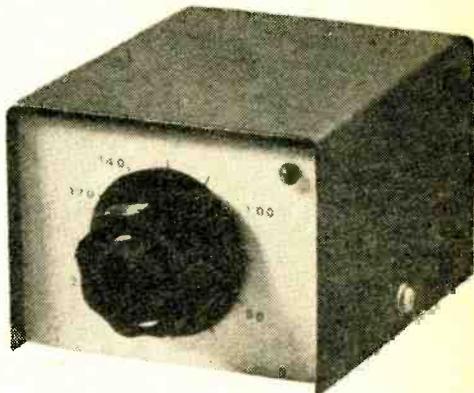
  

TOP VIEWS	

The layout shown above is for the single IC version. If you use two 555s, convert from the 556 numbers with the chart above.

voltage and temperature accuracy of the circuit.

**Construction.** Install the components on a 2½-in. x 3-in. piece of perf board, following the layout shown. Then mount the perf board on spacers in a 3 x 4 x 5-in. cabinet. Make a bracket for the 9-volt battery. Cut a hole in the cabinet wall for the speaker, and cover the hole with a piece of speaker cloth or perf board. Mount the speaker with small brackets or attach it with epoxy glue.



A musical tool for budding Beethovens.

When you're ready to calibrate, use press type or cut out a round piece of white cardboard to make the dial. Mark the beats-per-minute by counting them for sixty seconds at various settings of R1, or compare with a well-calibrated mechanical metronome. The range should be between approximately 40 and 210 beats-per-minute. If you would like a different range, change C1 to affect low beat frequencies and R2 for high frequencies. To change the sound of the metronome you may want to vary R6. You may also want to write the musical

(Continued on page 97)

□ Mechanical vs. electronic is not the first controversy surrounding the metronome (originally called the *chronometer*). There is a long-standing duel among musical historians that surrounds the name of the inventor. The actual date of the invention is thought to be around 1815. This is determined by the fact that Beethoven republished eight of his Symphonies in 1817; all were marked with metronome time. In fact, the Eighth Symphony has a series of staccata sixteenth notes in the *allegretto* movement that are thought to represent the tick of the metronome. Some historians believe it was Beethoven's feeling that no accomplished musician required the use of a metronome; apparently, any orchestra that could properly play the Eighth, was accomplished. It is believed that Beethoven learned of the metronome from his friend Johann Maelzel. However, in some musical records it appears that the actual inventor was one Dietrich Winkel. Whichever of these two gentlemen was actually responsible for the metronome may never be determined, but we're sure he would be pleased with the electronic advancements made to improve his tick-tock wooden pacesetters.

# HAVE A HEART

Just about everyone in middle age has the notion that exercise is good for him. Just about everyone, too, has heard about the weekend "athlete" who dropped dead from a heart attack on the tennis court. Outwardly he looked strong, had a fine set of muscles. But something went wrong. The question is, what kind of exercise can help you keep your heart in shape?

At "Cardio-Metrics" in New York City some of the answers to this question are provided, via a battery of electronically-monitored stress tests. Here, exercise is prescribed in a manner similar to the way doctors prescribe medications. The specific purpose of Cardio-Metrics is to determine the right exercise program for the individual's present level of fitness. It uses exercise as a means of preventing coronary heart disease, or in some cases warding off a second heart attack.

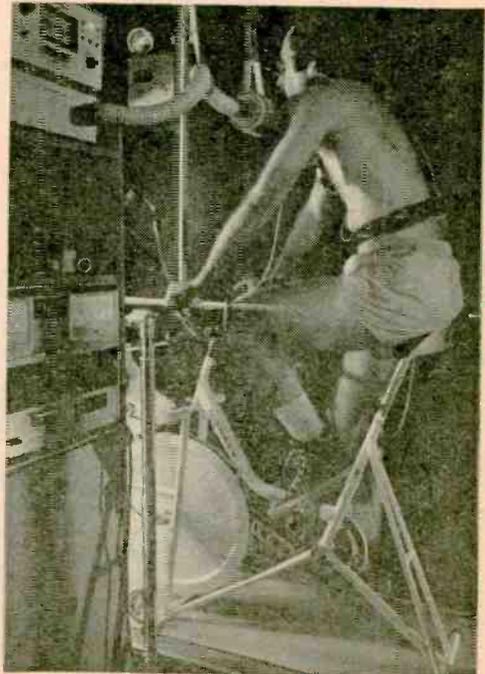
The basis of the Cardio-Metrics program is the exercise stress test, which is performed on either a treadmill or a bicycle ergometer. This test provides the necessary information to answer the questions: Is exercise safe for this patient? How much exercise, i.e. intensity (maximum strain on the heart), duration (times per session), and frequency (times per week) should



## Electronics helps you to



Patient undergoes stress test (above) under supervision of a physician, while an oscilloscope displays his electrocardiogram.



Patient progresses to stationary bicycle test (above), where his body's reactions are measured by electronic equipments.

# -A GOOD ONE

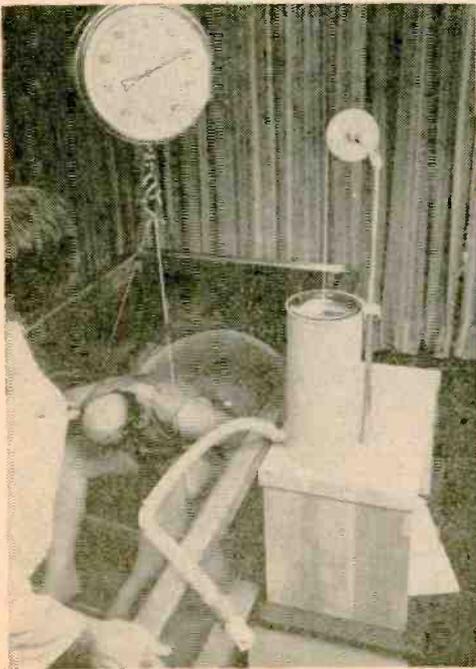


he do? During the stress test, the workloads are increased gradually to a level that stresses the individual to 85% of his heart rate system. As the patient performs the test his electrocardiogram, heart rate, blood pressure, and oxygen consumption are monitored closely by a physician with the help of a technician on the exercise controls.

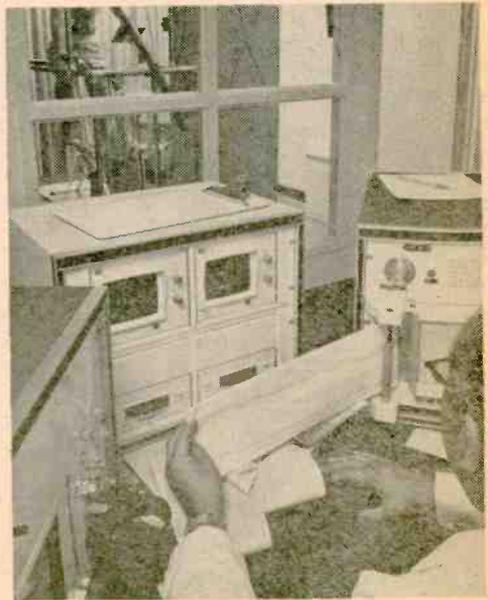
After the test data are reviewed, the patient is given his individualized exercise program. Activities such as swimming, cycling, jogging, and certain calisthenics form the basis of the training program. Patients are taught to take their own pulse rate, which they take routinely as they train. The pulse rate level is used to determine the limits of safe exercising.

The doctors at Cardio-Metrics do not say that their program will prolong life. This is a matter that depends on many unknown factors such as heredity, life-style, stress, and diet. But for the typical middle-aged person who is over-fed and underexercised and worried about his inactivity, the program does spell out in detail what his exercise limitations are and what he can do about them. ■

**prescribe your exercise Rx!**



Archimedes thought of it first! This patient (above) gets dunked in "fat tank" to determine specific gravity of his body.



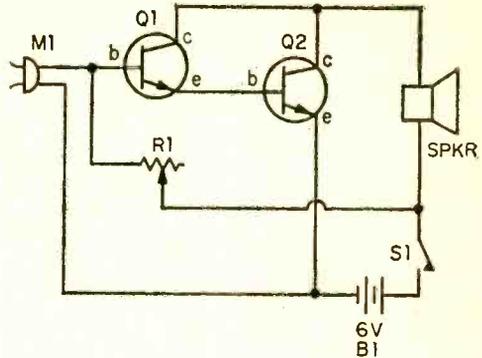
Physician (above) checks electrocardiogram, heart rate, and oxygen consumption. It couldn't be done without electronics!

# BUILD IT FAST..

Get out your tools, clean up a soldering iron and try your hand at one or both of these quick projects now!

## BIG VOICE

□ Build this loud hailer into a small cabinet and you'll be able to shout nearly everyone at the next free-for-all. The microphone should be mounted or held behind the front facing speaker to reduce the possibility of feedback. The speaker must be rated no higher than 8-ohms, though best results are



### PARTS LIST FOR BIG VOICE

- B1—6V lantern battery (Radio Shack 23-066 or equiv.)
- M1—Carbon microphone (telephone type)
- Q1, Q2—PNP transistors, (RCA 2N1486 or equiv.)
- R1—5000 ohm potentiometer, any taper (Radio Shack 271-1714 or equiv.)
- SPKR—3.2 or 4-ohm speaker
- S1—spst switch (Radio Shack 275-401 or equiv.)

obtained with speakers in the 3.2 to 4-ohm range. Adjust potentiometer R1 for minimum distortion coincident with maximum volume while speaking into the microphone.

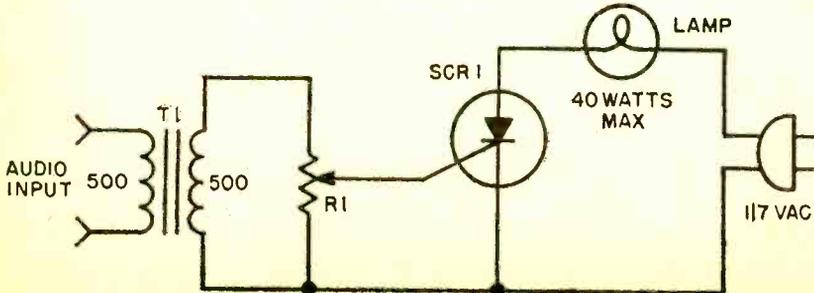
## BASIC COLOR ORGAN

□ This simple color organ is certain to keep your party from becoming a drag. Connected to your hi-fi amplifier's speaker output (across the speaker terminals) it will

throb in time to the music. Paint the bulb red or deep blue and your party room will take on the atmosphere of a rock club. Transformer T1 can be any matching transistor type in the range of 500/500 to 2500/2500 ohms. Note that none of the connections from SCR1 or its components are connected to ground. For safety's sake, you must keep the 117 volt line voltage from the amplifier connections; that's the reason for T1. To adjust, set potentiometer R1 "off" and adjust the amplifier volume control for a normal listening level. Then adjust R1 until lamp I1 starts to throb in step with the beat.

### PARTS LIST FOR BASIC COLOR ORGAN

- I1—117V lamp, not to exceed 40 watts
- R1—Potentiometer, 500 to 5000 ohms (Radio Shack 271-1714 or equiv.)
- SCR1—Silicon Controlled Rectifier. HEP-R1221 (Radio Shack 276-1067 or equiv.)
- T1—Transistor output transformer, see text



e/e speaks out on the....

# MARANTZ 4230 4-Channel/Dolby Receiver



**W**ANT stereo with built-in 4-channel potential? Dolby FM station decoding? Dolby pre-recorded tape-decoding? Dolbyized recording directly from the receiver from any signal source? Look no further, for it's all in the new Marantz 4230 receiver.

Basically, the 4230 is a discrete 4-channel AM/FM receiver—that is, it has AM and FM tuners and four power amplifiers with discrete high-level inputs for aux (or CD-4 demodulator output) and two tape. The magnetic phone input is stereo. A strapping amplifier switch combines the power output of the left front and rear, and the right front and rear for standard stereo. With the amplifiers strapped, the 4230 is an ordinary stereo receiver with 4-channel potential. If you decide to upgrade to 4-channel you'll find a pre-wired compartment on the underside of the chassis; simply snap a Marantz SQ decoder—with front/back logic—into the compartment, release the strapping switch, and the receiver is ready to play SQ-encoded records. Since the compartment is pre-wired to a front-panel mode selector, the

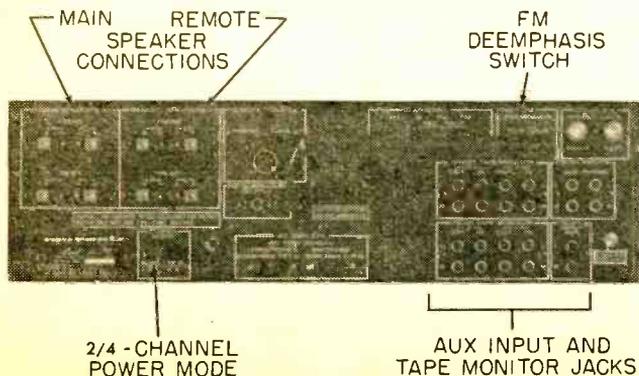
SQ matrix mode is selected just as if the receiver originally came with a built-in SQ decoder.

If you want to add CD-4 capability, you need only connect the output of an add-on CD-4 demodulator to the auxilliary input.

Since both tape-recorder inputs and outputs are 4-channel, recordings can be made of any quadraphonic program. Similarly, pre-recorded quadraphonic tapes can be played from 4-channel tape equipment.

**Down With Noise.** Moving along we find the Marantz 4230 has a complete record/play Dolby; there are play/calibrate and record-level controls, a 400-Hz Dolby-level oscillator and a meter switch that converts the AM/FM signal-strength meter into a Dolby-level (test) meter. What is unusual about this Dolby, as contrasted with some Dolby circuits usually found in receivers, is that it is basically independent of the receiver; it can be switched into just about any mode of operation. For example, the Dolby control switch has five positions: *Off*, *FM Dolby*, *Play*, *Record I* and *Record II*. These five positions provide just about every possible combination of Dolby operations for the front, or stereo channels (there is no Dolby on the rear channels). The best way to follow the Dolby operation is with some practical examples.

The Marantz 4230 4-Channel/Dolby receiver is from Superscope, Inc., 8150 Vineland Avenue, Sun Valley CA 91352. Suggested retail price is \$499.95.



Rear panel of the 4230 has a 2/4 channel power mode switch that lets you step right up to 4-channel sound by unstrapping the power amps into two pairs when your 4-channel speakers arrive. That means you upgrade your stereo system now, move into 4-channel when you can. For more info, circle No. 169 on the Literature Library page.

## MARANTZ 4230

The *Off* position disables the Dolby, of course. The *FM Dolby* position provides a de-processed (flat) speaker and tape-recorder output from FM stations that are using Dolby processing. The *Play* position provides a flat output from signals (other than FM) which are already Dolbyized—such as a pre-recorded tape. The *Record I* position will Dolby encode any signal source passing through the receiver to the tape recorder, but the amplifier output will be flat. The *Record II* position makes a flat recording from any Dolbyized signal source passing through the receiver, and the amplifier's output is flat.

**Double Check.** Take particular note that, in all instances, the user hears a flat output through the speakers. However, if the tapemonitor switch is depressed when Dolby-processing a program, the user will hear the accented high frequencies, thereby checking that a Dolby recording is, in fact, being made.

The Dolby decoder, when used for Dolbyized FM broadcasts, is factory-adjusted to the "FM Dolby level," which is 50% modulation. Our tests indicate the factory adjustment was within 2 dB of the 50% value (good). In the event the reference level is changed, or should you have reason to check or adjust the reference level using the calibration tone broadcast by the station, two recessed (left and right) FM Dolby calibrate controls are provided on the rear apron.

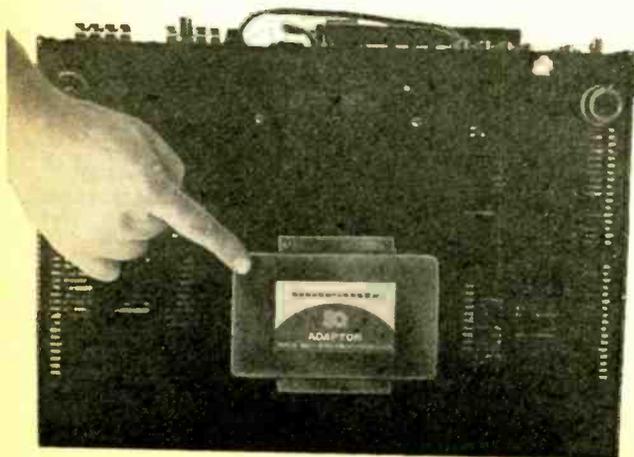
For all other uses, a complete set of

Dolby adjustments—such as found on "Dolby adaptors"—is provided on the front panel. Once these adjustments are made, for the particular tape recorder used, they can be left alone. All signals passing through the front channels will then be processed to the recorder-output jacks with "standard" Dolby level, and the tapes can be interchanged with other Dolby recorders. In a similar manner, pre-recorded Dolby tapes will play through the Marantz 4230 with standard Dolby decoding.

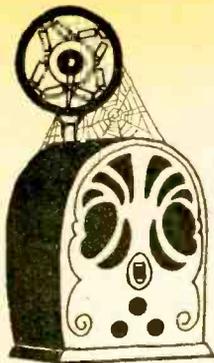
**It May Change.** There has been considerable talk of "modifying" the standard 75- $\mu$ sec pre-emphasis to 25  $\mu$ sec for Dolbyized FM stations. The FCC, however, has no present intention whatsoever of allowing this modification. But miracles do happen, and should the 25- $\mu$ sec pre-emphasis ever go through, the Marantz 4230 is prepared: a 25/75 $\mu$ sec pre-emphasis switch is provided.

A logical question is: "Why Dolby on the front channels only, since this is a 4-channel receiver?" Firstly, there's cost: a second "Dolby stereo pair" would add somewhere near \$100 to the package. Secondly, what purpose would 4-channel Dolby serve? The 4-channel FM broadcasts are matrix only, and they are best recorded as a stereo tape with decoding on the tape playback; for this, only a stereo Dolby is needed. Similarly, Dolby is presently used only on pre-recorded stereo tapes; again, only a stereo Dolby is needed. Records are not Dolby-encoded. In the event pre-recorded Dolbyized 4-channel reel-to-reel and 8-track cartridges become available, a standard stereo Dolby adaptor can be plugged into the rear-tape connections. In the meantime, the average stereo and quadriphile will have 100 percent of his Dolby needs covered by the Marantz 4230.

For more information circle number 169 on the Literature Library page. ■

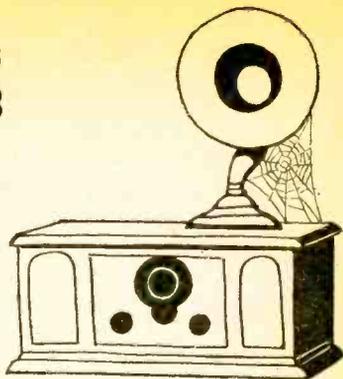


The optional front-back logic SQ decoder plugs into a pre-wired compartment on the underside of the receiver. The connector is pre-wired to the front-panel mode selector, so the decoder becomes an integral part of the receiver.



# ANTIQUE RADIO CORNER

by James A. Fred



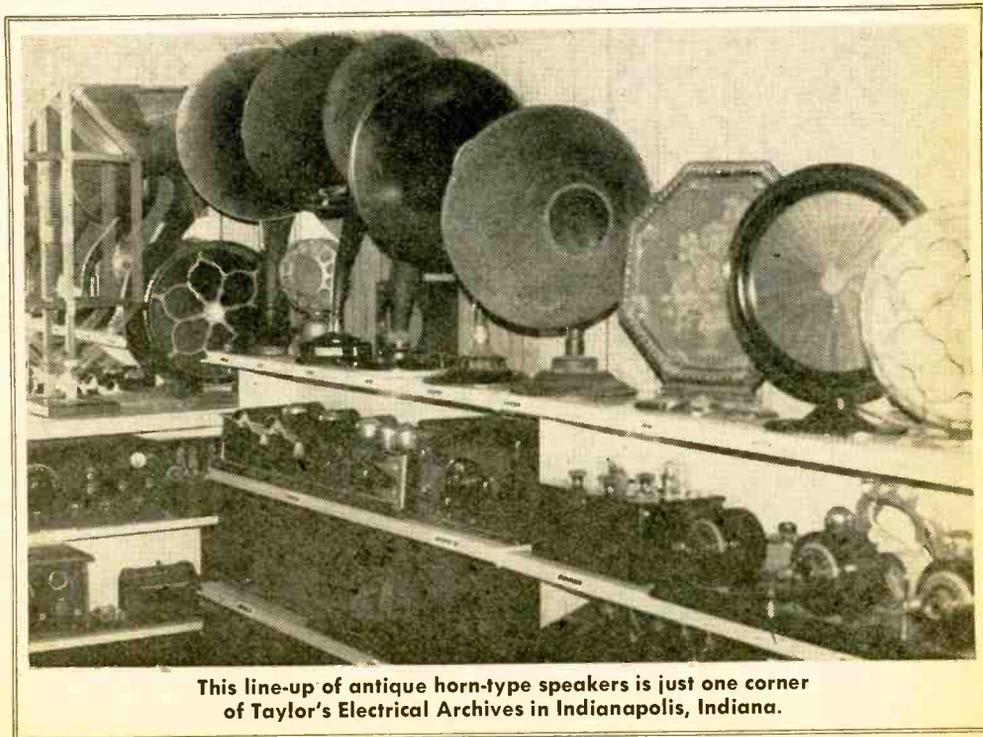
□ Hello out there in radio land! We are back again to talk about collecting antique radio and wireless equipment. Most families have just completed their spring housecleaning. This is one of the best times of the year to pick up items for your collection. You might not realize it, but one place to find old radios is at your local landfill (it used to be the city dump). The next time you drop off your accumulation of tin cans and trash make the acquaintance of the landfill operator. For just a little bit of money he will set aside radios, TV sets, electric motors, etc. for you. If he is really nice you can pay him to call you on the phone whenever he finds a "goody." Remember, what is one man's trash is another

man's treasure.

**Out West.** Council Bluffs, Iowa is the birth place of the world-famous Dr. Lee De Forest (1873-1961), known as the "Father of Radio" for his invention of the three-element vacuum tube in 1906, and for his early experimental work in radio-telephone transmission and reception.

De Forest was one of the discoverers of the regenerative feed-back principle, and he patented over 300 other inventions in the field of electronics. In the early 1920s De Forest did important work in the development of sound-on-film recording for the "talkies."

The son of a Congregational minister, Lee was born in the parsonage (believed



This line-up of antique horn-type speakers is just one corner of Taylor's Electrical Archives in Indianapolis, Indiana.

## e/e ANTIQUE RADIO CORNER

to have stood at 523 Fourth Street) in Council Bluffs, Iowa, on August 26, 1873. When Lee was three years old the family moved to Waterloo, Iowa, then to Muscatine, Iowa, and then to Talladega, Alabama, where Lee's father became president of Talladega College for Negroes. Lee received his elementary schooling in Talladega, and in Massachusetts, and then enrolled at Yale's Sheffield Scientific School where he received his Ph.D. in 1899.

It is interesting to note that De Forest invented his triode tube (grid audion) in his laboratory on the top floor of the old Parker Building in New York City, which was destroyed by fire in 1908. The building at 229 Park Avenue South, in which ELEMENTARY ELECTRONICS now has its offices, stands on the same spot.

It is also interesting that Lee De Forest's widow, the former Marie Mosquini, now living in Hemet, California, was leading lady to Will Rogers in many of his silent motion pictures. Thus, the actress of the silent days married "the man who made the movies talk." Marie De Forest is a radio amateur and operates station WB6ZJR.

When Art Trauffer moved to Council Bluffs twenty-four years ago, he saw that De Forest's birthplace had been torn down. Art, an electronics experimenter, writer, and photographer, has been writing "how to"

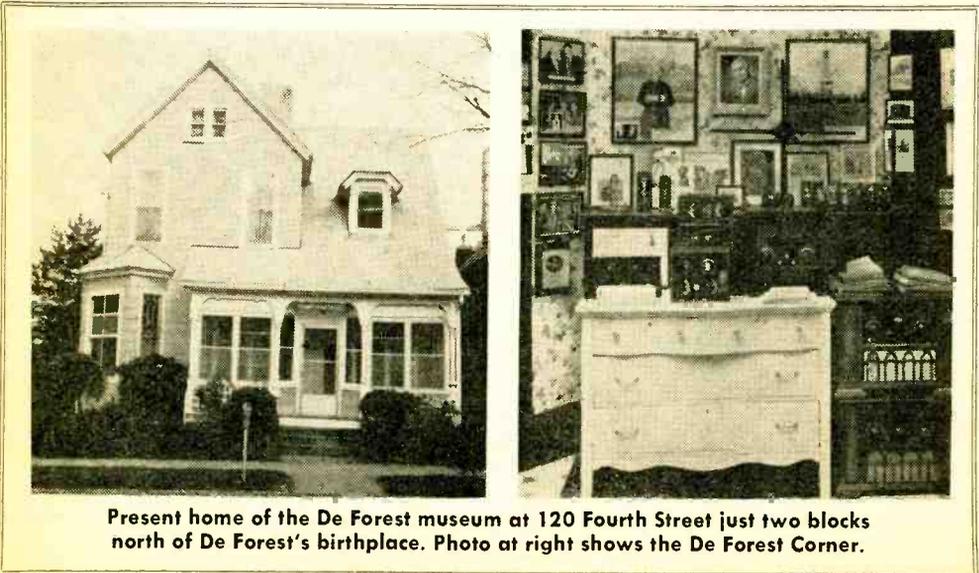
### ANTIQUe RADIO FACT SHEET

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

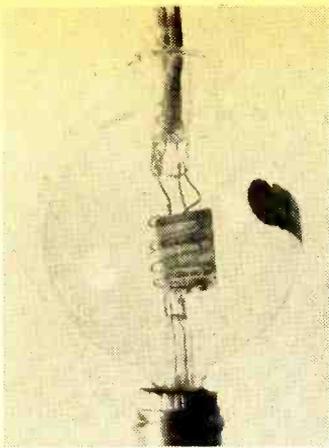
and constructional projects for mechanic, photography, and electronic magazines since 1934. In 1965 he started collecting memorabilia for a permanent museum display for posterity in Council Bluffs. He was also instrumental in having an elementary school in Council Bluffs named for De Forest. Recently the board of the new Iowa Western Community College in Council Bluffs named its administration building for De Forest. Art has a strict policy of not selling any of the De Forest items donated to his museum, as these are being preserved for posterity in Council Bluffs.

If you have any De Forest items of any kind you would like to donate to the Council Bluffs De Forest Memorial, contact Art Trauffer, Curator, 120 Fourth Street, Council Bluffs, Iowa 51501. Phone: 712 322-6278. You will be given due credit in the display.

Until a more public place is available, the De Forest Collection is on display in Art's



Present home of the De Forest museum at 120 Fourth Street just two blocks north of De Forest's birthplace. Photo at right shows the De Forest Corner.



**Early triode. De Forest added the grid that makes it possible for a tube to amplify.**

small apartment at 120 Fourth Street, visitors are most welcome, but an advance phone call would be appreciated. There is no admission charge.

**Old-fashioned Tar.** Removing imbedded components in the early AC radios seems to be one of the subjects most often mentioned by my readers. Potted or embedded components are usually transformers, condensers, and choke coils. The potting compound was usually pitch, or a hard wax. When restoring a set with imbedded parts the first thing to do is to determine what part is defective. On some sets, such as the early Atwater Kents, this is no easy matter. The power transformer, filter choke, and output transformer are imbedded in a large container with room left to slip in a can containing six condensers. Then, to complicate matters, the parts are interconnected and pitch poured over them, leads and all.

Many battery receivers had audio transformers potted into individual cans. You can usually isolate the defective part with an ohmmeter. Then you decide whether to take the cowards' way out and hide a replacement transformer under the chassis or do a professional restoration by removing the defective part and repairing or rewinding it.

If you decide to remove the imbedded part there seem to be three basic ways to do it. I have tried all three, and the one you use depends on your facilities and personal preferences. These three methods are as follows.

1. Use heat to melt the potting compound and remove the part. When doing this there are a few facts to consider. You should do it outdoors unless you have a barn or other non-living area to work in.

Use a very low heat, just enough to release the part. An electric hot plate or oven is ideal for this purpose. Keep the melted-out compound so you can pour it back into the restored container. If there is still a film of compound on the part you will have to dissolve the balance. (See method three.)

2. Put the parts container into a freezer and wait for the compound to become brittle. Regardless of what some restorers say, I was never able to get the compound cold enough in a home freezer. The best results I had was by using an environmental chamber set to  $-55$  deg. C. which is  $-67$  deg. F. When the compound becomes brittle it can be chipped away with a screwdriver and hammer. Again the film of compound left can be removed with a solvent. (See three.)

3. The third method is to dissolve the potting compound with a suitable solvent. This method is slow, less dangerous, creates very little odor, and can be left unattended. Initially, solvent is poured into the inside of the container and you wait. As the compound dissolves you pour out the dirty solvent and pour in new. You can filter the old solvent and reuse it. I have done many filter capacitor cans this way with good success. One of the safest, non-toxic solvents is Clorathene. Be very careful if you use gasoline, naphtha, kerosene, or fuel oil.

**IHRS to Host AWA Summer Meet.** The Indiana Historical Radio Society will host the Antique Wireless Association Summer meet on Saturday, June 22, 1974 in West Lafayette, Indiana. Arrangements have been made with Professor Clarence L. Coates, Jr., head of the Electrical Engineering Department at Purdue University, to hold the meet in Rooms 202 and 206 of the Stewart Center. The Center is located near the parking garage on State Street.

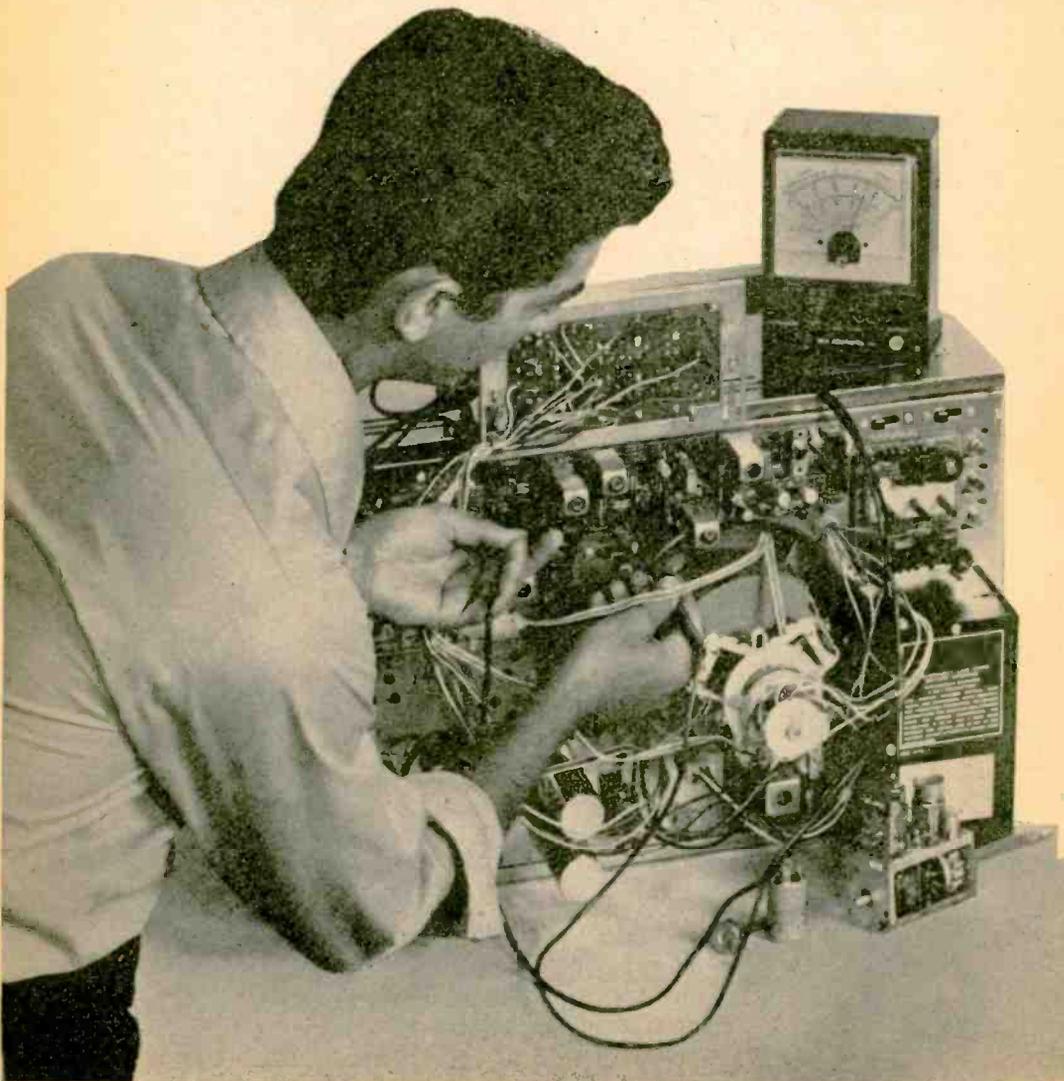
Room 206 will hold an exhibition of old radios, speakers, tubes, literature, and other accessories of the old days of radio. An old time receiver contest will be held. A Saturday evening banquet, featuring Bruce Kelly, Secretary of the AWA, as guest speaker, will close the one-day meeting.

Registration information may be obtained by writing Gary Vierk, 2505 Kickapoo Drive, Lafayette, Ind. 47905.

This is all for now. Next time I will tell you about the Yaxley Manufacturing Co., we will talk about old radio test equipment, and about other things of interest to antique radio collections. ■

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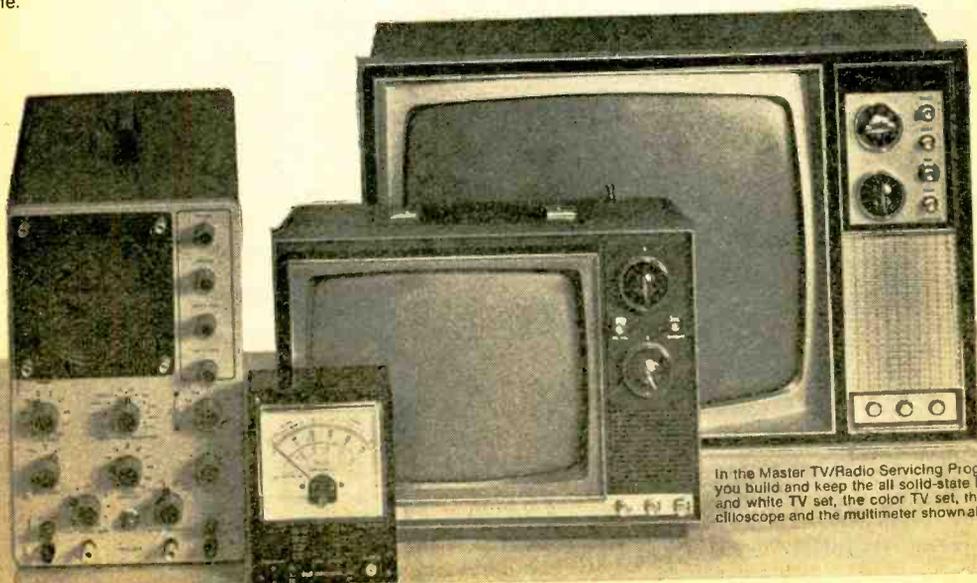
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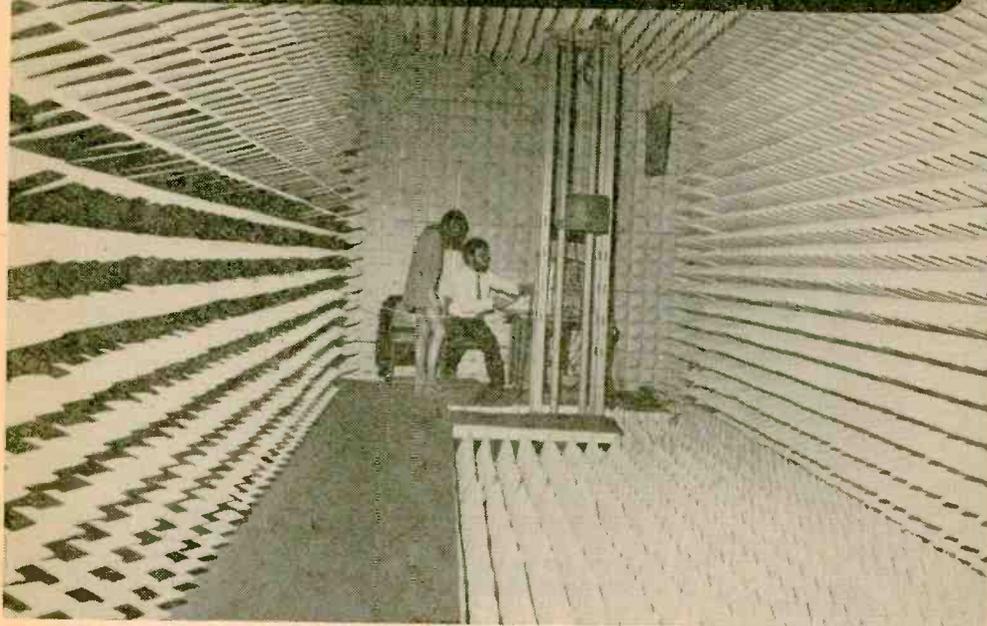
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**GTE SYLVANIA**



In the Master TV/Radio Servicing Program, you build and keep the all solid-state black and white TV set, the color TV set, the oscilloscope and the multimeter shown above.

# The Super-Squelch



by Joe Gronk

**These spikes squelch sound and radio waves too!**



Scientist R. L. Light holds up a section of sound-absorbent spikes, exposing the aluminum-alloy wall of the test chamber.

**A**N ANECHOIC CHAMBER lined with pyramid-shaped spikes produces the perfect setting for scientific sound and radiation studies which require absolute reflection-free and interference-free conditions. Producing such a room—which guarantees virtually no reflection of either *radio* or *sound* waves—is a very tall order; but scientists in England have developed a test chamber where only one in ten billion parts of an audio or RF signal is reflected. This “super-squelch” is used to measure aerial radiation patterns in the frequency range of from 500 MHz to 40 GHz.

When working inside the anechoic chamber, scientists—without ear protection—can use soundwaves directed away from them which are so intense that they would deafen anyone, even hundreds of feet away, in the open. Because of the almost complete sound-absorbency of the test chamber the scientists are completely safe! In fact, outside the so-called “quiet zone” down which the signal is sent, nothing can be heard, and the scientists make their observations in silence. Hmm . . . maybe this would be a good place for someone’s mother-in-law! ■

# An SWL's Guide to...

TIME PERIOD	SW	PRICE	FEATURES	MC BAND	METERS
LATE AFTERNOON AND EVENING	SW	5.0	...	MC BAND 2	48 METERS
AFTERNOON AND EARLY EVENING	SW	0.25	...	MC BAND 3	33 METERS
AFTERNOON AND EARLY EVENING	SW	11.85	...	MC BAND 4	25 METERS
MORNING AND AFTERNOON	SW	15.5	...	MC BAND 5	18 METERS

LOGGING SCALE

## Choosing the Right Receiver

by Don Jensen, Shortwave Editor

WHICH shortwave receiver should I buy? The answer—the one that's right for you—sounds like a cop-out, but it's the only honest answer there is. Buying an SW receiver is like purchasing your first car. Ask a Cadillac owner for advice and you'll get one answer; the driver of a Pinto or a Mustang II will give you another. A sports car buff will tell you four-on-the-floor is the only way to go, man!

They're all right in their way but they're talking about what's right for them, not necessarily what fits your needs, dreams, and wallet. Selecting a receiver is much the same. One that is right for John Q. DXer may be wrong for you. It's a choice only you can make. Of course, it isn't so hard if you're an electronics whiz and can understand those confusing receiver "specs." But there are a lot of people who don't know a microvolt from a decibel—and there's no shame in that!—but want to get in on the shortwave listening action.

To help you in custom-selecting your SW set, we've tried to analyze those factors which seem to be most important to most SWLs. And using a simple letter code, we'll take a look at a number of shortwave

receivers on the market today. We're not making value judgements; you'll have to do that to choose the receiver that fits your bill.

**Price.** There's no point in considering a set that costs a couple of grand if you've only got \$100 to spend. You get what you pay for, but maybe you don't really need all the plushy extras that add to the price. And there are some tremendous receiver bargains in the mid to low price brackets.

In our chart, sets priced under \$100 are coded (A); \$100 to \$200 as (B); (C) \$201-350; (D) \$351-\$500; (E) \$501-\$1,000; and (F) over \$1,000. The symbol (K) means a build-it-yourself kit, a good way of saving money, even if you know only a little bit about radio construction.

**Coverage.** Some receivers cover the full shortwave frequency range, usually considered to be 1,600 to 30,000 kHz (1.6-30 MHz), either continuously or in separate bands. Others allow you to select those particular bands in this entire range which most interest you. Still other sets offer frequency coverage of only part or parts of the shortwave spectrum.

The coverage possibilities are (A) full

### SHORTWAVE RECEIVER MANUFACTURERS/DISTRIBUTORS

Channel Master, Division of Avnet, Inc., Ellenville, NY 12428  
 Collins Radio Company, Cedar Rapids, IA 52406  
 R.L. Drake Company, 540 Richard Street, Miamisburg, OH 45342  
 Galaxy Electronics, RR #3, Lincoln, NE 68505  
 Heath Company, Benton Harbor, MI 49022  
 Radio Shack, 2617 W. Seventh Street, Ft. Worth, TX 76107  
 Zenith Radio Corporation, 1900 N. Austin, Chicago, IL 60639  
 Panasonic, 200 Park Ave., New York, NY 10017  
 Gilfer Associates Inc., P.O. Box 239, Park Ridge, NJ 05676  
 National Radio Company, Inc., 111 Washington Street, Melrose, MA 02176

# e/e SHORTWAVE RECEIVERS

SW range, continuous tuning; (B) full SW range, series of switchable bands; (C) coverage of certain shortwave bands which you choose, usually by plugging in appropriate accessory crystals; (D) partial coverage of SW frequencies in several fixed bands; and (E) a single predetermined band covering only part of the shortwave spectrum. The symbol (X) means that a rig will tune the FM broadcast, VHF police/public service and/or aircraft bands.

**Readout.** Frequency readout is the ability of a receiver to display the frequency tuned. If you tune an unknown station you want to be able to "read" its correct frequency. And if you're looking for a particular SW station on a particular frequency you have to know just where to set your dial.

The most accurate readout systems are (A) electronic digital, on which the exact frequency is displayed in illuminated numerals, and (B) mechanical direct frequency. Frequency accuracy is possible anywhere in the range from a fraction of a kilohertz to several kHz, depending on the specific receiver. Usually less expensive are sets with (C) electrical bandsread. These usually



**Panasonic  
RF-5000A  
Circle No. 165  
on Lit-Lib  
Coupon  
on page 100**

have two dial mechanisms, main tuning and bandsread. The bandsread, sometimes with dial markings for the popular shortwave bands, makes it easier to separate stations in a crowded band. With practice and the aid of home-made charts or graphs one can determine tuned frequencies quite accurately, possibly as close as some direct frequency readout receivers. But it is somewhat more work.

The simplest tuning system is a single main tuning without bandsread. It is con-

## SHORTWAVE RECEIVER COMPARISON CHART

Manufacturer	Model	Price	Coverage	Readout	Sel.	Port.
Barlow-Wadley	XCR-30*	C	A	B	B	B
Channel Master	6246	A	D-X	D	D	A
Collins	75S-3C	F	C	B	A	D
Collins	51S-1	F	B	B	A	E
Drake	SW-4A	C	D	B	B	E
Drake	R4-C	D	C	B	A	D
Drake	SPR-4	E	C	B	A	C
Drake	DSR-1	F	A	A	A	C
Galaxy	R-1530	F	B	B	A	C
Heath	SB-313	C-K	C	B	A	C
Heath	SW-717	A-K	B	C	D	C
Heath	GR-78	B-K	B	C	C	A
National	HRO-600	F	A	A	A	C
National	HRO-500	F	B	B	A	C
Panasonic	RF-5000A	C	B-X	D	C	A
Panasonic	RF-1700	B	D-X	D	D	A
Radio Shack	DX-150B	B	B	C	B	C
Zenith Royal	D7000Y	C	D-X	C	C	A

\*Distributed by Giffer Associates, Inc.



**Heathkit SW-717**  
 Circle No. 1 on Reader Service Page



**National HRO-500**  
 Circle No. 163 on  
 Lit-Lib on page 100

**Zenith Royal D-7000Y**  
 Circle No. 164 on Lit-Lib Coupon

**Channel Master 6246**  
 Circle No. 162 on  
 Lit-Lib on page 100

siderably harder to determine frequencies accurately, but if you are interested in more random tuning, or listening to the more powerful SW stations, you can get by.

**Selectivity.** Selectivity is the ability of a set to separate stations in a crowded short-wave band. With a very inexpensive radio, you might find eight or nine strong stations, plus a *jumble* of noise between these signals, on a typical shortwave band. With a more elaborate receiver you'll find the improved selectivity allows the separation of the

#### Features

- Single sideband clarifier, antenna trim
- VHF, FM broadcast, squelch
- Preselector, mechanical filters
- Mechanical filters, notch filter
- Crystal-lattice i.f. filters, tone
- Preselector, notch filter
- Notch filter, crystal calibrator
- Squelch, noise blanker, notch filter
- Crystal-lattice filters, bandwidth select.
- Preselector, AGC, crystal calibrator
- BFO, ANL, S-meter
- ANL, AGC, rechargeable battery
- Phase-locked frequency synthesizer
- Bandwidth selection, passband tuning
- BFO, ANL, AFC, bandwidth control
- VHF, FM bands, squelch
- BFO, ANL, antenna trimmer
- BFO, time zone scale



**Realistic DX-150B**  
 Circle No. 32 on Reader Service Page



**Collins 75S-3C**  
 Circle No. 161 on Lit-Lib on page 100

# e/e SHORTWAVE RECEIVERS

*jumble* into many readable signals.

Manufacturers use a number of techniques—double and triple conversion, filters of various types, passband tuning and others—to improve selectivity. But singly or in combination, they add to the price of a receiver. We rate selectivity from (A) to (E), excellent to poor. Admittedly it is somewhat subjective, but generally it is based on the number and types of selectivity features incorporated in the receiver designs.

If you are a beginner or a casual sometimes-listener, a set with relatively little in the way of selectivity may be more than adequate. A dyed-in-the-wool chaser of the flea-powered, hard-to-hear broadcasters will want as much selectivity in his receiver as he can afford.

**Portability.** Our fifth and final factor is portability. To some listeners it is unimportant, but many readers have indicated they are interested in a small, compact, battery-powered receiver. For some, space is at a premium. There's no room in a bedroom corner or college dorm for an elaborate DX shack. And, for the cottage at the lake, the cabin in the woods, or a home when a storm knocks down power lines, battery power is essential. It is perfect for DX-peditions into the country if your home location is plagued by big-city electrical interference. It is great for some casual shortwave listening at the beach or on a picnic.

Portability code symbols: (A) fully portable SW receiver which can operate on batteries or 117 VAC house current; (B) battery-operated only; (C) solid-state communications receiver, usually for fixed location use with 117 VAC power, but capable of 12 (or 18) volt DC operation; (D) hybrid design, vacuum tubes and solid-state; and (E) vacuum tube design. (D) and (E) generally are bulkier, require 117 VAC and are not really suitable for portable use.

The chart's last column lists a few, but by no means all, of the other features that may influence your choice. The abbreviations used include: BFO—beat frequency oscillator, useful for CW code and single sideband reception; ANL—automatic noise limiter, an anti-interference aid; AGC—automatic gain control, for combating the problem of fading and maintaining steady signal levels; and S-meter—a device to dis-



**Galaxy R-1530—Circle No. 160**  
on Lit-Lib Coupon on page 100



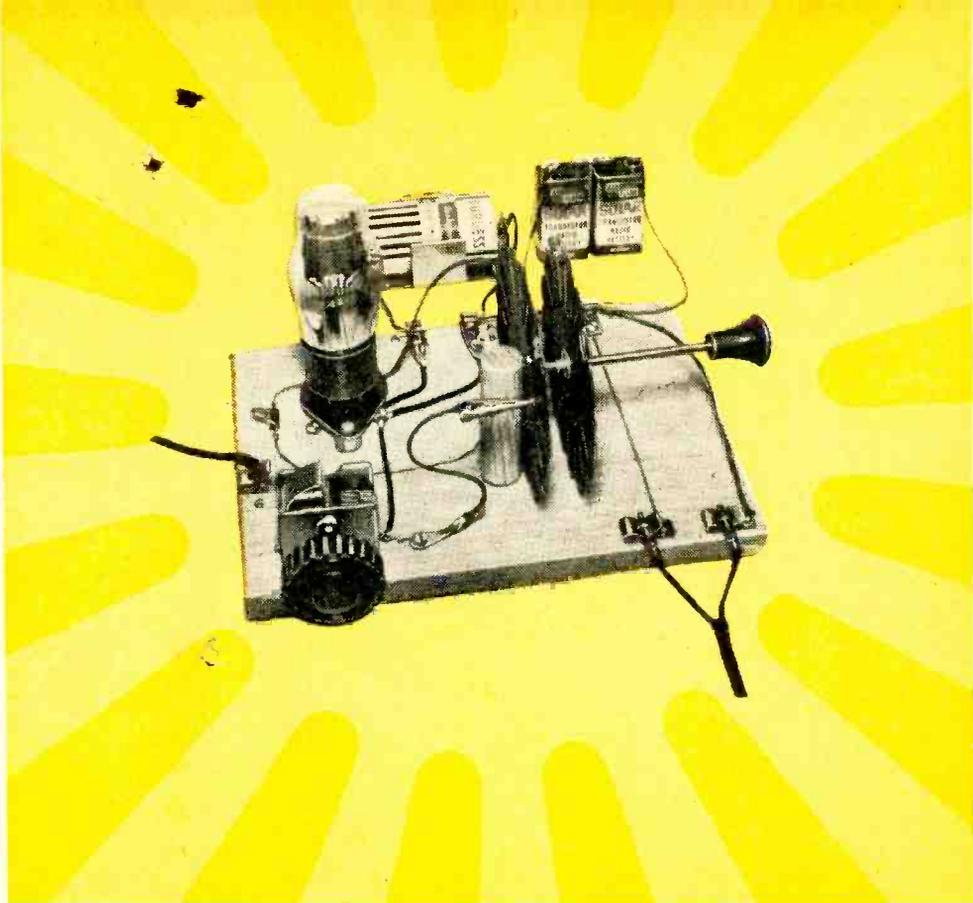
**Barlow Wadley XCR-30 (Gilfer)**  
Circle No. 159 on Lit-Lib  
Coupon on page 100



**Drake SW-4A—Circle No. 159**  
on Lit-Lib Coupon on page 100

play relative signal strengths.

Recognizing the buck is often the single most important factor; the best approach may be to check the chart for those sets within your price range. Then weigh the other factors in terms of what is most important to your listening habits and interests. If you're still undecided, the companies who manufacture or market the receivers will send you further information about their products. So go to it and custom-select the shortwave rig that's right for you and get a piece of the fascinating action that is shortwave listening! ■



## Build an antique ANTENNALESS 1-TUBE REGEN RECEIVER

**A model-maker's delight that actually works!**

by Art Trauffer

□ A number of people would like to build a one-tube regenerative receiver, similar to the popular one-tubers of the early 1920s, but they hesitate, thinking that a long outdoor antenna is needed. So here's a novel receiver, resurrected from an item in Hugo Gernsback's *RADIO NEWS* magazine of the early 1920s, which requires no antenna and works well with only a connection to your water pipe! As a bonus, you will get less man-made and natural static!

This breadboarded regen receiver is beautiful in its simplicity, and you can probably find most of the parts in your "junk box." Coils L1 and L2 are the highly efficient "spiderweb" type of coils that were popular

in the old days, and for capacitor C1 you could use the RF section of a gang capacitor salvaged from a junked AC-DC table radio. You can use any low-filament-voltage, low-filament-drain triode tube for V1. The writer used a type 30 in this project, since it has a filament drain of only .06 amps making it easy on the "A" battery. For a "B" battery, you need only two or three 9-volt transistor batteries connected in series!

**Spiderweb Coils.** The drawing of the coil form is an *actual size* pattern for making the two spiderweb coil forms. The writer used gray sheet fiber used for electrical insulation, but if you cannot obtain this use stiff cardboard and two coats of shellac.

# e/e 1-TUBE REG RIG

Spiderweb coil form shown at right is same-size pattern. You'll need two.

Stationary coil L1 consists of 55 turns of #26 gauge enameled copper magnet wire, having three taps near the outside of the coil. In winding the spiderweb coils you start on the inside of the forms and wind to the outside. Punch two small holes in the form and anchor the end of the wire in these holes, allowing six inches of wire for connections later. Wind about 25 turns on the form; then twist a small loop in the wire for a tap; then wind 15 more turns and make another tap. The 55th turn (outside end of winding) will be tap number 3. Put a little Dupont Duco cement on the twist of each tap to make the taps rigid so you can scrape off the enamel on the taps for clip connections later on.

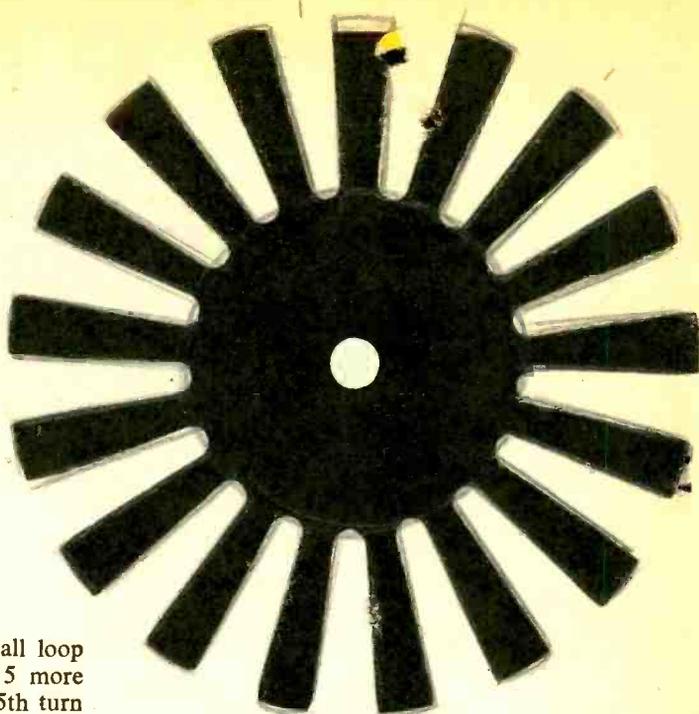
Spiderweb coil L2 is the feed-back coil, or "tickler coil" as it was sometimes called in the old days. L2 has about 50 turns of #26 wire, and no taps. Note that both coils should be wound and mounted so the turns of wire are in the same direction.

**Putting It Together.** Referring to photo of the regen radio, the hardwood baseboard (oak, walnut, maple, etc.) is 7½ in. by 5½ in. by ½ in. The supporting upright for the coil assembly is a 2½ in. length of ½ in., or ⅝ in. round or square wood dowel, screwfastened at the bottom using a 1 in.

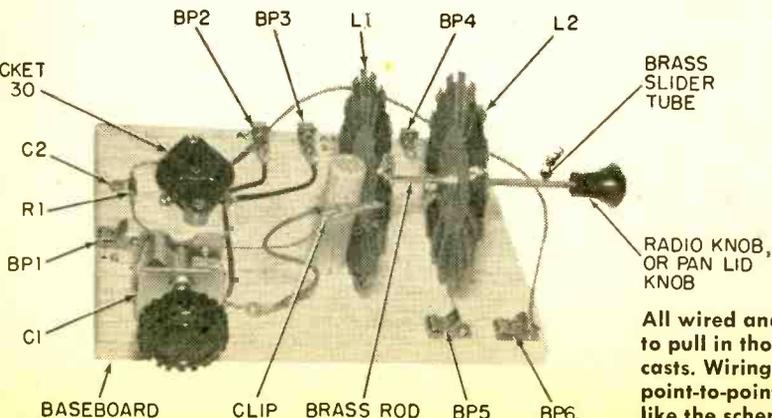
flat-head wood screw and glue.

To make the adjustable assembly for the coils, use small diameter brass tubing (two telescoping lengths) obtainable at hobby and crafts supply stores. The author used ⅛ in. diameter tubing for the stationary support "rod," and mating tubing for the sliding "rod," but you may want to use larger, more rigid pieces. The stationary member is about 3½ in. long, and the sliding member is about 3 in. long.

Drill holes of the required size through the center of coil L1 form, and through the wood upright near the top. Pass the stationary brass rod through the hole in the coil form and into the hole in the dowel. Glue or Duco cement is used to hold coil L1 securely to the wood upright.



4-PRONG  
WAFER SOCKET  
FOR TYPE 30  
TRIODE



All wired and ready to pull in those DX casts. Wiring is point-to-point just like the schematic.

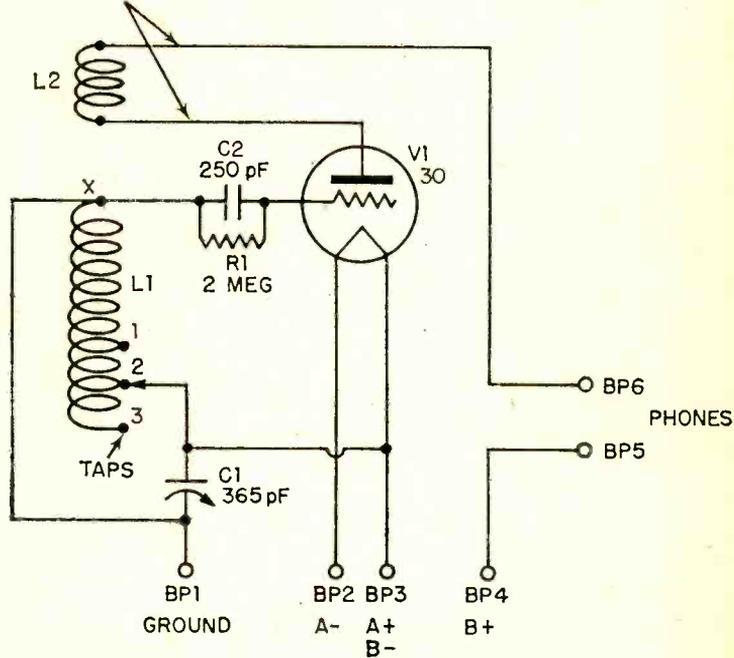
Drill a hole of required size through center of coil L2 form, and cement the coil form securely to one end of sliding brass tube. A knob goes on the other end of this brass tube.

The tube socket (type depending on tube used) is supported by two stand-off metal collars, as shown.

The schematic diagram shows the simple

hookup. Connections should be soldered wherever possible. Use a sensitive pair of high-impedance magnetic earphones when listening. A size D flashlight cell will last for a while with a type 30 tube, but a No. 6 ignition battery will last longer. No switch is used—simply disconnect the "A" battery! For the "B" battery, connect two or three 9 volt transistor batteries in series. ■

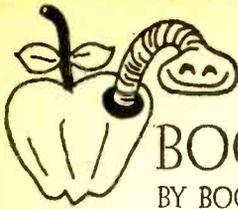
NOTE: IF RECEIVER DOES NOT OSCILLATE, REVERSE THESE TWO LEADS.



### PARTS LIST FOR ANTENNALESS 1-TUBE REGEN RECEIVER

- C1**—One 365 pF. variable capacitor (Radio Shack 272-1341, or equiv.)
- C2**—One 250 pF. (.00025 uF) ceramic disc capacitor (Radio Shack 272-124, 220 pF. is OK)
- R1**—One 2-megohm, ½ watt resistor. (Radio Shack 271-000 or equiv.)
- V1**—Any low filament voltage, low filament drain, triode vacuum tube (Author used type 30)
- 1**—One baseboard-mounting socket for vacuum tube (V1).
- BP1-BP6**—Six medium-size Fahnestock clips. (Radio Shack 270-393 or equiv.)
- L1**—Home-made spiderweb coil, with three taps (see text)
- L2**—Home-made spiderweb feed-back ("tickler") coil. (see text)
- 1**—¼ lb. #26 gauge enameled magnet wire for L1 and L2. (Radio Shack 278-005 or equiv.)
- 1**—4-in. by 8-in. piece gray sheet fiber, for making coil forms (see text)
- 1**—Wood baseboard, 7½-in. by 5½-in. by ½-in. hardwood
- 1**—Round or square ½-in. wood dowel, 2½-in.

- long (holds spiderweb coil assembly)
- 2**—Round or square telescoping brass tubing, for spiderweb coil slider. (see text).
- Misc.**—hardware: Knob for C1. Mounting screws for C1. Mounting screws for Fahnestock clips. Soldering lugs. Mounting screws and stand-off collars for tube socket. Hookup wire. Flexible wire for "tickler" coil (L2) pigtail leads. Small alligator clip. Pair high-impedance magnetic earphones. "A" battery for V1. "B" battery for V1. Two or three 9-volt transistor batteries connected in series. (see text).
- For type 30 tubes, try the following sources: Mr. George Haymans, WA4NED, Box 468, Gainesville, Georgia 30501. Modern Radio Labs., P.O. Box 1477, or 10322 Ballard Drive, Garden Grove, California 92642. Or any of the other surplus tube mail-order firms that advertise in radio and electronics magazines. Other low filament voltage, low drain, triode tubes: 1H4-G. 1G4-GT. VT-24/864. 1B5 /25S. 1H5-GT. 1LE3. 1LH4.



## BOOKMARK BY BOOKWORM

**PC Repair.** Printed-circuit board repair is a breeze using the techniques described in this new Art Margolis text *Ten-Minute Test Techniques*—a practical, easy-to-follow repair guide with scores of shortcuts for the beginning or practicing technician. The author's methods will enable any servicer to repair printed-

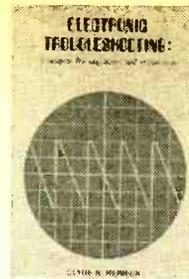


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circuit defects in ten minutes, after a little practice. The text tells how printed-circuit boards are made and how components are mounted, thus providing the reader with an understanding of printed-circuit basics upon which to build. Replacement techniques for damaged boards show how to construct a breadboard or etch a new copper-clad board. There is a detailed section on soldering and desoldering techniques for PC boards, plus the tools and chemicals needed for servicing work. The author reveals effective and unusual tricks used by the pros to remove and replace components without damaging fragile printed boards. Published by Tab Books, Blue Ridge Summit, PA 17214.

**What's Wrong.** With the rapid advance of electronic technology, particularly in the solid-state area, the need has become apparent for a generalized troubleshooting book. *Electronic Troubleshooting* by Clyde N. Herrick was written to fill that need. The text keeps theory to a minimum, and the troubleshooting aspects of electronic circuitry have been emphasized. A broad spectrum of topics has been chosen for instruction, including AM and FM broadcast radio receivers, hi-fi stereo units, tape recorders, black-and-white television, television cameras, color television, various radio transmitters and receivers, electronic organs, digital computers, electronic instruments, and MATV/

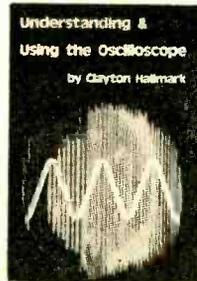


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**Looking at Pictures.** Here is a down-to-earth yet intensive text that makes using a scope as easy as A-B-C. *Understanding & Using The Oscilloscope* is designed especially for technicians who'd like to become more familiar with the most versatile piece of test equipment ever devised, and for the beginner who wants to get started in servicing the right way. This comprehensive volume is packed with detailed information on scopes of every type and price range. With special emphasis on solid-state circuits in modern scopes, the book describes basic functions, scope circuits, AC vs DC inputs, differentiated and integrated pulses and waveforms, and it outlines every conceivable electronic test likely to be performed on any equipment. The first new chap-



Soft cover  
256 pages  
170 illustrations  
\$4.95

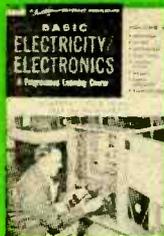
Circle No. 7 on Reader Service Coupon

ters cover the basics—how the scope works, how displays are created, how the cathode-ray tube presents the information, etc. One chapter is devoted to the how and why of scopes, with an introduction to internal and external sync, the relationship between sweep and input-signal frequencies, triggered sweep, blanking and unblanking—and it's all covered with practical, workable examples from the standpoint of the serviceman's everyday problems. Published by Tab Books, Blue Ridge Summit, PA 17214.

**DXer's Delight.** *Shortwave Listener's Handbook*, by Norman Fallon, offers the beginning listener a complete introduction to shortwave  
(Continued on page 102)

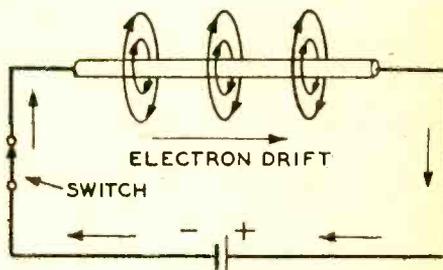
# e/e's

## ALL NEW BASIC COURSE in ELECTRICITY & ELECTRONICS



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

## INTRODUCTION TO ELECTRICITY



**W**hat You Will Learn. To become acquainted with the interesting world of electricity and electronics, you must learn what electricity is, what it does, and how it does it. You will use this information to obtain a better understanding of what electrical and electronic devices are all about, how they work, and how to test and repair them. This introduction is the beginners first look into electronics—this is where you start.



## THE BASIC QUESTION

What is electricity? Electricity is a combination of a force called *voltage* and the movement of invisible particles known as *current*.

### Voltage

The force of voltage can be compared to the force of a water pump. The force of a pump moves water through a distribution system, generally an arrangement of pipes. Voltage is the force which causes electric current to flow through a system of wires.

#### QUESTIONS

- Q1. The force in electricity is -----.  
Q2. The force of voltage is something like the force of a-----.

#### ANSWERS

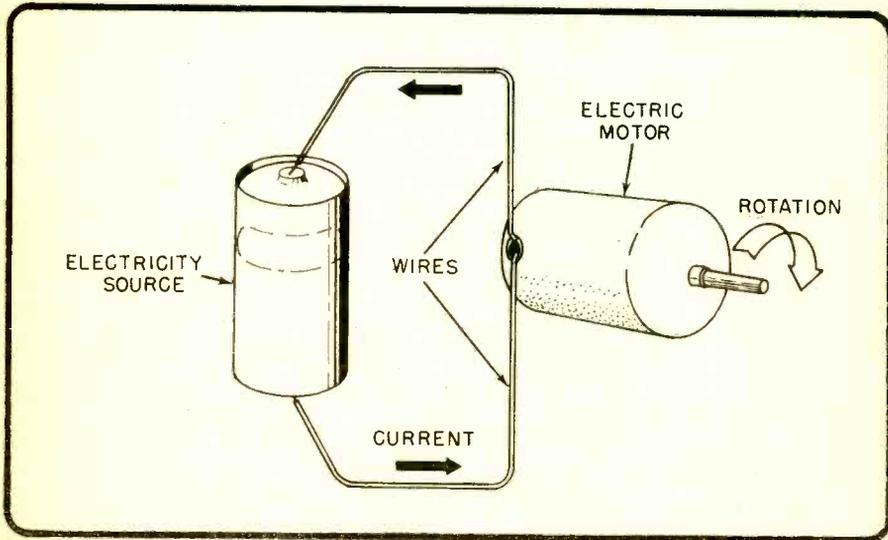
- A1. The force in electricity is voltage.  
A2. The force of voltage is something like the force of a water pump.

### Current

Current, the movement of invisible particles, causes electrical and electronic devices to operate. We cannot see current, but we can determine its presence by the effects it produces.

Current flows through the wires of an electrical or electronic device much the same as water flows through pipes.

### THIS IS A "CLOSED" CIRCUIT



Voltage is the electrical force that causes current to flow.

Current consists of invisible atomic particles called *electrons*.

There is an important difference between current in wires and water in pipes, however. Water can flow out of a broken pipe, but current cannot flow out of a broken wire. In fact, current will not flow anywhere in the broken wire. When the wire is broken, the force of the voltage is removed from across the motor.

#### QUESTIONS

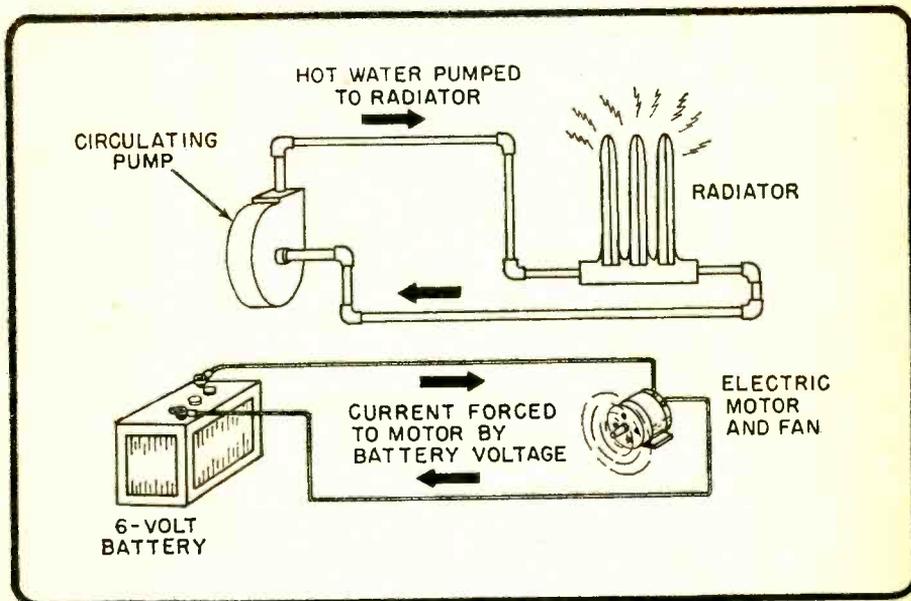
- Q3. Current is a movement of invisible particles called -----.

#### ANSWERS

- A3. Current is a movement of invisible particles called *electrons*.

- Q4. When electric lights are operating, you know that ..... is flowing.
- Q5. Water is to pipes as current is to .....
- Q6. Wires provide a path for ..... in much the same way that pipes provide a path for water.
- A4. When electric lights are operating, you know that current is flowing.
- A5. Water is to pipes as current is to wires.
- A6. Wires provide a path for current in much the same way that pipes provide a path for water.

### CLOSED CIRCUIT ANALOGY



### HOW ELECTRICAL DEVICES WORK

Every electrical and electronic device makes use of one or more properties of electrical current, such as heat and electromagnetism.

#### Heat

Wires can be heated until they are red or white-hot by causing current to flow through them. The amount of heat given off by a wire is determined by the type of metal in the wire and the quantity of current that is forced through it. A large current produces more heat in the same size and type of wire than a smaller current. If the current is the same, a smaller wire gives off more heat than one that is larger in diameter. Also, some metals produce more heat than others as the result of current flow.

In fact, manufacturers select the size and type of wire that will produce a desired amount of heat. To do this, they must know the amount of current that will flow through it.

**Electrical Appliances**—Electrical appliances, such as toasters, irons, heaters, and broilers, make use of the heat produced by current flowing through a wire.

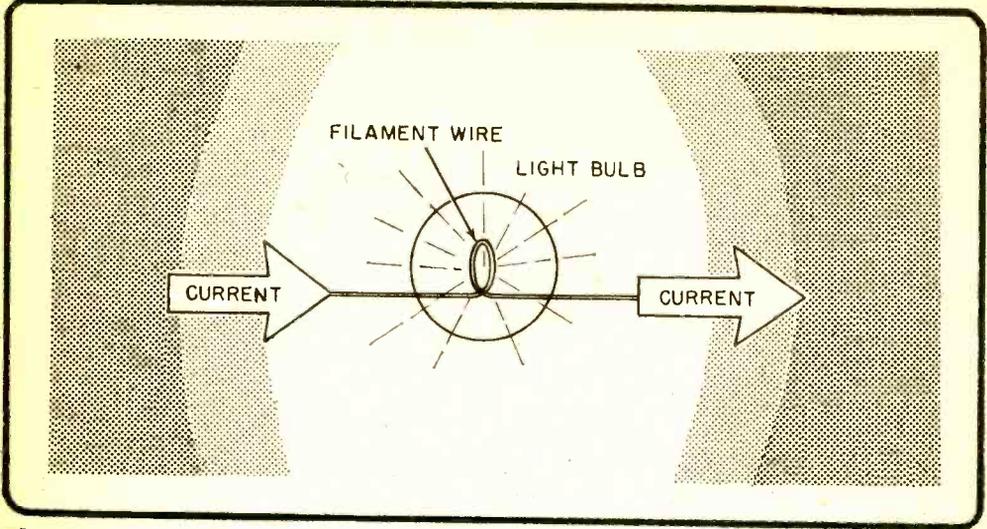
#### QUESTIONS

- Q7. Current flow ..... wires.
- Q8. Current flow makes the filament of an electric light bulb .....

#### ANSWERS

- A7. Current flow heats wires.
- A8. Current flow heats the filament of an electric light bulb white-hot.

### WHITE-HOT INCANDESCENT LAMP

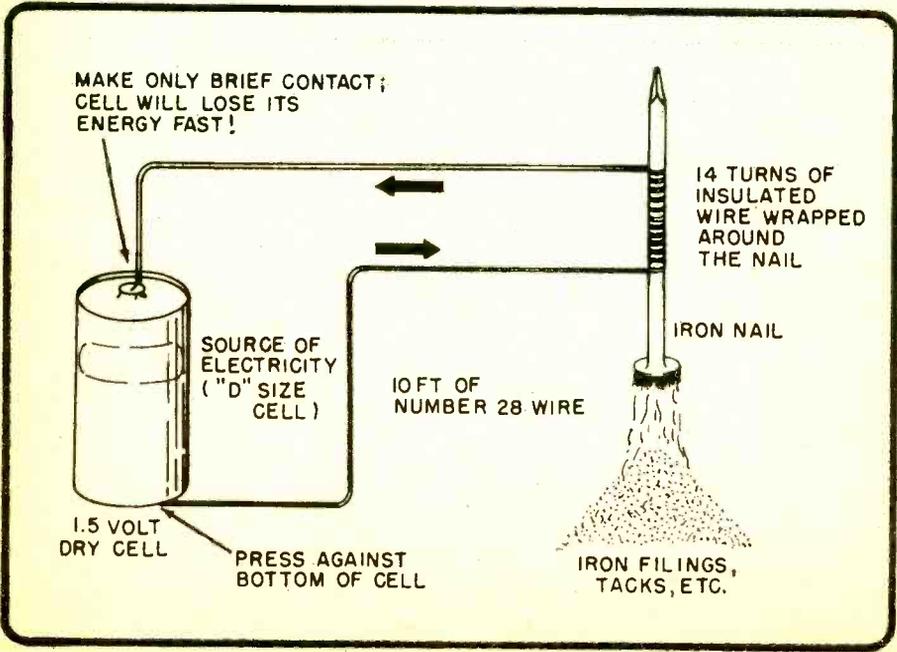


### Electromagnetism

When current flows through a coil of wire, the coil acts like a magnet. This can be proved by experimenting with an electromagnet like the one shown below.

Current flowing through a wire develops a magnetic field. This field is called an *electromagnetic force* because it is the result of the flow of electric current. If, as shown in the illustration, the magnetic field passes through certain kinds of metal, such as soft iron, the metal will become *magnetized* and take on the properties of a magnet.

### A SIMPLE ELECTROMAGNETIC EXPERIMENT



The electromagnet retains its magnetic capability—continues to attract iron filings—as long as current flows through the coil. When the current stops, the metal gradually loses its effectiveness as a magnet.

**The Telegraph**—The telegraph system also makes use of magnetic forces. Current flowing through a coil of wire creates magnetic forces to operate a buzzer, or other noise producers. The sounds from the buzzer represent the dots and dashes sent by the operator.

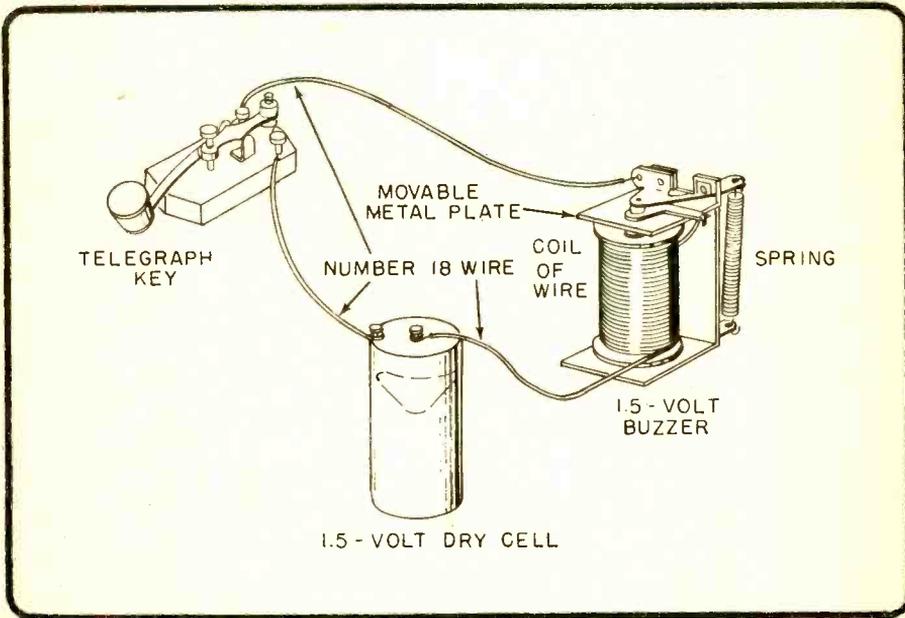
When the telegraph key is closed (pressed down), current flows from the battery through the coil of wire. The resulting magnetic force causes a movable metal plate to be attracted to the soft-iron core of the coil, producing a buzzing sound. In this manner dots and dashes (short and long buzzes) are transmitted.

**The Speaker**—The speaker in a radio, television, or telephone earpiece is an example of another familiar device operated by magnetic forces created by current flowing in a coil of wire.

The speaker consists of a permanent magnet and a coil of wire cemented to a paper cone. Electrical currents which represent voice, music, or other sound flow through the coil.

Magnetic forces created by these currents cause the coil and cone to be attracted and repelled by the permanent magnet. The movement of the paper cone creates corresponding changes in air pressure heard as sounds.

### A SIMPLE TELEGRAPH SYSTEM



#### QUESTIONS

- Q9. .... in the telegraph is created by current flowing in a coil of wire.
- Q10. Closing the key allows ..... to .... through a coil of wire.
- Q11. When currents are passed through the coil of a speaker, ..... are created.

#### ANSWERS

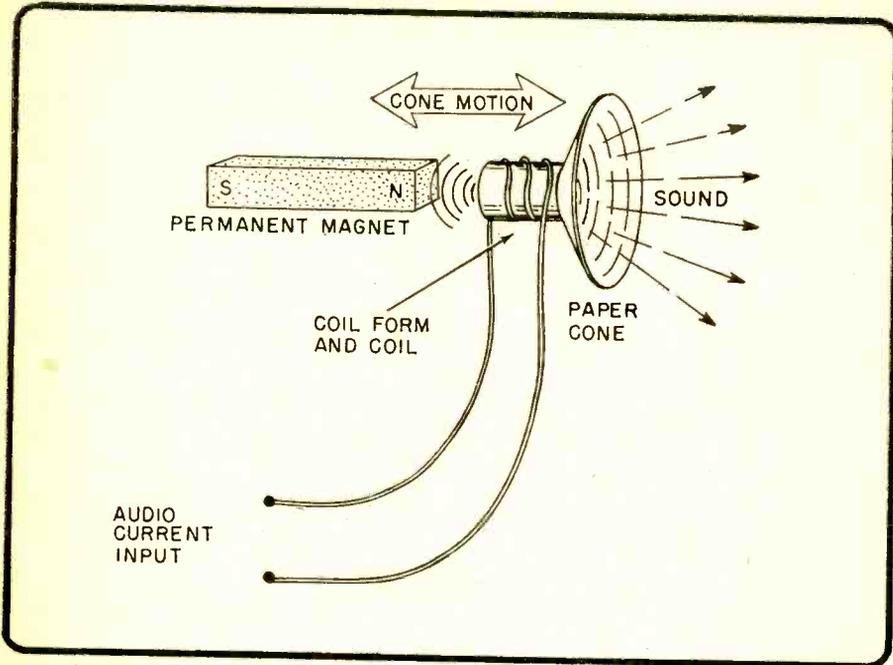
- A9. Magnetic force in the telegraph is created by current flowing in a coil of wire.
- A10. Closing the key allows current to flow through a coil of wire.
- A11. When currents are passed through the coil of a speaker, magnetic forces are created.



Q12. Magnetic force causes the coil and cone to be ----- or ----- by a permanent magnet, causing changes in air pressure.

A12. Magnetic force causes the coil and cone to be attracted or repelled by a permanent magnet, causing changes in air pressure.

### LOUDSPEAKER BASICS



Jobs in which heat is necessary can be performed by using electric current to heat wires. Jobs calling for mechanical motion can be performed by the forces developed by magnetic fields. Transmitting telegraph messages makes use of the magnetic forces in a buzzer coil.

These simple jobs are accomplished by using simple devices. However, even complex jobs, such as sending and receiving telephone or radio messages, sending and receiving television pictures, and completely controlling manufacturing processes, are also accomplished by using simple devices.

### WHAT HAVE YOU LEARNED

1. Electricity is a combination of a force called voltage and the movement of invisible particles called current.
2. Voltage, as a force, is similar to the force developed by a water pump. Current flows through wires in much the same way that water travels through pipes.
3. All electrical or electronic devices make use of one or more of the effects produced by current flow.
4. Electrical current causes wires to heat. Toasters, irons, heaters, broilers, and lights are examples of devices which use this electrical effect.
5. Current flowing through a wire or coil develops a magnetic field.

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

# newscan

## Electronics in the News!

### Hello Central, Give Me Aunt Maude

Santa Catalina Island lies only 26 miles off the coast of California, but it is 50 years away from the modern, frenetic space of the nation's most populous state. Life on Catalina is pretty much the same as it was in the '20s and '30s, when big bands playing the island's fabled Casino Ballroom would break into their rendition of "Avalon," and the radio station



Museum piece? No, it's a working phone in the central office on picturesque Santa Catalina Island. The island is served by a 50-year-old manual switching system that still works perfectly.

there would broadcast the night's festivities to the mainland. Back in those days—in 1923, to be exact—a brand-new manual telephone switching system was installed just up the block from the Catalina Hotel and subscribers to the service were issued one-digit numbers and paper-thin directories.

Time has taken its toll on Catalina. The big bands are gone; so is the local radio station. The Casino Ballroom sits on the bay, deserted, peering out at the weekly influx of recreational boaters who have replaced the "beautiful people" of a bygone era. The Catalina Hotel remains, however, doing a brisk business during the summer. And up the block, still operating flawlessly, but now issuing three and four-digit numbers to new subscribers, is

Pacific Tel's oldest surviving manual office with its original Western Electric switchboard.

"The great thing about that 50 year-old switchboard is that it never really had to be replaced," said WE installer Merv Meece. "It is absolutely compatible with the newer switching equipment used on the mainland, whether mechanical or electronic. It will never be obsolete."

Merv and fellow installer Tom Sympson, from Western Electric's Southern California Installation Area, recently completed a job on Catalina. They felt as if they had somehow been transported back in time. "We were adding 160 lines to the old switchboard," said Merv, "and after working a few hours behind that magnificent wooden antique we almost forgot we were in the Space Age. When we took a break, we half-expected the operators on the other side of the board to be dressed in the clothes of the Roaring Twenties.

So Catalina Island moves ever-so-slowly forward, reluctantly discarding old traditions when they are no longer feasible and adding innovations only if they're needed. A ferry service, for example, has been augmented by two seaplanes as a concession to speed. But until their 50-year old telephone system shows some sign of breaking down, the islanders are content to pick up their phones and say, "Hello Central, give me Aunt Maude." And it looks as if it's going to be that way for a long time to come.

### Touch of Memory

And now, the elephant telephone. Well, it's not actually an elephant, but Western Electric's *Touch-A-Matic* telephone has a memory that would be the envy of the fabled pachyderm. It even offers "trunk-ated" dialing. The new phone can be programmed to "remember" 31 telephone numbers, any of which can be called by pressing a single button.

Designed to save time for businesses which call particular numbers frequently, the *Touch-A-Matic* set displays the programmed phone numbers on a 32-position "repertoire" arrayed on the telephone housing. The extra position is a sort of "scratch-pad" which automatically records the last number dialed manually. If the number is busy, the caller can re-dial by pressing the "last number called" button.

To store a number the user depresses the "record" button, selects a space on the repertoire (which corresponds to a location in the memory), pushes the automatic dialing button for that space and dials the number. He then presses the "record off" button. After this process he merely has to press the automatic dialing button whenever he wishes to call that number. To change the entry in a particular space, the user dials in the new number over the old one. Up to 15 digits can be stored in any space, allowing the user to include outside access codes and area codes.

The Touch-A-Matic dialer's memory consists of silicon integrated circuits, including one for logic and another for switching. The circuitry contains 15,000 transistors. Integrated circuits require constant power to retain their memory. To prevent solid state amnesia in the event of a power failure or disconnection, the new telephone contains nickel-cadmium batteries for stand-by power. The batteries will safeguard the recorded numbers for about 24 hours. So that's the Touch-A-Matic. It's not really the elephant telephone; it's just the phenomenal phone with the mammoth memory from Western Electric. ■

## R/C Submarine

*Continued from page 33*

cult to see even a bright yellow sub under that much water, so I really don't know the maximum underwater control range. However, 40 feet is just about the maximum practical viewing range for an operator a few feet above the surface.

The usual mixture of model kit builder problems plagued this kit, too. For example, all illustrated instructions were missing. Only a two-sheet set of written instructions was found. Repeated attempts to have the missing sheets of instructions supplied, or an appropriate refund offered, went without success. (The store at no time knew their customer was an editor of this magazine.) I would, therefore, suggest taking all the time you need to thoroughly inspect hobby models before buying. It may help to avoid future problems with missing or damaged parts and instructions. The submarine is a Hegi U-FSII kit imported from West Germany by Polk's Hobby Shop in New York City.

**Lost-At-Lake?** Most radio control systems have a type of servo (those small motor-driven arms that duplicate the motion and position of the control stick) which is not self-neutralizing; that is, they remember and hold their last position as radio-control is lost. Because of this, it is necessary to add some type of fail-safe circuit or be in danger of losing your craft in an uncontrolled dive! Therefore, I was very careful to dive only after heading the bow toward the shoreline. Any loss of radio control would then have a tendency to beach her by bouncing and skipping up the sloping lake floor toward the water's edge. Just wait till next year! Some mighty surprised goose is going to get ducked from underneath. Or is it the other way around . . . ? ■

## Klaxon Fire Alarm

*Continued from page 42*

used for furnace rooms and attics should be rated 190° F.

For added protection a dated label should be affixed to the battery, and the battery should be changed at least once a year. It is also suggested that the alarm be checked periodically, say once a month, by simply shorting the connecting terminals with a screwdriver and seeing that the horn really sound off loudly. Alternately, you can connect a normally-open push-button test switch across the heat detectors.

The Editors would like to point out that this system is not suggested as a replacement for a primary fire alarm which should use only U.L. (Underwriter's Laboratories) listed components. This system is suggested only if you can not afford a U.L. listed fire alarm, for something is better than nothing. If you desire maximum reliability, we suggest substitution of U.L. listed equipment for relay RY1 and horn BU1. U.L. listed components are available from your local burglar-fire equipment dealer. ■

## Inside CB

*Continued from page 53*

difference; "A" is a basic AM mobile transceiver; "B" is a basic mobile SSB transceiver. If we consider that each individual circuit function is a *module* or *building block*, you can see that many more modules or building blocks are required for SSB. While the simplified AM transceiver can be produced as a reliable, low cost unit suitable for mobile operation, the basic SSB transceiver requires considerable circuit refinements and precision for fuss-free operation. The extra circuitry required for SSB is reflected in its substantially higher price compared to AM CB transceivers; however, because SSB transceivers must be built with a high degree of precision, all SSB models are inherently "gold plated specials" offering the highest level of performance.

**Preview.** For the remainder of this series we'll look into the individual modules that make up a CB transceiver, and show you how each module directly determines how much performance you'll get in your particular CB application. Next issue we'll take a look into the receiver, and see why one transceiver picks up two or three channels simultaneously, while another transceiver gets only the signal you want to hear. ■

## Gain Without Gamble

*Continued from page 50*

(signal) gain available from the transistor, while still preserving the top-notch DC-operating-point stability of the Fig. 3 circuit. Any transistor plugged into such a circuit will have the same DC operating point as any other transistor in that circuit, or one like it; however, the gain for the signal will differ markedly from one transistor to another.

So gambling with gain and bias is completely unnecessary, since simple methods let us predict accurately the exact values of resistors needed to obtain optimum operation and reliability from our transistor amplifiers. Hook-up a few circuits today and checkout what you have learned. Don't gamble on your memory. ■



## Hustler Monitor Match

*Continued from page 60*

VHF and UHF signals, without need for re-arranging the antenna connections.

The Monitor Match is housed in a 3 $\frac{7}{8}$ -in. x 1 $\frac{1}{8}$ -in. x 2 $\frac{5}{8}$ -in. metal enclosure. Swivel-ears at the rear allow the unit to be mounted out of sight anywhere under the dashboard. The antenna input and the output jacks, 5 in all, are the Motorola (car radio) type. Two 24-in. output leads with connectors are provided, additional leads can be obtained.

**We Tried It.** The first connection we made was to the car's AM/FM radio. Because of the extra lead length introduced to the antenna system, the AM radio signals were considerably attenuated. The instructions packed with the Monitor Match made note of this effect, and by re-peaking the AM radio's antenna trimmer we restored normal reception. (The instructions point out that the AM trimmer is located next to the radio's antenna input or under the volume control knob. We found our trimmer under the knob.)

Next, we connected a VHF-UHF monitor radio with only two antenna inputs—one for low and hi-band and one for UHF. Hustler's instructions state that low-hi antenna inputs should be connected to the 25-50 MHz output jack, so that's the connection we made. The UHF radio antenna input was connected to the 300-500 MHz output jack. With all connections firm and

the radios checked for operation, we went back and tried the AM/FM radio. Reception appeared to be the same with or without the VHF-UHF monitors connected.

Similarly, disconnecting the AM/FM antenna had no effect on the VHF-UHF performance. We then tried a hi-band VHF monitor connected to the 140-175 MHz output jacks, and again, there appeared to be no interaction between radios.

Finally, for comparison we connected the car antenna directly to each VHF-UHF radio input. There was a slight improvement in reception noted only on the much weaker signals; strong signals appeared to be the same. Naturally, when we connect monitor radios to an antenna specifically cut for each band, overall reception is considerably improved; but then, we are back to the mobile antenna farm and a lot of additional expense, both for antennas and their installation.

While no single antenna can deliver optimum performance on all frequencies, an ordinary AM car radio antenna did deliver admirable performance when combined with the Monitor Match. If the AM antenna is the telescopic type, rather than the flexible fixed-length whip supplied on some '73 and '74 cars, it can be telescoped for best reception on the VHF-UHF frequencies, with some sacrifice in AM performance on the DX stations. As a general rule, adjusting the AM antenna for optimum FM length, or using a fender type AM/FM antenna of optimum length for FM, provides the best all-around performance with the Monitor Match.

*(turn page)*

**Summing Up.** As you can see, we were impressed with the performance of Hustler's Monitor Match 5M5. It is certainly the most convenient way to provide an antenna

for several mobile monitor radios.

For additional Monitor Match 5M5 information, circle No. 14 on the Reader Service Coupon. ■

## Heathkit GR-2000 Color TV

*Continued from page 46*

er in both initial adjustments and future checks, the GR-2000 has a service module (with built-in color killer switches), a dot generator, and a test-meter package. Those circuits, which must be adjusted—such as the tuner (if you want to add a channel to accommodate a new station), dot generator, digital clock and convergence panel—are mounted in a slide-out service drawer accessible from the front of the set.

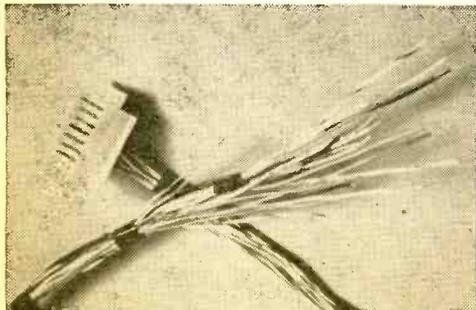
The optional remote control receiver which provides up-down channel selection, color control, tint control, up-down volume, and power on-off, also mounts in the service drawer. The associated ultrasonic transmitter is powered by a standard transistor radio battery, and has an effective range of up to 20 feet.

**More Than Dollars.** We don't have to look too closely at all the features in the new Heathkit GR-2000 color receiver to realize there is no other TV available at any price which incorporates what Heath has built into their latest color TV. Of course, the kit price of \$649.95, which does not include the cabinet, optional digital clock (\$29.95) or optional remote control (\$79.95) is not cheap. It is true that you can buy a color TV for a lot less—and it comes wired. We have all seen these cheaper sets at a neighbor's, with color that washes out in a bright room, green or magenta

flesh tones, and a "service contract" that should be framed over the set. In just a few years that service contract—which is not needed with a Heathkit—results in a total cost equal to or exceeding that of a GR-2000, and the color quality still isn't too good.

**To Explain.** After a local appliance dealer quotes the "sale price" on a color set he often follows with an "insurance offer" which offers "complete parts and service protection" after the warranty runs out. The price of this "protection" will cost you from \$20 to \$60 a year depending on how much "protection" he will talk you into. Sure, many color TVs come with a parts warranty, but they run about 90 days, and when you read the fine print you might find that only the parts are covered, the service is extra; and it is not unusual to get stuck for a \$25 service fee to replace a two dollar—supplied free!—tube. After the free parts warranty runs out *nothing* is free. And what do you do with a "store bought" TV when the color alignment needs a touch-up—which it does every so often. Either you put up with smeared color, as does your neighbor, or you again pay a stiff service fee for a job you could do yourself in minutes.

With a Heathkit GR-2000 you have none of these problems and none of the added expenses. Firstly, by building the color TV yourself you probably won't learn electronics, but you will learn what goes where and what happens when a particular circuit goes out. If you have trouble you simply pull out the offending module (the entire module, not a component) and ship the module off to Heath, or bring it in to a local Heathkit store. They will repair the module on a turn-around basis for a modest fee (or replace it). You get the module back, plug it into the main frame, and the set is back in operation. If you want to change the defective component yourself, you'll find Heathkit provides a complete parts list with prices, and they stock every item. You won't have to spend days on the phone trying to locate a replacement, or hear tell how the set is so new the spare parts aren't available yet (or the set is so old no one



Interconnecting cables come with plugs prewired and wire ends tinned.

has the parts), or the parts will be in on the next boat, assuming there's no labor strike.

As far as maintaining color quality is concerned, you're way ahead of the game when you finish the kit, for you will perform the convergence adjustments—sometimes called a color alignment—yourself. The first time out it takes about one hour to obtain an outstanding color picture. But once you learn the procedure you can run through a color convergence trim in a matter of minutes. Any time you feel the color is off you have both the experience and confidence to tackle a color alignment. (Fact is, once they see your color, you can expect friends and neighbors to ask if you can get the same color quality on their sets. Your best excuse is you will need their step-by-step service manual—that will put an end to all such requests.)

So you see, from just the service viewpoint alone you can expect years of precise color reception without unnecessary service costs.

The plain truth is, with service and repair costs soaring even for the most insignificant in-home repair or adjustment, the GR-2000 is the way all color TV sets will have to be made in the near future: with small user-serviced modules and easy-to-perform color convergence. As far as we can tell the Heathkit GR-2000 is tomorrow's color TV, today. So if you're ready for the best in color TV you can get more information by circling No. 1 on the Reader's Service Coupon on pages 17 and 103.

## IC Metronome

*Continued from page 63*

terms for various beat frequency ranges on the dial. They are:

Tempo Beats/Minute	
Presto	208—182
Allegro	182—154
Andante	154—124
Adagio	124—98
Larghetto	98—69
Largo	69—44

Perhaps that tall pyramid-like box which all music teachers once carried in their music case will become a thing of the past following the introduction of electronic metronomes. The old box is up against some stiff competition.

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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 midrange 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.

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**New York, N.Y. 10023**

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## DX Central Reporting

Continued from page 29

should check this frequency about sunrise for HILR, *Radio Clarin* in Santo Domingo, Dominican Republic . . . **3360**—For the short-wave contingent of the "Dawn Patrol," a fairly steady performer on the lower frequencies is the Guatemalan, *La Voz de Nahuala* . . . **3985**—Generally one doesn't find many of the European broadcasters this far down in the SW bands, but SWLs lately have been reporting the *Swiss Broadcasting Corporation's European Service* around 0600 and later, with English after 0700 . . . **4830**—Bad news for those hunting the on-again-off-again new transmitter at Franceville, Gabon: the *South African Broadcasting Corporation* has jumped on this frequency for one of its home service broadcasts during the prime African listening times . . . **5038**—Usually the first 60-meter band station to fade in during the afternoon hours in North America is *Bangui*, Central African Republic. African music and French announcements are the usual program items heard . . . **6218**—HIAU, *La Voz de la Libertad*, a Dominican Republic station has been

reported again since about Christmas time on this out-of-band frequency. Try during evening hours .

(Credits: Karl Forth, IL; Jim Whitehead, MA; Neil Perdue, TN; Ernest Behr, Ont.; Fred Huette, DC; Alvin Sizer, CT; Alan Roth, NY; National Radio Club, Box 127, Boonton, NJ 07005; North American SW Association, Box 8452, South Charleston, WV 25303)

**Backtalk.** Normally we don't cover very much in the "utility" DXing field. The "utilities" are those point-to-point and communications stations, commercial, government and military, which do not have normal program-type broadcasts. But some time ago we mentioned a booklet on DXing the utility stations and inadvertently caused a snafu.

The booklet, which was available from SPEEDX, a DX hobby club, was out of print, it turned out. Now, happily, an expanded and updated version is available. It is called "World Utility DX Handbook," and is available from SPEEDXRAS, 780 N.W. Wallula, Gresham, Oregon 97030, for \$7.95, postpaid.

Now a couple of quicky-questions.

"I just received *Radio South Africa* and I wonder if you could print the address so I can send my report," writes Tom Force, Farmingville, NY. (turn page)

← 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 contains a rugged 12-inch long-throw woofer with a 22-oz. Alnico magnet, a 5-inch sealed-back rubber-damped midrange, and two 3-inch dome tweeters from *Designers Audio Products*.

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

**145.** For CB'ers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-

color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

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

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

**148.** *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.

## Use Coupon on Left!

**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 GIs.

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

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

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

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

**137.** *Pace Communications* has a packet of information for you. The "Citizens two-way radio" answers all the questions from how to operate one to how much they will

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Actually, Tom, it's *Radio RSA*, and the address is Box 8606, Johannesburg.

"What is the difference between MHz and kHz and is there any way of converting one to the other?" This question, a common one received here at DX Central, is from Eileen Markmaan of Tallahassee, FL.

Hertz (Hz) means cycles per second. Kilo-hertz is 1000 cycles per second and megahertz is a million cycles per second. Multiply MHz by 1000 to get kHz; divide kHz by 1000 for MHz. Example: 9,745 kHz = 9.745 MHz. Easy, no?

A poem, no less, was received from Terry Nichols of Rockford, IL, recently. Titled simply "DX," Terry says, "It reflects the way most of us feel about the hobby." Sorry, Terry, it's a bit long to print in full, but here are a few lines. Referring to those who don't know the excitement of DXing . . .

"For if they had then they would know,  
the mystery of this hex.

This time-consuming, fiendish friend, referred to as DX.

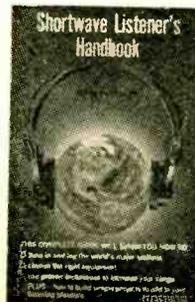
All in all we think it's nice, as you can plainly see.

To tour the world both far and near, on a radio frequency." ■

## Bookmark

*Continued from page 84*

listener a complete introduction to shortwave equipment and techniques. Even the experienced DXer will find many valuable tips to increase his listening pleasure in this convenient all-points guide published by Hayden Book Company, Inc. Covering the full range of equipment—from the common multiband solid-state portable and whip antenna to sophisticated communication receivers and antenna farms—the book discusses and evaluates all types of receivers and antennas. It covers tuning and logging stations, coping with listening conditions, hunting weak signals, and explains how to get reception reports, station schedules, and other useful data. Hayden will be happy to send you their catalog if you write to them at 116 W. 14th St., New York NY 10011.



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CIRCLE NO. 2 ON PAGE 17 OR 103

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## Ask Hank, He Knows!

*Continued from page 26*

thick and contain too much rosin. A smaller diameter solder with less rosin is especially made for printed circuit board wiring. I use it because the final job is neater and less "bridges" occur.

### Labor Is Expensive

Why is the cost for car tape units so high?

—A.Y., Detroit, MI

The prices are not high at all; in fact, since competition is keen, prices are very low. Your long letter, which I abbreviated, hints at installation costs. Now, these are high. An ordinary car cassette unit that sells for about \$100 costs a like amount to install in some garages. Do it yourself and save the cash.

### Who Needs It?

What is a DIN connector?

—L.M., Buffalo, NY

A DIN connector is Europe's answer to the RCA phono plug.

### Watch Out

What is the price of the cheapest burglar alarm I can buy?

—J.A., Reno, Nevada

One can of dog food!

### What Else!

Where can I buy a "like-new" Atwater-Kent Model 40 receiver?

—F.B., Tempe, AZ

Le Louvre! That's where they keep all works of art. Atwater-Kents are scarce. You'll never find them in retail stores. ■

## Hey, Look Me Over

*Continued from page 16*

volt plugs and comes with a plastic strap for attaching to power cords. Suggested retail price is \$2.50. For more information on Plug Lock, contact Mercury Manufacturing Company, 1212 Grove Street, Wyandotte, Michigan 48192.

### Priority P.A.

Radio Shack's new Realistic MPA-50, 50-watt public address system amplifier, features a priority switch that overrides any of its inputs for paging. The MPA-50 has four microphone inputs, an auxiliary input for tape or tuner, and rear panel switch for either ceramic or magnetic phono cartridge

*(Continued on page 106)*

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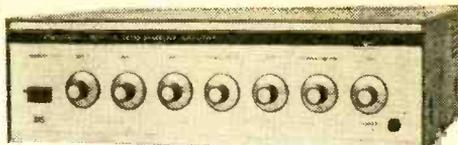
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(Continued from page 104)

input. Other features include a master volume and tone control, as well as level controls for each of its five inputs, and output

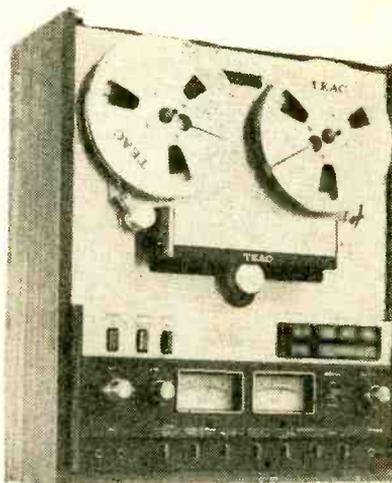


Circle No. 32 on Reader Service Coupon

protection circuitry with an overload light and reset button. Pushbutton on/off. The Realistic MPA-50 PA Amplifier is priced at \$129.95. Realistic products are available from more than 2500 Radio Shack stores in all 50 states and Canada.

**Direct Drive Servo Tape Machines**

A new generation of stereo reel-to-reel tape transports with direct-drive servo-controlled DC motor/capstan, which eliminates gears, idlers and belts for quieter, smoother operation is now available from TEAC. At the top of the line is the 5500 with dual-process Dolby noise reduction system and DC motor. The 5500 operates with a direct-drive servo-controlled capstan which substantially re-



Circle No. 166 on Lit-Lib on page 100

duces heat and vibration and fulfills the promise of excellent wow and flutter characteristics. Four separate circuit cards in the 5500 permit simultaneous Dolbyized recording with decoded tape monitoring, a distinct listening advantage not possible with some separate Dolby units. Price: \$899.50. TEAC will be happy to send data on the entire line. Write to TEAC, Dept. EE, 7733 Telegraph Rd., Montebello, CA 90640.

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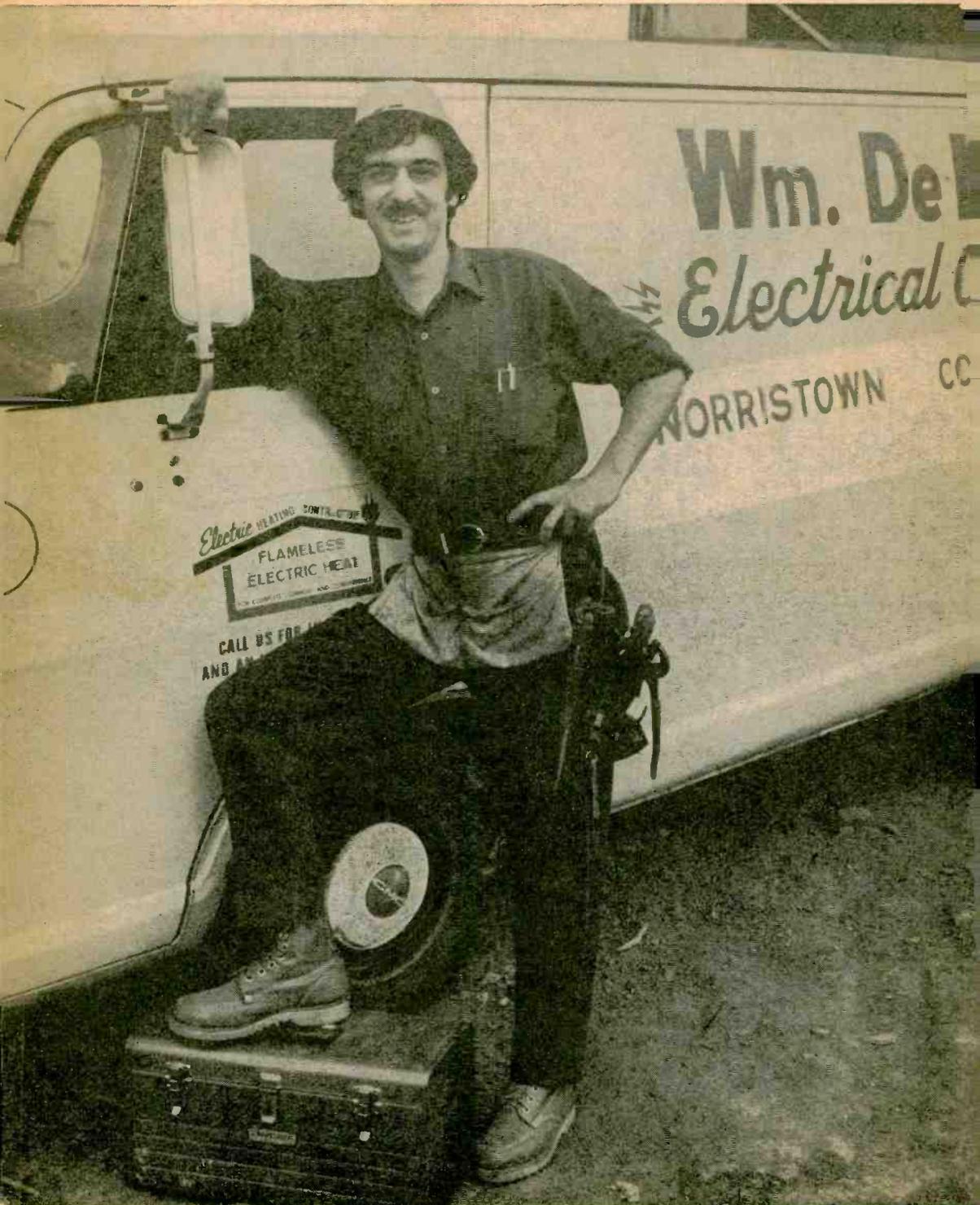
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CIRCLE NO. 32 ON PAGE 17 OR 103

MAY-JUNE, 1974

107

“Learn an honest trade,”  
“and you’ll never have to



# ny old man used to say, knuckle under to any man.”

(A TRUE STORY)

Bill De Medio of Conshohocken, Pa., has it made.

At 23, he's a licensed master electrician. The top of a trade where there aren't enough good men to go around.

But more important, Bill's his own boss and calls his own shots.

“I just went into my own business. And even before the sign on my truck was dry, I got my first big job.

“The contractor for a new group of houses asked me to do all the wiring. And there's bound to be a lot more work from him and other builders.

“If it wasn't for my ICS training as an electrician, I'd still be in some dead-end job—hating what I was doing, taking orders from everyone, and never getting any thanks for it.

“As a master electrician, you're the boss on the job—even when you're working for someone. You get respect, good money, and like my old man said, you don't have to take baloney from anyone.”

### The right combination for success

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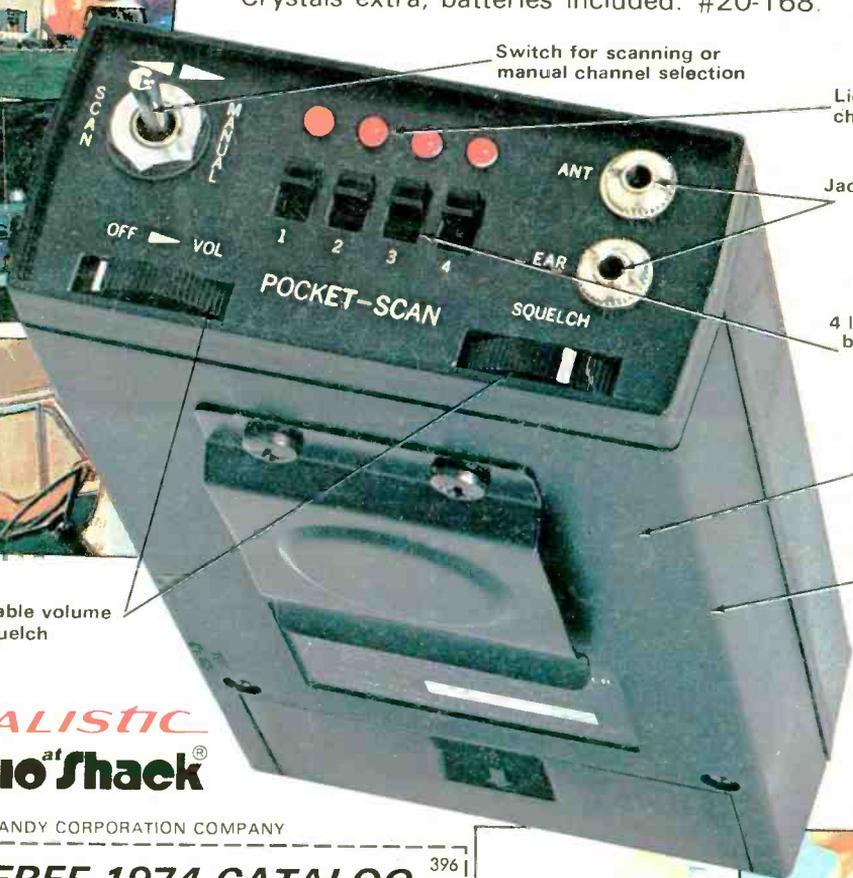
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