

# BUDGET Electronics

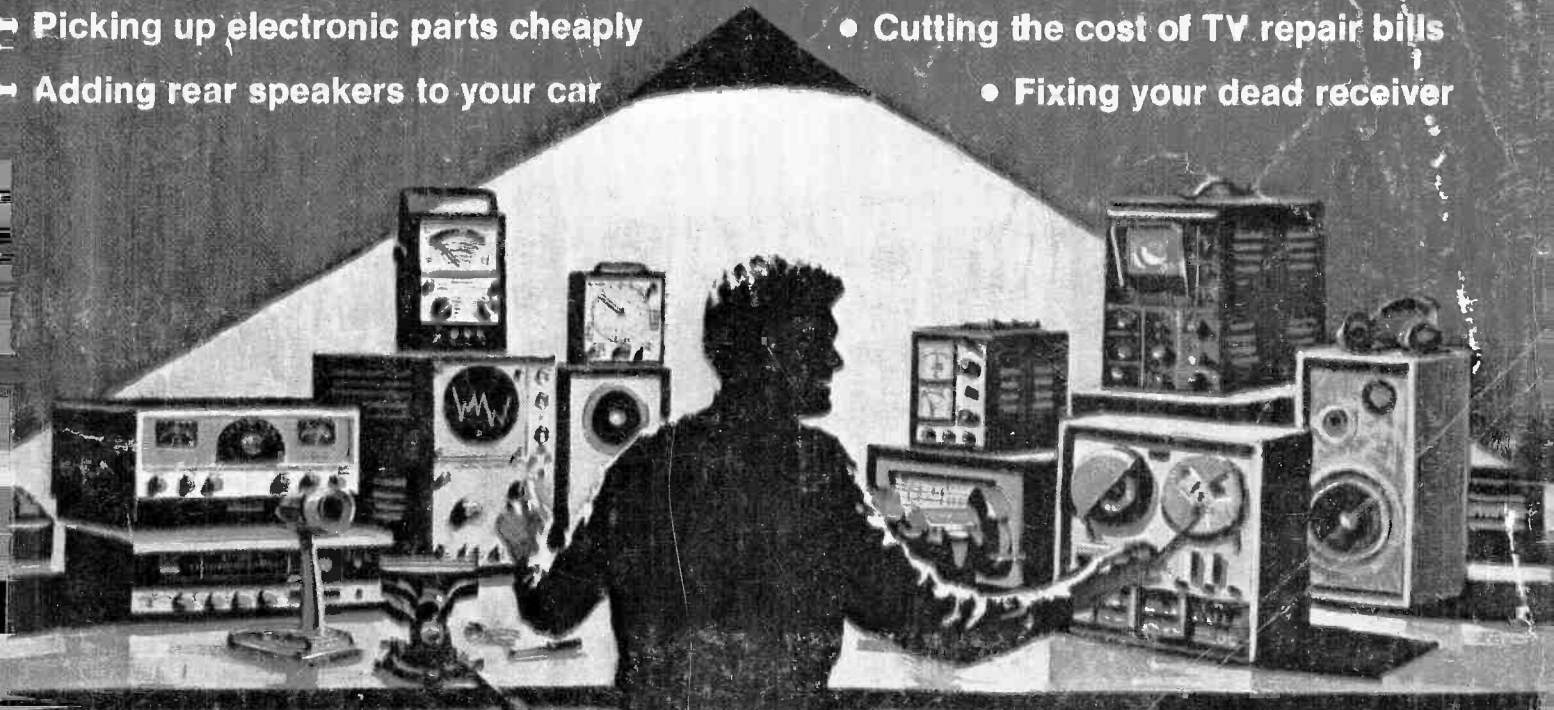
FIRST EDITION

1976 EDITION \$1.35 © 02040

by the Editors of ELEMENTARY ELECTRONICS

## INFLATION-FIGHTING IDEAS

- Troubleshooting your home appliances
- Building projects that save you money
- Picking up electronic parts cheaply
- Cutting the cost of TV repair bills
- Adding rear speakers to your car
- Fixing your dead receiver



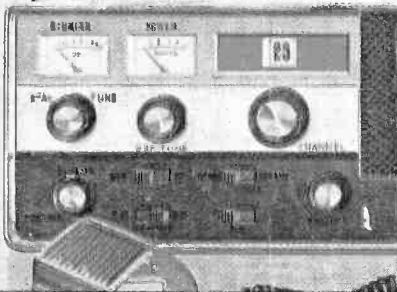
- Installing a home radio/intercom
- Selecting the right home study course
- Tuning the police/fire/aero bands
- Putting in a home wall ventilating fan
- Hiding antenna cables in walls
- Making a buck on antique radios

### CB

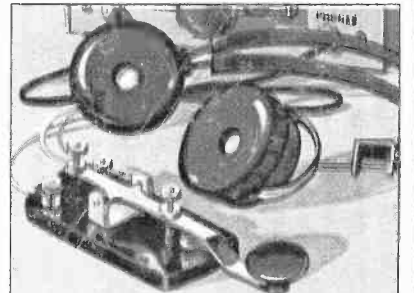
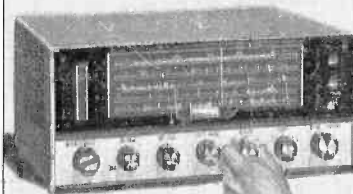
### HAM

### SWL

Low-cost personalized 2-way radio everyone should have and use



Listen to the wide world of exciting shortwave and monitor radio



Get started today in international communications on a shoestring

# New!

# Rugged! Reliable!

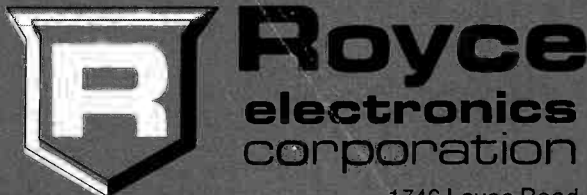


## NEW! Royce Model 1-601 23-Channel Mobile CB Transceiver

Loaded with features, too. Such as a great fine tuning system, tone and ANL pushbutton switches, and an extra large S-RF meter.

But, that's only the beginning. Check the features at right. See how much this new mobile CB has to offer you in ratio to cost.

Then, hurry to your Royce Dealer's, and see and hear for yourself. Thousands of CB-ers—beginners and professionals—will join you there. Your dealer can tell you and our sales figures prove it—Royce is the new trendsetter in the CB field!



1746 Levee Road  
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CALL (816)842-7505 • TELEX: 426-145

### Check Royce features...then compare!

- **PUSHBUTTON ANL (AUTOMATIC NOISE LIMITER)** reduces static to nearly zero.
- **FINE TUNING** with continuous receiver for better receive clarity.
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- **POSITIVE AND NEGATIVE GROUND OPERATION.**
- **PUSHBUTTON HIGH-LOW TONE SWITCH** for noisy locations.
- **AMC CIRCUIT** for full audio punch, without perils of overmodulation.
- **PUSHBUTTON CB-PA SWITCH.** Presto! It's a full, 4-watt P.A. system.
- **PLUS SO MANY MORE FEATURES WE DON'T HAVE SPACE** to tell you about them. You'll want to see them in person, anyway. Do that soon—at your Royce Dealer's. See for yourself! Compare for yourself!

# Why don't other TV/Audio home study schools put prices in their ads?

## Maybe they can't match this value!

NRI will give you complete TV/Audio service training with a solid state 25" diagonal color TV training kit, and all the electronic instruments and training services you need for as much as \$600 under the next leading home study school. Only NRI gives you a choice of five ways to learn, starting as low as \$370 . . . with convenient, inexpensive time payment plans.

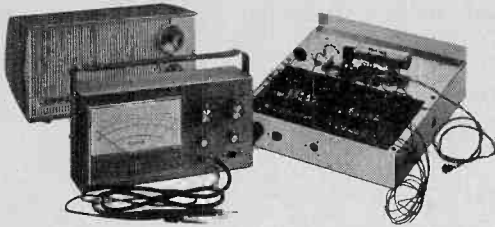
NRI pays no salesmen. We buy no outside "hobby kits" for our experiments and training kits. We pass the savings on to you, giving you the top educational value available anywhere.

## Take your choice in TV/Audio Training

Only NRI gives you a choice of *five* courses in TV/Audio servicing. Each comprehensive course features bite-size lessons, special reference texts, special engineered "power-on" training kits, and service instructions for black and white TV, color TV, FM multiplex receivers, PA systems, antennas, radios, tube, digital circuitry, transistor, and solid state circuits.

## Good with 7 kits...\$370 or low monthly terms

An up-to-date, comprehensive servicing course in which you build and experiment on your own solid state radio, volt-ohmmeter, and experimental electronics lab. Course covers FM multiplex receivers; tube, transistor, digital and solid state circuitry; black & white and color TV servicing.



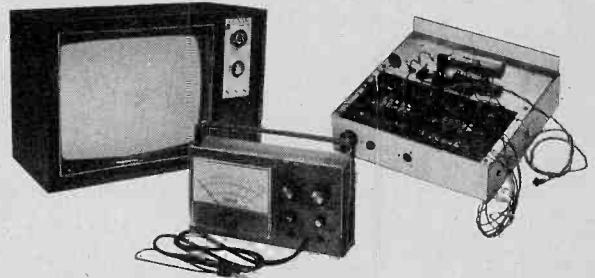
## Better with 11 kits and b/w TV...\$465 or low monthly terms

A complete course in black and white and color TV servicing. You build and experiment with your own solid state radio, volt-ohmmeter, electronics lab, and 12" diagonal solid state black & white portable TV.



## Better yet with 11 kits and 19" diagonal Color TV...\$795 or low monthly terms

Excellent color TV training with kits and experiments to build a solid state 19" diagonal color TV, complete with handsome cabinet, along with extra parts for performing experiments. Also includes electronics lab, and volt-ohmmeter. This \$795 course is the lowest priced "hands-on" color TV course available anywhere.



## Best with 14 kits and 25" diagonal Color TV...\$1,095 or low monthly terms

Master training includes kits and experiments to build NRI's unique "power-on" training 25" diagonal color TV (complete with cabinet); 5" triggered sweep oscilloscope; TV pattern generator; 3 1/2 digit digital multimeter; solid state radio and electronics lab.



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or low monthly terms

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1976 EDITION

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# BUILD 20 RADIO and Electronics Circuits

Reg. U. S.  
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Training Electronics Technicians Since 1946

## PROGRESSIVE HOME RADIO-T.V. COURSE

**Now Includes**

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

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

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

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL. You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios; you will work with the standard type of Punched metal chassis as well as the latest development of Printed Circuit chassis. You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material. You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics. Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

### THE KIT FOR EVERYONE

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

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

### PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio. You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a Professional Radio Technician. Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

### THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc. In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

### PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets. A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals. Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

### FREE EXTRAS

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

### SERVICING LESSONS

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

### FROM OUR MAIL BAG

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

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 501GT Hewlett, N.Y. 11557

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

NAME .....

ADDRESS .....

CITY & STATE ..... ZIP .....

### PROGRESSIVE "EDU-KITS" INC.

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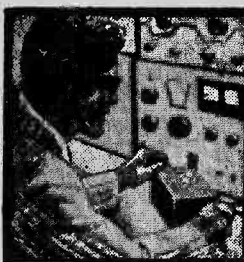
CIRCLE 9 ON READER SERVICE COUPON

### SELF-STUDY CB RADIO REPAIR COURSE

There's money to be made repairing CR radios. This easy-to-learn course can prepare you for a career in electronics enabling you to earn as much as \$16.00 an hour in your spare time. For details write:

**CB RADIO REPAIR COURSE**  
531 N. Ann Arbor Dept. EH/F5  
Oklahoma City, OK 73127

**YOU'RE THE SOLUTION  
TO WATER POLLUTION**



## ASK HANK, HE KNOWS!

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

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

### Light Suits Him

*Is it against the law to put an electrical fixture in a closet? I need light to pick out the clothes I need.*

—A. M., Sistersville, WV

First, let me say that we all have a common problem. We lose our sense of color as the light diminishes. A brown pair of slacks looks like a dark blue one in the dimness of a closet. By all means, install an electrical fixture according to the code in your area. This means Romex or BX cables in the walls, fixture totally inclosed with suitable switching circuit. Don't go for those add-on lamps operated by the opening of a door. These cheap jobs require a long run of "zip" or lamp cord to an outlet. You're inviting the fire department to your home.

### Likes to Poke Around

*I have many schematic plans that say to discharge the filter capacitor before you do anything to the circuit. What is a filter capacitor and how do you discharge it?*

—J. H., Yonkers, NY

Listen, pal, if you don't know what you are looking at, don't poke around. My advice to you is to start reading the Basic Course in ELEMENTARY ELECTRONICS each issue. To those of you who know what a filter capacitor is, short out the capacitor's leads with a 10-ohm, 2-watt resistor. Do not hold the resistor in your hand, but build it into a probe with a ground wire and clip. Never use a screwdriver!

### Pig's Ear Parts

*I have a chance to buy unused circuit boards containing parts that are new. The boards are surplus in the original military packaging material, not defective units that were replaced. Is this a good idea?*

—E. B., Cupertino, CA

Only if you have a need for the parts in quantity. It is foolish to strip down a PC board so you can use a 1000-ohm, 1-watt resistor next July. Also, are the transistors readily adaptable to your hobby needs? If not, don't buy. The best buys I get from deals like these are boards that can be modified to do a job. Used PC boards take up a lot of time to strip. Think hard about it.

### Honest John's Used CB

*Are used CB sets really worth the money?*

—J. S., St. Petersburg, FL

When I buy a used car, I usually kick the tires. I do this because I don't know what else to look for. In fact, I don't know why I kick the tires! As for used CB sets, they're blind items, too! If you have the test facilities to check out the unit, buy it on a "money back in 10 days if you are not fully satisfied—no questions asked" term. Under any other conditions you will have better results in Las Vegas with your cash.

### Just the Facts, Please

*I have recently acquired a Stewart Warner Model 9004-G combination phonograph-radio. Can you tell me what year or years it was made, the price at that time, and where I can get a schematic for it?*

—D. E., Levelland, TX

If you write to the Antique Radio Editor of this magazine, he would be happy to send you a fact sheet which will help you with your problem. I didn't pass your letter to him because you did not include your full address.

### Somewhat Backward

*Hank, I installed the batteries in my portable cassette player backwards. After realizing my mistake, I reversed the batteries. The motor mechanism works fine, but I hear nothing. What should I do?*

—A. F., Hartford, CT

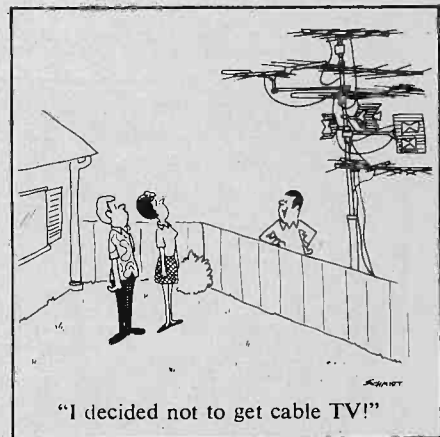
You have problems. Apparently, the unit had no "reverse-voltage" protection for the electronic circuits. You may have popped all the transistors and/or IC chips. Start troubleshooting, pal, and good luck!

### Hot Line

*What is the electrical code against line cord extensions?*

—W. B., Kingsport, TN

(Continued on page 8)



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And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in electronic, hobby and science items — plus 4,500 finds for fun, study or profit... for every member of the family.

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### 3-CHANNEL COLOR ORGAN KIT

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### BUILD A SOLAR HOME AND SAVE!

Beat the energy crisis—build a modern 10 room solar heated & air conditioned home designed by famous ecological architect Malcolm B. Wells! Its 10-yr.-proven Thomason "Solaris System" can cut conventional heating costs as much as 2/3! Your builder can modify or use as-is the complete blueprints included with "Solar House Plans III" (by Edmund, Homan, Thomason & Wells). Estimated \$40,000 building cost. 48-pg book shows all pro's and cons. Illustrated. No. 9469GA (8½ X 11" PPRBK) \$24.95 Ppd.



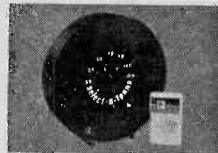
### ELECTRONIC DIGITAL STOPWATCH: \$69.95

A price breakthrough! New pocket size 4 oz. timer acc. to ±2% of last digit (1/100 sec. increments). Compares with others twice the price! Instant error-free readouts to 9999.99 sec. (over 2¾ hr). Starts, stops, re-starts (accumulates). Mechanical pushbutton & electrical remote on/off's w/ any 3.5-150v AC/DC source. Plug-in jack. Incls. 9v batt. Solid state. No. 1843GA (2¼ X 4¼ X 7/8") \$69.95 Ppd. DELUXE 2 EVENT STOPWATCH (±0.01% OF LAST DIGIT) No. 1653GA \$149.95 Ppd.



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### SUPER POWER FOR ANY AM RADIO



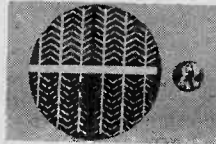
New antenna assist turns a tiny transistor into a tiger, has pulled in stations 1000 miles away! Just set it beside your radio (no wires, clips, grounding) and fine-tune Select-A-Tenna's dial to same frequency—"Gangbusters"! Terrific for sportsmen, vacationers. Great for clearing weak signals in radio depressed areas, off-coast islands, stations in crowded frequencies. Solid state—uses no electricity, batts., tubes. Works almost forever. Stock No. 72,095GA \$15.95 Ppd.

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### PRO ELECTRONIC SOUND CATCHER



Parabolic mike w/18¾" transparent reflecting shield & 2 I.C.'s in amplifier magnifies signals 100x that of omni-direction mikes. Catch sounds never before heard! Highest signal to noise ratio poss. Earphones, tape recorder output, tripod socket; req. two 9v trans., batt. (not incl.). No. 1649GA (5½ LB.) \$299.00 Ppd. LOW COST MODEL: NO EARPHONES, ELECTR. CIRC. No. 1665GA \$199.95 Ppd. LOWER SENSITIVITY ECON. MOD. W/O ELECTR. No. 80,242GA \$89.50 Ppd.

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## Ask Hank, He Knows!

An electrical line cord is suitable to extend the line cord of an electrical appliance or lamp that is not close enough to an outlet for direct connection. As a home safety guide, do not use line cords on electrical appliances rated at 350 watts or more. This is my personal standard. Also, do not use a line cord as an outlet extension. The common 3-way plug extension cord is commonly used in many homes to power several appliances at the same time. This is dangerous. Also, many people staple line cords to baseboards as a permanent installation, even paint over the line cord when the room is redecorating. A short in the line cord or over-loading the line cord may cause a fire before the usual 20-amp circuit breaker kicks out. I strongly advise against the use of line cords. If one must be used, only one low-power appliance or lamp per cord. Better still, install a new outlet where one is needed.

### Hissssssssss

*How can I reduce the hiss in my 8-track player? My inexpensive cassette machine is much quieter by comparison.*

—N. N., West Helena, AR

8-track players are very noisy. You can help reduce some of the noise by cleaning the playback head with a "cue-tip" and alcohol. Pick up a tapehead cleaning cartridge and run it through the machine as often as recommended on the cartridge. Cassette machines can get noisy too, so clean its head also, if you want it to continue to hiss less.

### Four for More Sound

*Last year I bought a "quad" system from my local hi-fi dealer and had trouble for about six months getting SQ and QS records. Now I'm able to buy them from a reasonably large selection. I went back to my hi-fi dealer to thank him for steering me to "quad." Guess what? He didn't have a 4-channel system in the store and told me that quad is dead. He tried to sell me a stereo system. What's going on?*

—M. K., Seattle, WA

Your dealer rides with the easiest sell and trend of the times. Stay away from him. 4-channel high-fidelity is not dead. Sales have slackened due to the recession in business. Many hi-fi manufacturers have reduced their 4-channel product lines but have not given 4-channel up. Stick with 4-channel, it's the sound of the future.

### Where Are They

*I know the Morse code and would like very much to have an Amateur Radio License. My problem is I don't know where the FCC test office is. Could you give me the address?*

—P. P., Chattanooga, TN

Address all your questions on ham radio to Federal Communications Commission, Washington, DC 20544. They'll help you out.

### Wants White's

*I have a 1973 issue of COMMUNICATIONS WORLD in which is found the fantastic White's Radio Log. However, it is out of date now. How can I update it?*

—W. D., Davenport, IA

Why update? Pick up the latest issue of COMMUNICATIONS WORLD on the newsstand now! If you can't find it, write to the magazine at 229 Park Avenue South, New York, NY 10003 and enclose \$1.35.

### What's a BFO

*I have an 8-band radio and on it there is a BFO switch. Can you tell me what it's for?*

—R. P., Edinburg, PA

Sure can. When the BFO is on, it will cause a whistle to be heard whenever a station's carrier is present. You may have to jiggle the fine tuner knob to get the tone you like to hear. Now this whistle, or tone, is annoying when listening to an AM station, and that's why you can turn it off. However, when a station is broadcasting an unmodulated or Morse code signal, the BFO provides the tone necessary to hear the signal. That way you can copy it down.

### Good Trio

*I'm looking for a shortwave receiver, one with good sensitivity. I picked out three receivers, one a Heathkit GR-78 which is a six-band covering 190 kHz to 30 MHz. I also saw a Lafayette HA-600, a 5-band amateur and shortwave receiver, covering 150 kHz to 30 MHz. The third one was a Realistic DX-160, 5-band covering 150 kHz to 30 MHz. Which one shall I get? I need some professional help.*

—J. G., Greenfield Park, Que.

All these products have published specifications which are believable—they are made by reliable outfits. As for which receiver to buy, it is your decision because only you can know exactly what you want. Check the specs carefully. Then check the features and compare the lot against the prices. Lots of luck!

### Wind Power

*I set up a fan-generator combination on a small tower and now I get about 30 amps AC at 15 volts. I'm using a car's alternator as the generator. What can I do with this power after seeing it is not reliable because the wind varies in speed?*

—E. E., Ellenville, NY

You're talking about 450 watts of power. Pass it through a resistor and use the heat to assist your regular heating system. Maybe the resistive load can be placed on your garage floor which will keep the car warm for fast starts on very cold mornings. The wind is fickle and you can't rely on a fixed frequency output or constant voltage output. But, a resistor doesn't care provided it can take the maximum power or current available. For maximum power transfer, the lead-in line must be #10 copper wire or better.

### Inside CB

*Can you advise me where I can get information on basic CB operation, rules and regulations. I am also interested in a copy of 1975 CB YEARBOOK. Where can I get one?*

—R. H., Davenport, IA

You're out of luck—the 1975 Edition of the CB YEARBOOK is sold out! But don't despair. ELEMENTARY ELECTRONICS has Kathi Martin giving inside info each issue along with timely and interesting features and technical reports throughout the year. And more! The 1976 issue of CB YEARBOOK is due on the newsstands on November 18, 1975. Look for it!

### Tube Switch

*I had my color TV picture tube replaced in my home. The repair man "broke the vacuum" and told me to get rid of the dud. In doing so, I noticed that he replaced a 18VBTP22 with a H-18VBKP22. Is he screwing me up?*

—B. M., Jeffers, MN

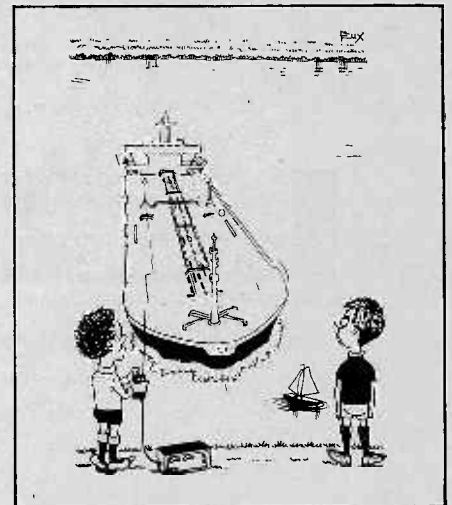
Heck no! The replacement is the new type to be used with your set. I'll bet it's an RCA make and uses the latest "matrix" which means better color than before. Also, the new tube contains improved X-radiation attenuating glass—a safety plus at no extra cost. You know, you have a good man servicing your TV set.

### Get the Point?

*I have a very large collection of 78 rpm records dating back to 1910 and play them from time to time using "Kati" needles. Alas, my supply has dwindled to zero and I can't seem to buy any. What should I do?*

—Edwin Strauch  
327 No. Penn St.  
Allentown, PA 18102

Some of our readers, Edwin, are sure to have a few spares they can let you have or let you know of a suitable substitute. May I suggest you record your discs on cassettes? Playback would be easier and record wear-and-tear reduced considerably.



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## Ask Hank, He Knows!

### Oldie

I have a Knight Model KG-221 FM monitor receiver (152 MHz-174 MHz) which I built from a kit. It has no RF amplifier stage. Is there anything I can do to it to improve its sensitivity?

—N.K., Highland, IN

Nope! When I first saw that front end, I swore it could not work, but I used the rig for an evening. It was very good for its day, but now's the time to swing over to a modern monitor. The newest top-of-the-line '76 models can be programmed for any channel without the use of a crystal.

### Never Too Old

I'm 60 come June and have done considerable work in Industrial Electronics. What I'm saying is I think I know my way around an electrical circuit. What about Amateur radio? Can you give the name of a book that will give me the inside information? Maybe this is what I need to retire and keep me active.

—H.H., Detroit, MI

I suggest you write to the ARRL today. They have several books at good buys. Write to them at 225 Main Street, Newington, CT 06111.

### CB Newcomer

I'm new to CBing. I would like to buy a 23-channel mobile unit. I can't afford a real expensive one, but I don't want a cheapie either. What do you suggest?

—D. G., Tyler, TX

Wait for the 1976 CB YEARBOOK. The Editor tells me it'll be on sale at your newsstand by mid November, 1975.

### No Coverage

I'd like to see some radio/control projects in e/e. Why have you guys avoided this hobby interest area?

—R. G., Medley, Alberta

Like R/C projects? Then save a bundle of cash and buy ready made units from model airplane stores and modify them for specific purposes. The R/C fans have come a long way to where they now have the best in functional and reliable radio control devices.

### Lights Out

I'd like to eliminate the idiot lights in my car for gauges. I lost one car from overheating and had dead batteries twice in my present bucket-of-bolts because the idiot lights came on after the damage was done. Where can I get reliable gauges?

—D.M., New City, NY

I know what'cha mean. If your local electronics store does not carry what you want, check out a wholesale automotive supply store—they sell to almost anyone. Also, write to J. C. Whitney & Co., 1917-19 Archer Avenue, Chicago, IL 60680 and ask for their automotive parts and accessories catalog.

### Hank Eats Crow

I noticed with interest your reply to the person who wanted to know why broadcast stations reduce their power at night. It had to be the most cockamamie piece of misinformation I have ever seen. The truth of the matter is that AM broadcast-band signals are propagated by "skip" at night, mainly by the E-layer, and there is some D-layer "skip" around noon, local time. Where the ground-wave portion of the radiated signal is somewhat limited in its range as it obeys the inverse-square law, with the reduction in ionospheric absorption at night, sky-wave signals in the medium-wave band can be propagated strongly for hundreds or thousands of miles. For this reason, many AM broadcast stations are not permitted to operate after local sunset, and others must reduce their power. Needless to say, I am very disappointed with your column.

—G.K., San Clemente, CA

When I try to oversimplify, I run into trouble. Thanks for writing.

### Can You Help Out?

▲ Vinson Brown can use an 6A8G vacuum tube. Write to him at P.O. Box 12274, W. Gastonia, NC 28052.

▲ If you have a manual for National FRR-24 receiver manufactured for the Navy, then maybe you can send it to Wayne Townsend, 301 Welcome Avenue, Greenville, SC 29611

# TRACE SIGNALS WITH YOUR TAPE RECORDER

□ A signal tracer can be easily improvised by using a cassette tape recorder (any tape recorder will do), a capacitor, and an earphone (or loudspeaker), connected as shown in the diagrams. Use the "monitor" switch to hear the output, or connect a loudspeaker or earphones, as shown. Connect the input to the auxiliary jack if tracing high level signals, and to the microphone jack if tracing low level signals.

Switch the recorder to the *record* mode to trace signals. It may be necessary to defeat the "erase protect" sensing lever in cassette recorders by pressing on it before pushing down on the *record* button. Otherwise, operate the recorder with a cassette in place.

**How It's Done.** Probing with the capacitor lead at the collector and base of each transistor in a circuit, in turn, allows the signal to be traced through the circuit; and faults, such as a dead stage, can be found in a few minutes.

If the amplitude of the input signal is too high, simply connect an attenuator (Fig. 2) across the input terminals to the tracer, as shown, and adjust the potentiometer for correct volume.

While the circuit is useful for trac-

Fig. 1

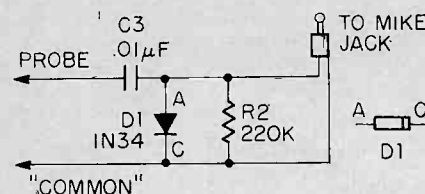


Fig. 2

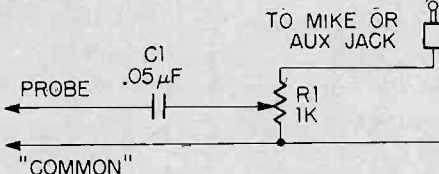
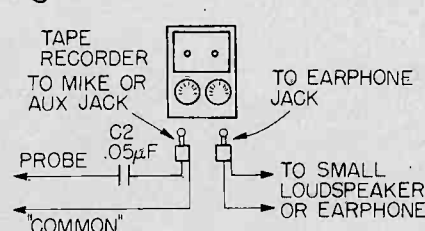


Fig. 3



by Hugh Gordon

ing the audio sections of an amplifier or receiver, you may also want to trace the radio frequency (RF) sections. This may be done by replacing the capacitor with a simple diode demodulator probe, a sketch of which is shown in Fig. 3.

**Safety First.** One good guide by which you should govern yourself when pattering about an apparently defective TV set, is not to perform any adjustment, poking, prying, snooping, cleaning, etc., that you would not permit a six-year-old child to do. After all, why is a child's life dearer than yours when TV service technicians are available to do the task efficiently and safely?

### PARTS LIST FOR A SIGNAL TRACER

- C1, C2—0.05-uF disc capacitor
- C3—0.01-uF disc capacitor
- D1—1N34, general purpose germanium diode
- R1—1000-ohm potentiometer, any available type
- R2—220,000-ohm, ½-watt resistor



# Build the REAL THING – Yourself!

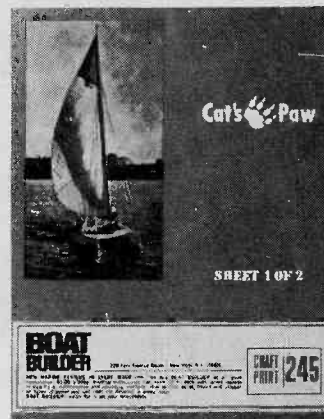
## Get top mileage from your own craft skills



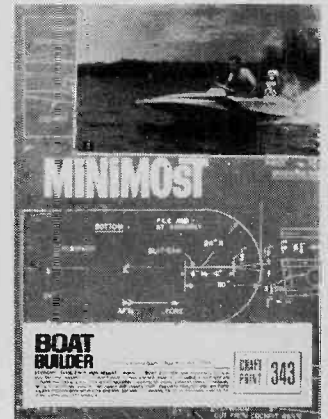
367. ROBIN is a versatile skiff that can be used for hunting or fishing, as a yacht club tender, or a work boat. It is rugged, yet its plywood construction makes it easy to build; no special jig or tools are needed. It can take a motor of 7-10 hp. L.O.A., 12'; beam, 5'1". \$5.00



75. KINGFISHER is a modern version of the Scandinavian pram developed hundreds of years ago. It rows easily, sails well, and propels nicely with a small outboard motor. Its 90 lb. weight and small size make it ideal to carry; construction is plywood. L.O.A., 9'; beam, 4'. \$5.00

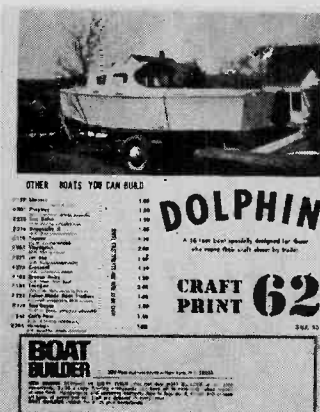


245. CAT'S PAW catamaran provides a stable base for a lot of sail area to make for fast sailing. And she's easy to build because of her straight-sided hulls, flat sheer, and straight bow and stern. It's an ideal boat in which to learn sailing. L.O.A., 12', beam, 6'2"; sail area, 85 sq. ft. \$6.00

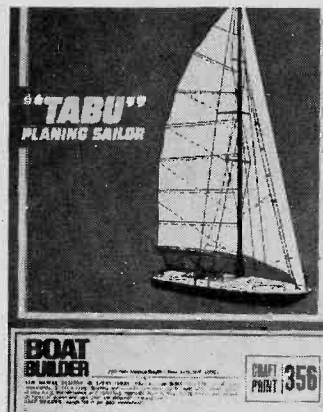


343. MINIMOST is an 8' outboard sports hydro you can build in just 15 hours, and at a cost of less than \$25 for materials. Its advanced underhull design makes speeds in the 30 mph range possible with a 10 hp motor. L.O.A., 8'. \$5.00  
Full-size pattern set 344 \$15.00

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62. DOLPHIN is small and light enough to be transported anywhere by trailer, yet it will accommodate two persons for extended cruising or a party of four on day trips. Plywood is used throughout, and the hull is designed to get the most from modest power. L.O.A., 16'; beam, 5'9". \$5.00



356. TABU gets up on plane, just like an outboard, to provide speeds up to four times higher than those possible with a conventional hull of the same size. Hull is of plywood, covered with resin and Dynel cloth. L.O.A., 16'; beam, 4'8"; draft, centerboard down, 2'6"; sail area, 165 sq. ft. \$5.00



371. JAMAICAN is a sailing surfboard of unique construction. Fiberglass and Dynel cloth are stretched and stapled in place over a wooden framework, then resin is applied. No special building jigs or forms are needed. Foamed-in-place polyurethane adds stiffness. L.O.A., 12'; beam, 3'. \$5.00



36. CHUM is a speedy little runabout that can be built as a single cockpit or double cockpit model. Use a light-weight engine of no more than 100 hp for top performance. Construction is of marine plywood over hardwood frames. Decks are of mahogany-faced plywood. L.O.A., 15'6". \$5.00

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# New Products

## Mobile PA Amplifier

Get ready for electioneering this fall with the new Realistic MPA-10 solid-state 10-watt mobile public address amplifier designed for 12-volt operation in cars, or anywhere that an AC power source is not available. The MPA-10 is only 1½ x 4½ x 6½-in. for easy mounting in or under dash, in a glove compartment, under a seat or in any convenient location. Comes with a ruggedly designed dynamic mike and hanger for clipping it to the side of the unit. Separate microphone and auxiliary input jacks allow you to connect a tuner, ceramic phono or tape player to the amplifier with push-button selection of either or both for paging over music.

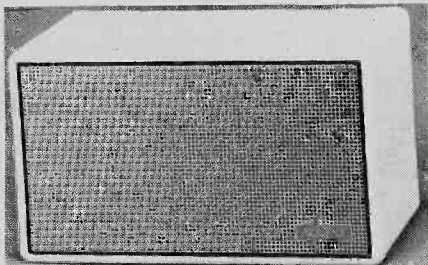


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A tone control allows adjustment for best tonal quality of sound. Response is given as 200 to 10,000 Hz at full power. Rated 10 watts rms at 8 ohms. The Realistic MPA-10 mobile PA amplifier is priced at \$39.95 complete with microphone and mounting hardware. Realistic products are available exclusively from more than 3,000 Radio Shack stores and authorized sales centers in all 50 states and Canada.

## Bookshelf Bargain

The Advent Model 400 loudspeaker is a miniaturized acoustic suspension speaker system housed in a reinforced polystyrene cabinet measuring just 6½ by 11 by 6-in. deep. The cabinet is a warm white color with a silver gray metal grille. Impedance is 8 ohms, and the Model 400 loudspeaker requires only 4 to 6 watts of power for ample levels in most small to medium size rooms. The suggested retail price is \$32.00. The single acoustic-suspension driver used in the Model 400 loudspeaker has a cone area, excursion capability, and magnetic structure sufficient to provide solid bass



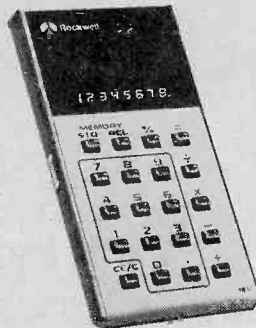
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at surprisingly high levels. At the same time, the driver's cone is small enough to provide extended and well-dispersed

treble response. For more information, write to Advent Corporation, 195 Albany Street, Cambridge, MA 02139.

## Memory and Percent

Rockwell's new 18R Memory-Percent calculator, priced at under \$20, has a



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two-key store/recall memory and percent key for automatic add-on and discount. Additional features of the calculator include: automatic repeat, automatic constant, chain calculations, floating decimal, 8-digit display, floating negative indicator, dual clear entry/clear key, automatic underflow, automatic leading and trailing zero suppression, and algebraic logic. The compact, hand-held unit has a manufacturer's suggested retail price of only \$19.88. Available at retail and department stores in North America. For more info, write to Rockwell International, Microelectronic Product Division, 3310 Miraloma Avenue, Anaheim, CA 92803.

## Baby-Sitter

Busy young mothers can call on a new Fanon electronic device to "baby-



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sit" for them as they go about their daily routine in the house or yard. Called the Echo Baby-Com, the transistorized unit is actually a little radio transmitter that "hears" baby's sounds and broadcasts them through any AM radio, portable or console, within range. The Baby-Com operates on any unused spot on the radio dial between 1250 and 1600 kHz you select. Baby-Com can also help shut-ins confined to their bed or sickroom to communicate with family or neighbors, and can be used to monitor remote areas for safety and protection. Echo Baby-Com comes with AC power supply, tuning wand for frequency adjustment and a built-in 3-meter long antenna. Controls include on/off, sensitivity and frequency adjustment. For complete details, write to Fanon/Courier, 990 South Fair Oaks Avenue, Pasadena, CA 91105.

## Carry the Torch

A UL listed propane Blow Torch Kit (UL 125P) in a newly-designed red polypropylene storage and carrying case has been offered by Bernzomatic. The compact kit contains a standard 14.1 ounce propane fuel cylinder, blow torch burner unit, soldering tip, utility burner, flame spreader, and spark lighter, plus case.



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The solid brass burner unit is equipped with a gas filter to assure clog-free operation. A must tool for heavy soldering. Bernzomatic is sold nationally at hardware and tool outlets and department stores.

## Super Tool Kit

A complete Vaco tool kit in a pouch offers the convenience of twenty of the most often used tools in a versatile roll up pouch. The Super Kit contains a standard and a stubby type heavy duty handle with snap-in interchangeable screw and nut driver blades, reamer and extension plus two pliers and an adjustable wrench. The screwdriver blades are 3/16-in. and ¼-in. slotted and No. 1 Phillips types. The twelve nut driver blades range in size from 3/16-in. to ½-in. including three stubby models. The reamer has a 5-in. body tapered from ½-in. in diameter to a point. The extension blade adds an additional 7-in. of

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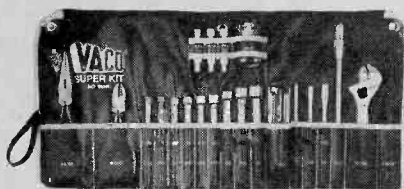
YES! Please send, without cost or obligation, my get-acquainted copy of ELEMENTARY ELECTRONICS. If I find it is everything you say it is, bill me for a year's subscription (5 additional issues, for a total of 6 in all) at just \$3.49. If I don't wish to subscribe, I will write "Cancel" across your bill, return it, and that will end the matter. Either way, the complimentary copy is mine to keep.

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SEND NO MONEY!**



# New Products



CIRCLE 29 ON READER SERVICE COUPON

working length to all of the nut driver and screwdriver components. All of the blades will fit into either the standard or the stubby handles. The kit also contains a 6-in. long needle nose plier with the wire cutter, a 5-in. diagonal wire cutter and a 6¼-in. adjustable wrench. The Vaco Super Kit measures 19½-in. high. The blue pouch with yellow trim is made from top grade, durable vinyl. Pockets and dividers are double stitched. A matching blue dust cover keeps all components clean. The kit can be mounted on a wall or pegboard through brass eyelets, or it can be rolled up for convenient, compact storage in a drawer or a tool kit. Priced to sell at hardware and tool outlets nationwide.

## Linear Motion Sound

Sansui's new Model LM-110 LM (Linear Motion) loudspeaker system has a number of features that help improve transient response and increase efficiency at the high-frequency end of the audio spectrum. The LM tweeter of the LM-110 uses a copper-clad aluminum wire voice coil to reduce moving mass. The dia-



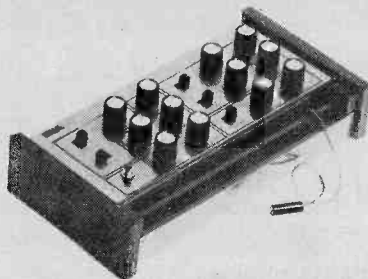
CIRCLE 30 ON READER SERVICE COUPON

phragm features a steeply convex phase equalizer to eliminate phase interference inside the cone. Since the LM tweeter is mounted on a separate baffle, it requires no back cap or cavity to block the strong and potentially damaging high pressure waves created by the woofer. The die-cast aluminum frame of the tweeter of the LM-110 is ported to correspond to the three openings in the multi-radiation baffle and so the tweeter diaphragm is free to move back and forth. It does so in linear response to the input signals with fast rise time. The LM-110 has a

peak power rating of 35 watts and an impedance of 8 ohms. Frequency range is 38 Hz to 20,000 Hz. The woofer is a 6½-in. cone type. Priced at \$249.95 the pair. For further information, contact Sansui Electronics Corp., 55-11 Queens Blvd., Woodside, NY 11377.

## Micro-Synthesizer Kit

If you think you could really get into synthesizers but are having trouble justifying the heavy cash outlay on pure speculation, the PAIA Gnome Micro-Synthesizer is designed just for you. The 10-by-6-by-2½-inch case houses an 8-octave voltage-controlled oscillator, linear controller, noise source, 6-octave voltage-controlled filter, voltage-controlled amplifier, and two separate envelope generators. "Normalized" controls completely



CIRCLE 31 ON READER SERVICE COUPON

eliminate patch-cords and permit a wide variety of sounds and effects. Tunes are played by moving a wiper probe over the surface of a resistance-element controller strip; it's said that even non-musicians can pick out tunes in the first few minutes. Battery-operated, the PAIA Gnome Micro-Synthesizer can be taken anywhere. And if you decide to take the next step up, PAIA also has modular synthesizer kits that let you expand your system just as you choose. The Gnome kit is \$48.95 from PAIA Electronics, Inc., Box 14359-EE, Oklahoma City, OK 73114.

## CB Headset with Mike

An improvement in CB communications is possible with the Model CB 1200 boom-mike/headset made by Telex. The



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CB 1200 headset is specifically designed to meet the safety, comfort, and performance requirements of the mobile or base station operator. It is a single side headset so the mobile operator never loses contact with his environment in traffic. The dynamic, foam-cushioned receiver is adjustable for maximum comfort and provides a much clearer intelligibility than is possible through conventional CB speakers. The fully adjustable boom microphone can be placed directly in front of the mouth for crisp transmissions or can be pushed up and out of the way when not in use. The built-in battery powered FET amplifier matches the mike to any CB unit. The long-life 1.4-volt mercury battery is inexpensive, readily available, and easy to replace. An in-line push-to-talk switch is supplied with clothing clip. It readily attaches to a shirt pocket or jacket lapel. The switch can be depressed momentarily for short transmissions or locks in for longer transmissions. The operator can then talk and yet keep both hands on the wheel or take notes. The ruggedly constructed CB 1200 headset can be worn over left or right ear. It's priced at \$59.95. For more information, contact Telex, 9600 Aldrich Avenue South, Minneapolis, MN 55420.

## Weather Alarm Radio

How would you like to have a receiver that warns the user of impending severe weather conditions automatically? Regency has one, designated model ACT-A-4W. The new 4-channel radio will carry a suggested retail price of \$125.00. The weather alarm monitor radio/scanner provides the listener with automatic weather information plus an additional three channels can be of particular value to emergency crews on VHF high band in the event of disaster. The extra three channels can be of particular value to such organizations as civil defense, police and fire departments, hospitals and others by permitting them to monitor each other's activities in an emergency situation. The alarm function is activated by the National Weather Service. A flip of a switch takes the radio off alarm status, putting it on programmable scan. The radios come complete with built-in



CIRCLE 35 ON READER SERVICE COUPON

# LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO's* 1976 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* 1976 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency broadcasts).

104. *Dynascan's* new *B & K* catalog features test equipment for industrial labs, schools, and TV servicing.

105. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

106. Get *Antenna Specialists'* catalog of latest mobile antennas, test equipment, wattmeters, accessories.

107. Want a deluxe CB base station? Then get the specs on *Tram's* super CB rigs.

108. Compact is the word for *Xcelite's* 9 different sets of midget screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

110. *Turner* has two booklets on their Signal Kicker antennas. They give specifications and prices on their variety of CB base and mobile line. Construction details help in your choice.

111. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

112. The *EDI (Electronic Distributors, Inc.)* catalog is updated 5 times a year. It has an index of manufacturers literally from A to X (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.

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. CBers, *GC Electronic's* 8-page catalog offers the latest in CB accessories. There are base and mobile mikes; phone plugs; adaptors and connectors; antenna switchers and matchers; TV1 filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1976 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

120. *Edmund Scientific's* new catalog contains over 4500 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* 1976 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

123. Get *Lafayette Radio's* "new look" 1976 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

127. There are *Avanti* antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

128. A new free catalog is available from *McGee Radio*. It contains electronic product bargains.

129. Semiconductor Supermart is a new 1976 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. There are over 350 kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

131. *E. F. Johnson* offers their CB 2-way radio catalog to help you when you make the American vacation scene. A selection guide to the features of the various messenger models will aid you as you go through the book.

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.

137. *Pace* communications equipment covers 2-way radios for business, industrial and CB operations. Marine radiotelephones and scanning receivers are also in this 18-p. book.

138. *Shakespeare's* new pocket-size catalog lists and describes their full line of fiberglass CB antennas, mounts and accessories offered in 1976.

142. *Royce Electronics'* new full-color catalog updates information on their CB transceivers (base, mobile, handheld). It also describes new product lines—CB antennas and a VHF marine radiotelephone.

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 CBers 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.

150. Send for the free *NRI/McGraw Hill* 100-page color catalog detailing over 15 electronics courses. Courses cover TV-audio servicing, industrial and digital computer electronics, CB communications servicing, among others. G.I. Bill approved, courses are sold by mail.

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

153. *MFJ* offers a free catalog of amateur radio equipment—CW and SSB audio filters, electronic components, etc. Other lit. is free.

154. A government FCC License can help you qualify for a career in electronics. Send for information from *Cleveland Institute of Electronics*.

155. New for CBers from *Anixter-Mark* is a colorful 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Heliwhip.

156. Send for *Continental Specialties* new breadboarding prototest devices. They vary in prices from a mini-budget kit at \$19.95. Featured is the new logic monitor, giving information on what it does, how it works, and how to use it.

**Budget Electronics** **1976 Edition**  
**Box 886, Ansonia Station**  
**New York, N.Y. 10003** **Not valid after March 4, 1976**

Please arrange to have the literature whose numbers I have circled below sent to me as soon as possible. I am enclosing 50¢ for each group of 5 to cover handling. (No stamps, please.) Allow 4-6 weeks for delivery.

Indicate total number of booklets requested.

101	102	103	104	105	106	107	108	110	111	112	113
115	116	117	118	119	120	121	122	123	127	128	129
130	131	132	133	134	135	137	138	142	144	145	150
152	153	154	155	156							

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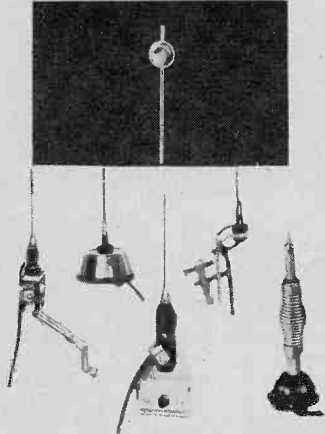
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

# New Products

speaker and detachable telescope antenna. Get the facts direct from Regency Electronics, Inc., 7707 Records Street, Indianapolis, IN 46226.

## Range Rider

Here's a new line of center-loaded CB antennas which offer unique performance advantages. Nicknamed "Range Riders",

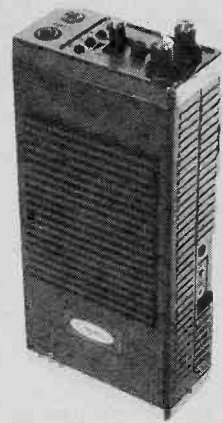


CIRCLE 36 ON READER SERVICE COUPON

all models in this Antenna Specialists line have special tuning tips which allow adjustment without the need for cut-and-try antenna trimming. The "static ball" tuning tip acts electrically as a capacity hat and can be moved up and down on the active element to achieve resonance and optimum performance. The new Range Rider line also features a completely waterproof center-loaded coil assembly. Included in the new Range Rider line are models for a wide variety of applications, including dual mirror mount types for heavy duty trucks and the A/S Quick Grip mount for permanent no-holes installations on passenger car trunk lids. All models are supplied complete with coaxial line and connectors plus phasing harnesses when required. Details on the new Range Rider line are available by contacting The Antenna Specialists Company, 12435 Euclid Avenue, Cleveland, Ohio 44106.

## High and Low Band

Cop-Scan VHFHL is a new Fanon/Courier dual band 4-channel portable FM monitor receiver for public safety, weather or other broadcasts on low band VHF (25-54 MHz) or high band VHF (146-175 MHz). The new Courier design uses dual crystal sockets to permit any channel to be assigned to either high band or low band use. All Cop-Scan units exhibit superior protection against intermodulation



CIRCLE 33 ON READER SERVICE COUPON

and feature superior selectivity and sensitivity with excellent adjacent channel rejection characteristics. Cop-Scan VHFHL utilizes dual conversion super-heterodyne circuitry with both high frequency crystal filter and ceramic IF filter. A screw mounted flexible antenna is provided as standard equipment and the unit comes equipped with provision for earplug, 6-volt power supply, and external battery charger operation if an optional nickel-cadmium package is employed. Priced at \$134.95. Get additional information by writing to Fanon/Courier Corp., 990 South Fair Oaks Avenue, Pasadena, CA 91105.

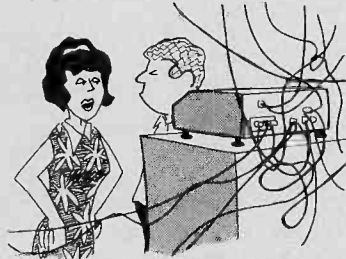
# Quad Conversions

by Jack Schmidt

LOANS



"I can't help it . . . it draws more power than I thought it would . . ."



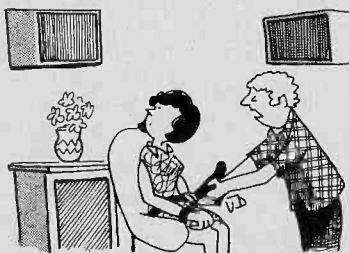
"Is that the best you can do with the wiring?"



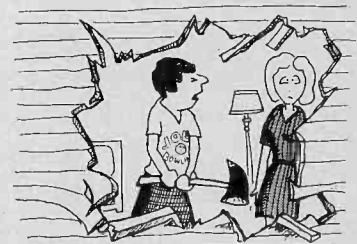
" . . . and then I'll install four 15-inch woofers with 36-ounce dual-diameter magnets, six 8-inch lower midrange speakers with ceramic magnets, and for tweeters . . ."



"OK . . . so you designed a quadraphonic headset . . . let's see you wear it!"



" . . . got to be sure you're firmly strapped in before you hear this!"



"I have to move this wall back to place the new speakers!"



# ELECTRONICS INFORMATION CENTER

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At no cost to you the Editor will have information and literature about products and services advertised in this issue sent to you at no cost!

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- Print or type your name and address on the coupon.
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1976 Edition

Void after March 4, 1976

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We would like to know about you. Please help us by placing an "X" in the appropriate boxes. • Do you own a CB transceiver? <sup>76</sup>  Yes <sup>77</sup>  No • If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. <sup>78</sup>  Base Station <sup>79</sup>  Mobile Unit <sup>80</sup>  Portable • Do you use CB in your work? <sup>81</sup>  Yes <sup>82</sup>  No

Name (print clearly) \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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Name (print clearly) \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

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

# The whole neighborhood wondered what Frank Mallon was up to in his workshop.

Word had it he was up to something mighty peculiar. And when he didn't show up for bowling practice one Wednesday night, the Wabash Cannonballs (that was the name of his neighborhood team) began to wonder, too.

So it was that a bunch of the boys decided to pay their "star" a visit, and talk him out of his workshop and back into action.

It didn't happen that way, though.

Matter of fact, it was Frank Mallon who talked the Wabash Cannonballs out of their bowling night and down into his workshop. What was it... what could be exciting enough to keep a bunch of ten-pin tigers from their favorite pastime? One of the most fascinating learn-at-home programs in the world, that's what!

**Actually build and experiment with the new generation color TV in Bell & Howell Schools' fascinating learn-at-home program. It will help you develop new occupational skills as an electronics troubleshooter.**

You'll set up your own electronics laboratory to learn first-hand, the technology behind such innovations as digital-display wrist-watches and tiny pocket calculators.

In fact, as part of the program, you'll actually build and experiment with a 25" diagonal color TV incorporating digital features.

But most important of all will be the new skills you'll develop all along the way... the kind of skills that could lead you in exciting new directions. While we cannot offer assurance of income opportunities, once you've completed the program you can use your training:

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

**Go exploring at home, in your spare time. No traveling to class. No lectures. No one looking over your shoulder.**

Bell & Howell Schools wants to introduce you to the modern way to learn. It means you'll be able to develop new skills in your own home—on whatever days and hours you choose. So you don't have to give up your present job or paycheck just because you want to learn new occupational skills.

What's more, we believe that when you're exploring a field as fascinating as electronics, reading about it is just not enough.

That's why you'll get lots of "hands on" experience with some of the most impressive electronic training tools you've ever seen.

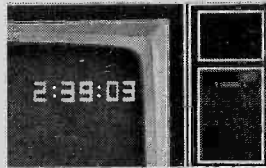
**No electronics background necessary.**

That's one of the advantages of this program. We start you off with the basics and help you work your way up, one step at a time. In fact, with your first lesson you receive a Lab Starter Kit to give you immediate working experience on equipment.

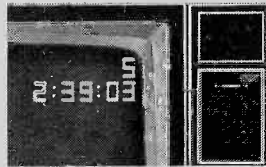
**You build and perform exciting experiments with Bell & Howell's Electro-Lab®. An exclusive electronics training system.**

First comes the design console. After you assemble it, you'll be able to set up and examine circuits without soldering.

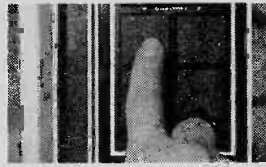
Next, you'll put together a digital multimeter. This instrument measures voltage, current and resistance, and displays its findings in big, clear numbers like on a digital clock.



On-screen digital clock



Channel numbers that flash on the screen



Automatic pre-set channel selector

Then comes the solid-state "triggered sweep" oscilloscope. An instrument similar in principle to the kind used in hospital operating rooms to monitor heartbeats. You'll use it to analyze the "heartbeats" of tiny integrated circuits. The "triggered sweep" feature locks in signals for easier observation.

**You'll build and work with Bell & Howell's new generation color TV... investigating digital features you've probably never seen before!**

This 25" diagonal color TV has digital features that are likely to appear on all TV's of the future.

As you build it, you'll probe into the technology behind all-electronic tuning. And into the digital circuitry of channel numbers that appear right on the screen! You'll also build in a remarkable on-the-screen digital clock that will flash the time in hours, minutes and seconds.

And you'll program a special automatic channel selector to skip over "dead" channels and go directly to the channels of your choice.

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

After building and experimenting with this TV, you'll be equipped with the kinds of skills that could put you ahead of the field in electronics know-how.

**We try to give more personal attention than other learn-at-home programs.**

1. Toll-free phone-in assistance. Should you ever run into a rough spot, we'll be there to help. While many schools make you mail in your questions, we have a toll-free line for questions that can't wait.

2. In-person "help sessions". These are held in 50 major cities at various times throughout the year, where you can talk shop with your instructors and fellow students.

So take a tip from Frank Mallon. Find out more about the first learn-at-home program that could stir up your neighborhood!

**Mail this postage-paid card today for more details!**

Taken for vocational purposes, this program is approved for Veterans' Benefits.

**If card has been removed, write:**

An Electronics Home Study School  
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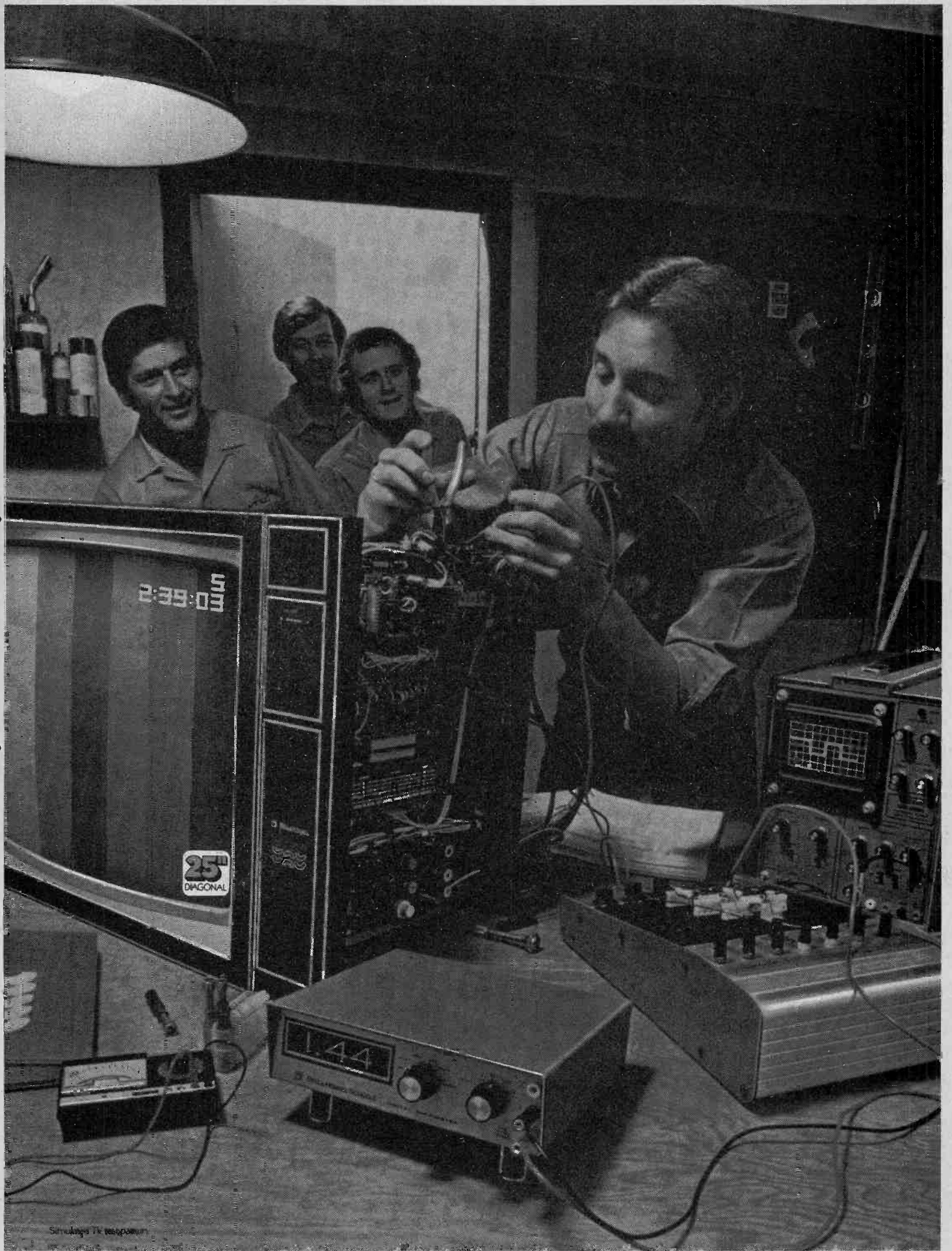
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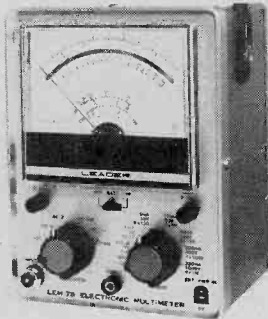
Синтез на телевизионни



# New Products

## Battery/AC FET Multimeter

A battery operated full-sized FET multimeter, Leader Model LEM-75, is both portable and AC operable. The LEM-75 offers a wide range of use for most every electronic application, employs a large 4½-in. mirror scale and has an input impedance of ten megohms. There are full scales of 0.3 V and 30 uA, AC and DC. Minimum sensitivities are 10 mV and



CIRCLE 37 ON READER SERVICE COUPON

1 uV on both AC and DC for checking and servicing extremely sensitive low voltage and low current parameters of the most advanced solid-state devices in use today. The LEM-75 is supplied with an AC adapter for field or workbench use. The unit, which sells for \$149.95, comes complete with a heavy duty test probe as well as an AC adapter. Get more information direct from Leader Instruments Corp., 151 Dupont Street, Plainview, NY 11803.

## RF Signal Generator

The Leader LSG-16 wide band signal generator is ideal for service, hobby, education, or industrial use. It features FET oscillator circuitry for high stability performance plus an accurately calibrated frequency dial. Frequency range is 100 kHz to 100 MHz, and up to 300



CIRCLE 38 ON READER SERVICE COUPON

MHz on harmonics. Internal modulation is 1 kHz at 30% or higher while external modulation is 50 Hz—20 kHz at less than 1 Vrms. The LSG-16 is capable of functioning as a marker-generator when used in conjunction with a sweep generator and will check and align RF and IF circuits in TV, FM, and communication-type receivers and transmitters. Use of the product is further ex-

tended by provisions to accommodate a 1-15 MHz crystal. The LSG-16 offers a 115/230 V, 50/60 Hz, 3 VA approx. power supply. It sells for \$109.95. Write to Leader at 151 Dupont Street, Plainview, NY 11803 and ask for their catalog.

## Hand-Held Scanners

Here are two new Bearcat hand-held scanners! Available in two models: a two-band version, covering both the low and high VHF bands; and a single-band



CIRCLE 39 ON READER SERVICE COUPON

model, covering UHF frequencies. Both Bearcat hand-holds feature four channel operation, including light-emitting diode channel indicators plus individual channel lockout switches. Also included is an auto/manual selector switch plus volume and squelch controls. The units come equipped with a telescoping antenna, but provision for an optional rubberized antenna has also been included. Weighing only 11 ounces, they operate on 4 AA batteries. Scan rate is 8 channels per second. Suggested retail price for both models is \$129.95. Crystals are not included. The Electra Company, a division of Masco Corporation of Indiana, is located at 300 South on East County Line Road, Cumberland, IN 46229. Write to them for more information.

## Mobile CB

Introducing the new 23 channel AM citizen 2-way radio, the Pace CB 144! Transmitting at full legal power output, the CB 144 is equipped with: noise



CIRCLE 27 ON READER SERVICE COUPON

blanker switch for suppressing impulse noise interference, automatic noise limiter switch, S/RF-meter for monitoring incoming signal strength and relative power output, RF gain control for receiver sensitivity adjustment, delta tune for compensating off-frequency transmitting of other party, to name a few. Technical features include a dual conversion receiver for optimum performance. Unit is engineered for positive or negative ground applications. Suggested retail price is \$179.95. Get all the facts from Pace Communications, 24049 So. Frampton Avenue, Harbor City, CA 90710.

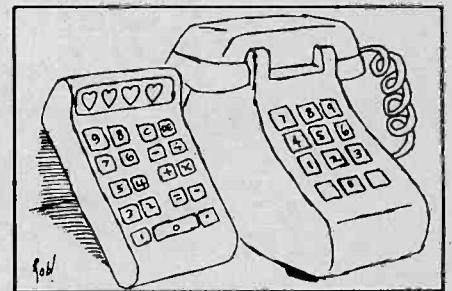
## Brazing Kit

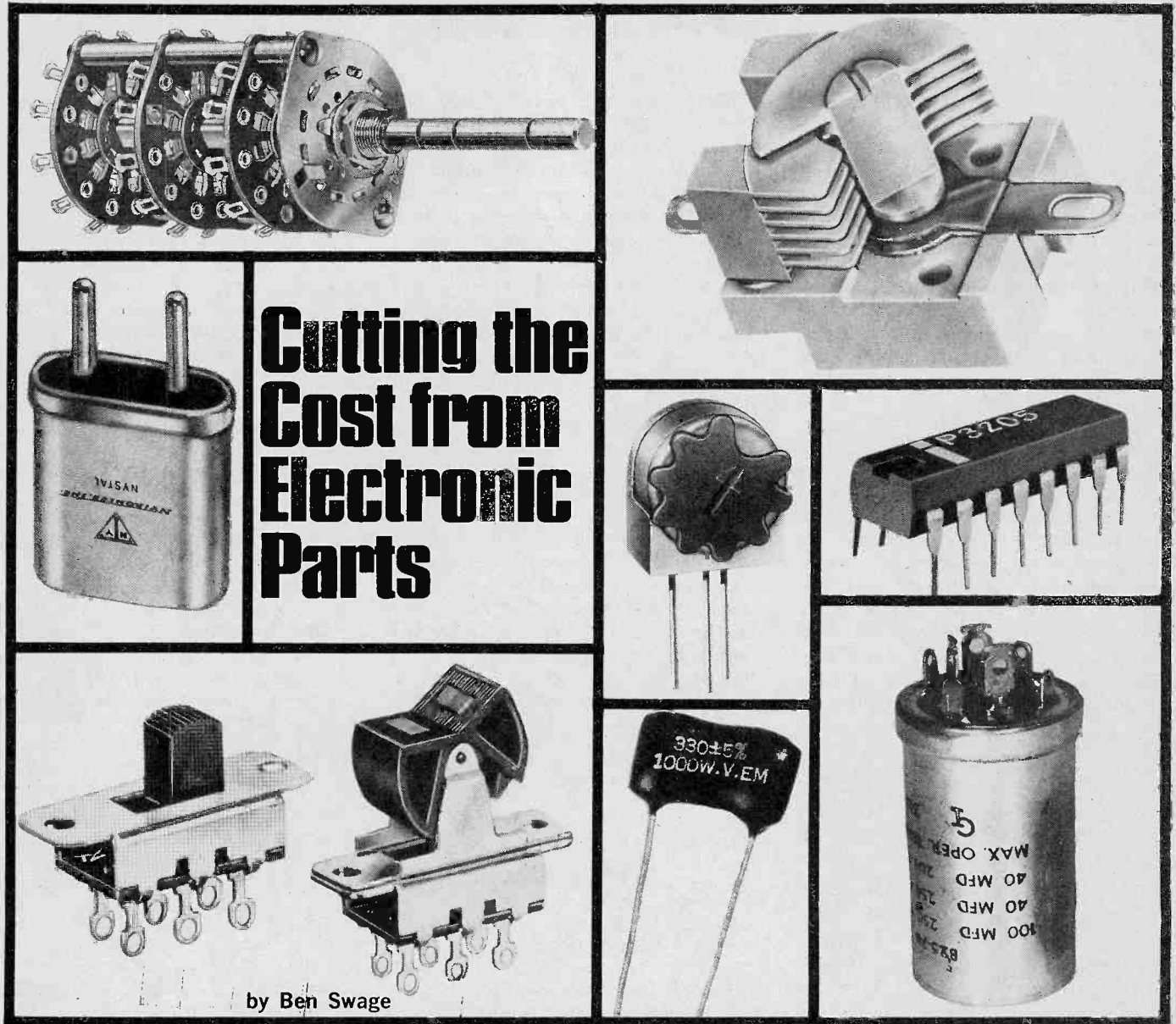
A 12-piece Super Torch Brazing Kit that can do most of the work of higher priced welding equipment has been introduced by Bernzomatic. The combination of Mapp gas and Bernzomatic's pressure-regulated Super Torch burner produces a flame of 3700 degrees Fahrenheit, 500 degrees hotter than that produced by



CIRCLE 40 ON READER SERVICE COUPON

most propane torches. The kit, MG3700, contains a 16-ounce Bernzomatic Mapp gas cylinder, the Super Torch pressure regulated burner unit with a brush type burner for broad heating plus a pencil flame burner for fine work. Other items included are six brazing rods—two copper phosphorous, two flux coated bronze, and two aluminum; spark lighter; cylinder stand; protective eye-glasses; and detailed brazing guide. In addition to brazing, silver soldering, and aluminum chassis welding, the Super Torch can be used for such jobs as flame hardening, metallizing, and heat treating. It may also be used for ordinary soft soldering and can produce finished results faster than with propane. The MG 3700 Super Torch Brazing Kit is available at discount, home centers, and hardware stores.





# Cutting the Cost from Electronic Parts

by Ben Swage

## The guy behind the parts counter will rip you off if you don't buy wisely!

IS IT WORTHWHILE spending \$50 to \$100 to build a project your next-door neighbor can build for \$10? No! Then consider this: We have a sister publication called 101 ELECTRONIC PROJECTS FOR UNDER \$15. We know every project in that publication can really be built for less than \$15 using readily available components, yet we have received letters from readers insisting they built certain projects "using the exact components called for" for total costs running between \$50 and \$100. Obviously, something is wrong with the way many hobbyists shop for parts.

If you regularly build projects there's no reason why you can't bring it in for as little as 20% of the list price of the components at your local parts distributor—and bear in mind that in today's marketplace the so-called "amateur net," or "user net" price is really full list. Just to show you what you're up against when it comes to buying parts let's digress for a moment and talk of a very popular blister-packaged semiconductor line. Originally, the blister cards had two prices: Printed on the card would be a list price, say \$1.59. Then there was a small tab with "user net price" of 95¢, a difference of 64 cents, or almost 33% of the true user price. Supposedly, the buyer was getting a discount from the list price. But many, many distributors got cute and wanted to squeeze every penny out of the sale, so they removed the net price tab, and the buyer pays the full list price—a price originally intended to be imaginary; no one believed anyone would pay the list price.

(Continued on next page)

## CUTTING COSTS

Let's digress one more time so you get the full flavor of what you're up against; and then we'll show you how to save *big* dollars on every project. A UL-approved U-ground plug (the standard three wire electrical 110-volt plug used for household and consumer equipments) sells for well under a dollar in *full list price* hardware stores; generally the price is 89 cents. Private-label packed for a discount store the plug might run from 69 cents to 99 cents. This very same plug, blister packaged under a nationally known electronic brand name, sells in "electronic part stores" for \$1.69.

You can get big savings by simply keeping in mind you're not building projects for the military, nor a NASA shot at Mars. Unless a component used in a project is directly specified as "do not substitute," as a general rule just about any experimenter grade component will work well. For example, you can pay as high as \$1 (or more) for a low-noise metalized resistor, yet most projects work just as well with a run-of-the-mill 3-cent carbon 1/2 watt resistor. Similarly, you can pay two or

three dollars for a tantalum capacitor to be used in a circuit that works perfectly well with a 29-cent electrolytic. Even when you need precision value components there's a way to get them for pennies on the dollar.

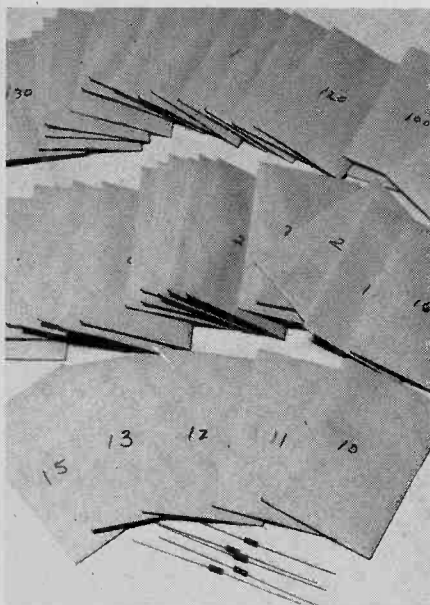
**Start Looking.** The first place you can save money is with a well stocked "junk box," for anything you have in stock is a 100% savings. Any project or experimental device you no longer use or need should be dismantled for the usable parts. Now, we don't mean a complete salvage job for nothing is as dull, or as likely to turn you off, as trying to salvage resistors and capacitors with half-inch leads; there is simply no logic to spending an entire evening trying to salvage a few dollars worth of resistors that will probably wind up never being used because of short leads. Go instead for the big, expensive hardware.

For example, filament type power transformers (perfect for solid state projects) can set you back from almost \$2 to well over \$5. Any filament or power transformer—even with extra short-leads—is worth saving. And don't overlook switches: Last year's \$1 subminiature toggle switch goes for at least \$1.75 this year; in some places as high as \$2.25. A potentiometer? That's worth at

least a buck, or more if it has a switch. A tuning capacitor? You're talking big money; that subminiature you used to use in shortwave boosters that cost 49¢ now goes for \$1.39 and up, while that "surplus" tuning capacitor you bought for under 50¢ will set you back almost \$2.50 if you buy it for a new project. Phono jacks used to be under 10¢; the same jacks, now in a fancy blister package, are about 25¢ each; yet phono and phone jacks are easy to salvage.

Get the idea? Don't bog down salvaging the nickle and dime stuff; you'll get tired and quit. Go right for the big, expensive items and squirrel them away for the next project. And don't forget the cabinet itself, particularly since a \$1.49 minibox sells for up to \$5 in some stores. Save the good half. For example, suppose you've made a project in the main section of a 3 x 4 x 5-inch cabinet. Save the cover, as it has no holes. The next 3 x 4 x 5-inch project you salvage might have been assembled on the cover, and you can salvage the base. Now you have one base and one cover: a complete cabinet. Again, *big* money saved rather than nickles and dimes.

**The Small Stuff.** Naturally, you will never have enough parts in the junk box to cover everything. The first place you're likely to run short is in resistors



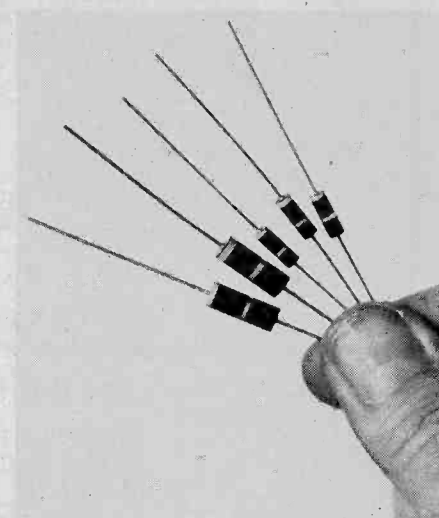
Real savings and convenience come in a resistor "proto-kit." Averaging out to less than 4¢ apiece, this 1/4-watt, 5%-tolerance kit has ten resistors of every standard 5% value from 10 ohms to 1 megohm. Part of the cost goes into the packaging that separates each value in a small envelope that fits a standard kitchen drawer cutlery tray—making for convenient storage and value selection. Smaller kits are also available in standard 10%-tolerance values at proportional reduction in cost.



An example of surplus buying. Top axial lead capacitor costs 49¢ in a blister pack. Lower capacitor of same value with single-ended leads (printed circuit) was purchased from a surplus dealer for 5¢. Isn't it worth 42¢ just to re-arrange a couple of circuit leads?

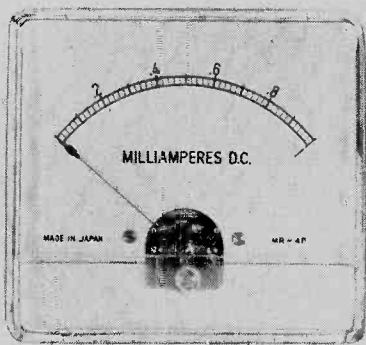


What do you do with salvaged and excess resistors? File them! Here, the author files resistors in a four-shelf bin he's used for years. If you can't find one, look in 5- & 10¢ stores for plastic bins used to file buttons and small parts. Surplus resistors are never used if you can find them quickly.

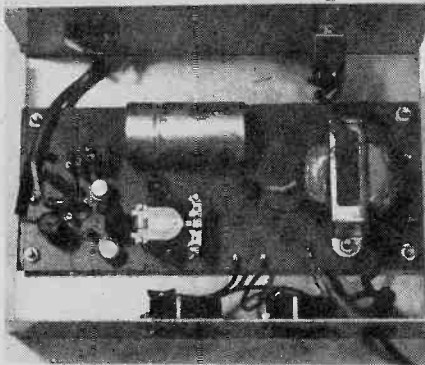


If you don't mind separating the resistors yourself the small "100 for \$..." resistor kits are the best buy, and you might wind up with precision lo-noise type resistors; but in general you get standard resistors. As an example of what you get and save, the resistor on top is 10,000 ohms, 1/2 watt, 10% and cost 15¢ at the local "parts distributor." The resistor on bottom looks the same, and it is, but it cost only 3¢ in a "100 for \$3" kit. But make certain the kit has standard values in decent proportions. Too often, the "100 for..." kits have oddball values in quantity, like 30 pieces of 1 megohm, and 1 meg isn't too common in solid state projects.

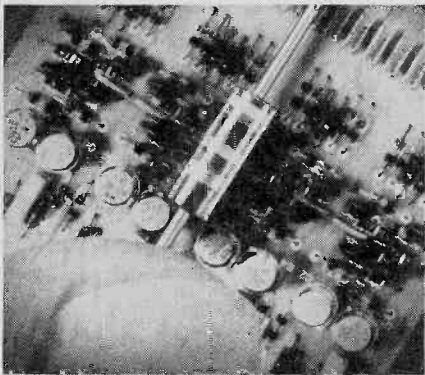




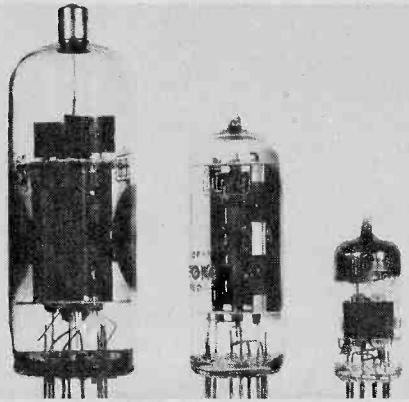
Considering the out-of-sight price of meters, never discard a meter. In fact, the meter shown in the photo was used in four projects and is currently being worked into a new project. Meters are hard to come by, so look to junk electronic items where meters are a part of the unit.



Those old projects are a gold mine. If you try to salvage every resistor and capacitor you'll probably get bored and scrap the whole bit. Go for the big, expensive hardware: AC sockets, transformer, relay, switch, and high- $\mu$ F capacitor. The rest is scrapped. Just these six items alone represent \$18.89 at current prices and going higher every day. Would you believe this entire project including cabinet cost under \$10 just a few years ago—using "all new" components?



Where did I find thee? "Why on an old printed circuit board along with eight 2N1305 transistors, 14 signal diodes, 14 disc capacitors and a bunch of other resistors like me in size but of different values," said the color-coded 5%-tolerance resistor. This surplus bargain was picked up locally by the author for only one dollar.



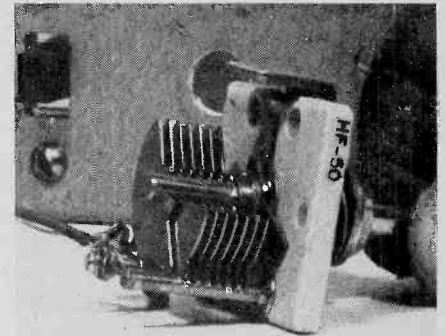
Don't quit on vacuum tubes. There are many worthwhile projects you can build from old magazine articles (even some new ones) that use vacuum tubes. In many cases you can salvage vacuum tubes from old projects, radios, hi-fi equipment and television sets at no cost. Wipe them clean with a damp cloth. If you can't read the tube-type markings, breathe on the glass, it may bring up the lettering.

and capacitors. A resistor sells in most stores for 15¢ each ( $\frac{1}{2}$  watt, 10% variety). If your project calls for, say, 10 resistors, you've got a buck-and-a-half right in the pot and you haven't even started construction. But if you buy in *bulk* you knock the cost down to 3¢ or less per resistor.

Almost all the major distributors, such as Radio Shack and Lafayette, offer popular value assortments of 100 resistors for about \$3. You generally get sufficient "standard" values to meet most needs, or you can parallel and/or series connect a few resistors for any desired value. But, face it, there will be times when you run out of values and will have to pay premium prices for one or two pieces. You can, however, if you're an active experimenter, get one of the Mouser Electronics proto-kits: 10 each of every 10% standard value from 1 ohm to 22 megohms (890 resistors) for \$42.95, or you can buy in bulk at about  $2\frac{1}{2}$ ¢ per resistor in quantities of 100. For the active experimenter a single proto-kit is good for years of construction.

While we're on the subject of Mouser Electronics, they sell electrolytic capacitors in single quantities for about 30% of what they cost in the local stores. Only the "surplus" dealers can beat their prices. A Mouser catalog is a must have for any builder, though Mouser has a minimum order of \$20 total. But their catalog is so packed with top quality components at rock-bottom prices that the active hobbyist or experimenter can easily meet the minimum figure.

**Solid Talk.** Before moving on to the subject of "surplus" dealers, where you



When salvaging old projects keep your eyes open for parts you can't get anymore, even if you can't think of a need for them now. A few years ago this capacitor was standard stock in just about any "radio parts store." If you needed one today you'd find it easier to locate the Holy Grail or a golden-egg-laying goose. And you'd pay what a golden egg is worth. This type of salvage is literally worth its weight in gold. Save it all.

can get outstanding quality components for next to nothing—or lose your shirt—let's talk about solid state devices such as transistors, diodes, popular ICs, SCRs, etc. This is the type of material which might be classed as *non-digital*—material for amplifiers, power supplies, control circuits, etc. While it is quite true that there are many tens of thousands of transistor and diode types, it is also true that for general hobbyist and experimenter applications several hundred types or even several thousand types can be substituted for by one single unit. The reason for this is that many solid state devices are upgraded as they come off the production line. For example, from one production run of transistors everything that comes out with a gain of 50 might be designated 2NXXX1, while others with a gain of 100 to 300 might be 2NXXX2 while still others with a gain of 300 to 500 might be 2NXXX3. This is how many transistor "types" were originally "developed." Then again, many solid state devices were originally designed for specific applications. For example, the 2N4888 is a general-purpose high voltage transistor sought after by radio amateurs for use in transmitter keyers because it is a *silicon* PNP rated for use in 150-volt circuits and sells for about 50¢. (Keep this figure of 50¢ in mind.) There is absolutely no reason why this transistor cannot be used in any circuit of less than 150 volts, and in fact many other transistor types are similar in performance with the exception of the voltage rating.

Now finding a 2N4888—should you need one—is second only to the search for the Holy Grail. It is almost impos-

## CUTTING COSTS

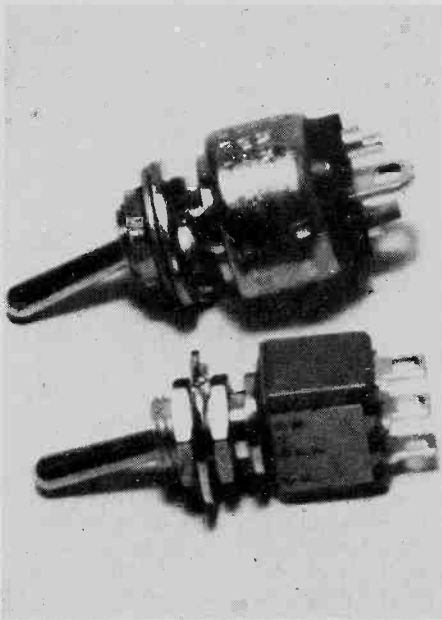
sible to locate any specific transistor type other than early experimenter types such as the 2N107 and 2N109 because there are just too many different devices for even the largest electronics dealer to stock. And this lack of stock applies equally to diodes, SCRs, ICs, etc.

But since performance specifications are so similar between devices, and because so many different types can be used in lower voltage circuits—for example, the popular 1N4005 rectifier diode replaces the 1N4001, 1N4002, 1N4003, and 1N4004, while the 1N4007 replaces all of these and a few more—it is possible to come up with a line of a hundred or so “general replacements” that will cover just about all popular, and some not-so-popular, solid state devices.

**Buck Grabbers.** Several large and a few smaller blister-packaged lines are available with so-called “general replacement devices,” and in most instances you will find a general replacement for the specific transistor, diode, or SCR you might want. But you pay heavily for this convenience. For example, the 2N4888 transistor previously mentioned, which is available for about 50¢, will cost you between \$3 and \$4 as a general replacement. Yet in most hobbyist circuits and projects you could replace the 2N4888 with a 2N5400 or a 2N5401, both costing less than one dollar, a fraction of the general replacement cost.

Let's look at another example: Poly-Paks will sell you the popular 1N4004 rectifier diode for 7½¢ (10 for 75¢); a general replacement for the 1N4004 from a nationally distributed line will cost you at least 45¢ apiece. If you needed a bridge rectifier, the four Poly-Paks diodes would cost you a total of 30¢. If you used general replacement diodes the rectifier would cost you at least \$1.80. Multiply this type of price differential by several times and you know why some hobbyists can build a project for less than \$10 while the guy next door spends \$25, \$50, or even \$100 for the same project.

**Surplus.** While it is true that you cannot run down to the average local electronic parts distributor and buy the exact solid state device called for, there are many, many “surplus” dealers specializing in just the type of devices you need. In most instances the “surplus” stock is first quality—generally an overrun, or excess purchase the dealer

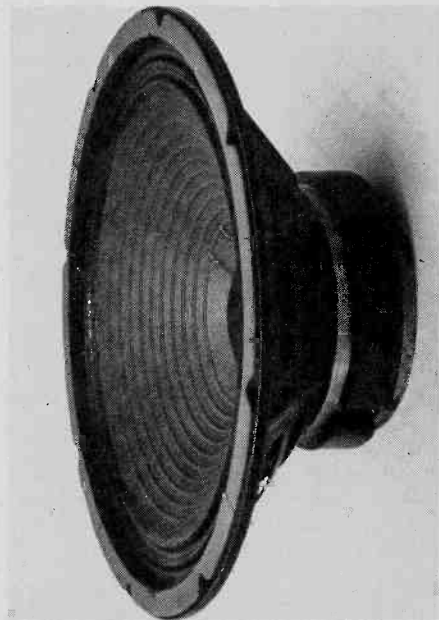


Thank heaven for surplus! The SPDT mini-switch at bottom came right off a peg-board rack for \$1.75. The SPDT mini-switch on top has the same contact ratings and was purchased new through a mail order surplus house at 10 for \$1, or 10¢ each. Maybe there would be a difference in performance on a NASA space shot, but not in a hobby project.

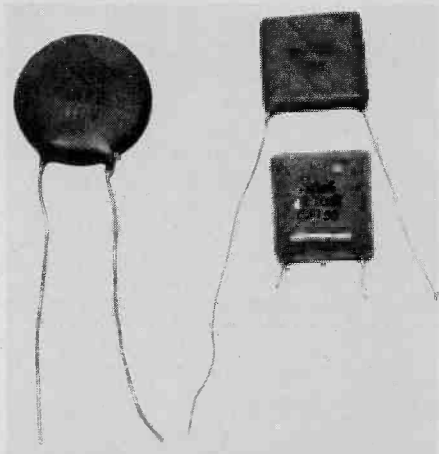
picked up at bulk rates. It makes no difference how he got the parts, he resells it to hobbyists at really rock-bottom prices. For example, you can get most “standard” 7400 series digital ICs from the surplus dealers for an average of 25¢ each. The same item from a blister-packaged job-rack might cost you over a dollar.

Then again, even if a surplus dealer doesn't have the exact part you need he will probably have a direct substitute—again at bargain prices. How do you know what to substitute? With the most important book in any hobbyist's library: the Howard W. Sams Transistor Substitution Guide. (There are many other guides but this is *the best*.) The guide tells you what transistors (and diodes) are direct substitutes, close substitutes, and even the closest “nationally distributed general replacements.” Guides are also available (from other sources) for IC substitutions (try National Semiconductor, Motorola, and RCA). It is more than likely that at least one of the surplus dealers will have the exact devices needed or a direct substitute; but just as you can't tell the players without a scorecard you can't tell the substitute from the specified part without a guide.

**Mentioning Names.** There are several surplus dealers, all with excellent reputations, that specialize almost entirely, or to a large extent, in solid state



Never throw out a loudspeaker—they cost too much! Salvage from old radios and television sets, even old car radios and CB sets. True, they go bad with time and dampness, but if you have a supply, a few should be serviceable. Fix small punctures and tears in the paper cone with nail polish. Store with cardboard over the face of the cone to protect it from accidental damage.

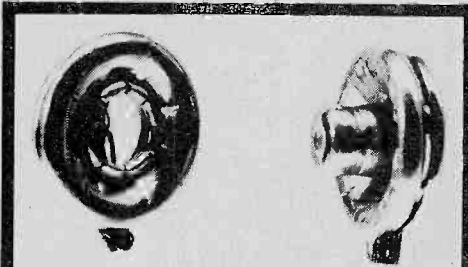


Using your head can save big money. A new 0.47 uF low voltage capacitor (left) costs 89¢. Two salvaged capacitors (right)—0.2 uF and 0.25 uF—connected in parallel equal 0.45 uF; close enough in value to 0.47 uF to substitute, and they cost you nothing. Or, the parallel capacitors might be new items you had in stock; remember, using what you have is also a savings.

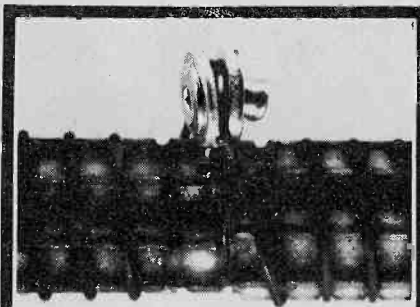
devices at low prices. Among the best known are Circuit Specialists Co., ADVA, James, RGS, Ancrona, and the aforementioned Poly-Paks. Several surplus dealers, as well as others such as John Meshna, Babylon, RGS and Selectronics, also specialize in surplus of just about anything—such as capacitors, po-

(Continued on page 101)

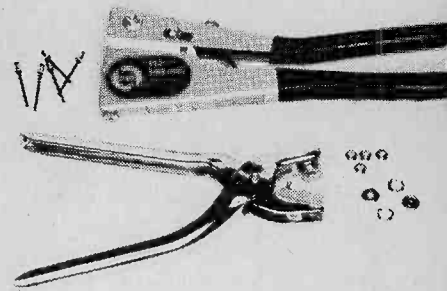
# Eyelet-Popping Connectors



**Hot-Wire 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.



**Take-Apart 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.

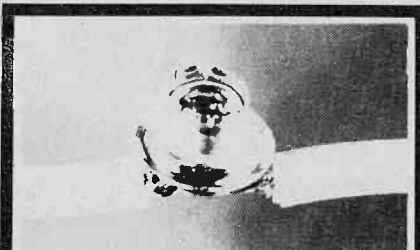


by Jorma Hyypia

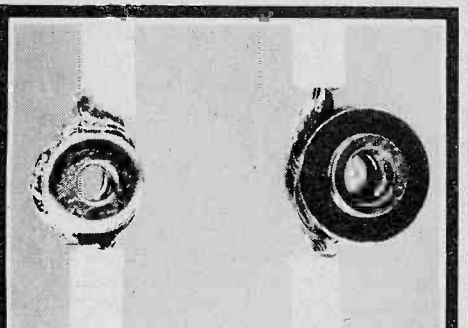
□ Here are several handy ways to use a "pop" rivet tool and an eyelet tool to make solderless connections when building electronic gadgets and when repairing home appliances. Obtain several sizes of rivets and a stock of washers that will slip neatly over the rivet shanks. If a rivet is too long for 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. Always check that the appliance or gadget you have fixed or assembled is safe to operate. Check carefully for shock hazards. Be sure insulation is sufficient.



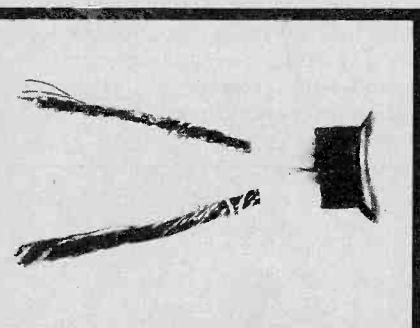
**Components Joiner.** Want to join several resistors, capacitors or other electronic components together in a jiffy? Just wrap each lead a full turn around the shank of an eyelet, and pinch the eyelet shut with the tool. This provides a good mechanical joining of the wires, but you can run in some solder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



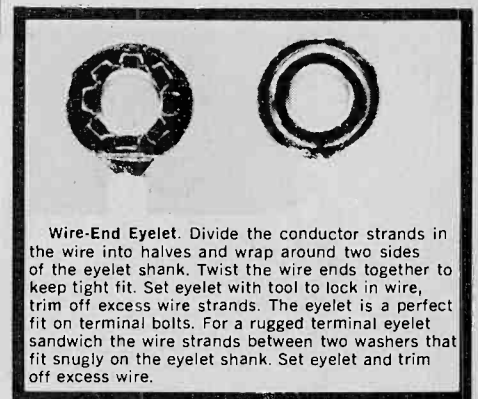
**Rivet-Eyelet Connector.** Insert the bared wire ends into an eyelet from the flange side, then add a  $\frac{1}{8}$ " x  $\frac{1}{8}$ " "pop" rivet from the same side. Set the rivet with the rivet tool. The wire ends are thus pinched between the rivet and inside of the eyelet for a tight fit. Note 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.



**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.



**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.



**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.



# CB on a Shoestring

How to get started in two-way communications on a one-way budget.

by Gerald Gardner

This go-go dancer feels much safer with a CB rig in her car. A flat tire in the sleazy part of town or on the pike can spell disaster for her and other defenseless motorists. Switch to channel 9 and press the push-to-talk button for road assistance. In emergencies a quick call could speed police or ambulance.

**B**ACK IN THE pioneer days of Citizens Band (CB) radio there was only one basic type of transceiver—it turned on and off, the volume could be adjusted, it had a squelch, and more often than not it operated on one, two, or three channels. Color it cheap.

Of course, those were the days when CB operators were as scarce as Eskimos in Ecuador; nobody knew about fancy refinements, state-of-the-art, and that sort of thing. The majority of CB manufacturers were hand-constructing a few dozen CB rigs per week to meet their needs.

I suppose that by now you've heard that the awkward child has grown up; CB radio has turned into the darling of the public, a 9-headed monster for the FCC, and one of the few industries which is still smiling (and often back-ordered) through the current industrial/economic "situation."

And, as you might have imagined, the equipment design, styling, refinements, and *prices* have come a long way up the pike since the old days. Specialized CB rigs are available for installation in cars, trucks, boats, and even motorcycles! To add spice to the mar-

ket, CB rigs with all sorts of exotic technical gizmos and developments now confront the CB shopper, things such as single-sideband (SSB), crystal synthesis, power-booster modulation, all channel operation, speech clipping, remote control, telephone handsets, tone alert, integrated circuits, light emitting diodes, receive preamplification, variable sensitivity, public-address systems, tone control, VOX, mechanical and ceramic filters, noise blankers, digital alarm clocks, desk mikes, fully metered functions, dual base/mobile power supplies, and lots of designer styling. Naturally,



Lafayette Radio's Micro-66 is a low-priced rig which offers 6-channel push-button operation. Another feature is slide-lever volume and squelch controls. And don't forget the "range boost" modulation circuit. Who said that low cost units are bare bones? This one goes for \$69.95, and a base station power supply is a \$22.95 option. For mobile operation the extra power supply isn't required. Crystals extra (\$2.25 per channel, 2 required per channel).

CIRCLE 12 ON READER SERVICE COUPON



CIRCLE 13 ON READER SERVICE COUPON

Midland's 13-854 is another contender in the low-cost market, weighing in at \$99.95, and that includes channel 9 crystals. The rig has a 6-channel capability and offers the deluxe bonus of a PA system built in. An external base station power supply would add about \$20 to its cost.

as hoped for by the manufacturers, sets containing combinations of these features are sensational sellers in the CB marketplace—some tipping the scales at the \$600 price mark!

**Why the Rip-Off?** What's happened is that, somewhere in the backwash and dust of all of this clamor, the poor soul who just wants to get on the air, no strain, no pain, has gotten the impression that unless there is an ability and willingness to unload about \$1300 on a base station (and there's still that mobile installation to think of too!), there is hardly any point in trying to get involved in CB radio, for certainly any installation which doesn't include a

\$600 rig, a monster \$350 directional beam and rotor perched atop a 50-foot \$175 to \$350 transmission tower and fed with 20¢-per-foot super-low-loss coaxial cable, will not put even a feeble signal across the neighborhood. *Not so!*

Back in the past, CBers forgot their humble roots, that they could operate quite effectively for most local communications purposes with a rather miniscule investment. They have forgotten that while all of the chrome and frills are spiffy to have (if you have the cash to invest), these extras are far from being absolutely necessary in order to fulfill CB's basis premise, that of being able to get a message from here

to somewhere else.

Yes, in the midst of the glitter and dazzle of space-age exotic technology, the consumer has managed to *disremember* that beneath the facade of knobs, meters, gadgets, and chrome of even the most spectacular deluxe CB rig there lurks (in one form or another, and by whatever fancy technical terms it may be described) a 5-watt transmitter and a 27-MHz receiver; and these same two components were part of a CB rig 15 years ago, and they are still part of even the most inexpensive CB gear today!

And while you can put as much as \$350 into a great-looking tower, you can still get your message from here to there without one—or with something a lot less costly which will accomplish the same purposes. You can, if you wish, spend \$350 on an antenna and rotor, but you can also send your signal out in all directions for about 5 percent of this cost.

And you can also get your signal to travel to the antenna without the deluxe accommodations of coax costing 20¢ per foot.

**Many Just Don't Know.** The fact of the matter is that CB is a consumer market, and the average CB consumer is not sufficiently hip to the ins and outs of CB radio in order to avoid overbuying, even without any coaxing from a high-pressure salesman. If a \$3000 Chevy is good, a \$6000 Buick is twice as good, right? So if a \$1300 CB installation is great, a \$650 installation is fair, and a \$325 installation is a joke, right? Wrong!

Inexpensive CB gear is still being produced, quietly and with far less hullabaloo than the stuff with the fancy trimmings. Let's see how a fully operational and effective CB station might be assembled on a shoestring. Let's see if each and every one of the frills is necessary to your installation, to your needs.

First, decide exactly what you want of your CB installation. Most often the CBER wishes to communicate between a single base station and one or more mobile units.

If this is what you have in mind, why do you need a set that operates on all 23 channels? To talk to your own mobile units takes only one channel, and possibly a secondary frequency in case the primary channel is noisy or busy for a long stretch. You would also want to be able to operate on channel 9, which might be used to summon help in the event the vehicle(s) is/are stuck. So let's forget about getting a 23-channel CB rig, because you can get by on about 3 channels.

Next, let's really think about the



Realistic (Radio Shack) TRC-9A is really tiny—so it not only saves money (it's \$59.95) but also space. Channels are selected by 3-position slide switch, and it comes equipped with crystals for operation on channel 9. To run it as a base station you can obtain a Realistic power supply for \$19.95. To get an idea of just how compact this set is, compare it to the microphone, which is palm-sized.

CIRCLE 14 ON READER SERVICE COUPON

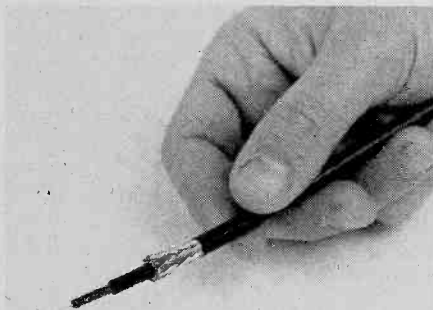
## CB ON A SHOESTRING

chrome trim and the wood-grain finish—pretty, but it doesn't make the old signal any louder, does it?

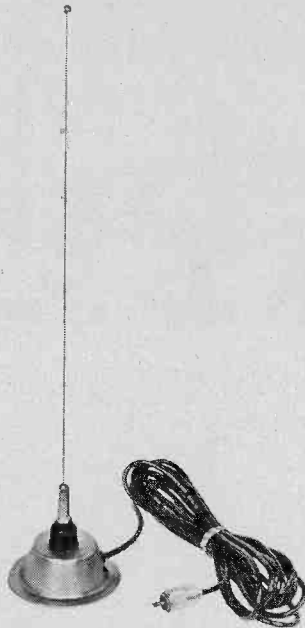
You get the idea: Start evaluating things like clocks, variable sensitivity, and other cost-adding features. How often will you use a public-address system, for instance? Start scratching these features from your list.

**What's Available.** Now, let's see what you might buy. You could go to Radio Shack and buy their TRC-9A rig, 3 channels and only \$59.95. Lafayette offers a Micro-66 which has 6 channels and costs only \$69.95! Yes—look through the catalogs—there's the Royce 1-509A (\$64.95), the Midland 13-854 (\$69.95), and all of the rest. Many manufacturers produce CB rigs for under \$70, and you'll be surprised to see that they aren't all bare-bones models; most seem to be rather nicely designed and several incorporate a few deluxe features.

**A Roof-Topper.** Now we get to the antenna, which you need to radiate your signal. If you absolutely *must* get the very last drizzle of signal into a remote corner of the county, you will probably require an expensive band-blaster running several hundred dollars. Want good general coverage? Well, don't overlook the old CB standby, the *ground plane* type antenna. There was a time when every CB base station used one, and you can still get them for about \$12.95 and it will let you communicate in all directions without the need of a rotor to turn it, and it will send out your signal for about as much distance you would need for normal local communications. And for mobile communications, save money by purchasing any inexpensive mobile antenna that catches your fancy.



Here's a length of coaxial cable—sharp shopping can mean the difference between spending 20¢ per foot or only 10¢ per foot. Regardless of impressive-sounding technical specs, the lower cost cable will do a dandy job at any CB installation.



Inexpensive mobile antenna? They're all so good it's hard to pick one type above the rest. This one has a magnetic base which grips to the roof of the car—and hangs on well past the national 55-mph speed limit. It's another money saver—it's cheap to buy (about \$19, depending on manufacturer), can't be stolen since you quickly remove it whenever you park, and you won't have to patch any antenna holes in the car when you go to sell it or trade it in.

Mobile antennas are all so well designed today that it would be hard to find a lemon at any price, even if you went looking for one.

If you've heard that to stretch your coverage you must put your base station antenna atop a tower, that is quite true. Now, maybe you can get adequate coverage with the antenna right on the roof of the building and you can avoid the whole question—for a base station antenna atop the roof (or chimney) of even a 2-story frame house will cover most suburban communities. A jazzy communications tower which will run your antenna up 50 feet will probably set you back \$175 to \$350. But here's a suggestion which can save you big cash: Check out the prices of telescoping TV masts. You can get a 50-footer for less than \$25, and it will hold up your ground plane with ease. And if you don't need quite that much height, there are all sorts of telescoping TV masts of lesser heights for lower prices.

You may also come to feel that the coaxial cable which feeds signals between the CB set and antenna is a vital link in your ability to effectively communicate, and, in actual fact, it is. Some CB operators go to hysterical ends to insure that not even the most miniscule

pinch of signal is lost in the process. Towards this end they purchase sophisticated low-loss cable which sets 'em back at least 20¢ per foot—a 50-foot run of the stuff costs \$10, plus the cost of the connector at each end. The amount of loss, however, that they would have suffered in 50 feet of less expensive type RG-58A/U coaxial cable would have been insignificant to the point of being practically undetectable in their most difficult communications. A 50-foot length of RG-58A/U cable would cost about \$3.70, and the two connectors 60¢ each—or you can buy the cable with the connectors already attached for \$6; and since putting the connectors onto the cable is a tricky soldering job for a novice, it's an affordable luxury you might wish to use to your advantage.

**The Bottom Line.** Now let's see where we stand—a CB rig for about \$65, a \$13 antenna atop a \$25 mast, connected together with \$6 worth of cable. Grand total, including a few extra dollars for miscellaneous hardware: about \$125 for a complete, effective, and versatile CB station—about 1/10th the cost of going the full route!

Maybe you'd like to think of it as a 90 percent discount, or a \$1200 rebate—for certainly you will have effective local coverage with this shoestring CB station. After all is said and done, what more did you really want in the first place?

The editors of BUDGET ELECTRONICS are providing readers with a free booklet from the Electronics Industries Association (EIA) about CB radio. If you would like a copy, just fill out the coupon, check the correct box, and send it in. And don't forget "Kathi's CB Notes" for straight info on how to get and fill out an FCC license application.

Kathi's CB Notes  
BUDGET ELECTRONICS  
229 Park Ave. South  
New York, N.Y. 10003

- Yes, I'd like to receive the EIA booklet about CB radio.
- I would also like to receive information about the specific CB products advertised in this issue.
- Be sure to include copy of "Kathi's CB Notes."

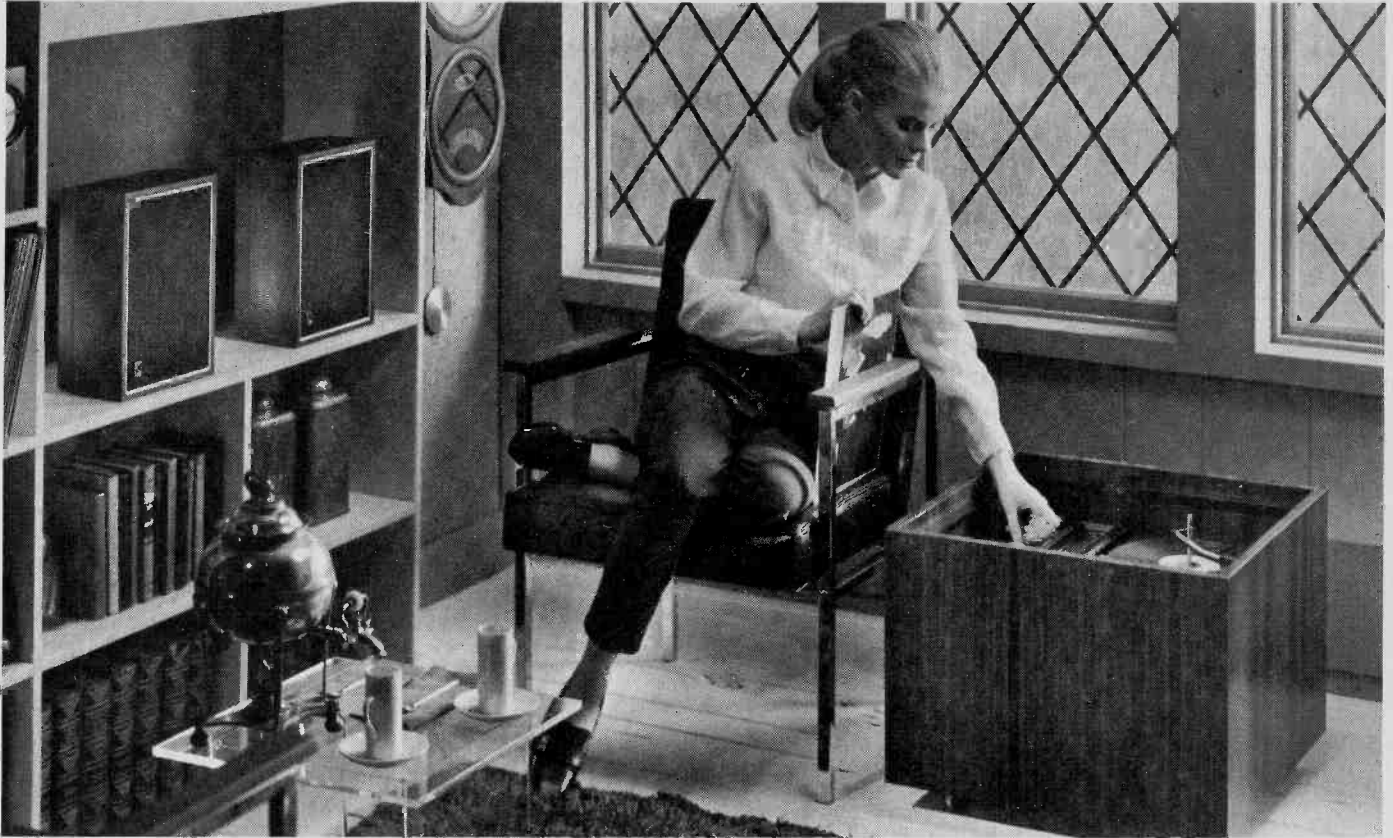
Name \_\_\_\_\_ (Please Print)

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_





## HOW YOU CAN GET HI-FI FOR UNDER \$300

by Stan Grannitt

**I**F YOU WALK into a typical high fidelity equipment showroom (or salon, as they're called) when the shelves are more than plain steel racks, you'll probably find that a turntable the salesman is willing to call "a basic hi-fi turntable" probably costs more than you have budgeted for a complete hi-fi system consisting of, at the very least, a turntable, phono pickup, receiver or amplifier, a pair of speakers, and possibly a cassette, cartridge, or tape deck.

If you add up the individual unit prices of the equipment usually suggested—by salesman or magazine—for a hi-fi system you'll probably come up with a figure that starts near \$1000 and goes up, up, and up as you add features, performance, and tape equipment.

But just because it is commonly accepted that hi-fi is expensive when you're looking for perfection in sound, there is no reason to believe that you can't get a good quality, budget priced stereo system. You can, in fact, get some very decent performance for under \$300.

"Well," you might ask, "if it is possible to get hi-fi for less than \$300 why do they sell so much expensive equipment to so many audiophiles?" A good question, which doesn't take a complex

answer. The plain fact of the matter is that there is no personal standard for high fidelity sound. To illustrate, first consider the young college student. Most likely his or her hearing is as good as it will ever be, with full-frequency range capacity. On top of this excellent hearing our college student likes his music loud. Well then, he might want a full-frequency high power system; that means every component in the system must complement the performance of the other components, and once we're talking about full-frequency/high power we're talking about expensive hardware.

On the other hand, let's consider the senior citizen. More than likely he has a hearing loss of the higher frequencies, and couldn't hear them even if they were coming out of the speaker. Also, it's a good bet he prefers a soft background-type music. Surveys have shown that the typical senior citizen tends to favor the sound quality of a good table radio—yet he calls what he likes "high fidelity."

Yes, high fidelity is subjective. The purists might insist that high fidelity is only the perfect, uncolored reproduction of the original sound or program source; yet to most individuals high fidelity is some indefinable sound quality that's

pleasant to listen to over a long period of time. For most individuals a pleasant sound means a good (possibly full) frequency range of 50 to 15,000 Hz (or 20 to 20,000 Hz) at moderate power levels; enough power to fill the room but not necessarily so great it rattles the windows on the house across the street. And once you're willing to sacrifice thunderous sound levels, overall equipment costs plunge well into the budget category, and \$300 would not be an unreasonable low-cost figure for a decent high fidelity system.

**Speaker-Receiver Matchup.** The secret to success to the under-\$300 hi-fi system is some trade-offs in performance vs. power-handling capacity. For example, an acoustic suspension speaker usually is inefficient and requires a relatively high power input for a given loudness, and putting high power output into an amplifier is what costs money; preamplifiers run about the same overall price in budget and moderate priced amplifiers—what you generally pay for is power output.

If you select high efficiency speakers you can produce the same loudness (volume level) in the room with a lot less amplifier power. You save money on the amplifier and on the speakers, for in the

## HI-FI FOR UNDER \$300

budget category high efficiency speakers usually cost less than the less efficient full-range acoustic suspension models. Lose some quality? Of course! In this life you can't get something for nothing. As a general rule, in the budget category high efficiency speakers usually do not produce the deep solid bass (or even "muddy" lower bass) of the acoustic suspension models. The higher efficiency speakers are often quite good, with an overall clean sound and a moderate bass output. Unless you like the bass vibrating the floor you will most likely find a model that sounds pleasing and full-bodied to your ears.

Few hi-fi dealers—and almost no salons—stock budget priced speakers. In fact, few models are available. The off-brands, and even some house-brand speakers sold in novelty stores, are great on appearance but really short on sound quality, and you generally wind up pay-

ing many times what they are really worth. Among the best sources for high efficiency low cost speakers are the chain stores such as Lafayette Radio, Radio Shack, and Olson. It's not so much that the chains stock low cost speakers, they will usually give you a full demonstration in comparison with more expensive models so you get a true picture of exactly the sound quality you are buying.

Just for example, Lafayette has a very nice 20-watt capacity high efficiency acoustic suspension speaker for \$24.95, while Radio Shack has a similar budget buy for the same \$24.95. Generally, the chains compete with each other and you'll find similar values. Also as a general rule, at the rock bottom end of the price range you'll find about \$5 separates the different models; you'll find speakers for about \$20, \$25, \$30, etc. Each incremental increase buys a bit more performance, so you can really tailor the performance to your budget.

**Next Pick.** Okay, you've got the speakers, now what about the amplifier or receiver? Well, if you start right off

with a receiver you have a program source in the AM and FM; a record player and/or tape can be added later. If your big listening is from records you can get by with an amplifier and turntable, adding an AM/FM tuner when needed, or when there's room in the budget for extras.

Whether you go the receiver or amplifier route the power output requirements are the same. With high efficiency speakers at least 10 watts RMS per channel is required. Generally, you will find typical budget equipment somewhere around 15 watts per channel, give or take a few watts.

Surprisingly, some of the biggest names in high fidelity, with well-respected high performance models priced close to \$1000 and up, also make some excellent low-end equipment. (The trouble is you won't generally find the low priced equipment in the typical audio showroom or salon.) For example, a recent visit to a discount store turned up some Kenwood receivers priced at \$250 and down. A general music store turned up some low priced

### A beginner's hi-fi does not mean high cost . . .

CIRCLE 15 ON READER SERVICE COUPON



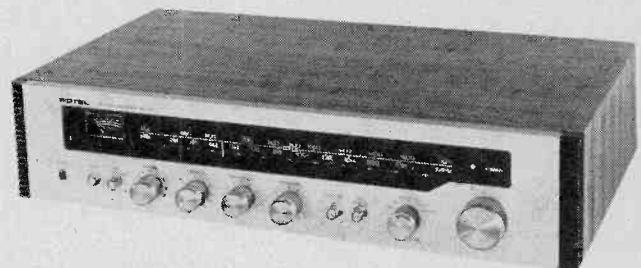
Channel Master's Model HP6083 home stereo system offers an AM/FM-stereo receiver with a built-in 8-track player/recorder and two 3-way speaker systems for \$249.95.

CIRCLE 16 ON READER SERVICE COUPON



The Heathkit AC-1118 AM/FM-stereo receiver is available from the Heath Company for \$139.95, or with two speakers and a record changer, as shown, for \$222.85 plus shipping.

CIRCLE 17 ON READER SERVICE COUPON



Rotel's RX-102 AM/FM-stereo receiver is powered at 5.5 watts RMS from 60-20,000 Hz and is priced at \$159.95.

Pioneer and Harman-Kardon receivers. A department store offered budget priced JVC and Superscope receivers, while yet another store had Panasonic models for the tight budget. These companies, along with others such as Sony, Onkyo, Rotel, and Hitachi (just to name a few) have reputations to protect, so you'll find their low priced gear is generally several steps ahead of Brand X equipment dollar for dollar.

Other sources for decent low priced amplifiers and receivers are the Lafayette and Radio Shack stores, and of course Heathkit.

If you can string together a couple of weeks of free evenings you can get some very good budget gear by building it yourself. Heathkit's AR-1214 AM/FM stereo receiver is an outstanding value at \$189.95, while the amplifier alone—the AA-1214—is only \$104.95.

Note that the common denominator for budget equipment, other than Heathkit, is someplace other than the typical audio showroom or salon. But wherever you go be careful to avoid unknown, or Brand X, equipment. On the surface,

some unknown gear might appear to be a fantastic value; maybe it's a receiver with a turntable built into the top of the cabinet and a built-in 8-track cartridge player—all for \$199.95. Now, no one can offer that much equipment for so little. What you wind up with is a lot of second-rate performance from the record player, the tape, the tuners, and the amplifier.

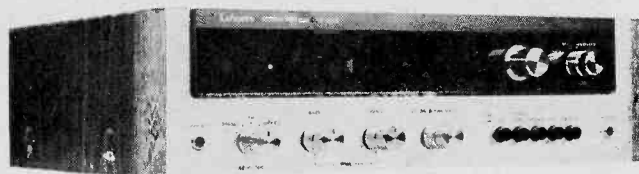
From time to time you will run across a truly outstanding value from a Brand X closeout. You might well get a fine amplifier, receiver, or music center for a rock-bottom price; but if you have never heard of the name make certain the company is, or will be, in business when you need service. While any service technician can handle a repair to an amplifier or receiver, turntables, tape equipment, and sometimes the tuner might use parts which suddenly are no longer available because the importer no longer handles the line, or the authorized service facility has closed down, or one of a hundred other excuses. It's always the budget buyer who gets stuck with unusable equipment

when all that's needed is a small inexpensive part not available to him or his local service technician. In the long run you save money by sticking to the well-known brands.

Turntables and record changers can be a real obstacle course when assembling a budget hi-fi system. The most important thing to keep in mind is that the fewer the parts the less you pay. Take automatic turntable model XYZ and remove all the automatic operating components and you knock fifty to a hundred dollars off the price. Go for an electronically regulated motor and you add from \$100-and-up to the basic price. Fortunately, very few audiophiles really need electronic motor speed control because the ordinary AC motor used in almost all major brand turntables delivers the same speed regulation as an electronically-controlled motor, for the electric system in the U.S. isn't all that bad.

**A Freebie.** As a general rule, a dealer will usually throw in a magnetic phono pickup with a turntable for free, a penny, or a few dollars. Take the offer.

... it does mean sound judgment and planning!



Lafayette's LR-310A AM/FM-stereo receiver provides 13.5 watts RMS from 40-20,000 Hz and costs \$199.95 at Lafayette Radio stores.

CIRCLE 12 ON READER SERVICE COUPON



The Realistic STA-20 AM/FM-stereo receiver from Radio Shack offers 7 watts RMS from 20-20,000 Hz and is priced at \$159.95.



Harman/Kardon's 330B AM/FM-stereo receiver puts out 18 watts RMS from 50-20,000 Hz and costs \$199.95.

CIRCLE 18 ON READER SERVICE COUPON



The Heathkit AR-1214 AM/FM-stereo receiver is rated at 15 watts RMS, 20-20,000 Hz, \$199.95, from Heath Company, Benton Harbor, MI 49022.

CIRCLE 16 ON READER SERVICE COUPON



## HI-FI FOR UNDER \$300

Any magnetic pickup is better than the usual ceramic pickup supplied in budget priced turntables.

As to the turntable itself, it generally isn't all that bad if it has an adjustable counterweight, a calibrated stylus force adjustment, a calibrated anti-skate, and a tonearm lift (or cueing lever). If the stylus force adjustment is set entirely by a non-calibrated spring adjustment, if there is no anti-skate adjustment, or an easy way to remove the pickup (such as a plug-in slide or shell), look for some other model. As a general rule you can pick up a decent quality name-brand automatic turntable/record changer with base and magnetic pickup for \$75 to \$100. This much quality will generally be usable if you upgrade your amplifier and speakers in the future.

If you have no need for multi-play (record changer) operation, by all means go for the manual record player consisting of a motor, integral base, tonearm (and pickup) and possibly an integral dust cover. While even the budget priced manual record players are in the neighborhood of \$100—somewhat more than you might consider spending for a record changer—you get a far superior turntable; something well suited to a complete upgrading of your hi-fi system in the future. Basically, by eliminating the record changer mechanism your money will go into a higher performance turntable and tonearm—the real “heart” of any record player.

**Save Some More.** If you plan on using your stereo system in a small room, say a school dormitory or a bedroom—or perhaps you just want a low-level background music system—you don't need 10 or 15 watts per channel; you can get by with a lot less power output, and the amplifier/receiver price drops sharply. You can't save on the turntable or speakers because you still need those, but you can make a substantial saving on the receiver and/or amplifier—often enough to pay for a cartridge player or an inexpensive cassette deck. The savings here come in the form of Heathkit's “Value-Components,” a line of inexpensive, smaller hi-fi equipment. For example, the basic Heathkit Value-Component package is the \$139.95 AC-1118 AM/FM receiver rated 4.5 watts RMS per channel into 8 ohms. You can get the same receiver with a built-in 8-track cartridge player for \$179.95, or an amplifier/cartridge version for \$169.95. There is even a 4-channel Valu-Component receiver with an 8-track 4-channel cartridge

player for \$239.95. All the Valu-Components are intended for lower power applications, while the receiver sections perform best in urban areas (near the FM transmitters). It's not exactly deep fringe FM performance, but it's a lot better than you'll get in much of the low-cost mass-merchandised receivers. Heathkit has a turntable/ceramic pickup and speakers for the Valu-Component line. The speakers are quite good, even at their price of \$34.95 a pair (you could pay a lot more and get poorer sound quality). The ceramic pickup in the turntable is decent, and is matched to the ceramic phono input of the Valu-Components. It might not be the highest-fi going, but if you're looking for a rock-bottom total cost you won't find better performance for so few dollars.

Regardless of what equipment you decide on, other than Heathkits, there are certain times of the year you can get up to 50 percent off the usual price of name brand components. Two sets of bargain days occur right around the time of the electronic industry's consumer-product winter and spring shows when new models are introduced. Once the new models are out, last year's models are a dead item and are generally heavily discounted. The winter bargain days are right after Christmas—the deals are due to the winter product show, not post-Christmas sales. You generally can pick up about a 1/3 discount on many branded items, particularly turntables, amplifiers, and recorders. The past few years have seen some unbelievably low prices on tape equipment during the months of January and February. Some hi-fi dealers will put together a package consisting of some “outdated” equipment such as a receiver and turntable with current production speakers. Generally, the package price is still an excellent buy.

**Summer Discounts.** But it is when spring flows into summer, June and early July, that the real bargains are available. Just about everyone brings out a new model of something: receivers, amplifiers, turntables, speakers, recorders, headphones, etc. Often, the new model is the same as the old model except for a redesigned cabinet to conceal a price rise. Much of the now outdated equipment is unloaded through the larger hi-fi showrooms and distributors. Since much of the new equipment is at the lower end of the price range, you—the budget buyer—are more likely to find precisely what you want at budget prices than the audiophile who is willing to spend a thousand or so for an installation.

At this very moment, while this article

is being prepared, the second ranking phono pickup, used in many high performance hi-fi installations, has been replaced by a new model; the old model is now discounted 70 percent and is actually less expensive than a much inferior budget priced pickup. Several of the absolute top name receivers with the highest evaluations by consumer test labs and magazines are available with typical discounts of 30 percent, and up to 45 percent if you're willing to buy a complete package of receiver, turntable, and speakers. The turntable and speakers are also last year's model, but what a buy!

If you can plan six months to a year ahead, and are willing to sacrifice some supposed “state-of-the-art development,” you will be able to assemble either a good stereo system at a rock bottom price, or a very good system for a budget price. Here's why: If you plan on spending, say, \$300 on a system consisting of components A, B, and C, and you can get them on special sale for \$150 to \$200, you're obviously ahead of the game. But if you actually spend the \$300 you budgeted, at special sale time you might get components X, Y, and Z, which normally sell for \$400 or perhaps \$500. In short, more performance for the same amount of money.

A good way to know when a special sale is coming up, particularly in tape equipments, is to keep track of the new products mentioned in hi-fi publications, such as HI-FI STEREO BUYERS' GUIDE. If you see a “new” 7-in. reel-to-reel recorder having virtually the same specs and features as a model presently on the market you can be certain the old model is already on a closeout, or will be on a closeout price in a few months. The same is true of receivers, amplifiers, turntables, and sometimes loudspeakers.

Quite often there are simultaneous model changes in receivers, amplifiers, record players, and speakers; and you can get a package deal on a system consisting of all “outdated” components. The savings can run well into the hundreds of dollars.

**Summing Up.** If you get the urge to run down to your local store and come home with a hi-fi system as soon as you're bit by the stereo or new equipment bug there's little chance you're going to get the best possible equipment for the least amount of money. But if you're willing to do a little research, spend some time listening to different component combinations at the hi-fi showroom, and you're willing to wait for special sale days, you most likely will be able to come up with a good hi-fi system for under \$300. ■



# STUDY YOUR WAY INTO THE BIG MONEY IN ELECTRONICS

by Jorma Hyypia

Enrolling in a correspondence course to train yourself for a career in electronics could be one of the most important moves you will ever make. Be sure to pick the right school and best study program for your needs.

**Y**OU'VE SEEN the ads many times, and you will see them again in this very publication. "Step into the digital age," they coax. "Don't envy the man with skills in electronics . . . become one!" "Prepare now for a rewarding career in electronics," they beckon. And you are sorely tempted to at long last take that big step and sign up for a course that will free you from your present drab, low-paying job with no future. Boy! Won't it be sweet one day to tell you boss what he can do with his . . . (you complete the sentence).

If you aren't yet fully convinced that a correspondence course in electronics is your escape hatch to a better future, you might be thinking: "What the heck, even if I don't go all the way, I'll at least get myself a new color TV set and enough training to keep it in good shape." If that's the best argument you can muster, back off and re-think your plans. If you are willing to settle for a

TV set "if things don't work out," you'll save money in the long run by just buying a set from your nearest dealer and letting professional servicemen take care of it; you can buy a lot of service with the money you will save by not wasting it on a correspondence course that is the wrong one for you. However, if you pick the right course, for the right reasons, you may truly be on the way to the kind of career the school ads offer.

You won't find any pat answers to questions like "Which school is best?" in this article because there are no such answers to give. Every prospective student has different personal needs to satisfy, so each must decide for himself what training will best meet those needs at lowest possible cost. However, we can point you in the right direction by underscoring some of the things you should evaluate as you pore over the fascinating promotional brochures that the various correspondence schools are

eager to send to you.

**Bucket of Parts.** The lure of kit building is undeniable, and the schools see to it that you are made aware of the mouth-watering kits you will build, including a yours-to-keep color TV set. Practical hands-on kit assembly and electronic experimentation is indeed an important part of a good training program, but you must be aware that kit-building cannot be a substitute for basic book learning. The schools can make the learning of theory as easy as possible by use of carefully prepared texts, but you will still have to work to grasp and remember the fundamentals that you *must* acquire to become a professional in any electronics field.

The building of a color TV set can be a very worthwhile part of your training if you are aiming for a career in TV repair or some related field. For certain other career objectives such set building would be a waste of time and money,

Some of the ads for electronics correspondence schools are shown above. As you can see, many of them feature big-size color TV kits, as well as various other pieces of electronic equipment—from simple to sophisticated—for your training use. Some of the schools feature tear-out cards in their ads to make it easier for you to get various catalogs, course offerings, and other information right away. Which school is right for you? It's easy to find out!

## SCHOOL DAYS PAY

and in fact you would not get the set with such study programs. You should also know that your school probably won't ship the TV set, if it is included in the course, until you have progressed far enough to have paid at least 75 percent of the cost of the program—in which case you are by then *obligated* by contract to pay the *full* course fee whether or not you complete the course. So there's no way you can go "just far enough" to grab a TV set and then pull out—except at a stiff price.

If you read the promotional literature of competing schools carefully, you will detect the in-fighting that has developed around the TV bit. While one school emphasizes that you will get a "complete" TV, rather than a stripped down version used only for teaching, another school proclaims that it doesn't stoop to using "hobby" type TV kits, but instead uses a TV set specially designed to aid in the teaching process. So there you have it—the same situation argued from two points of view to draw diametrically opposite conclusions. If you want the most for your tuition money, do your best to find out—in advance of signing the contract—just how thoroughly the TV set building is integrated with the teaching of both electronic theory and TV troubleshooting. If all you do is put together a kit without direct correlation with textbook learning, you gain precious little practical experience from all the work except the ability to plug things together and solder A to B in follow-the-directions cookbook style. You don't need a course in electronics to do that; just buy a kit and soldering iron.

We should qualify these comments about kit-building when dealing with test instruments. Here again you hope to learn some theory through the kit assembly process; but even if you don't, you are at least putting together instruments that you will be able to use in practical manner to test and troubleshoot electronic equipment.

Finally, don't be swayed too much by the numbers game sometimes used to suggest that "our" course offers more fascinating "experiments" than does some other school's course. You will undoubtedly perform 200 or some other number of experiments if the school in question says so, but not all of the experiments will involve the use of sophisticated electronic equipment. Some of the experiments will require the use of *very* simple pieces of equipment—a magnet and some iron filings, for example.

This does not mean that the simple experiments have no purpose; in fact, you may be learning very important electronic principles through such experimentation. All we are doing here is to warn you not to get too starry-eyed about the presumed truckload of equipment you must need to do so many experiments.

Also note that some schools offer the use of very expensive, specialized equipment needed for some types of course work. You can use the equipment at the school's laboratories, or have it shipped to your home for a week or two, but you must return it within the specified time and pay all shipping and insurance charges. If you can get the same type of equipment on loan locally, you should be free to do so.

### How Much Will Your Training Cost?

The usual magazine advertising used by electronic correspondence schools doesn't even begin to reveal, much less describe, the many different types of courses that are available. So don't be surprised that you can pay anywhere from about \$100 for a "basic" electronics course to as much as \$1700 for a course that leads to an engineering degree as well as a diploma. A course

that involves the building of a color TV set can run anywhere from about \$700 to \$1800.

These approximate quotes are for *cash* payment of the full tuition at the time of enrollment. If you opt for time payments, know exactly how much extra you will pay in interest—in both actual dollars and the *true annual interest* rate (which enables you to realistically compare the time payment offerings of different schools even if the total course fees are substantially different). You will probably be required to keep up regular monthly payments even if you fall behind in your studies. So don't count on slowing down your study program just to avoid putting off a monthly payment when you happen to be financially strapped.

If you pay cash on the barrelhead, you avoid the additional charges. On the other hand, you will lose out on savings bank interest you could be earning on part of the money. Thus, if you have the money to pay cash, figure out how much more you would actually pay using the time payment plan as compared to the cash payment plus lost interest.

If you are a veteran eligible for benefits under the GI bill, be sure to file the necessary applications on time or you could lose out on some payments. After expiration of ten days following your enrollment in a school program (provided by a school recognized by the Veterans Administration, of course), submit a written affirmation of your enrollment with the VA. Don't assume that the school will do this for you. The VA will not authorize payment for any lessons you might have completed before the filing of the affirmation. The VA pays 90 percent of the cost of tuition. You (not the school) are paid quarterly, and the size of each VA check is calculated by multiplying the number of completed lessons by the cost per lesson. This means that you must have the money to pay the school on time, even though you will get 90 percent of it back from VA months later.

**Termination and Refunds.** The best laid plans can go awry, so know in advance what it will cost you to drop out of your training program at any point along the way.

You are given a brief initial time period in which to examine the first package of course material and send it back without suffering a monetary penalty. Usually this examination period is ten days, but it could be as short as five days, so check it out. After that the amount you are obligated to pay depends on how much course material

(Continued on page 99)

### LEADING ELECTRONICS CORRESPONDENCE SCHOOLS

Cleveland Institute of Electronics,  
Inc. (CIE)  
1776 East 17th Street  
Cleveland, OH 44114

DeVry Institute of Technology  
Bell & Howell Schools  
4141 Belmont  
Chicago, IL 60641

Grantham School of Engineering  
2000 Stoner Avenue  
Los Angeles, CA 90025

National Technical Schools (NTS)  
4000 South Figueroa Street  
Los Angeles, CA 90037

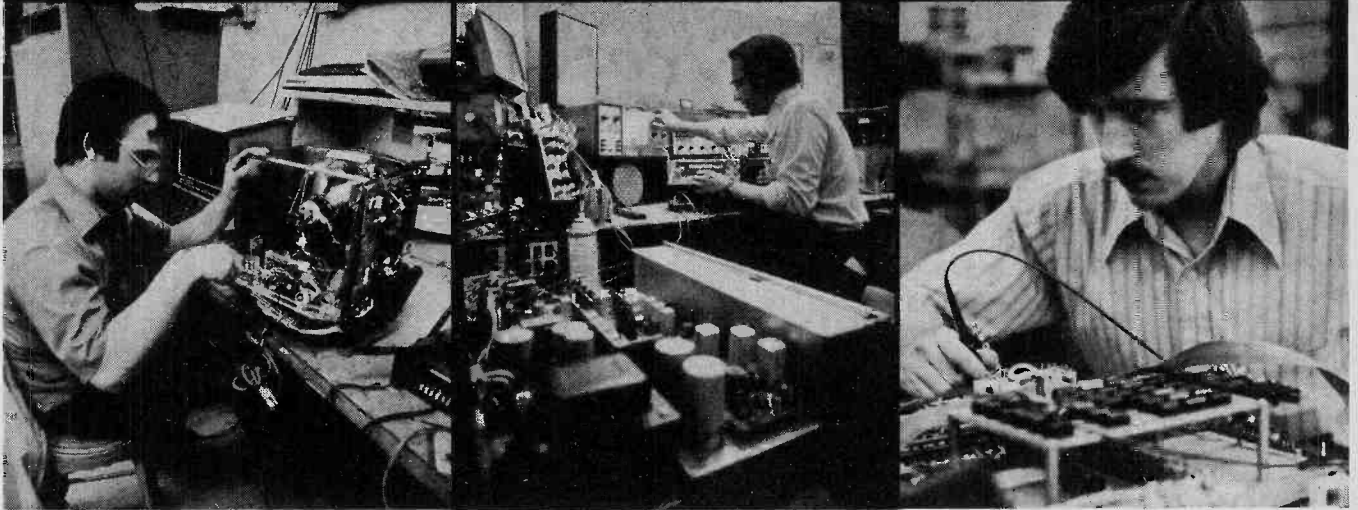
NRI Schools  
McGraw-Hill Continuing Education  
Center  
3939 Wisconsin Avenue  
Washington, DC 20016

International Correspondence  
Schools (ICS)  
Scranton, PA 18515

Technical Home Study Schools  
Electronics Technical Institute Div.  
1500 Cardinal Drive  
Little Falls, NJ 07424



# 16 ways to move ahead in electronics!



Choose the one that's just right for you...the one that can make your future more rewarding, more secure, more enjoyable...starting now! These ways to move ahead are yours from Electronics Technical Institute...the finest electronics home study courses and programs ever offered!

## Fundamental Electronics

Get a solid foundation for entering the fast-moving world of electronics where today is great, and tomorrow will be greater. Learn it the simple, easy, step-by-step, programmed way called *Autotext*, exclusive with ETI!

## Electronics Drafting

Learn a vitally needed specialty that translates new technological concepts and developments to the practical drawing board. Become a specialist-in-demand, through ETI's training. Learn it at home...get your future moving now!

## Color TV Servicing

There's a real future waiting for the established color television technician. You become that technician through this program that takes you step-by-step to *theoretical and practical* mastery of color TV. Get your tomorrow started today!

## Master TV/Radio Servicing

Here is true "master" preparation for a career that can take you as far as you want to go into radio and television servicing, both black and white, and color. The helpful, practical ETI way can be your way to more money, security, success!

## Communications

ETI's communications program opens up a whole range of career development possibilities in electronics. Solid-state receivers, solid-state audio equipment, communications equipment, CATV, as well as preparation for FCC-licensed positions in commercial broadcasting and mobile communications. You can find a real future here!

## Industrial Electronics

You open great career opportunities through this program, as instrumentation technician, electronic equipment maintenance technician, electronic calculating machine technician and audio technician. It also prepares you to move into and up in communications, automation and industrial electronics!

## Digital Technology

Join the digital revolution which is radically altering our lives today and tomorrow. Get solidly trained in the new digital specialties that can lead to a real future as a digital control technician, electronic calculating machine technician, field representative, computer sales representative, manufacturer's representative.

## Electronics Technology

Learn electronics across the board! You'll be ready for real career advancement with training that can lead to technical positions in communication, automation and industrial electronics, and can also help you in sales positions, management and administration.

## Computers

ETI offers training opportunities in Computer Technology and Computer Programming. Learn at home, and get ready to enter a field where incredible developments are sure to continue. It's practical, useful—the step-by-step ETI way!

## Advanced Electronics

Want greater challenges and career advancement? This course is for you. It can be valuable preparation not only for a technical career, but also for the fields of sales, management and administration. Make your move now!

## Digital Electronics—Advanced

Here's a special course for those already in the field of digital electronics, ready to move into more advanced areas. This is how to move up in sales, management and administration. Here's your tomorrow!

## Black and White TV Servicing—Advanced

This can be your own "advance" course to black-and-white TV competence from A to Z. You'll construct a receiver yourself, if you wish. A key to lifetime success!

## Industrial Instrumentation—Advanced

Move up in the world...the wonderful electronics world! This course opens up a whole range of careers in the industrial field, as instrumentation technician, laboratory technician, process control technician or electronic calculating machine technician. Get ready...and go!

## Color TV Servicing—Advanced

Here is the "graduate" course in color TV for those who already know television fundamentals. You'll learn color TV from top to bottom, build your own set if you choose. A great way to build your future!

## Solid-State Electronics—Advanced

Applications of transistors are increasing all the time and the transistor may be a breakthrough

comparable in importance to the development of nuclear energy. Solid-state can mean your solid career development, too, through ETI!

## FCC License Preparation

Here is real down-to-earth practical preparation to take your 3rd, 2nd or 1st class Federal Communication Commission Radiotelephone License examinations. Get yourself ready now for any of the FCC-licensed positions involving broadcasting, mobile communications, microwave communications links, marine communications equipment or in many other positions in solid-state, communications, CATV. Get ready for tomorrow...today!

Get all the facts...free!

Send the coupon now for ETI's colorfully illustrated new 44-page catalog giving you all the details. You owe it to yourself. There's no obligation, and no salesman will call. Send for yours today!



## Electronics Technical Institute

Division of Technical Home Study Schools

Electronics Technical Institute, Dept. 497-115  
Little Falls, New Jersey 07424

Send me the Electronics Technical Institute Catalog.

Name \_\_\_\_\_ (please print)

Address \_\_\_\_\_

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

Interested in another field? Check the Technical Home Study School program that interests you most. No salesman will call. PLEASE CHECK ONLY ONE.

- |   |  |
|---|--|
| <input type="checkbox"/> Typewriter and Office Machine Repair   | <input type="checkbox"/> Locksmithing            |
| <input type="checkbox"/> Upholstery and Decorating              | <input type="checkbox"/> Legal Investigation     |
| <input type="checkbox"/> Accident and Insurance Claim Adjusting | <input type="checkbox"/> Security/Alarm Business |
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Check here for information on Veterans Benefits.

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# Tuning The Cops... Strictly For Fun

Here's an expanding hobby made possible by new inexpensive receivers that did not exist five years ago.

by Don Jensen



THE LONG ARM of the law reaches out from your TV screen and puts the collar on your imagination. Cop shows seem to abound on television again this season: *Police Story*, *The Rookies*, *Adam-12*, even Jack Webb's *Dragnet* show up on the networks or in syndicated reruns.

The reason for the continuing popularity of the cop shows is clear. Police actions are interesting and exciting. But this is all hyped-up drama, not the real thing—as any real-life police officer will be quick to tell you. In the city streets and on rural roads, it's true, much of a policeman's job is routine. But there is also *excitement* and, for the guy with the badge, *danger*. The stories don't necessarily wrap up neatly in 28 minutes with time for a commercial and the closing credits. There is, in real police work, sometimes action and always uncertainty about what will break loose in the next minute.

So if you've wearied of make-believe cops on the boob tube, why not tune in on the real thing instead, police communications on the very-high-frequency (VHF) and ultra-high-frequency (UHF) action bands?

Monitoring the public service bands is very likely the fastest growing phase of DXing around these days. If you have any doubts about that, a visit to almost any store that deals in radios will convince you. Even in department stores and discount centers, marketplaces where you might not think you'd find DXing electronic gear, you'll see rows of receivers designed to tune the VHF/UHF frequencies.

Why this spurt of interest by the public at large in recent years? One major reason may be the transistor and the blossoming of the solid-state age that has brought the price of suitable receivers down to the point where anyone can afford a radio that will tune these bands.

A second reason suggested is a spin-off of the popularity of citizens band two-way communications. Across the country, CBers formed organizations, REACT groups, mobile patrols and rescue teams in which they could offer a public service (and gain some public recognition) using their citizens band transmitting stations. To aid in this work, countless thousands purchased VHF/UHF communications receivers so they could monitor local police and Civil Defense channels. And in doing so, many became "hooked" on tuning police communications, quite apart from their CB activities.

**Rules Are Rules.** Chances are that you too will be hooked once you get a taste of public service band monitoring.

What's more, the price is right for the beginner who has no equipment of any kind.

But first, since we're talking about listening in on John Law, let's take a quick look at the legalities.

Point One: There is a major distinction between a broadcasting station and action band communications on VHF/UHF. The former, your local AM radio station, TV or FM outlet, and even overseas shortwave stations broadcast their programs to general audiences. Their programs are intended to entertain you and anyone else with a radio or TV.

Public service transmissions, including police communications, have a totally different purpose. They are in theory private communications, generally two-way in nature. This is "working" radio, not intended for the entertainment, education, or amusement of a general radio audience. The users have a job to do and radio communications helps them to do it.

Point Two: Despite this, these communications are not really private messages. The signals can and frequently are picked up by persons to whom the messages are not directly aimed. This is a flat-out fact, recognized by all parties, the police, the government's Federal Communications Commission (which regulates radio activities in the U.S.), and by communications monitors themselves. Considering these factors, it is easily understood why there are some governing regulations—some dos and don'ts—involved.

Point Three: Basically, the rules are simple and easy to understand. And they can be boiled down to a simple maxim: Keep your monitoring of the "fuzz" frequencies strictly for fun!

Under the provisions of the Communications Act, Section 605, as amended, you are not prohibited from listening in on police signals or, for that matter, any transmission in the entire radio frequency spectrum. And that makes sense since there's no way such a non-listening law could be enforced.

But you may not "divulge or beneficially use" the information derived from your monitoring. In other words, keep mum about what you hear and, more importantly, don't try to make any personal gain from the information you hear.

As a law-abiding citizen this won't hamper you in any way. But clearly a gang bent on burglary, monitoring police frequencies to learn of squad car dispositions before setting out on a night's work, can have an extra charge tacked onto their crimes when caught.

But warning a neighbor that you've

**Bearcat 101**  
16 channels, scans  
all bands without  
crystals, \$349.95

CIRCLE 19 ON READER SERVICE COUPON



**Surveyor 10HLP**  
VHF Hi, 10 channels,  
\$169.00

CIRCLE 20 ON READER SERVICE COUPON



**Pace Scan 10-4H**  
4-channel, VHF Hi,  
\$99.95

CIRCLE 21 ON READER SERVICE COUPON



**Fanon Scanfare**  
4-channel VHF Hi/Lo  
intermix, \$212.50

CIRCLE 22  
ON  
READER SERVICE  
COUPON



**Realistic PRO-16**  
3 bands, 16 channels,  
\$229.95

CIRCLE 14 ON READER SERVICE COUPON



just heard the desk sergeant directing a unit to set up a radar speed check at 12th and Elm is also *verboten*. And so is gossiping that you'd overheard the cops were sent to the Joneses' last night because Joe punched Mabel in the eye again.

In a few areas of the country there are local or state laws that add additional restrictions. Usually, though, they involve monitoring police signals with a receiver in your auto. If you have any doubts about the situation in your community, a call to your local state or district attorney's office will get you the information you need about legality. Generally speaking, however, if you keep your monitoring just for fun you're OK.

**How to Get Started.** You will need a receiver that can tune the right frequencies. If you own a shortwave receiver (unless it is one of those multi-band portable jobs that include the police bands) you'll find it won't bring in the police communications. The

shortwave frequencies run from about 1,605 kHz, just above the frequency point where the standard AM band ends, to 30,000 kHz (30 MHz). There was a time some years back when most police calls were on shortwave, the frequencies from about 1,700 to perhaps 2,000 kHz. But no more. Police communications, with very rare exceptions, have been moved to VHF/UHF frequencies.

The very high frequencies extend from 30 to 300 MHz, the ultra highs continue above 300 MHz, well above the shortwave bands.

There are two VHF public service bands, the lower covering the frequencies between about 30 and 50 MHz, the higher one spanning 150 to 174 MHz. Within these VHF bands, most law enforcement agencies are assigned frequencies between 37.02 and 46.42 MHz and 151.45 and 159.21 MHz. Across the U.S., some 20,000 law agencies use and share these channels. In a growing number of communities,



## TUNING THE COPS

and especially in the larger cities, the police use frequencies in the UHF range, around 450 to 470 MHz.

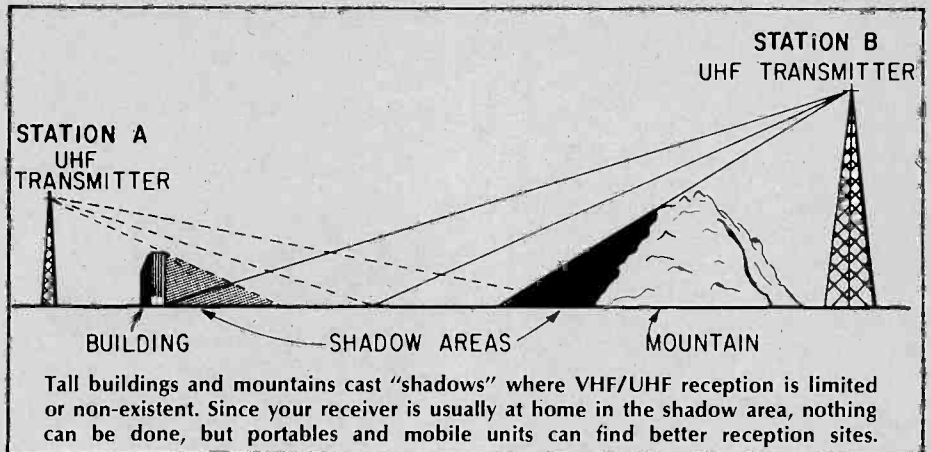
**What Freq?** How can you tell which of the three police bands is used by your hometown officers? You could ask the radio technician at your local department. Or a radio dealer who sells monitoring receivers. Or you could just glance at the next police cruiser you spot. If it sports a long buggywhip type antenna, you can bet the 30-50 MHz VHF low band is the one in use. An antenna only 18 inches long suggests usage of the VHF high band. If it's only a few inches long, bet on UHF.

Communications monitoring requires some different techniques if your previous DXing has been confined to the shortwave bands. One reason is that the VHF/UHF frequencies, unlike shortwave, are primarily used for relatively short range communications. You can completely forget about picking up overseas police calls from Africa or Asia. For the most part, you'll be hearing signals from your own city or town, plus those from neighboring communities, 25 to perhaps 50 miles away. But then you will be more interested, undoubtedly, in what you hear rather than how far away it is.

Day-to-day reception, depending on the terrain, the number of stations operating in your area, your antenna and receiver, and some other factors, will be relatively short haul. Normal reception on the VHF/UHF bands is roughly limited to the line-of-sight from the top of your receiving antenna to the top of the transmitting antenna. The earth's curvature, thus, has a direct bearing on the range, along with the proximity of mountains or hills and, to a degree, tall buildings.

**All About Bounce.** That is the normal state of affairs. But under certain conditions relatively long range reception—several hundred to perhaps 1,500 miles or so—is possible. One of these special conditions is known as sporadic E reception. Any radio signal, as it leaves a transmitting antenna, travels in a straight line. As the earth, in effect, bends away from the signal path of travel at the horizon, the electromagnetic energy that carries the message heads outward into space.

If not for several gaseous bands circling the globe out there in the ionosphere, all radio signals would be limited to a line-of-sight range. But these bands, labeled by scientists the D, E, and F layers have an effect on radio frequency signals.



The E and F layers can act as electronic mirrors, bouncing the radio signals back to earth at points far distant from the transmitter. This, of course, is why long distance medium and shortwave reception is possible.

Normally, though, the wavelengths of VHF and UHF transmissions are too short to be so reflected and we are left with only short range reception. But on occasion the E layer becomes sufficiently dense (electrically) to reflect these high frequency signals and we can hear distant stations.

This condition is never predictable (though it is more prevalent in summer), and is sporadic in nature, hence the name sporadic E.

Because the degree to which the E layer reflects VHF signals varies considerably, even from minute to minute, this sort of reception can be characterized by strong fading . . . one moment the signal is loud and clear, but totally gone the next. And such distant reception may be very selective geographically.

A monitor in New York City may hear a station operated by a police department in, say, Missouri, but hear nothing from stations in Kansas or Iowa or Illinois. On different frequencies he may hear numerous distant stations from throughout a one or several state area.

Another propagational phenomenon that may bring in far-off police communications is known as tropospheric bending. Unlike E-skip (sporadic E reception) the action that returns a distant radio signal to earth is a phenomenon of our own atmosphere. (The E layer is located in the ionosphere, out beyond the limit of the atmosphere.) Tropospheric bending, sometimes called just tropo or tropo by listeners, is a weather-related phenomenon. Inverted temperature layers—when a warm front overrides cooler air—can create a sort of signal duct, a pipeline that bends the radio signals back to earth. This can

occur anytime during the year but is most common in the spring and fall.

The distances of tropo-bent signals aren't as great as with sporadic E reflection, but usually the reception is steadier. Most tropo DX will be from stations located 200 to about 700 miles away, though 1,000-mile or more DX has been reported. The rule of thumb for communications monitors is to look to your local area signals for regular reception. Distant DX is a sometimes bonus that adds to the fun of eavesdropping on the police.

**Eye on Price.** To try your hand at monitoring the law enforcement agencies, all you really need is a suitable receiver. Since budgetary considerations were the reason you picked this magazine from your corner newsstand, it may come as a pleasant surprise to learn that a major investment isn't necessary to get started.

There is a tremendous range of equipment for VHF/UHF monitoring on the market today. On the low end of the scale, price-wise, the author recently spent all of \$11 for a tiny pocket transistor set at a local discount store. In size it measures about 5 by 3 by 1 inches, with a telescoping whip antenna which extends about a foot. In frequency it covers the normal AM radio band and the VHF high band for police signals. It does a perfectly adequate job in bringing in local police signals.

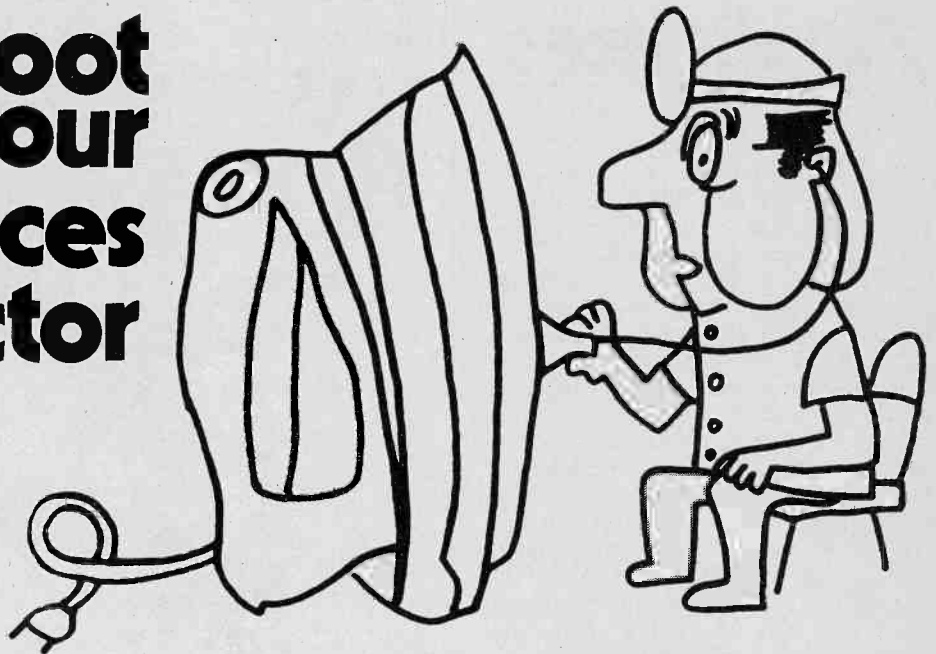
On the other hand you could spend several hundred dollars for a fancy receiver with all the goodies, and perhaps another \$20 to \$25 for an exterior ground plane antenna. Mount the antenna on a 40-foot tower and the costs go even higher. And there are many different receivers, with a wide range of features, across the price spectrum between these extremes. Quite literally, you can decide in advance how much you want to invest in your monitoring gear and then buy a set that fits your wallet to a "T."

(Continued on page 104)

# Troubleshoot your Appliances like a Doctor

Take a tip from your last physical checkup and do as your doctor does if you want to pocket the big repair bills and replacement costs.

by Jorma Hyypia



**Y**OU MAY HAVE been pronounced perfectly healthy during your last physical checkup, and yet your doctor may have advised that you have an electrocardiogram (EKG) made. Why? To provide a record of the *normal* electrical characteristics of your heartbeat. If diagnostic EKGs need to be made in the future, they can be compared with the normal EKG for faster and more accurate evaluation of your health problems. In like manner, troubleshooting your small appliances when they break down will be much easier if you now prepare a set of appliance ECGs—*electroconductivitygrams*—while the gadgets are still in good working condition.

Actually, you'll measure the *resistance* to conductivity exhibited by the total circuitry of each appliance because resistance is faster and easier to measure

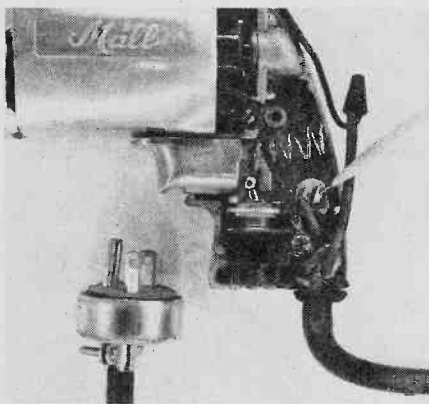
than is conductivity. All you need for the job is a volt-ohmmeter (VOM) that can be purchased from a retail audio supply store. Prices start below ten dollars.

**Measuring Resistance.** To measure the total circuit resistance of an appliance, unplug it from the wall socket and apply the meter probes to the prongs of the power cord plug. Adjust the meter control to provide an easy-to-read resistance value when the appliance switch is turned on. If the appliance has several settings (cool, hot, low, medium, high) take a reading at each setting.

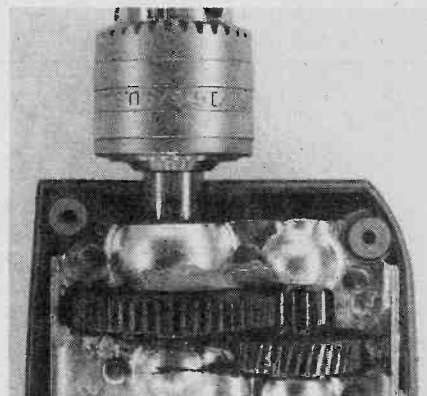
You should end up with a "Typical Appliance Resistance Chart" much like the one shown here. So why not just file away this ready-made chart for your own use? Because your brands and models of appliances may have different resistance characteristics, although in most instances they probably will be fairly close to those indicated here. And you can't always be wholly certain that each unit of the identical brand and model will behave in the same manner; for example, two seemingly identical cool-mist humidifiers exhibited resistances of 14 and 25 ohms respectively.

If you don't get around to making up your own chart before something breaks down, use our chart as a rough guide to the *probable* resistance your similar appliance should have. Note that in some cases a resistance range is indicated. The resistance of a power drill may climb from 12 ohms up to an apparent "infinity" reading as the speed control is adjusted. A food mixer may have several separate resistances (32/60/90 ohms, for example) for the high, medium, and low speed settings.

**Resistance Interpretations.** By comparing the measured resistance of a defective appliance against the same unit's normal resistance, you can speed diagnosis of the problem. If the appliance still has the proper resistance, look for *mechanical* rather than electrical trouble—stuck gears, for example. If the measured resistance is zero, you would suspect a short circuit in the power cord or elsewhere. If the resistance is very high (infinity) when it should be in the tens or hundreds of ohms, search for an open (break) in the circuit; this could be a broken wire, a wire worked loose from a terminal connection, a defective component such as a resistor or thermostat, or maybe nothing more than the accumulation of corrosion products



Old style power tools that do not have insulating plastic housings should be fitted with three-conductor grounding cords. Here the ground wire is attached to a bolt used to hold the switch in place. Worn grommet where power cord emerges from the tool should be replaced.



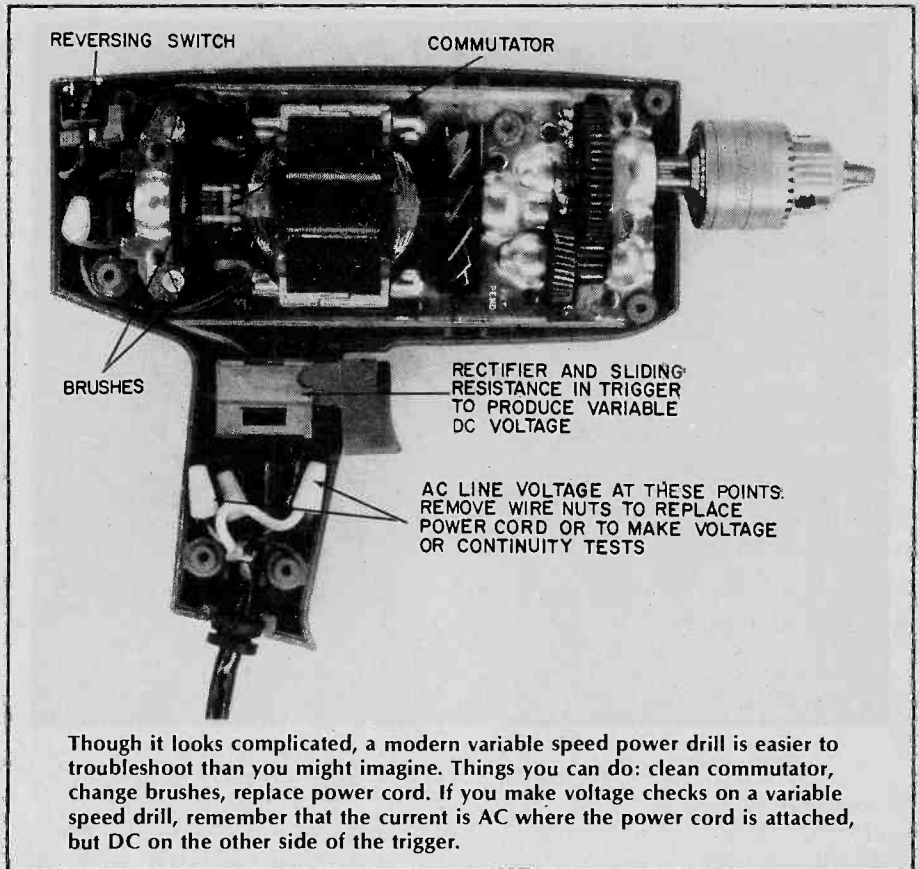
Cause of malfunction of a tool or appliance can sometimes be mechanical rather than electrical. For example, drill gearing systems may reveal damaged gear teeth, or grease may have dried out or become dirty. Replacement of damaged gears would be a factory or service shop job, but you can easily clean out old grease and pack with fresh lubricant.

# Appliances

that impede current flow. If the measured resistance is a readable value (other than zero or infinity) but considerably higher than normal, look for a break where only part of the total circuit is affected, thus allowing current to flow through an alternate route having a higher resistance than the combined normal routes. In this case you could pretty well rule out the power cord because a break here would knock out the entire circuit and exhibit "infinity" resistance. Finally, if the observed resistance is significantly lower than normal (but still not zero), hunt for a place where current might be leaking from one part of the circuit to another to flow through a shortened, lower resistance path than normal.

Once you learn the very simple technique of making resistance measurements with a VOM, and get the hang of interpreting the results, your troubleshooting skills increase greatly. Obviously the VOM provides much more significant information than you could obtain with a simple continuity tester (such as the battery-bulb tester shown in this article) which usually shows only whether a given circuit will or will not pass current of low voltage. However, the continuity tester is worth building because a great many appliance problems can be found with this simple device.

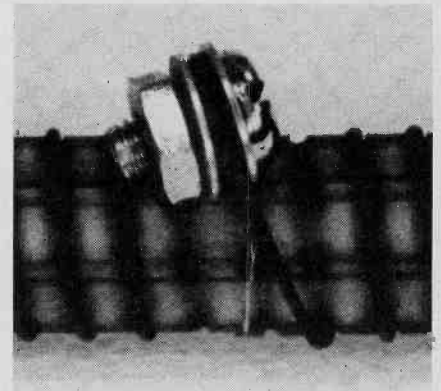
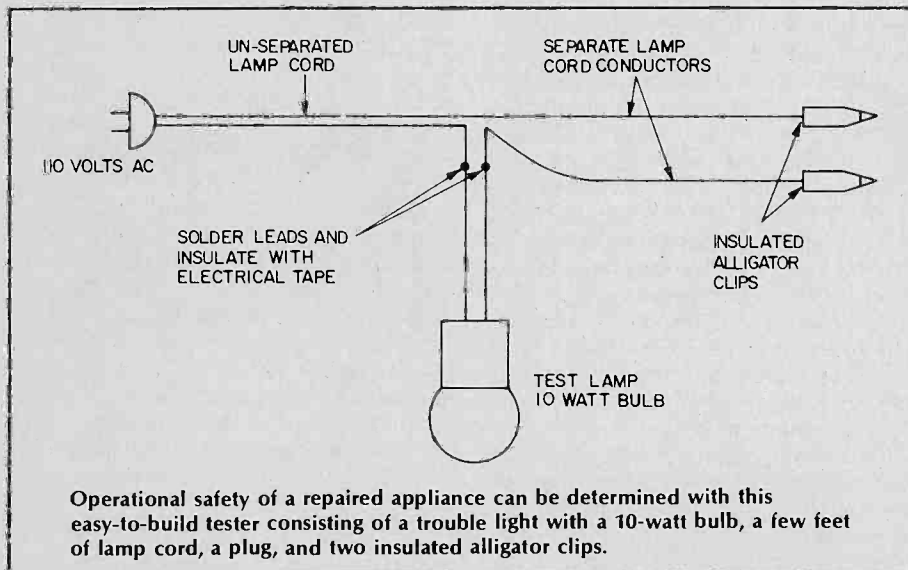
**Continuity Testing.** If you have reason to suspect the power cord of a defective appliance, either the VOM or bulb continuity tester can be used to check the cord. If the cord can be sep-



Though it looks complicated, a modern variable speed power drill is easier to troubleshoot than you might imagine. Things you can do: clean commutator, change brushes, replace power cord. If you make voltage checks on a variable speed drill, remember that the current is AC where the power cord is attached, but DC on the other side of the trigger.

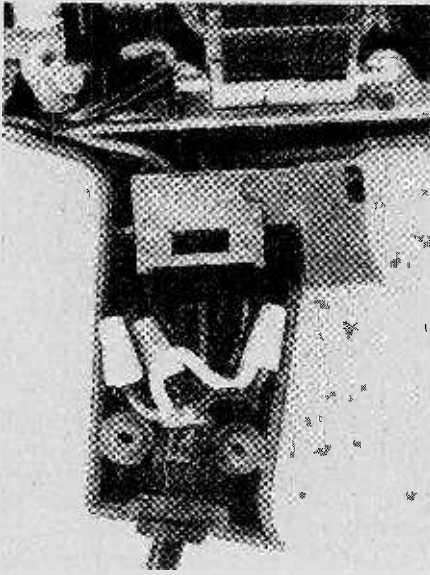
arated from the appliance, hold one probe of the continuity tester or VOM to a contact in the plug-in section, and touch the other probe to each of the wall plug prongs, one at a time. If the bulb lights when touched to one prong, but not when touched to the other, you know that one conductor is free of breaks and has no short circuit to the other conductor. Now move the probe to the other contact in the plug-in section, and test the prongs again. If the bulb lights when touched to one prong,

but not when touched to the other, the second conductor is OK. If the bulb fails to light when the probe is touched to either prong, a break in the wire or a loose connection inside one or other of the end sections is indicated. If the bulb lights no matter which prong is touched, look for a short circuit. The



A broken wire coil heater element can sometimes be repaired by forming loops on the ends of the resistance wire and bolting together, using washers on each side of the loops. Very old resistance wire may be too brittle to permit forming the loops. Heater elements consisting of metal ribbon, rather than wire, can sometimes be repaired by clamping ribbon ends together with special clamps that can be obtained from appliance repair shops.



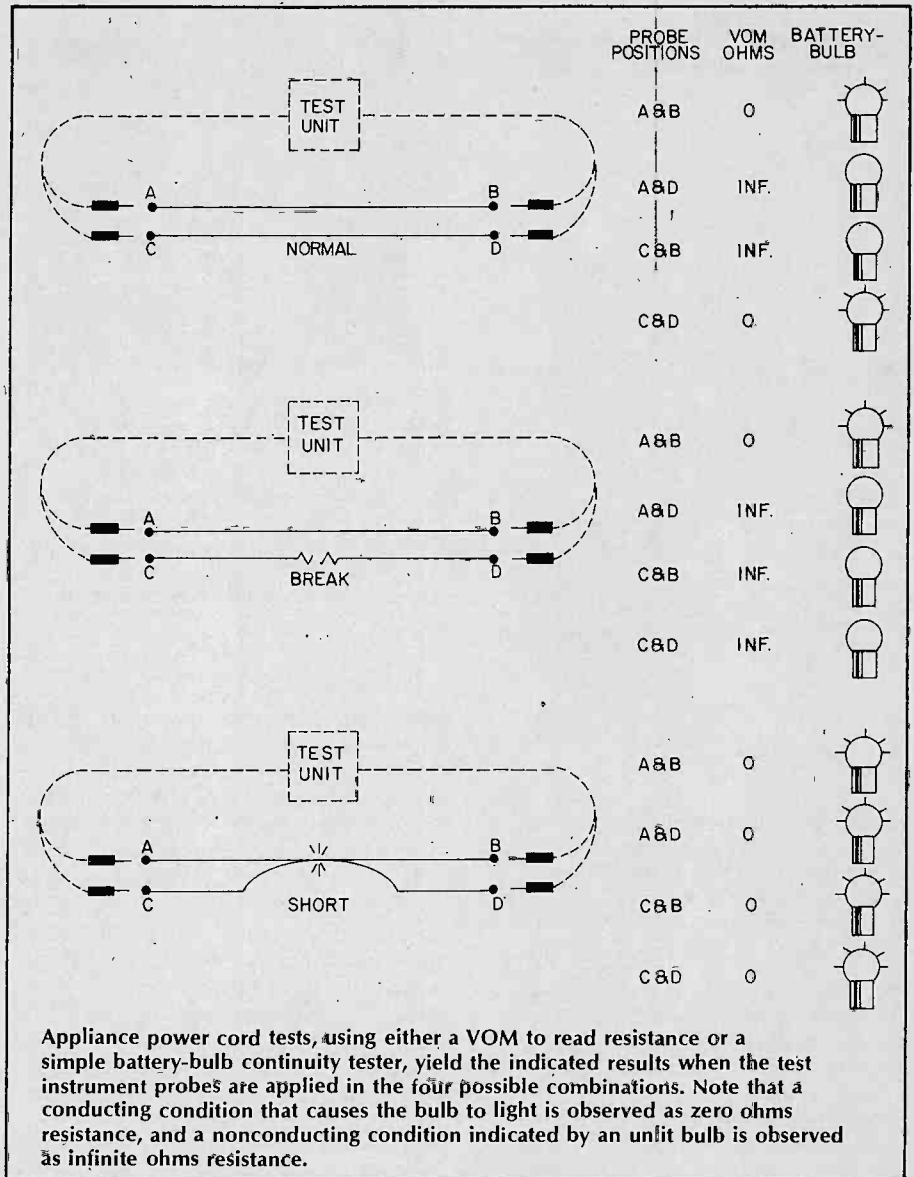


Trigger of a variable speed power drill contains a silicon-controlled rectifier (SCR) to convert incoming AC current to DC current, and a slide resistor to vary the voltage and thus vary speed of the drill motor. If malfunction is traced to this component, replace with a new trigger unit.

VOM provides the same information, except that a break is indicated if you get an infinity resistance reading no matter which prong of the wall plug you touch while the meter's other probe is held against one contact at the other end of the power cord. If you get a zero resistance reading at both plug prongs while the other probe remains in contact with the same terminal at the other end of the cord, a short circuit is indicated.

If the power cord is permanently wired to the appliance, open the appliance and disconnect the power cord before making the tests. Be sure to reconnect the wires as they were before—black to black and white to white in most cases. If the cord has a three-conductor grounding cord that terminates in a plug with three prongs, be extra careful to reconnect the ground conductor to its proper place inside the appliance. Otherwise you may feed lethal current to the outer body of the appliance.

**Safety Checks.** Before a repaired appliance is plugged in for a final performance test, you should make some sort of safety check to be certain that there isn't a short to the outer body or other metal part of the appliance or tool. The VOM can be used by touching one probe to the metal housing of the appliance and the other alternately to each of the prongs of the power cord plug. If you get anything other than an infinity reading on the meter as you dial through the various multiplier settings



of the ohmmeter portion of the VOM, repair the indicated short before you apply full 110 volts to the appliance.

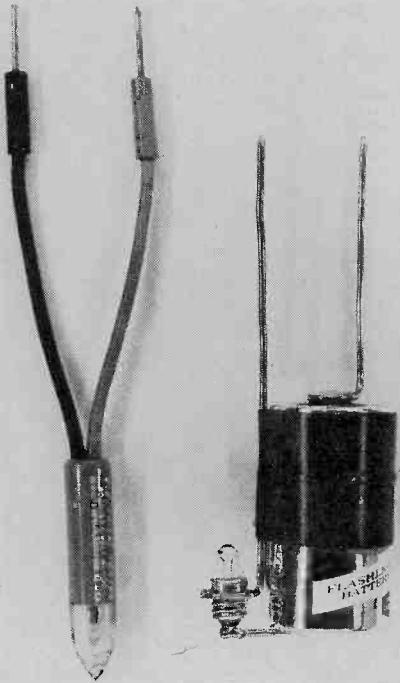
The VOM safety check is better than none at all, but not as reliable as the test you can perform with the simple tester shown in the drawing, because the higher, 110-volt test voltage can "punch through" a poorly insulated place to reveal a potential hazard that the very minute voltage generated by the VOM cannot do. Before using the tester, be certain that the bulb is good. Then attach one alligator clip to the metal housing of the appliance (in an unpainted area) and the other clip to one of the prongs of the power cord plug. *Momentarily* insert the tester plug into a wall socket while you keep clear of the appliance and tester. If the bulb glows you have a hazardous short. Perform this test with the appliance switch in both on and off positions. **Caution:** Do not leave the tester plug in the wall

socket even for a moment; withdraw it as you take your hand away so that you won't accidentally get a shock from the alligator clips. The tester can also be used as a continuity tester for power cords. Observe the same safety rules: make the proper clip connections, stand clear, then plug the tester into a wall outlet momentarily.

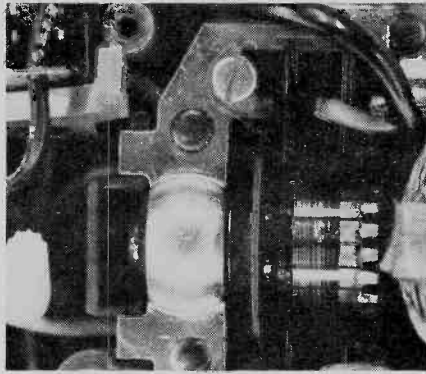
**Power Tools.** Troubleshooting a single speed portable power drill is quite simple. First check the power cord in the manner already described. If the cord is good, make resistance or continuity tests from the power cord terminals to the brush terminals. If there's no indication of current flow, look for a break between the power cord and brushes. Unloosen and retighten any connecting screws, bolts, or nuts; the scraping action can cut through corrosion that may be impeding current flow.

If the brushes look worn, replace

# Appliances



A handy continuity tester can be made by soldering a stiff copper wire to the end terminal of a size D flashlight battery, and taping a second wire to the body of the battery after forming a loop to hold a 1 1/2-volt flashlight bulb. Solder a short length of wire from the end contact of the battery to the bottom of the battery. Other ready-made neon test lamp is handy for checking 110-volt circuits, as in home wall outlets to make certain that fuses or circuit breakers have not blown to cause seeming malfunction of appliances.



Good place to check DC current in a variable speed drill is at the terminals of the reversing switch, which in this case is located in the top left corner of the drill housing. Worn brushes are easily replaced by taking out the two bolts that hold down plastic brush sleeves. Avoid using harsh abrasives when cleaning commutators of appliance and tool motors.

them with new ones you can obtain from an appliance repair shop or from some hardware stores. Accumulated dirt on the commutator, which could impede current flow from the brushes, should be cleaned off carefully with a piece of rough cloth. Avoid the use of sandpaper, steel wool, or other harsh abrasives that could scratch the commutator or leave gritty or gummy particles in the works.

If your old-fashioned drill with a metal housing does not have a three-conductor grounding cord, it would be wise to add one. Connect the current-

carrying conductors of the new cord in the same manner as were those of the old cord. Attach the ground lead to the metal body of the drill. Usually you can find a hold-down screw or bolt (not used to connect a wire) to which the ground conductor can be added. Use your VOM or continuity tester to make sure that the body of the drill is in fact connected to the third, odd-shaped prong on the power cord plug.

Troubleshooting a modern, variable speed drill is somewhat different. Such drills do not need a three conductor power cord because the plastic housing provides virtually foolproof protection.

To test or replace the power cord, open the drill casing *slowly* while you peer in through the crack to make certain you know where all the inner parts fit.

Resistance measurements made at the prongs of the power cord will vary, depending on how the speed control is set; expect a reading of about 12 to 25 ohms at the higher speed settings, and a seeming infinity reading at very low speed settings.

To make voltage checks, lay the opened drill on a pad of towels (to keep it from sliding around), preset the speed control to a low level, lock the trigger into the "on" position, and then carefully plug the tool to the power source. *Caution:* Do not attempt to run the open drill at any but a low to medium speed.

You should find 110 to 120 volts AC at the power cord terminals. But on the other side of the trigger switch you will be measuring variable DC voltage, so

## TYPICAL APPLIANCE RESISTANCE READINGS

(Measured Across Power Cord Plug Prongs)

### Shop Tools

	Ohms
Power drill, single speed	55
Power drill, variable speed	12 to ∞
Power drill, variable speed, heavy duty	6 to ∞
Soldering gun, 30 watts	28
Soldering gun, 240/325 watts	4
Saber saw	12
Radial arm saw	1.5
Circular saw, portable	3.8
Belt sander, portable	2
Belt sander, non-portable	2
Orbital sander	28
Router	2.5
Drill press	1.5
Shop vacuum	3
Tool grinder	5

### Kitchen Appliances

	Ohms
Toaster, 2-slice	12
Toaster, 4-slice	8
Toaster oven	10 to 18
Waffle iron, 550 watts	24
Knife sharpener	10

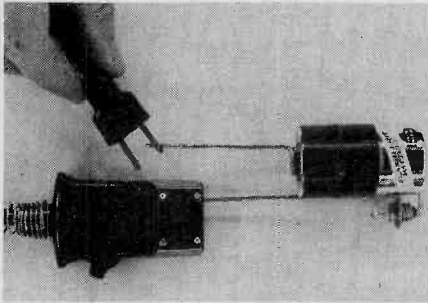
Food mixer, hand-held	32/60/90
Food mixer, hand-held	65 to 110
Coffee maker, 12 to 32 cups	20

### Personal Items

	Ohms
Shaver, man's	1250
Shaver, woman's	150
Hair dryer, table model	8/7/6/6
Hair dryer, hand-held, 275 watts	28/55
Hair dryer, hand-held, 215 watts	21/26
Face massager	90
Electric blanket, 2-contact jack	115
Electric blanket, 5-contact jack	48/60/90/150

### Misc. Appliances

	Ohms
Steam iron	12
Vacuum cleaner	13
Space heater	17
Hedge clipper	22
Humidifier, cool mist	14 and 25 (see text)
Humidifier, hot mist	3000 to 4000
Dehumidifier	7
Slide projector, 300 watts	2
Shoe buffer	32
Timer clock	900



Continuity tests on appliance power cords are easy with the battery and bulb tester. This plug-in unit has its own on-off switch which cuts off current in one conductor only, leaving the other conductor "alive" (as indicated by a glowing test lamp) even when the switch is in the "off" position.

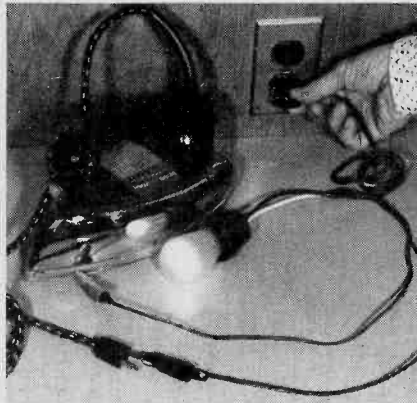
reset your VOM to the DC section, beginning with a high voltage setting and working down until the meter needle provides a reading somewhat away from the end of the scale. If you get no measurable voltage on the DC side, the SCR (silicon-controlled rectifier) or the slide resistance built into the trigger unit is probably defective. The only solution is to obtain a replacement trigger.

A convenient place to make DC voltage checks is at the terminals of the double - pole - double - throw reversing switch (if your drill is reversible). At very low speeds you might find only about 4 volts DC at these terminals. The voltage increases gradually as you cautiously increase the speed of the drill. You should also be able to read DC voltage across the brush connections. If the voltage is lower than at the reversing switch, look for poor contacts, bad brushes, dirty commutator. When the power is on, jiggle suspected parts only with a non-conducting tool such as a plastic swizzle stick or a length of dry wood dowel.

Basically the same troubleshooting methods would be used to find defects in any other powered shop tools. Single-speed tools will surely have AC motors. Look for DC currents in tools that feature variable speeds that are electrically rather than mechanically speed-controlled.

**Household Appliances.** Motorized household appliances, and the motorized sections of other appliances (the fan circuit of a space heater, for example), would be tested in like manner. But many appliances also have heater circuits requiring different troubleshooting methods.

If the appliance is completely dead, you first check the power cord. If that is good, take the appliance apart far



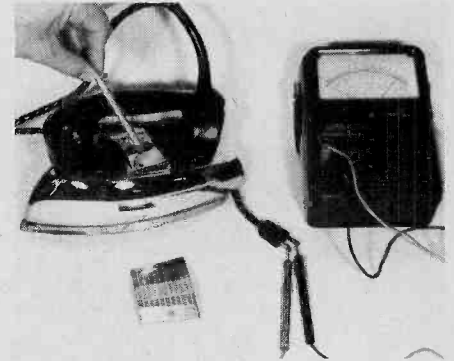
Safety check revealed that this steam iron had a dangerous current leak to the exposed metal surfaces. Note one alligator clip attached to the iron, the other to a power cord plug prong. Lamp should not light. Caution: keep hands away from appliance during test, and withdraw tester plug from wall outlet when you take your hand away to avoid shocks from alligator clips.

enough to get a good look at the inner components. Trace each circuit carefully, looking for breaks or bad contacts.

If you discover a break in a heating element, it usually means that you will have to obtain a replacement part. Remove the old element from, say, the steam iron or toaster, and take it to your appliance repair shop to aid in the selection of the proper replacement. Also take along the model number of the appliance. If the appliance is quite old, and an exact replacement is not available, the professional repairman may be able to make a simple wattage test of your defective element and suggest an alternative replacement (assuming that it would physically fit into your appliance).

If the appliance uses a coil-type heating element, a break can be repaired if the broken ends can be formed into small loops. (Sometimes the heater coil is so brittle that it keeps on breaking as you try to form the loops, in which case replacement of the entire coil is the only answer.) If you do succeed in forming loops, bolt them together as shown in the photo. Obviously the connection must be mechanical (bolt or rivet) because solder and cements wouldn't last even a few seconds when the coil heats up again.

**Thermostat Repairs.** Heat-producing appliances usually have thermostats that turn power on and off automatically to maintain desired heat levels. Sooner or later the thermostats begin to show signs of wear because of the pitting and corrosion that result from the inevitable arcing.



Simple resistance reading off power cord prongs can provide some indication of an appliance's condition. Hole in steam iron under nameplate provides access to thermostat adjustment screw.

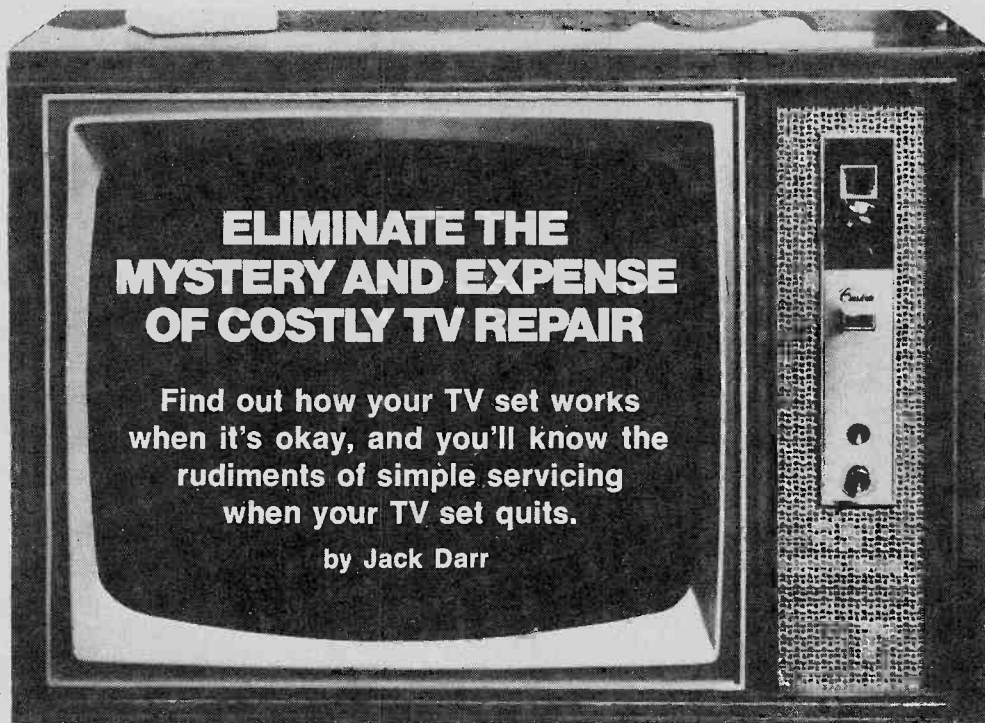
In many appliances the thermostats are adjustable, so if the appliance behaves normally except that it runs too hot or too cold, first try adjusting the thermostat with a control screw that increases or decreases tension on the contact points, depending on which direction the screw is turned. Usually, a clockwise turn will decrease the temperature, but this is not always the case—so experiment. If the thermostat has no adjustment screw, try bending the arms holding the contact points to increase or decrease the contact tension.

Incidentally, you may not even have to take the appliance apart to make thermostat adjustments. For example, many steam and dry irons have a nameplate on top of the iron, just below the handle, that is removable by prying at one edge to get at the assembly bolts. Next to the bolt you are likely to see a hole through which you can insert a screwdriver to the thermostat adjustment screw.

If the thermostat contacts are moderately corroded, gentle cleaning may help. If badly pitted, replacement may be the only answer. Dress the contacts *gently* with a fine file *only* as a last resort before buying a replacement, because the filing might only aggravate the problem by removing what still remains of the original hard metal contacts. However, sometimes the dressing can significantly lengthen the life of the thermostat.

You can use a small AM radio to test an appliance thermostat without even opening the appliance. Just place the radio near the appliance and tune clear of any very strong station, then operate the appliance. A good thermostat, when it goes on and off, will cause a short click in the radio; a bad thermostat will create a prolonged, raspy sound. ■





**E**VERY PROFESSIONAL television technician knows that a certain percentage of his service calls are going to be "nuisance calls." There won't be any *real* trouble with the TV set. It will be the simple things: set not plugged in, antenna lead-in unhooked, controls not set properly, and so on. The technicians call these "nuisance" calls because they really are to him. He doesn't like to have to charge you for a service call, but he has to; it costs him money to make it.

If you know how your TV set works, and how to check for the simple things, you can save yourself a lot of time and money. So we'll tell you about all of the nuisance-things, and how to find them yourself. It's easy. We will also tell you how to know when you *should* call a technician; you'll see, hear, and *smell* things that mean trouble. Besides these, we'll tell you several things that you should *not* do, to keep from doing further damage to the TV set. This will be confined to tube and hybrid type TV sets, for the solid-state TV sets can't be serviced by anyone but a pro. However, a whole lot of these tests will apply to all types.

**Using the Controls.** A lot of this will deal with the various controls on the TV set. We'll tell you how to check these controls for proper operation. You can use these tests to tell whether the set is working or not. In many cases, these controls will have been set wrongly, either by accident or by someone who didn't know how to set them. (Small-type kid brothers are very good at this; for the women's libbers, so are

small-type kid sisters!) So we'll tell you how to set them. If you know what each of these controls is supposed to do, you can tell whether the trouble is a simple misadjustment or some real problem in the set. We'll also tell you about the ones you must *not* adjust. Fiddling with these can mean that you will have to have a service call. There are also some conditions that mean "turn it off quick." If the set is left on when these things happen, it can cause more damage, and make the bill higher. We'll get to these later on.

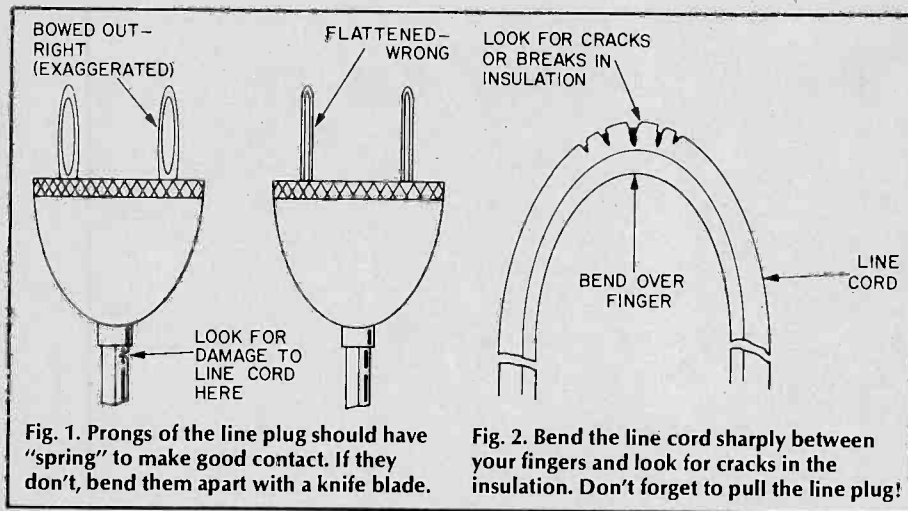
**Power.** If the complaint is, "The set doesn't light up at all," the first thing to check is the AC line cord. Be sure it's plugged in. Cleaning around the back of the set can accidentally pull the line plug. If the screen of the set doesn't light up, check to see that the pilot light (if any) is on. If it isn't this could mean that there is no power at all getting to the set. Peep in through the holes in the back cover and see if the tubes are lighting up. If they are, but the pilot light isn't on, the pilot light is burned out.

**No Light on Screen.** If the pilot light is on, but you have no light on the screen, you are getting power to the set. Check the brightness control. Someone may have turned it down too far. If you hear the sound, but the screen doesn't light, this could mean that the brightness control is turned off, or something more serious. Here is one of the main "no-nos." If you can get sound, but the screen refuses to light up at all, turn it off *quick*. Leaving a TV set on in this condition can cause quite a bit of

extra damage to tubes and parts, in certain conditions. There is one thing you can check: Look on the back of the set for a small red shaft coming out of the chassis, usually near the place where the line cord goes in. This is the circuit breaker. Push this in, and see if this brings back the light on the screen. If so, and it stays on, OK. However, if you push this and the set lights up but goes out in about one minute or less, *don't* push it again. You have some kind of short-circuit in the set, and it will need a service call. Repeated setting of the breaker can cause more unnecessary damage.

**TV Set Goes Off and On.** If the picture, sound, and pilot light go off and on at irregular intervals, check the line cord and the AC outlet. If everything quits at the same time, this is a very good suspect. Hold the plug in the outlet with one hand and move the line cord back and forth with the other. If this makes the set cut in and out, the wires are probably broken inside the insulation. Get a new plug, and cut the line cord at a point about 3 inches from the original plug. Most of these breaks will be right at the point where the wire goes into the plug. Check the other end of the line cord, too. If the break is at the point where the line cord goes into the set, you'll have to have a technician replace it. The "interlock" plug on the set end is molded on the cord and can't be replaced.

There is one other common cause for this. Check to see if the plug fits tightly into the outlet. When you push it in, you should feel a good deal of friction.



If it slips in easily it can fall out just as easily. Check the prongs of the plug. Many of these are "doubled" to give a spring action to make good contact. If they're flattened out, push the tip of a knife blade between them, to give them more "spring." Fig. 1 shows how to do this. If the plug is still very loose in the outlet after you do this, the outlet itself is worn out and will have to be replaced. Try the plug of a lamp in the same outlet to find out if it will light up.

**Check that Line Cord!** While you're working on the line cord, check its condition *very* carefully. You've probably heard of the alarming number of "fires caused by TV sets" in the media. This is exaggerated very badly, but it is quite possible for a bad line cord to cause a fire. These are almost always near curtains and other flammable materials, so if they should short, it's easy to start a fire. This is due to deterioration of the insulation of the cord. Pull the plug, and look it over very carefully.

The insulation should be smooth and "live." Bend the cord sharply between your fingers, and check it right at the bend. If the insulation has aged, you'll see fine cracks, or perhaps even breaks, exposing the wires. A line cord which has these conditions must be replaced at once. *Don't* tape it up and leave it; get a new one. Fig. 2 shows how this looks.

**Bad Pictures.** Now let's look at some of the troubles that you can have. If you do have a picture and sound, but they're not as good as they should be (Fig. 3), there are several simple things which can cause this. There are several of these which can fake troubles inside the set, and cause you to call a technician. Let's see about the ones you can check out.

One of these is too much snow in the picture. The sound may be all right, or it may have a blowing or roaring sound if the picture is very weak. This can be caused by trouble in the TV antenna or

the lead-in. Whether you have an outside antenna, rabbit-ears, or a cable, check the connections on the back of the set. The lead-in connects to two small screws on an insulating panel, usually near the top of the set. If one of the wires is off, you'll get snow. Be sure that the wires are tightly held under the screws. If you have one of the "quick disconnect" antenna connectors, called "clothespins," be sure that this hasn't slipped off. The screws should be loosened about two turns so the clothespin can get a grip on them. Most sets now have two sets of antenna connectors, one for VHF and the other for UHF. If the antenna lead-in is fastened to the UHF terminals, and your stations are all VHF, you'll get very bad pictures.

If you have an outside antenna, the lead-in may have broken on one side, due to the constant flexing from the wind. The lead-in is usually a flat ribbon type of wire called "300-ohm twin-lead." It is quite possible for one side of this wire to break, inside the insulation. The fastest way to check this is with an ohmmeter. Take the lead-in off the TV set, and check between the two wires. This should be a complete DC circuit, from one wire up through the antenna and back down the other. You should see about 5-6 ohms in the average lead-in antenna combination. For the rabbit-ears antennas, you may see continuity from one side of the lead-in to the other, or you may not. If you don't, check from each wire to one arm of the antenna; one wire will go to each one.

If you do find the lead-in open, you'll have to lower the antenna and put on a new lead-in. The plastic insulation of the lead-in will deteriorate after a few years of sunlight, and a new line will often improve reception noticeably. Most antennas can be lowered without too much trouble, or reached from a ladder. You should have a lightning



Fig. 3. Snow in the picture. Weak signal. This may indicate antenna trouble.

arrester installed right at the place where the lead-in goes into the house. Take the lead-in off this and check it. If it has been hit by lightning, the arrester itself may be damaged, and shorting out. You should read a completely open circuit across the two terminals of the arrester.

The final test for antenna trouble is to try another TV set on it. If this set too shows too much snow, then you can be pretty sure that the antenna itself is the problem. If the test set shows a good clean picture, then it's time to take the first one to a shop; it has a weak tube or some kind of trouble in the tuner. Make all of the other tests first, of course.

**Scrambled Pictures.** If you can see that there is a good strong picture signal present, but it's what many people call "scrambled," you have a "sync problem." Every TV set has two controls to hold the picture in place, or "in synchronization" (and from now on it's "sync" for short). Strangely enough, we call these the "hold" controls. One holds the picture vertically, and the other horizontally. In the older sets, these controls will be at the bottom of the front panel; in portables, they may be on the side; and in some sets, on the back apron of the chassis (Fig. 4). They'll be marked "H(orizontal) Hold" or "V(ertical) Hold."

**The Vertical Hold Control.** The best way of learning how these controls work is to try them out on a set that is in good shape. The vertical hold control, turned one way, should make the picture roll downward. At first, it'll roll slowly, and as you turn the control farther, it'll go faster. Turn the control back to the center, and stop the picture. Now go the other way. Normally, turning this way, the picture should stay locked in until you reach a certain point, and then break out, going upward pretty fast. Technicians usually say "rolling" for a picture moving down, and "flipping" for one that's moving up. Remember how these control-reactions work; we're going to use

## ELIMINATE COSTLY TV REPAIRS

them in a minute.

If the vertical hold control is turned away too far in either direction, the picture may be moving so fast that you can see two pictures at once; there will usually be quite a lot of flickering. Now check: Move the hold control very *slowly* from one end to the other. At some point near the center of rotation, the picture should slow down, then stop and lock, if the set is working all right. Now, here are a few abnormal reactions that mean you must call a technician: One, if you can not make the picture even slow down in its rolling or flipping by turning the vertical hold control. Two, if you can make the picture stop, but it will not lock; it floats up and down. Try this before sending the set to the shop: Roll the picture down very slowly by setting the vertical hold control. Watch the horizontal black bar across the picture. This is the "vertical blanking bar" between each picture. When this bar reaches a point about 2 inches from the bottom of the screen, the picture should suddenly "snap" into hold, even if only for a second. However, if the bar floats smoothly on down without even pausing, or if you can turn the vertical hold control in the other direction and make the picture move *up* very slowly, you have a sync problem. This means a trip to the shop.

Here are a couple of no-nos: On the back of the set you will see two controls marked "V Size" (or "V Height") and "Vert Lin"(earity). Leave these alone. If you get these adjusted so that the picture is *stretched* too far, you can cause a fake sync problem, and an unnecessary trip to the shop.

**The Horizontal Hold.** Now we come to the control which will show a different reaction. When the picture is rolling vertically, it's easy to see that there is a picture there. However, if the picture is out of sync horizontally, you get an entirely different pattern. Remember that the picture is still being scanned vertically. So if the horizontal hold is out of adjustment, you'll see a pattern that looks like Fig. 5. You won't be able to see a picture at all—nothing but a series of slanting lines. (The fact that there *are* thick, black lines on the screen shows that you *do* have a picture, but it's out of sync horizontally.) These lines may slant from upper right to lower left, or upper left to lower right, depending on which way the horizontal sync is off. If you have only 2 or 3 horizontal lines, you may be

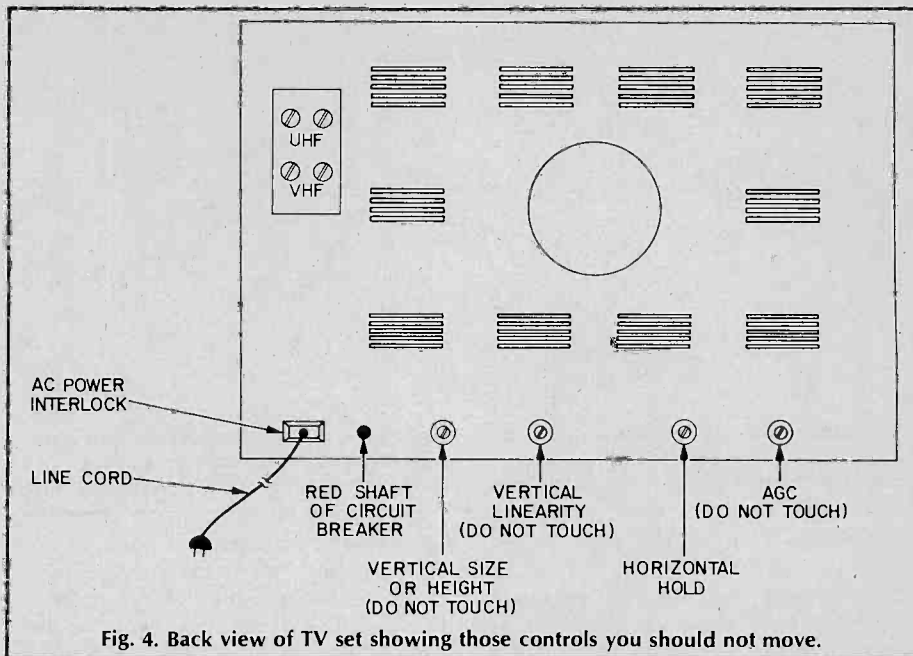


Fig. 4. Back view of TV set showing those controls you should not move.

able to see a distorted picture in there. This means that the horizontal hold control isn't too far off. However, if you see 8 or 10 slanting lines, the hold control is quite a bit off the right setting. The more lines you see, the farther it's off, and the less they'll slant. In some cases they may even look as if they are actually horizontal, but they're not.

To clear this up, turn the horizontal hold control very slowly, watching the screen. If the horizontal hold control is on the back of the set, prop up a mirror in front of the set so that you can check the screen. When you move the hold control, you'll see the lines change. If you get *more* and thinner lines, you're turning the wrong way. Back up, and you'll see the lines get thicker, more slanting, and fewer. This is right. Keep on turning slowly and you should find a point where the picture will straighten up and lock in.

Now, turn the horizontal hold control just a little bit more. To check for correct operation of this control, turn the channel selector to another station, or to a dead channel, then back to one with a picture. If you have it set just right, the picture will snap in, firmly locked. If you see it break up into slanting lines for a second or two and then lock in, it's not quite right yet. Adjust the horizontal hold control just a little bit and repeat the channel-change test. If it's worse this time, you went the wrong way. Turn it just a wee bit in the other direction and repeat. Keep on until you see the picture snap in, tightly locked.

**Finding Troubles.** Now then: If you can't get the picture to lock in by adjusting the horizontal hold control, but

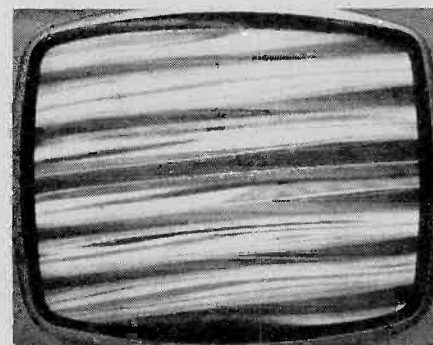


Fig. 5. Slanting lines are a sure sign of horizontal trouble. You may not see a partial picture, just light and dark lines.

it "sits up" for a split second and then falls out slanting the other way, there is trouble in the set. In a lot of these, if you carefully "fiddle" the horizontal hold control, you can make the picture straighten up; it will float off sideways, or fall out of sync again whenever there is a change in the program. This means a trip to the TV shop. All horizontal hold controls should have a "hold range" of about one half of a turn at least before the picture starts to be unstable.

There are two common types of horizontal hold controls. One is a variable resistor like a volume control. These will have a range rotation of about 320 degrees. Normally, you won't be able to get the picture very far out of sync with this type. The other type is actually the adjustable core of a coil. (The horizontal oscillator coil.) This type *should* have a special knob with an "ear" on it, so that it can't be turned more than 320 degrees. How-

(Continued on page 101)



# Who Said Amateur Radio Is A Rich Man's Hobby?

by James R. Fisk, W1DTY



IF YOU ARE INTERESTED in radio and the thrill of direct two-way radio communication with persons on the other side of the world, would like to try satellite communications from your own home with equipment you can build yourself, or would like to help out with emergency communications during times of disaster, the world of amateur radio is the answer. More than a million people, of all ages and occupations, in almost every country of the world, are enthusiastic radio amateurs, and each night's operation is a new adventure. As you tune your shortwave receiver across an amateur band you may hear an Arabian prince talking to a sheep herder in Australia, or position reports from a teakwood raft drifting across the South Atlantic, or one of the descendants of the crew of the *HMS Bounty* discussing the weather on tiny Pitcairn Island in the remote Pacific.

Further up the band you may find members of an Antarctic expedition running phone patches to their families in the States, or a missionary in the jungles of the Amazon requesting medical supplies. But listening is only a small part of the thrill of amateur radio—turning on your own transmitter and talking to these same stations is even more exciting.

It's not difficult to become an amateur, nor expensive, and anyone can qualify regardless of previous training or experience. Boys and girls 10 years old have become amateurs, as have men and women of eighty. You do have to pass a license exam, but it's no more difficult than obtaining a driver's license and requires about the same amount of study. Once you have your license you can put an amateur station on the air for \$100 or less (my first station cost the equivalent of \$75 of today's inflationary dollars), and if you plan your

purchases carefully, you can get nearly 100% return on your investment when you want to improve your equipment.

**Amateur Licenses.** In the United States the amateur licensing structure is arranged like a ladder with the easiest license, the Novice class, at the bottom, and the most difficult, the Extra class, at the top. In between are the Technician, General, and Advanced classes, with each additional class providing more operating privileges. Most amateurs begin as Novices and progress up the ladder as they improve their skills.

The Novice license requires that you send and receive International Morse code at five words per minute and pass a relatively simple, twenty-question, multiple choice test on radio fundamentals and regulations. This exam can be given in the relaxed atmosphere of your own home under the supervision of a General class amateur, so you're not under the pressure of unfamiliar surroundings or an unsympathetic test administrator. With more than 275,000 licensed amateurs in the United States, more than likely there is another amateur right in your own home town and perhaps a local radio club. They can be located through your local radio parts store, high school science teacher or Boy Scout troop and will help you get off to a good start.

The code requirement may sound difficult, but it isn't—if you can memorize the code elements for the twenty-six letters of the alphabet, ten numerals, and a few punctuation marks, you can probably already receive code at about six words per minute. You can bone up for the written part of the test with *The Radio Amateur's License Manual* which is published by the American Radio Relay League. They also publish a book on learning the code.

Within a month of deciding you want

## SOME BOOKS FOR THE BEGINNING AMATEUR

The American Radio Relay League is located at 225 Main Street, Newington, CT 06111. Their *Gateway to Amateur Radio*, priced at \$2.50, includes *How to Become A Radio Amateur*, *The Radio Amateur's License Manual*, and *Learning the Radiotelegraph Code*. Another excellent book is the *Novice Radio Guide* (\$3.50) published by Ham Radio Magazine, Greenville, NH 03048.

to become an amateur you should be able to prepare yourself, in your spare time, to take the Novice exam. After you have passed the test and are waiting for your new license ("ticket" in ham parlance) to arrive, you can start thinking about putting your amateur station together. Remember, however, that there are heavy penalties for operating an unlicensed transmitter—a maximum of two years in jail and a fine of \$10,000—so don't get on the air until you have actually received your license from the FCC.

**Station Equipment.** When it comes to putting your first amateur station together, there are many possible choices including home-built equipment (called "home-brew"), surplus radio gear, kits, and second-hand or brand new, factory fresh equipment. Your local radio club may have some "loaner" equipment to get you started, or a local amateur may have some spare equipment he will let you borrow, but eventually you will want to have your own.

At this point you are probably asking yourself, "What exactly is the *minimum* equipment required for a practical, working amateur radio station?" Well, the five basic items are a communications receiver, a crystal-controlled transmitter, a lowpass filter, a telegraph key, and an antenna. You'll also need a sta-

## RICH MAN'S HOBBY

tion logbook to record your transmissions (and contacts, if you want) and a good clock. Later you may want to add a changeover relay which automatically switches your antenna between the receiver and transmitter, a line monitor which tells you how well your transmitter is matched to your antenna, or a variable-frequency oscillator (VFO) that allows you to easily move your transmitter from one frequency to another, but these aren't necessary to get started.

You should also arrange to have a sturdy table to put your equipment on and a comfortable chair. Folding card tables aren't usually very satisfactory for operating tables because they are much too flimsy, and radio equipment is heavy, but you can often find a reasonably priced kitchen table or old desk at your local Goodwill or Salvation Army store. A cushioned secretarial chair is ideal, but nearly anything except a deep-cushioned living-room chair is usable.

**The Receiver.** Of all the items in your amateur station, the receiver is the most important. It is also the most expensive item, but since you can use the same receiver as you progress up the amateur ladder, a good investment in the beginning will pay off in the future. Although some Novices build their own receivers, this approach is full of pitfalls unless you have a more experienced amateur looking over your shoulder, and I recommend that you begin with a good, used communications receiver. Later on, after you have built some simple radio equipment, you may want to tackle your own receiver.

Although performance is the most important consideration when you buy a communications receiver, buying a receiver is a lot like buying a camera or an automobile—all other things being equal, your ultimate choice is based on personal preference and the "feel" of the operating controls. Although "feel" is difficult to define, performance boils down to three main categories: sensitivity, selectivity, and bandwidth.

Sensitivity is a measure of the receiver's ability to receive weak signals and is specified in terms of input voltage at the receiver's antenna terminals in microvolts (millionths of a volt) to produce a 10 dB signal-to-noise ratio (signal ten times as loud as the receiver's background noise). Sensitivity of one microvolt is adequate for operation on the Novice 80- and 40-meter bands while one-half microvolt sensitivity is



adequate on 15 meters.

Receiver selectivity indicates how well the receiver separates desired signals from interference and is closely tied to bandwidth and dial calibration. Many low cost receivers, for example, use only an inch or less of dial space to cover a complete amateur band so it's practically impossible to separate one signal from another. On the other hand, more expensive receivers designed specifically for amateur use spread the band out over 10 or 12 inches or more so adjacent signals are further apart on the dial. Selectivity is provided by narrow-tuned amplifiers or filters in the receiver that can be visualized as a narrow gate through which the signals emerge. However, if the receiver tunes by the gate too quickly (narrow bandwidth), it's practically impossible to line up the desired signal with the gate.

Before you buy your receiver, talk to local amateurs and ask their opinions.

They can also give you an idea of pricing and may even know someone who has a good receiver for sale. When you have made your choice, try to arrange to use the receiver for a short time on a trial basis to find out if it really meets your needs.

Following are several different communications receivers, arranged in ascending order by price, that will give good performance on the amateur bands. Resale value was also considered when making this list and, in general, if the receiver is still in good condition when you decide to sell it (or trade it in on a more expensive model), you can expect to sell it for nearly what you paid for it.

- BC342. Military surplus general-coverage receiver for 1.5 to 18 MHz in six bands. Two rf amplifiers, crystal filter, 117 VAC operation (the BC312 and BC348 are similar but are designed for 12 or 28 volt DC power supplies).

1942-1945. About \$50.

- National NC300. Dual-conversion amateur band receiver, 1.7 to 30 MHz, plus 30 to 35 MHz for VHF converters. 1955-1958. NC303 is updated version introduced in 1958, \$75 to \$135.

- RME 4350A. Dual-conversion amateur band receiver for 1.8 through 29.7 MHz. 1956-1957. About \$90.

- Hallicrafters SX101. Double-conversion amateur band receiver with one rf stage, selectable sideband, and crystal calibrator. SX101A is later model. 1957-1960. \$90 to \$125.

- Hammarlund HQ110. Amateur band receiver with dual conversion above 7 MHz. Product detector and one rf stage. Introduced in 1958, replaced by HQ110A in 1962. \$100 to \$150.

- National HRO-60. Amateur band receiver with plug-in coil assemblies, dual conversion above 7 MHz. Has rf amplifier stage, good bandsread and selectivity. Many still in use. \$150 to \$175.

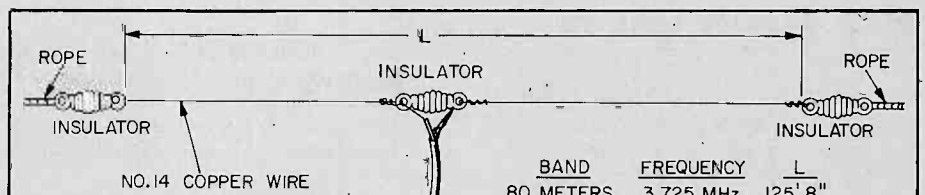
- Drake 2C. Triple-conversion amateur band receiver with 500-kHz tuning segments on each band. (1968). Hybrid design using both tubes and transistors. Drake 2A (1960) and 2B (1961) are earlier versions. \$150 to \$180.

- Heath SB-300. Amateur band receiver covers 3.5 to 30 MHz with 500-kHz segments. Rf amplifier, crystal lattice bandpass filters (1963). SB301 (1969) and SB303 (1971) are later versions with increased use of semi-conductors. Homebuilt from kits. \$200 to \$300, depending upon model.

- Collins 75A4. High performance amateur band receiver with variable IF, highly selective IF filters, crystal calibrator, noise limiter, and Q-multiplier. Generally conceded to be one of the best amateur receivers ever produced. \$300 to \$450, with high serial numbers (5000 and above) demanding higher prices. Collins 75A1, 75A2 and 75A3 are earlier versions priced in the range from \$125 to \$250.

This is only a sample of the many used communications receivers which can be found on the market, but will give you an idea of what is available. Generally speaking, the newer models offer a little better performance, or include more built-in amenities such as crystal calibrators, highly-selective filters, and Q-multipliers; but just being newer doesn't necessarily make it better. Some older, well built receivers will run circles around brand-new, inexpensive models fresh off the shelf.

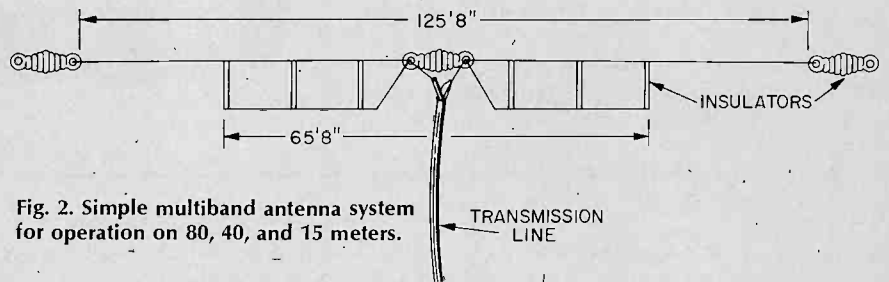
**Receiver Kits.** You may want to consider building your own receiver from a kit. This approach has few of the pitfalls associated with building a receiver from scratch, and you can learn a lot about radio construction



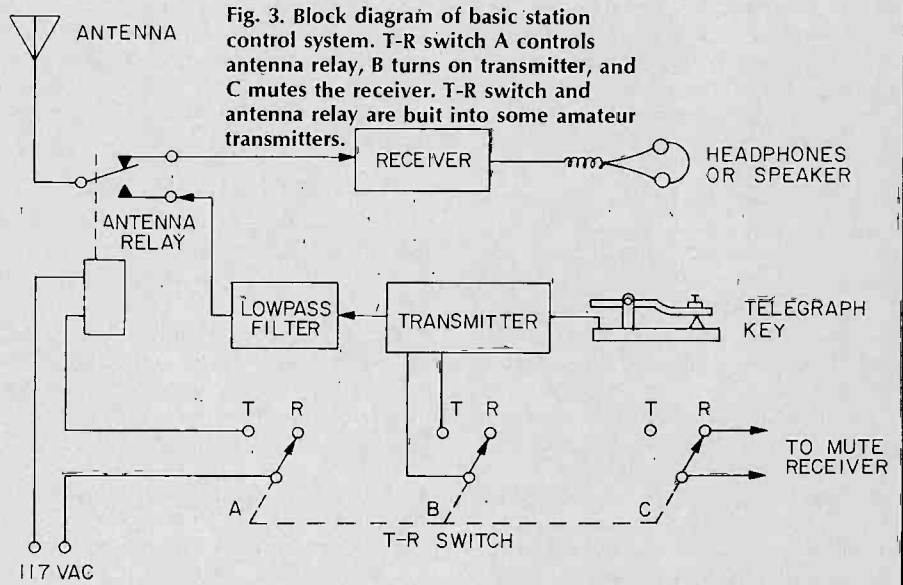
**Fig. 1. Simple half-wavelength dipole antenna is inexpensive and easy to build. Length depends upon the desired operating frequency.**

BAND	FREQUENCY	L
80 METERS	3.725 MHz	125' 8"
40 METERS	7.125 MHz	65' 8"
15 METERS	21.150 MHz	22' 2"
10 METERS	28.150 MHz	16' 8"

PL-259 COAXIAL CONNECTOR  
COAXIAL TRANSMISSION LINE TO EQUIPMENT (RG-11/U OR RG-59/U)



**Fig. 2. Simple multiband antenna system for operation on 80, 40, and 15 meters.**



**Fig. 3. Block diagram of basic station control system. T-R switch A controls antenna relay, B turns on transmitter, and C mutes the receiver. T-R switch and antenna relay are built into some amateur transmitters.**

from building a kit. Even if you've never built any electronic gear before, you should have no trouble—the construction manuals are well illustrated and provide step-by-step assembly instructions.

The Heathkit HR-10B five-band amateur receiver kit, for example, covers the amateur bands from 3.5 to 30 MHz, includes a selective crystal IF filter, and offers performance comparable to much more expensive factory-built receivers. The HR-10B has a built-in signal-strength meter (S-meter), a calibrated slide-rule dial, separate rf and audio gain controls and is priced just over a hundred dollars. You will need a vacuum-tube voltmeter (VTVM) and a signal generator for receiver alignment,

but you can probably borrow these items from a local radio amateur or electronics hobbyist.

**The Transmitter.** Since Novices are limited to CW (telegraphy) operation and transmitting powers of 75 watts, as you progress up the amateur ladder the first item in the station to get replaced is the transmitter—usually with a higher-power unit that can be used for voice transmissions (called phone or single sideband). This means that new Novices have a large selection of used equipment from which to pick. There are also some excellent older CW-only transmitters on the market which are very good values. Many of these are still being used by old-timers who prefer CW operation to phone, but they



## RICH MAN'S HOBBY

can still be found if you look around. There may even be an amateur in your home town who has an unused CW transmitter sitting on his shelf, the one he started with and has held onto for sentimental reasons.

Novices have the choice of crystal control or VFO operation. Although a VFO allows you to move at will from one frequency to another, you must have a well calibrated VFO or receiver to make sure you don't operate outside the Novice band limits. Crystal control, on the other hand, is less expensive, and you know exactly what frequency you're operating on. As a Novice I recommend that you start out with crystal control, and after you've gotten your feet wet with some actual on-the-air operation you can consider going to VFO frequency control.

Some amateurs have started with military surplus transmitters, but except for the old ARC-5 series (also known as Command Sets), military equipment usually presents more problems than the beginning radio amateur can cope with. They are poorly shielded for the most part, so you may have difficulties with television interference, and many require rather special power supplies. If you happen across a surplus military transmitter that has already been debugged by a more experienced amateur, it may be a good buy, but I recommend that you stick to transmitters which were designed specifically for the amateur service.

You may also elect to build your own transmitter. Compared to receivers, transmitters are relatively simple and can be built without too much difficulty. In fact, if you pick up a couple of junked tube-type television sets from your local radio-TV store, you will probably end up with enough parts to build several transmitters! Several excellent transmitter circuits appear in the *Radio Amateur's Handbook* and *Understanding Amateur Radio*, both of which are available from the ARRL.

You may also want to consider building your transmitter from a kit. The Heathkit DX-60B, for example, which sells for about \$110, is designed to operate at the 75-watt level with crystal or VFO control. An optional VFO, the Heathkit HG-10B, is priced at \$57. Since the DX-60B will work on all five high-frequency amateur bands, and also includes built-in amplitude modulation for phone operation, it makes an excellent starter transmitter because it will provide good service as you advance to the General class.

The Heathkit HW-16 is one of the few transceivers ever designed specifically for the Novice amateur. It features CW operation on the 80, 40, and 15 meter bands, true break-in capability with solid state T/R switching, 75 watts input for Novices and up to 90 watts for General and above. The HW-16 is available for \$129.95 plus shipping from Heath Company, Benton Harbor, MI 49022.



CIRCLE 16 ON READER SERVICE COUPON

For the budget-minded Novice, however, the used equipment market represents a vast resource. Following are some excellent CW transmitters that can be found on the used equipment market. Although some of these units will run higher power than Novices are permitted, they can be easily throttled back to 75 watts input.

### GOLDEN OLDIES

- Heath DX20. 50-watt crystal-controlled transmitter, originally built from a kit. 80 through 10 meters. 1955-1959. \$15 to \$25.
- Heath DX35. 90-watt crystal-controlled transmitter originally built from a kit. Includes built-in modulation for phone operation. 80 through 10 meters. DX45 is later version. 1958-1961. \$25 to \$50.
- Heath DX100. 180-watt transmitter with built-in VFO and modulator for phone operation. 80 through 10 meters. DX100B is later version. 1958-1965. \$40 to \$75.
- Ten-Tec TX100. 75-watt crystal-controlled transmitter designed for Novice 80, 40, and 15 meter bands. Features preset antenna loading control for simplified tune-up. \$50 to \$75.
- Drake 2-NT. All-band CW transmitter with built-in antenna changeover relay, and CW break-in circuit. 100 watts input. Optional VFO available. Companion to Drake 2C receiver. Designed specifically for the Novice. 1967-1968. \$65 to \$90.
- Johnson Ranger. All-band CW transmitter with built-in VFO. Originally available as a kit or factory built. 90 watts input. Still very popular, price is stable. \$75 to \$100, with higher prices for factory-built units.
- Collins 32V3. All-band CW trans-

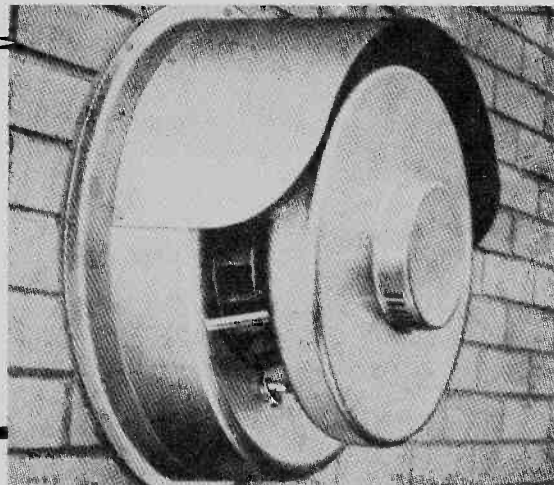
mitter with excellent built-in VFO. About 150 watts inputs. Ruggedly built, typical price of this transmitter has changed little in 10 years. 1950s. \$125 to \$150.

● Johnson Valiant. 200-watt CW transmitter with built-in VFO, break-in, antenna changeover relay and provision for phone operation with optional modulator or SSB adapter. Factory and kit versions. Valiant II is later model. \$125 to \$200.

**Transceivers.** Still another possibility for the beginning amateur is the transceiver—a unit which combines the receiver and transmitter into a single unit of equipment. Although a bit more expensive than either a transmitter or receiver, in many cases the transceiver represents an overall savings on buying separate units. Unfortunately, few transceivers have been designed specifically for the Novice (the Heath HW-16, \$129.95, is one exception). However, there are a number of higher-power amateur transceivers which can be used by the Novice. Before you purchase a transceiver, however, get some help from a more experienced amateur because some of these units cannot be efficiently operated at 75 watts input, the maximum Novice power level.

**The Antenna.** The antenna is a very important part of your amateur radio station, but it is also the least expensive. (Your antenna can also be the most expensive item, but few beginning amateurs install anything more complex than the simple dipole antenna shown in Fig. 1.) Your antenna should be as high as possible, and suspended away from any nearby objects, but many amateurs operate very successfully with antennas in their attics or with antennas

(Continued on page 100)



# Cut In a Wall Fan and Save Cool Cash

by Dan Gannon

**I**N THIS TIME of soaring prices and costs one of the best ways to save a buck is to install a wall fan. No, we're not kidding. Wall fans can give you a couple of extra years on a paint job, eliminate the need for an air conditioner or two, keep your basement shop supplied with fresh air to cut down on tool rust, exhaust chemical fumes from your darkroom or printed circuit board preparation area, and even get rid of stale household odors (though odors don't generally cost you money).

Still think we're joking? Okay, let's take a closer look at how a wall fan works for you. First the kitchen. Any family cooking introduces grease molecules into the air. Unless it's sucked out

by a well-ducted range hood (not one of those recirculating filters) the grease spreads throughout the house, darkening wall and ceiling paint and wallpaper. Quite often the house that needs re-painting every three or four years can get six years or more on a paint job (or wallpaper) if there's a good wall fan in the kitchen.

And when it comes to saving power, a good fan is king. Say you've got a good size air conditioner in the living room or den. But the kitchen and dining area steams from the oven when you cook. There's no need to invest in extra air conditioners—and the extra electric cost; just install a moderate size wall fan in the kitchen or dining area

—about 600 to 650 cfm (cubic feet per minute). It will pull in just enough cool air to keep the kitchen and dining area comfortable. You won't need a sweater, but you won't be supporting the local electric company with extra—unnecessary—air conditioners. You can pull off the same trick if you have a small bedroom or den opposite an air conditioned room. A small wall fan will generally pull in enough cool air to keep you comfortable without exhausting all the cold air in the next room. Just keep in mind that a wall fan takes a lot less electric power than an air conditioner, and a kilowatt saved pays for the next increase in gasoline and home heating oil.



**Fig. 1.** Pick a location for the grille-damper, and make certain it's between two wall studs. Using the duct as a template, scribe the outline on the wall and then use a razor to cut away the wallpaper.



**Fig. 2.** If the wall is sheetrock (drywall) score the outline with a knife, a narrow chisel, or an old screwdriver, then cut all the way through and punch out the circle.



**Fig. 3.** If the wall is plaster, scribe the outline and then chip out the plaster until the lath is exposed. The lath can be either strips of wood, wire mesh, or plasterboard—a sheetrock-type material with a pattern of large holes into which the plaster locks when dry.

## WALL FAN SAVES COOL CASH

Down in your shop a wall fan will expel damp moist air and suck in drier air from upstairs. It's not as efficient as a dehumidifier, but a dehumidifier is really a small air conditioner and costs almost as much to run. Not every basement is damp enough for a dehumidifier; often, a fan is all that's needed to keep rust off your tools. And don't overlook the fact that a fan will suck out the fumes from printed circuit chemicals, Krylon-type spray paints, and plastic solvents. The lungs you save

might be your own.

"Fine," you say, "I'm ready for a wall fan." Unfortunately, a commercial installer will charge the cost of his next vacation to install any fan. And if your house has brick walls, he'll take his next *two* vacations on you. But the truth is a wall fan installation can be done by anyone familiar with tools, and you as an electronics hobbyist should be perfectly able to do a professional installation. After all, you have most of the tools, and what you don't have can be

rented for well under \$10 a day.

Before we show you how easy it is to install a wall fan, the first step is to get the right fan. Virtually every hardware and discount store sells wall fans; there are more models than politicians looking to raise your taxes. We suggest the type where the fan itself is outside the house (in a waterproof housing), so it sucks the air through a duct, rather than pushing it through. What's the difference? Almost maintenance-free ducts. When the fan is inside the house



Fig. 4. If you have made a measuring error and find a stud running past the hole, don't panic. The wall will stand even if you cut through one stud. Use a saber saw to trim the stud so the cuts correspond to the circular duct pattern.



Fig. 5. Remove any insulation between the inner and outer walls and then drill through the exact center of the outer wall. The hole will be the pilot when you're working on the outside. If the wall is masonry or brick use a carbide tipped bit. A standard bit is okay for a frame construction (wood siding).

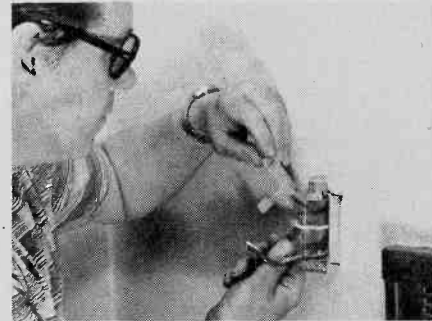


Fig. 6. Before cutting the outer wall and mounting the fan unit, install all the necessary electrical wiring. While you can use a simple on-off switch, a multi-speed selector switch or variable speed control can be a great help when you want to move air slowly, in small quantities.

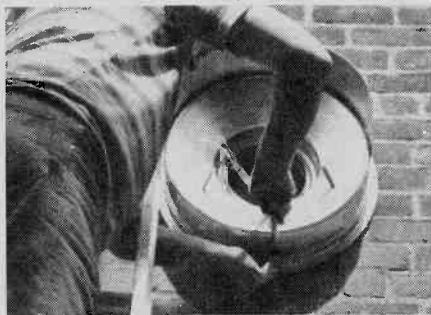


Fig. 10. If you have no one to help when mounting the fan assembly, cut down the overall weight by removing the motor and fan from the rain shield. Secure the shield to the wall and then install the motor and fan. Note the electric wires from inside the house coming up through the shield.



Fig. 11. Install the motor, making certain the BX cable armor runs all the way to the motor connection box to provide a solid electrical ground. If you're using Romex wire make certain you use the type with the ground wire, and double-check that the ground is secure at the motor.

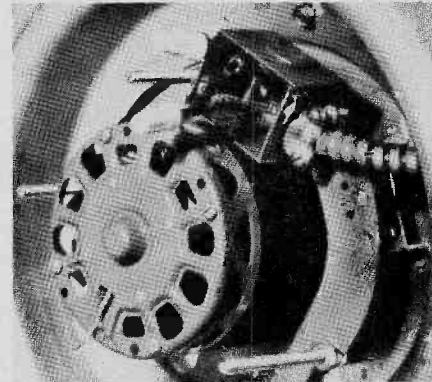


Fig. 12. Here is a close-up of the fan motor and electrical connections. BX cable comes from house wiring and connects to an electrical box mounted on the motor. Wire nuts cover the splices.



at the start of the duct to the outside, the fan pushes the air into the duct. The air pressure decreases along the duct and the grease drops off along the duct. Eventually, the duct will have a heavy grease layer that will have to be cleaned out.

When the fan is on the outside, at the end of the duct, the air velocity builds as it travels through the duct to the fan, and much more grease is discharged—less settles along the duct.

When the fan is mounted outside,

the input to the duct has automatic damper doors that keep out the cold air in winter and bugs in summer. When the fan starts, air velocity (suction on the duct side) causes the doors to automatically open.

One of the best choices in fans from a budget and ease-of-installation viewpoint is the NuTone WF-1N for wall mounting, or its cousin the RF-1N roof fan. Both are rain-proof and are the same type as used at your local pizzeria—and you know what kind of ex-

haust problems a pizzeria has, or for that matter, any restaurant.

Both fans take a multi-speed control, standard 8-in. round ducts, automatic damper, and a mesh grease filter. To show how easy a wall fan installation can be, we've taken on the most difficult of all: a house with a brick wall. Just follow the steps shown in the photographs and you'll have as little trouble as our installer—an electronics hobbyist with little in the way of carpentry experience. ■

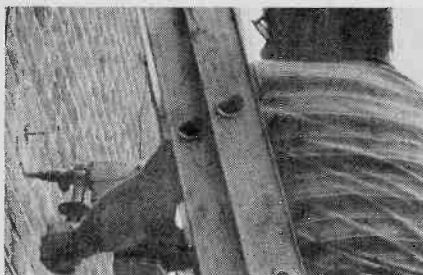


Fig. 7. While a saber saw can be used to cut through a frame outer wall, something a lot heavier is needed for brick. You can hack away at the brick with a cold chisel and sledge, but a few dollars spent to rent an electric hammer (with chisel bit) will let you bust out the wall in minutes. Note the screw sticking through the pilot hole, used to center the duct circle scribed with chalk.



Fig. 8. The final trim is done by hand with a cold chisel and small sledge. The sheet metal duct should just slide through the hole without bends or a force fit. Chip away small bits of brick until the duct can slide in and out easily.

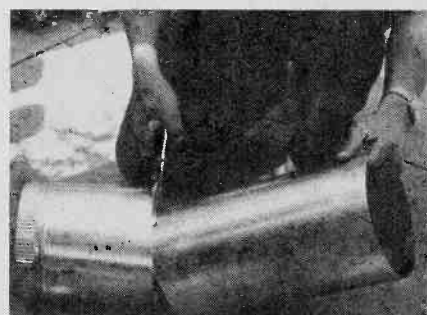


Fig. 9. The damper assembly is generally long enough to pass through thin-walled buildings. If you need extra length, standard 8-in. flue pipe obtainable at local plumbing outlets can be cut to size.

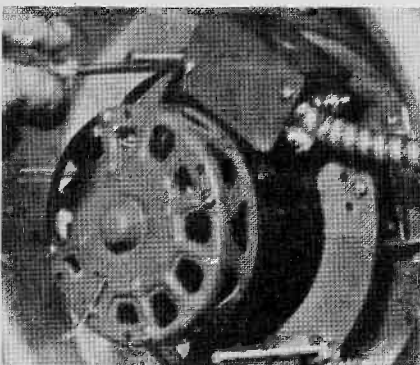


Fig. 13. After the connection has been made, the box cover is screwed in place. Now check that the fan rotates freely and the housing is secured firmly to the wall. Some weatherproofing caulking is necessary. Less than one half a cartridge from a grease-gun squirter is needed.

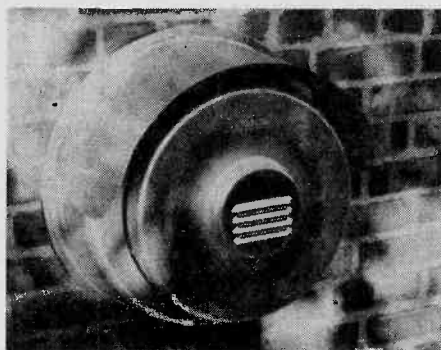


Fig. 14. Finally, secure the motor's cover in place to complete the outside installation. Turn the power on and check that the fan rotates quietly without hitting any obstruction in the 8-inch duct. The neat appearance and low noise level of the fan will not be offensive to your neighbors.



Fig. 15. After the fan is checked out for operation and multi-speed control (if so equipped), install the automatic damper doors and grille on the inside. Be very careful not to bend or force the damper doors into the duct. Make certain the dampers swing open at all settings of the fan's multi-speed control. The wire screen should be removed periodically for cleaning. Don't wait too long; if you do, you'll be wasting valuable electricity.

NuTone offers an interesting fan catalog you can obtain by circling No. 23 on the Reader Service Coupon on page 17

# PUTTING HI-FI IN

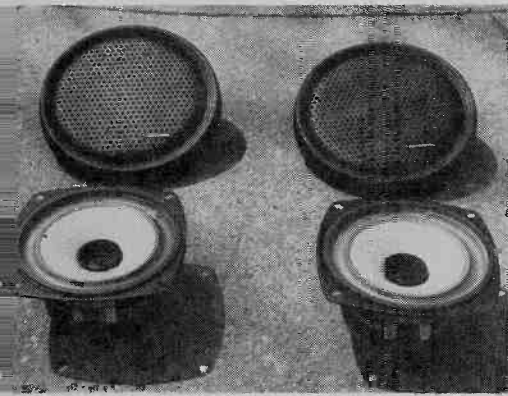


Fig. 1. The basic rear speaker package has the speakers and matching protective grill assemblies. Note the large outer surround on the speaker cones; a pretty reliable guide that these relatively small Radio Shack speakers pack a lot of solid bass.



Fig. 2. You might have to jackknife yourself into the trunk to make a few connections so make certain the trunk is completely empty before you start. Yes, get rid of the spare tire too.

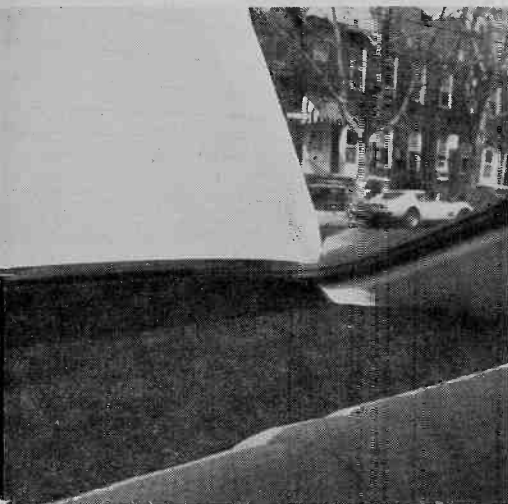


Fig. 3. The rear deck. Concealed beneath that layer of carpeting is a steel deck with the speaker cutouts already prepared at the factory. Even the speaker mounting studs might already be installed.

BESIDES THE OBVIOUS luxury of carpeted floors, leather seats, and leg room for a giant, big fat luxury cars generally have much better sounding radios and tape players. Quite often the luxury car's sound quality begins to approach or equal what we'd accept as hi-fi in our home.

But the secret to a luxury car's better sound is not necessarily that the radio or tape player is any better than what's put into a budget car; rather, the gold-plated Detroit Iron probably has rear deck speakers, and that's what gives it that big sound.

When speakers are mounted on the rear deck the entire trunk becomes a speaker enclosure, and it is a fundamental rule of automobile sound that the larger the enclosure the better the bass. Also, with the speakers facing upwards the highs bounce off the slanting rear windows towards the passengers; the reflection also disperses the highs, creating a "surround-sound" that envelops the passengers in a total experience—as if they were one of the musicians.

Yes, rear deck speakers make any auto radio or tape player sound better, but there's no reason you have to wait for a luxury car in order to enjoy a big, rich sound. We don't know about those cheap foreign imports where everything but the four wheels and a body is left off to keep the price down, but American-made cars are factory-equipped for rear speakers. In most cases a piece of cardboard is all that separates you from rear speakers. You see, here in the U.S. the manufacturer can't be bothered



with making one model for the guy who wants rear speakers and a different model for the buyer who doesn't even want a radio. So he makes one basic metal rear deck pre-cut for speakers. If you order the car without speakers the assembly plant covers the metal rear deck with cardboard, hardboard, or fabric, concealing the speaker cutouts. If you order speakers factory installed, the assembly plant simply substitutes a cover that also has speaker cutouts, and installs the speakers. If you get the car without speakers and then decide you want rear speakers the dealer hands a knife to the least skilled man in the shop and tells him to cut out the cover and install the speakers.

To make life just a little bit easier for everyone, many cars are already pre-wired for rear deck speakers even if they haven't been installed at the assembly plant. Again, it's often easier for Detroit car makers to stock one general



Fig. 4. Just one speck of dust in the cone from installation will rattle for ever and ever. But if you wrap the speaker in an old pantyhose (or even new pantyhose of the 2-for-a-\$1 variety) you'll be able to keep chips out during installation, and the heavier dust—which also rattles—that settles in after the speakers are installed. Leave enough slack in the material so it can be completely wrapped around the speaker when you're finished.



Fig. 5. If you cut and wrap the pantyhose carefully it should look like a factory installation.

# THE REAR DECK



purpose wiring harness than several different models. Often, the rear speaker wiring is tucked into a rear quarter panel along with some extra wires for a rear window defogger, trunk lamp, etc. If you have been wise enough to get your car's service manual you'll be able to locate concealed wires by using the schematic and wiring pictorials supplied in the manual's electrical and accessory sections. Even if your car isn't prewired, the manual will tell you where the front-to-rear wiring channel is located. If you know where the channel is located you can run a wire from the trunk to the dashboard in less than 15 minutes. If you don't know where the channel is located, or even if there is one (and there is), you can spend an hour or more trying to get a pair of speaker wires from trunk to dash.

As for the speakers themselves, get the best; the difference in price between good-quality speakers and poor

ones is only a few dollars. It won't be worth your time and effort if you save a couple of bucks only to wind up with fourth-rate sound quality.

The best place to find high-quality auto speakers is a local general parts distributor (not an auto-sound specialty shop), or one of the national chains; for it is in these places that you'll get a chance to listen to the actual speaker you'll buy, or at least have easy return privileges if you decide you want a better-quality speaker.

The rear deck speaker kits shown in this article came from Radio Shack. You'll note that although the speakers are small they have a relatively large magnet and an obvious large and soft cone surround. This is the stuff of big bass, even in small speakers, and is the payoff when you've completed the installation. Your only problem is to check the size of the cutouts in the rear deck first, and then get the speakers that match. For example, you might have 5-inch round cut outs, or 4 x 5-inch or 5 x 7-inch oval. Get the right size. Don't try to use a 4 x 5 in a 5 x 7 cutout. Part of the sound quality is determined by the fit of the speaker against the rear deck, so match the speaker to the cutout. Finally, get a complete mounting kit: It will save problems later when you try to match a protective grille to a speaker bought earlier; somehow, it usually doesn't come out right because the holes don't match when you buy one piece here, another piece there.

Okay. Ready? Just follow the photographic illustrations to terrific sound. ■

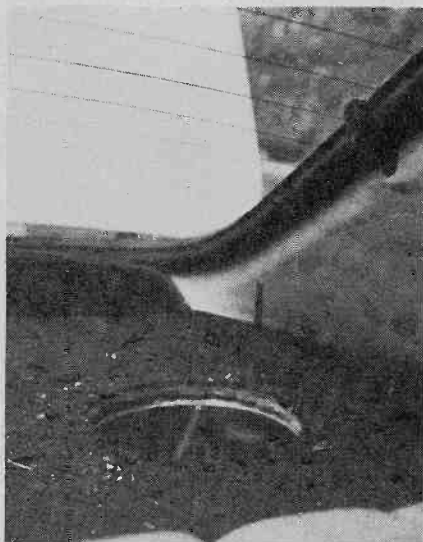


Fig. 6. Cut a hole in the rear deck cover corresponding to the cutout in the steel deck underneath.



Fig. 7. Here's how it looks from inside the trunk. Note that in this car even the speaker mounting holes are pre-punched. Just drill through the rear deck cover from the trunk side. The metal tabs at the rear hold the speaker wires when they are bent upwards.

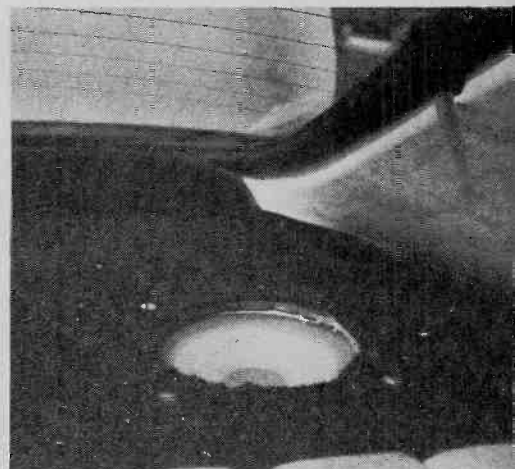


Fig. 10. View from the top. Brush all debris and chips off the pantyhose shield.

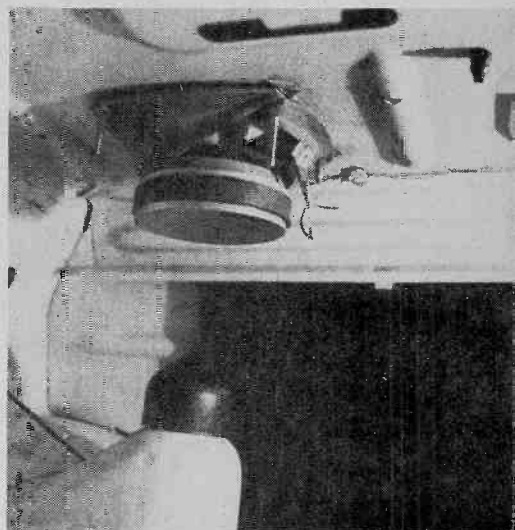


Fig. 9. Connect the speaker wires and route the wires so they are off the floor where they cannot be damaged.

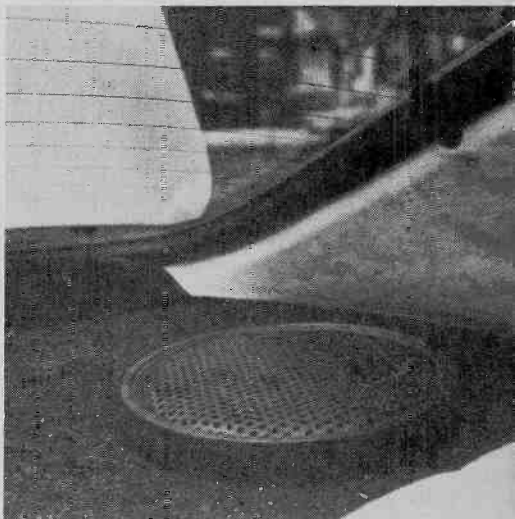


Fig. 8. Install the mounting screws—held in place with Tinnerman nuts, or tape—and then carefully fit the speaker over the screws. Snap down the grill and the installation is complete. A neat, professional job that looks like it came straight off the assembly line.



Economy and convenience is reason enough to install unsightly CB, Ham, SW, TV and radio antenna cables where they belong.

# ANTENNAS FROM YOUR WALLS

by Kathi Martin

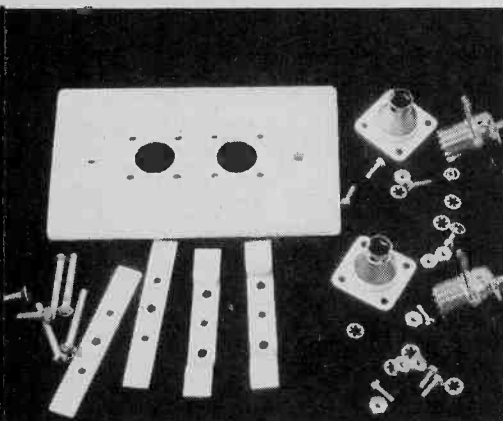


Fig. 1. A Mosley outlet kit comes with every part needed. There's no "electrical" box because none is needed. The four metal strips screw together to form a quick-mount, the easiest way to attach the plate to the wall. Note the UHF connectors are supplied with hoods to maintain a transmission line's characteristic impedance. Outlet kits are available in many configurations: with TV connectors, rotator jacks, single or dual connectors, etc. You can even get just the plastic plates and customize your own outlet.

**I**N YEARS PAST only radio amateurs and shortwave listeners needed outdoor antennas, and the usual place for the receiving or transmitting equipment was the bedroom or basement. To bring a transmission line in from the cold, one simply punched a hole in the wall, routed the line through the hole, packed in caulk for weatherproofing and, most likely as not, strung the line across the ceiling to equipment.

Today, with CB (citizens band radio) in the living room, not to forget VHF-TV, UHF-TV, antenna rotators and 2-meter radio amateur transceivers, the wiring can easily start to resemble a rat's nest of criss-crossed leads and cables running around radiators, doorways, and mouldings.

One way to keep down the number of chips in the plaster from cable tacks and clamps is to take a tip from new home/office construction and simply build in a *communications outlet* right adjacent to the equipment. Just as you would plug in the equipment's line cord, so you would plug in the antenna.

Communication outlets provide just about any type of connection needed for modern communications or consumer equipment. Using a standard electri-

cal-size plastic plate, they come with UHF connectors, 300-ohm ribbon and 75-ohm coaxial TV connectors, antenna rotator cable jacks, TV distribution J-jacks, combinations of jacks and connectors, or just blank so you can customize the outlet to your needs. Best of all, the plates come with *quick-mounts* that eliminate the need for metallic electrical boxes and/or adaptors.

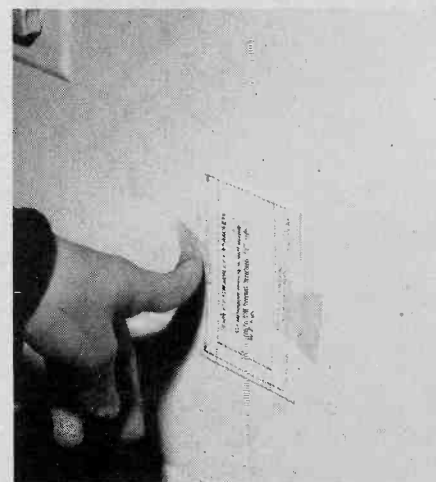


Fig. 2. First step is to tape the supplied cut-out template to the wall. Then cut through the wall following the template.

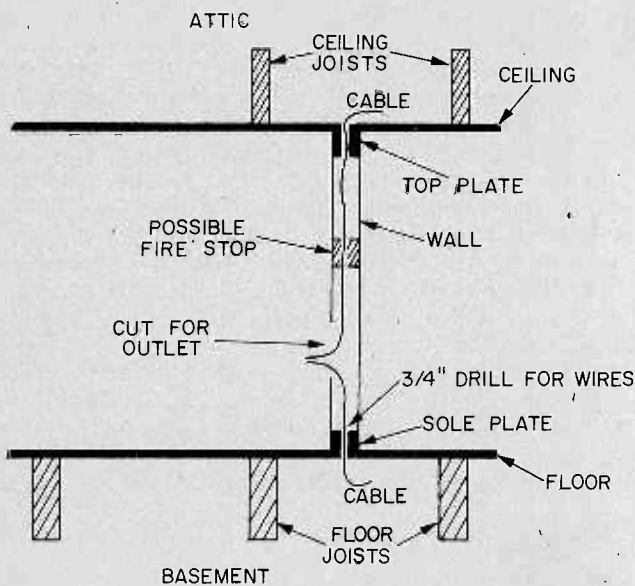


Fig. 3. In typical modern wall construction used in your home there is a top and bottom (sole) plate to which the studs are nailed. You must drill through both the ceiling or floor and the plate in order to get your wiring into the wall. In some construction a fire stop (or "cat") is nailed between the studs. Either you must break through the wall in order to drill through the fire stop or route the cable up from the basement.

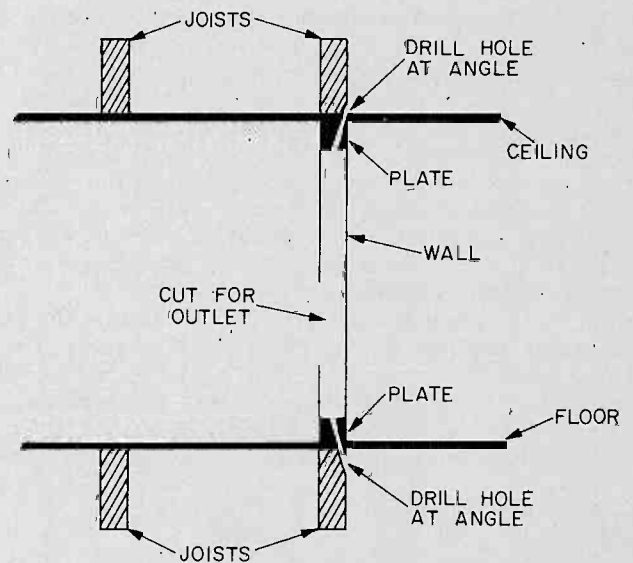


Fig. 4. If you should be so unlucky as to have the wall directly under or over a joist simply drill in at a shallow angle—but be careful the angle isn't so flat you come out in the room outside the wall. A 12-in. or 16-in. extension for the drill bit will allow you to easily drill at better than 45 degrees to the ceiling or floor.

In my case I needed connections for both a CB and 2-meter transceiver, so I selected a Mosley kit with two UHF connectors (see Fig. 1). The kit came complete right down to the last lock-washer and nut. I got the two connectors, hoods to maintain the characteristic coax cable impedance at the connector, a pre-drilled wall plate, all the miscellaneous hardware and four metal strips that turned out to be the easiest plate mounting hardware I ever used. Most important, the kit contained a full-size template for the wall opening.

With a little help from the boy who delivers the morning papers, I had the whole bit installed in less than 30 minutes. True, getting the antennas on the roof took longer, but that's another story.

**Get Started.** First step in installing a communications outlet is to get the antenna cables from the outside to the wall where the outlet will be. Best bet is to run the transmission line into the attic or basement where it can cross to the wall sight unseen. That's the easy part.

Next, locate a hollow spot in the wall—between the wall studs—and mark the desired outlet location. Tape the template to the wall and cut the opening (see Fig. 2). If the wall is sheet rock

(drywall) you can cut the opening with a keyhole saw. If the wall is plaster use a drill, saw and/or chisel and lots o' luck. A good way to keep plaster dust from settling on everything in the room is to run a vacuum cleaner with the nozzle right up against the opening as you cut through.

Now you must get the transmission cables from the attic or basement into the wall opening. Fig. 3 shows a cross-section of a typical wall construction. Note there is a top and bottom (sole) plate, which is generally a 2 x 3 or 2 x 4 to which the wall studs are nailed. Whether bringing the cables in from the attic or basement, you must drill through both the flooring (or ceiling) and the plate. The best tool for this job is a 3/4-in. or 1-in. spade bit mounted in a 12-in. or 16-in. extension. An extension for the bit is generally required because a spade bit shank is usually just a mite short of going through the floor and plate.

What do you do if the wall is directly over or under a floor or ceiling joist so you can't drill straight up or down? No problem. Place the bit on the joist about 1 in. from the floor or ceiling and drill through at a sharp angle. You've got from three to four inches of wall thickness so the drill should wind up inside

the wall. But take care. If the drill bit angle is too flat the drill will wind up outside the wall—in the room. Figure 4 shows how easy it is.

**In and On the Wall.** Pass the cables into the wall and fish them through the cutout in the wall. (See Fig. 5). Leave about two feet of cable in the room. Excess cable remaining after the installation is complete can be folded back

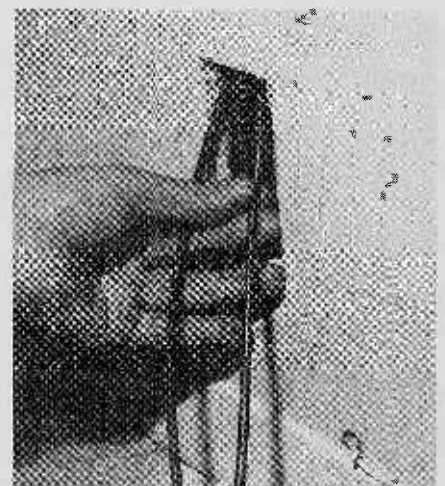


Fig. 5. Fish the cable(s) through the cut-out and leave about two feet outside the wall. The excess can be folded into the wall when you're finishing the installation.

## ANTENNAS FROM YOUR WALLS

into the wall or pulled back up towards the antenna. To avoid possible damage if a transmitter will be used, tag the cables so you know which cable is what antenna.

Attach the required connectors to the cables. If you're using coaxial cable as shown in Fig. 6, temporarily secure the hood to the connector with one or two screws when soldering the cable shield to the hood. Remove the screws before installing the connector(s) on the plate.

Next, install the quick-mount strips to the wall cutout; one pair at the top and one pair at the bottom. They *clamp* to the wall via screws—no drilling is needed. The plate will be flat to the wall only if the indented part of the strips

point towards the interior of the wall.

Install the connectors on the plate and position the plate against the quick-mount strips. You should be able to see the threaded holes in the strips through the plate's mounting holes. If you can't see the threaded holes, loosen one strip's screws and reposition the strip until the holes in both strips line up with the holes in the plate. Do not try to force the strips—loosen the screws. The strips are secure and firm if the wall is undamaged, but forcing the strips without loosening their screws will damage the wall.

**Just a Bit More.** Finally, you must be certain you haven't shorted the cables when soldering to the connectors. Good reception of a TV picture is an indication of proper installation of TV cables. An ohmmeter will suffice as

checkout for a rotator cable before applying power.

But if you have installed transmitting cables you must check out the installation with an SWR indicator (meter, bridge, etc.). The SWR meter reading should be, at most, a smidgen higher than the antenna's normal SWR value. If you get readings such as 3:1, 5:1, 10:1, etc., it's most likely you have some problem at the connector—probably the connection between the cable's shield and the connector's hood.

If everything checks out, simply plug your equipment in, just as you would an ordinary power plug. No matter if you install an MATV (Master Antenna-TV) system or quad antenna for your CB rig, the installation cost to you will only be the price of parts—you pocket the inflation-boosted labor charges. ■

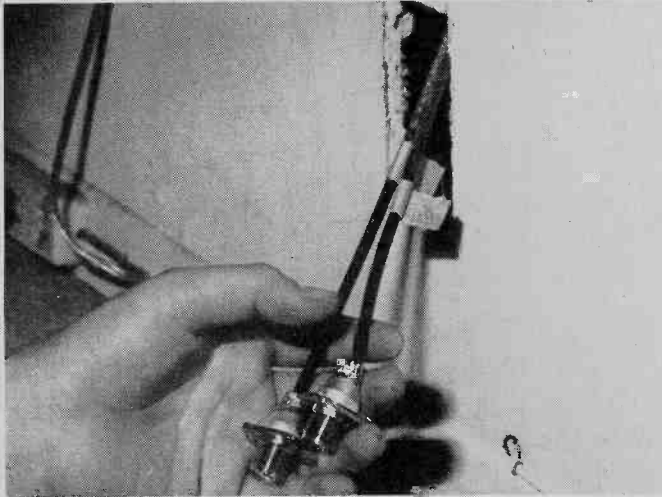


Fig. 6. Attach the cables to the connectors before the connectors are mounted on the plate. If your connectors have hoods, as shown, secure the hood to the connector with a single screw to insure a proper cable-shield-to-hood solder connection (with no shorts).

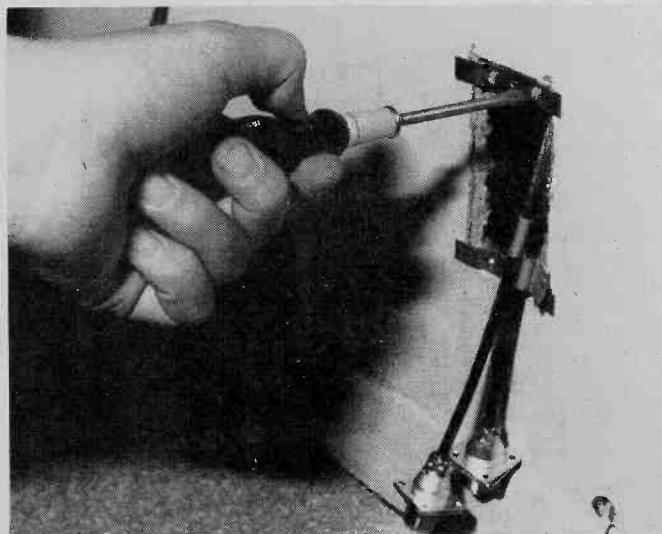


Fig. 7. Install the quick-mount strips; the U-indent on the outside strip must face the interior of the wall.

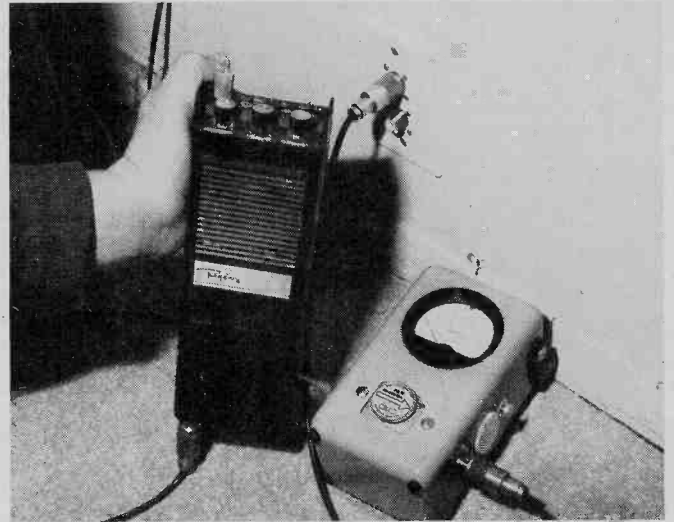


Fig. 8. Finally, attach the connectors to the plate and secure the plate to the quick-mount strips. If the installation is to be used for transmitting you must check out the system with a transmitter and VSWR meter.



Fig. 9. Tom Gavaras of Wayzata, MN keeps a neat shack with antenna cables as well as other leads out of sight. That's an RT8 ex-military receiver that pulls in long and medium wave signals.



# The DXer's First Listening Shack



All you need to know about getting started in shortwave, radio and TV listening with rich man results on a tight budget!

by Don Jensen

**T**HE HOBBY of distant radio listening—DXing—began over a half century ago when electronics was still in its infancy. But it is still growing in popularity today. The basic reason is that DXing is a hobby that anyone can enjoy. Listeners include ten-year-olds with no more technical background than a grade school science course can provide. But also numbered among their ranks are retired electrical engineers and college profs with physics Ph.D.s. By occupation, DXers are lawyers and laborers, technicians and truck drivers, secretaries and students and, yes, even a hermit living in the wilds of northern Michigan.

In DXing, money is no object. That is, the state of one's bank balance is not a major factor. Sure, you can invest thousands in elaborate radio gear. One company, the Technical Materiel Corporation, sells its GPR-110 receiver for a cool \$6,240. But if you've only got a relatively few bucks in your jeans you can still buy a piece of the DX action. And with a bit of luck and resourcefulness you could get started in the hobby for as little as "zip," nothing, zero dollars!

At first blush you might think that DXing is an expensive hobby. And if you plan to fork over, say, \$500 for a cushy radio receiver at the outset, you'd be at least partially right. The outlay might be less formidable, however, when you realize that with a minimum of upkeep that rig can bring you thousands of hours of DXing enjoyment over the next decade or so. On a cost-per-year basis there are plenty of hobbies more costly.

Still, if you haven't the half a thou now, all that is dream talk and much beside the point. So let's talk realities and how you can get started in DXing on a penny-pinching budget.

**Where to Hang Your Hat.** The first order of business, of course, is to set up your DX shack. Shack? OK, that's a bit of hobby nostalgia that has survived in the DXer's jargon from the early days of radio. Then, perhaps, a DX shack was literally that, a backyard shed or workshop where the hobbyist could retire (or in some instances, no doubt, was exiled) to putter with his electronic gadgetry. Thus Mom was spared the worry of solder splattered on the parlor rug and the youngsters could play safely far from high voltage sparks without depriving Pop of his fun.

Today, though, most DX shacks can be found in a spare bedroom, a rec room or den, or maybe in the corner of the basement. Less colorful than in days of yore, perhaps, but infinitely more comfortable for the DXer.

Don't forget the creature comforts when you select a location for your DX shack. In attic, basement or unused room things may be dandy in summer, but heating may be a problem in January. A space heater could be the answer here. Consider, also, air conditioning if that seems appropriate in your climate. Since either can be costly, though, a little foresight in selecting a spot for your listening can pay off. DXing is supposed to be relaxing, and shivers and perspiration, in season, are not conducive to that.

Power and light . . . both are factors. While it is possible to operate some DX

gear on batteries, the cost of C and D cells or nine-volt batteries can mount quickly. You'll want a suitable electrical outlet near your operating area. When it comes to lighting, about all that can be said is that it should be adequate for the job to be done. Who wants to squint through the gloom to read the frequency on the receiver's dial? Some DXers prefer incandescent lighting to fluorescent. Older fluorescent lamps had a nasty tendency to produce electrical noise (QRM) in a receiver. Today, modern fluorescents seem to have licked the worst of these problems.

Besides these considerations your shack should be equipped with a comfortable chair and, of course, work space for your gear. This could be an old desk, a table, or a shelf built of plywood or lumber odds and ends you may have around. The budget-minded will have little difficulty in scrounging up the necessary items to outfit his shack. A bookcase, a file cabinet, whatever else suits your fancy can be added.

**The Big Ear.** The one essential piece of equipment in any DXing setup is, it goes without saying, the receiver. Radios suitable for the hobby come in a wide range of prices. A communications receiver, one designed especially for monitoring the more distant signals under conditions which are seldom optimum, can cost thousands, as previously noted. Excellent communications sets can be had new for around \$500-\$600; in kit form for several hundred dollars less.

Unfortunately, these days it is not possible to buy, as it was a few years ago, a true communications receiver,

# Listening Shack

new and assembled, for under \$150. But if you have even a little electronics know-how . . . or if you can read and follow directions . . . a receiver kit may be the ticket. Heathkit (Heath Company, Benton Harbor, MI 49022) has a couple of relatively inexpensive kits that may interest you.

With the dwindling number of new communications receivers on the market now, many DXers are giving serious consideration to a good used set. Communications rigs that sold new for several to many hundreds of dollars can be purchased for a fraction of their original price—25, 50, 75 percent off what the original owner paid for them, depending on age and condition. One listener in Hawaii tells of picking up a 30-year-old communications receiver at a flea market for one dollar. "Believe it or not," he wrote to us recently, "it works!"

Flea markets and gatherings of radio "hams" are good places to hunt for a receiver bargain. If you can buy cheaply enough you can afford a thorough overhauling by a competent radio serviceman to bring a so-so receiver up to snuff. Don't let the radio's age alone deter you. A number of the top DXers around frankly prefer communications receivers originally manufactured a decade or more ago to some of the current models.

Radio dealers, especially those who deal in amateur radio equipment, often

take older receivers in trade on newer ham gear. Usually these distributors will check out, realign and refurbish these used receivers before reselling them. Most will guarantee that these sets are in good working order. It usually will be a bit more expensive to buy a used communications receiver from a ham equipment dealer than from a private party, but your chances of getting a "dog" are less too. The wise buyer of a used receiver will at least look the set over before purchasing. Preferably he'll try it out in advance.

**What to Look For.** Check first for general appearance. While a scratched or dented cabinet may not be important, it may be an indication of the treatment a receiver has had. Inside the chassis, check for charred resistors, tell-tales of past short circuits. Are the tuning knobs excessively worn? Do the screws that fasten the cabinet to the chassis look worn or stripped, possibly indicating repeated entries to the set to make repairs? Another warning signal is an obviously repainted set.

If you can—and be wary of the seller who exhibits reluctance here—try it out. With at least some sort of antenna connected, run a quick check of the set's sensitivity, selectivity, and stability.

For a check of adequate sensitivity, slowly scan across each band. You'll hear some stations, of course. But you should hear at least some background noise on all frequencies. To determine how much of this background hash is sensitivity to received signals and how much is internally-produced receiver noise, disconnect the antenna and run the same sweep. If most of the back-

ground noise doesn't now drop out of the picture, tell the man you're not interested.

Selectivity—the ability of the receiver to "separate" signals located on adjacent frequencies—is important. Much of the added cost of a high quality communications receiver is due to costly circuitry and filtering devices incorporated to improve selectivity.

Your determination of how good a receiver's selectivity is is somewhat subjective. But, basically, as you tune the radio across a crowded portion of the dial, you should be able to "separate" stations into listenable signals. If you get too much unintelligible jumble, if stations seem jammed on top of each other, it isn't much of a DX "machine." However, the receiver with perfect selectivity is the impossible dream. Selectivity and the state of your wallet must compromise.

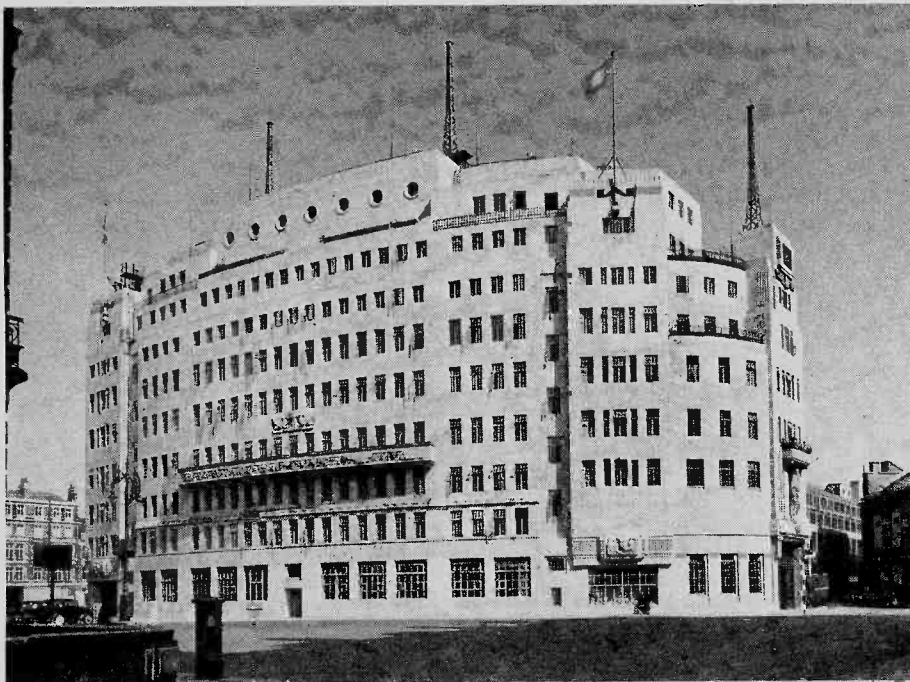
The third factor to consider is stability, the ability of a receiver to stay tuned to the tuned frequency without drifting up or down. There are two aspects to be considered, thermal and mechanical stability.

Heat, obviously, causes thermal instability. A transistorized or solid-state set does not develop heat as does a radio designed with vacuum tubes, hence there is no thermal problem. All tube sets will drift somewhat. To determine if thermal stability is a problem with a tube model, tune in a clear, steady signal, such as the standard time station WWV (5, 10, 15, 20, etc. MHz). As the receiver warms up, you'll notice some drifting off frequency. After 15 to 20 minutes, carefully retune the receiver to the peak signal. After that initial warmup period, further drifting should be minimal.

Mechanical stability is usually assured by solid construction of the receiver's chassis. To check it out, again tune a steady signal. Then switch to another band without retuning the dial. When you switch back to the original band you should again hear the same clear signal without having to retune.

**Other Receiver Checks.** Check the calibration. Does the frequency readout on the set's dial closely approximate the actual frequency of the station you've tuned? Do all the controls on the front panel work? Is the audio "mushy"? It could indicate the automatic volume

When you tune across the shortwave bands it is likely that one of the first stations you'll come across is the British Broadcasting Corporation. From these studios in London, the BBC's programs go out to all the world.



control, if the set has this feature, isn't working properly. When you switch or tune the control knobs do you hear a crackling noise in the speaker? If the contacts are worn or dirty they could cause problems.

Chances are a set won't pass all the tests with flying colors. And if it doesn't, some problem areas can be easily and cheaply corrected. A ham friend or radio-TV serviceman may be able to give you his opinion based on his electronics knowledge. There are some terrific buys to be had in used communications equipment, but it also is possible to be stung. It is a choice only you can make.

Most beginning DXers these days probably opt for one of the many multi-band portable receivers on the market. Admittedly these are not in the same ballpark as a true communications receiver. For one thing, frequency read-out is normally less accurate. That is, it is harder to know precisely the frequency you are tuning, or want to tune, with the rather limited "sliderule" type tuning indicator. Also, you can't expect to get the degree of signal selectivity you'd find in a communications type receiver.

But the price is right and you will still be able to hear plenty of DX signals from around the world on a solid-state, multi-band portable. You can find such receivers, some battery-operated only, some with provisions for AC current operation as well, at department stores, discount centers, mail order dealers, practically everywhere. Most are oriental imports and sell for anything from about \$20 to several hundred dollars.

All feature the regular AM medium wave band (540-1600 kHz); some have FM coverage in addition. You'll find sets with at least some of the shortwave bands and also the VHF public service (police, weather, aero, etc.) frequencies as well.

**You Forgot About These!** Ah, but you say, you're still talking about money. How about the freebies you mentioned at the start? The freebies, my friend, are those receivers you already have around the house but have never thought of as DX machines.

If it's medium wave DX you're interested in—and many listeners are—almost any AM radio will start you out:

a small transistor model, a clock radio, even the radio in your car. If you've never strayed from the handful of frequencies used by your local area stations you may be surprised at what you can hear, especially during the hours of darkness. You'll find a goodly number of distant stations, even on a very unsophisticated radio, things like KSL, Salt Lake City; WOAI, San Antonio, Texas; KDA, Pittsburgh; and others from Los Angeles to New York City. Perhaps you'll find French-speaking signals from Canadian outlets and Spanish language programs from Cuba and Mexico.

For shortwave DX, foreign signals from China, Japan, South Africa, the Soviet Union, beyond and between, you may already have a suitable receiver in your home. It may be one of the multi-band portables already mentioned. But it could also be an old console model radio, three or four decades old, that has been gathering dust in the attic for years.

The bargain basement DXer can't afford to overlook DXing equipment already at hand, but previously neglected, forgotten, and unappreciated.

**The Sky Hook.** While your radio receiver is the single most important item in your DXing shack, it won't produce must listening without an antenna. The antenna's job is to capture the electromagnetic energy transmitted from a station five or five thousand miles away. Through its lead-in wire, the antenna delivers this energy to your receiver

where it is converted into the audio signal you can hear.

With a multi-band portable comes a built-in whip type antenna. While not normally as efficient as a good outdoor antenna, a listener can still manage to hear quite a lot using nothing more than the telescoping rod.

At DX Central, purely as an experiment to test the effectiveness of a whip antenna on a good quality portable receiver, we tuned a rather strong signal from Radio Tahiti's 19 meter band outlet. Slowly the antenna was telescoped down. It wasn't until only six inches of the antenna remained exposed that the signal was finally lost.

But undoubtedly, more DX listeners use a simple longwire antenna than any other aerial around. The receiving portion of the longwire antenna, often called the flat top, may be of any convenient length. More often than not the length is determined merely by the distance between two convenient existing end supports, such as a pair of trees, the roofs of your garage and home, or what have you. The flat top portion should be at least 20 feet in length, but it is doubtful that any significant benefits are obtained if it is longer than about 150 feet.

It should be constructed of a sturdy conductive wire, copper, phosphor bronze, or aluminum, perhaps. It should be strong enough to support its own weight, even in a good windstorm or when loaded with ice in the winter. The wire may be insulated or not.



An uncomplicated but highly effective DX shack belonging to Cesar Objio of the Dominican Republic. Needless to say, there are DX fans around the world. Cesar's receiver is an older model of Lafayette's HE-30.



# Listening Shack

The longwire antenna should be insulated at each end, using non-conducting ceramic or glass insulators. And it should be located as far as possible from potential interference sources such as power lines or busy streets. (Auto ignition systems can cause electrical noise in radios.)

Usually the flat top portion of the longwire antenna will run roughly parallel to the ground but this is not critical and the general arrangement, again, is often dictated by the end supports available. Essentially a longwire is not very directional so compass point orientation isn't awfully important.

At the flat top end nearest your shack, solder the lead-in wire. The lead-in should be only long enough to reach to your receiver. As it will no doubt touch other objects as it enters your DX shack, the lead-in should be of insulated wire. Overall, the critical concern is that the antenna is not "shorted out" anywhere along its length.

As the diagram shows, the classic longwire with a horizontal flat top, fed by a lead-in leaving one end at approximately a right angle to the receiving portion, looks something like an upside-down letter "L." Hence it is sometimes called an "inverted L" antenna.

The major advantages of a longwire antenna for the beginning DXer on a budget are, of course, simplicity of construction and—what else—cost. If you already have enough wire about the house, great. If not, everything you need should not set you back more than about five bucks.

There are other antenna options open to the listener. Sometimes they aren't really options at all, but necessities caused by an unsympathetic landlord who isn't about to have wires strung about his property.

Experimentation is often the name of the game with antennas. Several well-known city-dwelling DXers manage remarkable listening feats with some unusual but effective antennas.

If you don't live in a steel-framed (thus electrically shielded) apartment complex, you may get satisfactory results with an indoor antenna. Twenty or so feet of antenna wire running around your room where the walls meet the ceiling can make an effective sky-hook.

Apartment dwellers can simply hang a length of insulated wire from a window, with a small weight at the end and the opposite end connected to the receiver antenna terminal. It is invisible at night. During daylight hours the DXer can reel in the wire—though this does limit you to nocturnal listening.

But if you have backyard space for an antenna you might try the second cousin to the "inverted L" longwire, the "T" antenna. The only basic difference is that the flat top is fed to the lead-in at the center, rather than an end. The reason for choosing a T is purely practical. Your available supporting points are on either side of your DX shack's location, as the diagram shows.

Similar in appearance to the "T" is the Windom antenna. But unlike the "inverted L" and "T" it is not a broad band antenna. The Windom works best on the particular frequency band for which it was designed.

If you find, for example, that much of your shortwave listening is done on the 31 meter band, base your calculations on a frequency such as 9,800 kHz (9.8 MHz). Plug this figure into the following formula:

$$L = \frac{468}{\text{freq. (in MHz)}}$$

The flat top portion should be  $468 \div 9.8 = 47.75$  feet. Practically speaking, 48 feet is close enough.

The Windom is erected as you would a "T" antenna, except the lead-in should be attached to the flat top one

third of the way from the end nearest your receiver. The Windom will perform on other shortwave bands but will give best results on its designed shortwave band.

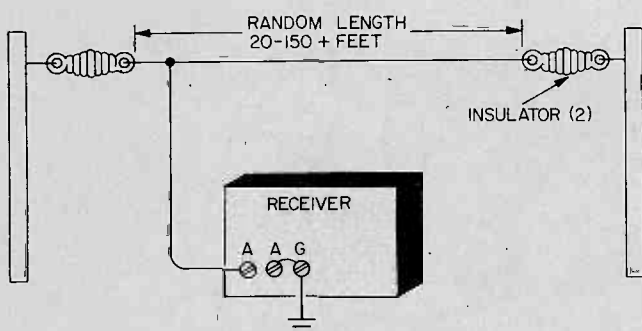
Only a bit more complicated is the folded dipole. Even more so than the Windom, the folded dipole is a one-band antenna. Since it has a balanced feeder lead-in, you should be sure first that your receiver has two antenna terminal connectors. Many communications receivers do, but not all. And if your set doesn't—few portable receivers do—forget about the folded dipole.

The folded dipole can be constructed with common 300 ohm twin TV lead-in wire. Determine the overall length of the dipole as you would for the Windom, using the same formula. Join and solder the two wires at each end and suspend the antenna from terminating insulators. In the center cut one—and only one—of the wires. Attach and solder to each side of the "cut" one of the two wires in the twin-lead. And, at the "shack" end, one wire to each antenna terminal. A dipole has some directionality, receiving best those signals which approach from right angles to its length.

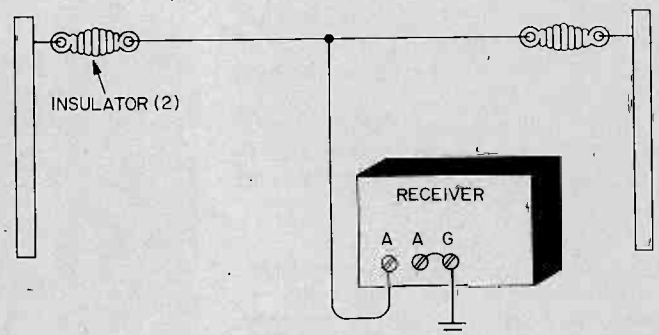
**The Frills.** Essentially, with receiver and antenna, your DX shack is ready to go. But there are several accessories you can add. One that is very nearly as important, especially if you plan to be a QSL hunter, is an accurate clock.

A QSL, or verification, is a letter or card sent by stations you log in response to reception reports you send them. Half the fun of DXing is collecting these verifications from the stations you hear. Your report letter sent to the station you receive should do several things: (1) inform the broadcaster that you heard their programs, (2) tell the station how well it was received, and (3) politely request that your report be confirmed if found to be correct.

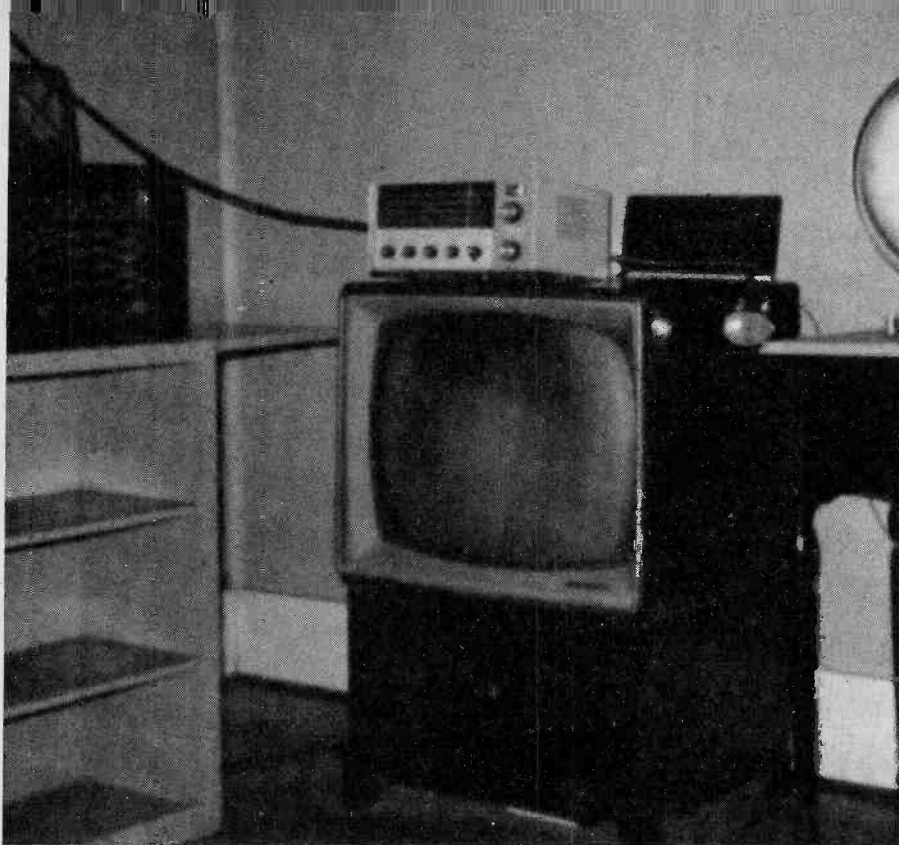
At the heart of it, a QSL is supposed to be your proof that you actually did receive programs transmitted by Station



Simple longwire or inverted "L" antenna.



Longwire "T" antenna that can be made to fit.



This photo illustrates many of the points made in the text. Jim Phillips of Waverly, VA uses an older model Heathkit GR-91 receiver (on top of the RCA TV set used for snow-band signal monitoring) and an aged GE, no doubt rescued from oblivion for some medium wave AM listening. Just partially visible at the extreme left is an all-band portable.

may get most of your DXing kicks on the AM medium wave band. There are over 5,000 such broadcast band (BCB) stations across North America. And, as already noted, foreign DX is possible too. Not only Mexico, Canada (if you're a stateside resident) and Cuba, but many Central American stations are loggable by listeners with rather unsophisticated equipment.

Even more distant BCB signals are possible with good equipment and listening experience. Strange as it may seem, there are veteran medium wave DXers in the U.S. who have logged as many as 50 or 100 or more difficult countries on the AM broadcast band.

And there are some DX listeners whose interests are broad-gauge. They don't specialize, but get their enjoyment tuning all types of stations; broadcast, ham, utility, medium wave and shortwave. There are DX fans of FM and TV distant signals—but that's a whole new story. And, of course, a growing number of persons monitor the VHF (very high frequency) and UHF (ultra high frequency) public service bands (police, aero, weather, etc.) located above 30,000 kHz.

There's a lot to learn about the ins and outs of DXing. One good way is to regularly read COMMUNICATIONS WORLD, a twice-a-year publication totally devoted to DXing. You can find it on your newsstand, or you can order a copy from Davis Magazine Mart, 229 Park Avenue South, New York, NY

*(Continued on page 101)*

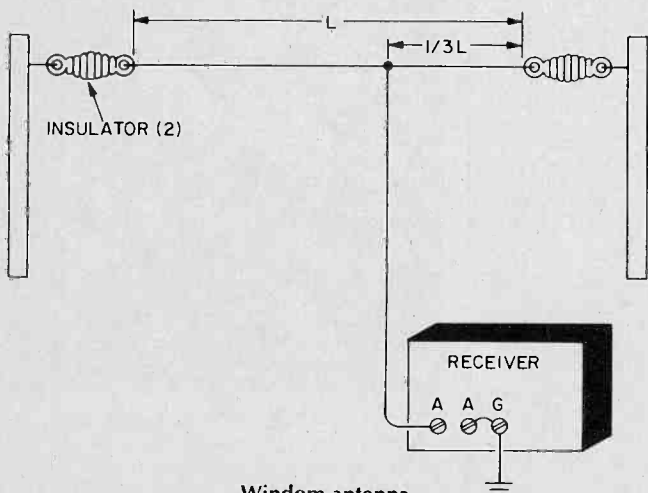
X. But in order for the station to be certain that it was its programs you received, you have to describe where you heard it (the frequency), what you heard (some details of the program content), and when you heard it (date and time).

Your receiver's dial (or a frequency announcement) will give you the "where." Your ears will provide the "what." Besides a calendar, a clock will give you the "when."

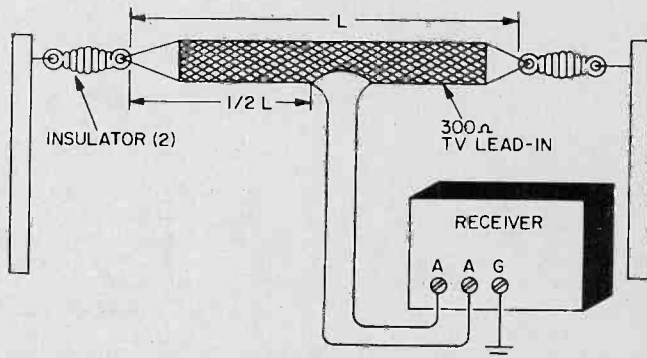
Nonessentials, but useful nonetheless, include a cassette or reel tape recorder. Taping the stations you hear can be fun. It allows you, at a later time, to play back your loggings for your own amusement or to show off to visiting friends. An added bonus in taping is that if you somehow miss the station identification announcement, you can

play it back again and again until, hopefully, you can make it out. After all, reception—even of the more powerful stations—can and often is marred by interference. Replaying a taped ID can help you identify a station whose call you missed the first time around.

Like many DXers, you can focus your listening activities on just one portion of the radio spectrum, say the shortwaves from about 1,605 to 30,000 kHz. (Though most shortwave broadcasts are clustered in a dozen relatively small frequency ranges or bands within this vast span.) Also in the shortwave range you'll find the hams and radio amateurs, plus the so-called utility stations, military, point-to-point, marine and aeronautical operations, AM and single sideband (SSB) voice transmissions, and morse code (CW) signals. You



Windom antenna.



TV lead-in wire for folded dipole antenna.

# BUILD A PROFESSIONAL DWELL/TACH

Stretch more miles  
from your gas supply,  
plus tune-up tips!

by C. R. Lewart

**W**ITH GASOLINE prices going up, and with the growing concern about air pollution caused by automobile exhaust, a well-tuned car becomes a must. One of the essential tools for a tune-up is a dwell/tachometer that helps you adjust your engine to its optimum specs. What we describe here is a dwell/tach based on a newly-developed integrated circuit. It's easy and inexpensive to build, but with the IC it will also be more precise and easier to handle than most currently available commercial units. You may either put the unit in a portable case, as we have done, for use as a diagnostic tool, or you may mount it permanently on the dashboard.

The main advantages of the circuit are readings basically independent of the battery voltage, temperature, and the shape of the voltage at the points.

**How Does It Work?** First let's consider the shape of the voltage at the distributor points. When the points open there is a sharp spike of 100 to 300 volts followed by damped oscillation settling at the battery voltage as shown

in the illustration. When the contacts close, ground is applied to the bottom of the ignition coil, and voltage across the points drops to zero as current flows in the ignition coil primary.

In the integrated circuit there is a temperature-compensated monostable pulse generator section, an amplifier-limiter section, and a voltage regulator section.

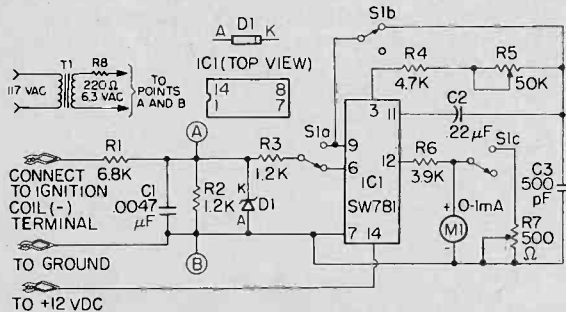
For the tachometer mode, the input circuit (R1, R2, R3, D1 and C1) assures that only the initial high-voltage spike caused by the opening points triggers the pulse generator. The generator produces a single rectangular pulse whose amplitude is determined by the IC parameters, and whose pulse width is determined by R4, R5, and C2. The pulses are amplified and fed into a one-milliamper meter which reads the average current. The higher the RPM, the more pulses, and the higher the meter reading.

In the dwell meter mode we bypass the pulse-generator section of the IC and apply the signal directly to the

amplifier-limiter section. The meter reading then corresponds directly to the percentage of time the points are closed.

**Calibration.** The easiest way to initially adjust your unit is to connect it to a 12-volt battery and use a small 6.3-volt filament transformer to supply 60 pulses per second from the power line. A 60-Hz line frequency corresponds to the following meter reading in rpm. Set meter to the proper reading with calibration control R5. A 4-cylinder engine scale would read 1800 rpm with the 60-Hz input, a 6-cylinder engine would read 1200 rpm, and an 8-cylinder engine, 900 rpm.

If, for example, you decide on a 2000-rpm full scale for a 6-cylinder engine (equivalent to 3000 rpm for a "4-banger" and 1500 for a V-8), set calibration control R5 for a 0.6 mA reading. The calibration reference for a 6-cylinder engine in rpm (1200) divided by the full scale in rpm (2000) times the full scale meter reading (1 mA) equals the calibration point meter reading in current (0.6 mA). Once calibrated, the rpm value is determined by multiplying the meter reading and the full scale. In this example the full scale is 2000 rpm, so a meter reading of, say,

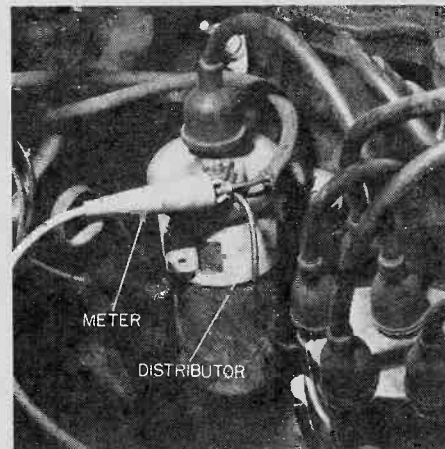


PARTS LIST FOR DWELL/TACH—A GASOLINE ECONOMIZER

- C1—0.005- $\mu$ F capacitor
- C2—0.22- $\mu$ F capacitor
- C3—470-pF capacitor
- D1—Zener diode, 9-volt, 1/2-watt
- IC1—SW781 (available directly from the manufacturer, Stewart Warner Corp., 730 E. Evelyn Ave., Sunnyvale CA 94086, for \$5.25 postpaid)
- M1—0-1 mA meter
- R1—6200-ohm, 1-watt resistor (you can use two 12,000-ohm, 1/2-watt resistors in parallel)

- R2, R3—1200-ohm, 1/2-watt resistor
- R4—4700-ohm, 1/2-watt resistor
- R5—50,000-ohm potentiometer
- R6—3900-ohm, 1/2-watt resistor
- R7—500-ohm potentiometer
- R8—220-ohm, 1/2-watt resistor
- S1—4PDT switch, 3 sections used
- T1—Transformer, 117 VAC to 6.3 VAC

Misc.—Cabinet, perf board, clip leads, wire, solder, etc.

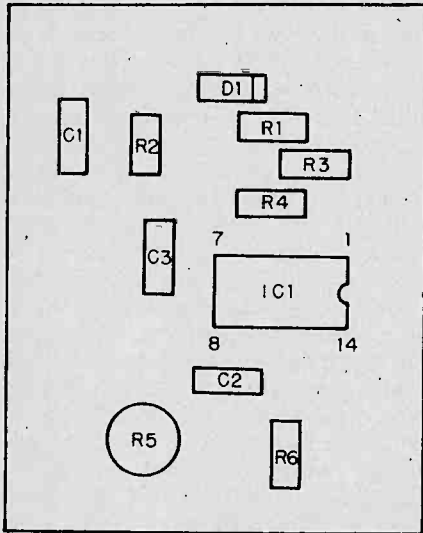


Clip "meter" wire from dwell/tach to ignition coil minus terminal. Look for "distributor" wire. It runs from the (-) terminal to the base of your distributor.



0.4 mA would mean an engine rpm of 800. Once R5 is set it should not require recalibration unless accidentally moved. If you prefer several ranges on a tachometer, or if you would like to use the same scale for 6- and 8-cylinder engines, switch-select a second pot of the same value as R5. Use one switch setting to calibrate for 6-cylinder engines, then throw the switch and use the second pot to calibrate for 8-cylinder engines.

It might be a good idea to tape a small mA-to-rpm conversion chart to the back of your meter. Compute rpm values for major meter divisions to give



Use perfboard construction and lay out circuit components as shown. R7, S1, and M1 are located on front panel.

yourself a quick conversion capability, particularly if you choose a full scale of other than 1000 rpm. If you select a 1000-rpm full scale for V-8 engines, the meter will read directly in rpm. Just ignore the decimal point. For example, .55 would be 550 rpm.

With the values of components shown, you can adjust R5 for a full scale reading for a 6-cylinder engine between approximately 1200 and 6000 rpm.

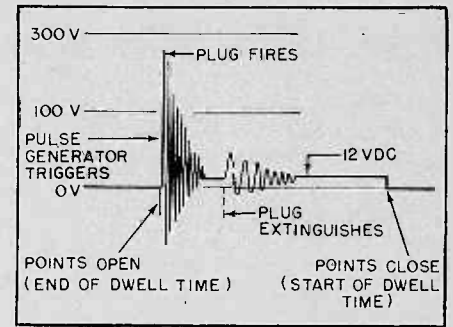
A dwell meter adjustment is done

with R7. When the input (points) lead is disconnected, the meter should read full scale. Due to excellent voltage regulation in the IC, this potentiometer should not need adjustment after your initial setting. Full scale automatically corresponds to a 45-degree angle for an 8-cylinder engine, 60 degrees for a 6-cylinder, and 90 degrees for a 4.

**Operation.** Connect plus and minus power input leads to your 12-volt car battery. Switch S1 to the dwell function and adjust if necessary for a full scale meter reading, then connect the third lead to the points (thin wire going from coil minus to the distributor housing). Now you are ready to take measurements.

**Auto Ignition Info.** Let's define some of the points about ignition points. A term used very widely is distributor contact dwell. Degrees of distributor dwell are the degrees of rotation during which the breaker, or contact points, remain closed. This is commonly referred to as dwell angle or cam angle. Correct distributor contact dwell is essential for good ignition performance and point life. Distributor contact dwell in effect is the amount of time that the points remain closed. During this interval of time, magnetic energy builds up in the ignition coil, which, when the points open, generates the high voltage pulse that arcs across the spark plug electrode. Generally a longer dwell period (larger dwell angle) is more advantageous for high speed operations.

Replacing ignition points is a simple matter of unscrewing the point retaining plate and screwing down the new one. This is just the beginning of a good tune-up. To check dwell reading you should have a dwell meter. Like most, ours is combined with a tachometer. With the engine running and the dwell meter/tachometer connected you should observe the dwell meter reading. If the dwell reading is within specifications for the engine then you can assume you have the correct gap, and that point contacts are in satisfactory condition. If the



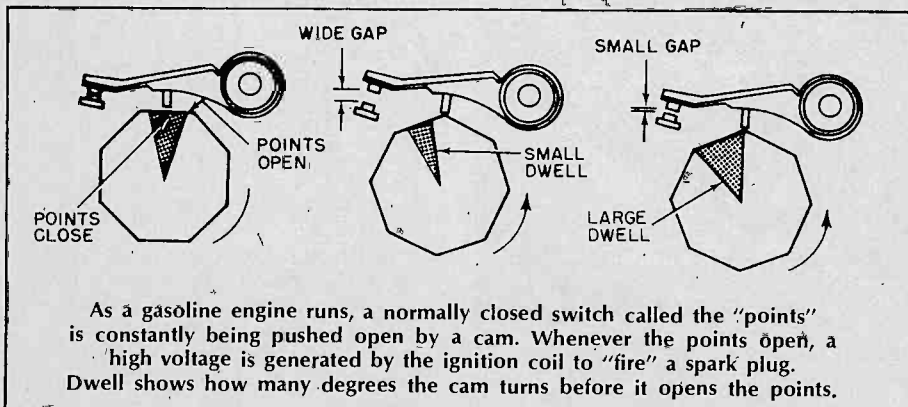
A pulse generator in your dwell/tach is designed to trigger just once each time the points open and a plug fires. Erratic behavior in some non-electronic tachometers is due to this complex wave.

dwell reading is not within specifications, the point gap may be incorrect, the cam worn, the rubbing block worn or the moveable contact arm may be distorted.

**Mini Lube Job.** Distributor lubrication is something which is usually overdone. If the distributor has an oiler on the outside of the distributor base, add three or four drops of SAE10W motor oil to the oiler. If there is a felt wick under the rotor at the top of the distributor cam, use three to six drops of SAE10W oil. All grease should be wiped from the distributor cam and rubbing block. It's very important that the ignition points be free of grease or oil.

Many ignition systems use dual breaker points. These dual breaker point systems are designed for long life and good high speed performance. They are handled in the same way as single ignition points with the following exceptions: One set of contacts should be blocked open with a clean insulator. A matchbook section makes a good clean insulator for this. Adjust the opposite set of points to specifications using a dwell meter. Loosen the stationary contact block screw just enough so that the stationary contact can be moved with a light touch, otherwise it will be difficult to set the contacts accurately. When the one set of contacts has been adjusted for the correct clearance, tighten the stationary contact lock screw. Block the adjusted set of contacts with an insulator and adjust the other set of contacts in the same manner as the first set. Remove the insulator and recheck the tightness of the stationary contact lock screw. If the contacts have been properly adjusted the dwell should be as specified for both contact sets. Again you must make sure that the gap and the dwell specifications are met for both sets of points.

**Don't Overlook The Carb.** A list of malfunctions caused by a sick carburetor reads like a "Who's Who of Auto



## PROFESSIONAL DWELL/TACH

Ailments." It includes hard starting, flooding, delayed acceleration, poor gas mileage, stalling, rough running, fouled spark plugs, and the gas leaks at the carburetor.

Not all of these problems, however, result only from an ailing carburetor. For this reason you should make sure spark plugs, ignition parts, compression, and timing are all in good condition before beginning carburetor service. In short, make sure your engine is correctly tuned, because your carb depends on the proper operation of the rest of the engine.

All types of carbs—no matter how many barrels—have only one throttle adjusting screw. Two- and four-barrel units, however, have two idle adjusting screws—one for each idle system.

Warm the engine to operating temperature and have the choke valve completely open when adjusting. Start the engine and let it idle. If it stalls, turn the throttle screw in until the engine is running steady without any foot pressure on the accelerator.

The idle mixture should be adjusted to give a smooth idle. Missing is a sign of too lean an idle mixture, while rolling or loping indicates too rich a mixture. Turning the screw in leans the mixture. It may be necessary to read-

just the idle speed and mixture after the air cleaner is installed.

(Note: late model smog-controlled cars usually have a plastic limiter that restricts the movement of the mixture screw. An acceptable mixture of adjustment should be possible within its limits.)

Turn the idle adjusting screw in slowly until the engine is about to stall. At this point, turn it out about a half-turn. If the engine seems to race, turn the throttle adjusting screw out slowly until the speed comes down.

**Service Your Plugs.** Be extremely careful how you apply the socket wrench over the spark plug insulators. While they can resist the sledge-hammer blows under extreme temperatures and load that take place inside the cylinder each time they fire, they can be cracked by carelessly banging them with a wrench either taking them out or putting them in.

After removing your spark plugs, you have three things you can do: put them right back in the engine, have them cleaned and regapped and reinstalled, or replace them with new spark plugs.

In the first case, you may merely want to examine the general condition of the plugs or check to see if the heat range is correct for the particular engine. Choice number two would be normal if spark plugs have only been used for around 5,000 miles and show nor-

mal wear. Clean and regap after 5,000 miles of use. Choice three would normally apply to spark plugs that have 10,000 miles of use or more on them.

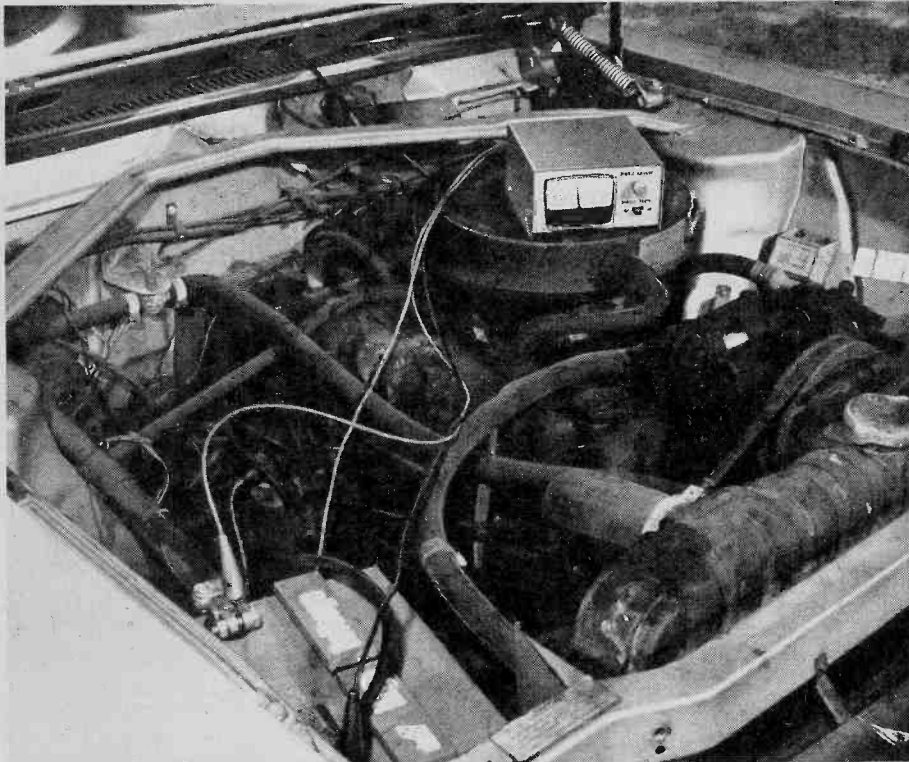
Assuming that no particular complications exist, soak the spark plugs in a good parts cleaner for a few minutes to remove any oily deposits that exist.

To remove carbon deposits, use a small knife or any other small tool which will fit up inside the plug along the insulator. Be careful not to chip the ceramic and avoid the use of a wire wheel, which will completely ruin the plug.

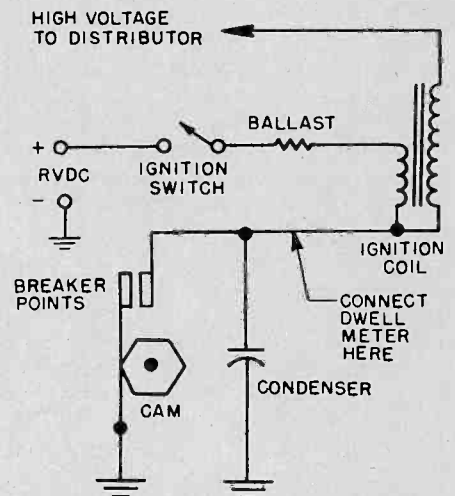
Hard carbon formations are often impossible to remove. As you examine the plugs, you may notice such a condition, or possibly a burned condition of the electrodes. In such a case, it's advisable to install a new set of spark plugs as you'll need them soon anyway.

If the condition of the spark plugs is satisfactory after cleaning, open the gap. File the electrode sparking surface with an ignition point file before opening up the gap. You will get better firing from clean, flat surfaces, so this is an important part of spark plug servicing. Finally, adjust the gap to the manufacturer's specifications (Check the owners manual).

Making sure you have the right spark plugs installed and that they are in good condition is vital to good ignition system performance. But it's only part of the story. Other parts of the system must be working properly if the plugs are to do their job. Wiring, distributor components, and coil condition all affect the production of a healthy spark. ■



Tune-up helped this overdrive equipped '68 Rambler increase mileage from 21 to over 25 mpg at today's 50-mph speeds. They laughed when I ordered overdrive back in 1968. Now one tank gives us a 375-mile driving range!



This is a typical non-electronic ignition system used for nearly all auto and truck engines since Henry Ford dropped buzzer ignition for his Model A. Additional part of ignition switch usually shorts out the ballast for more spark during starting.

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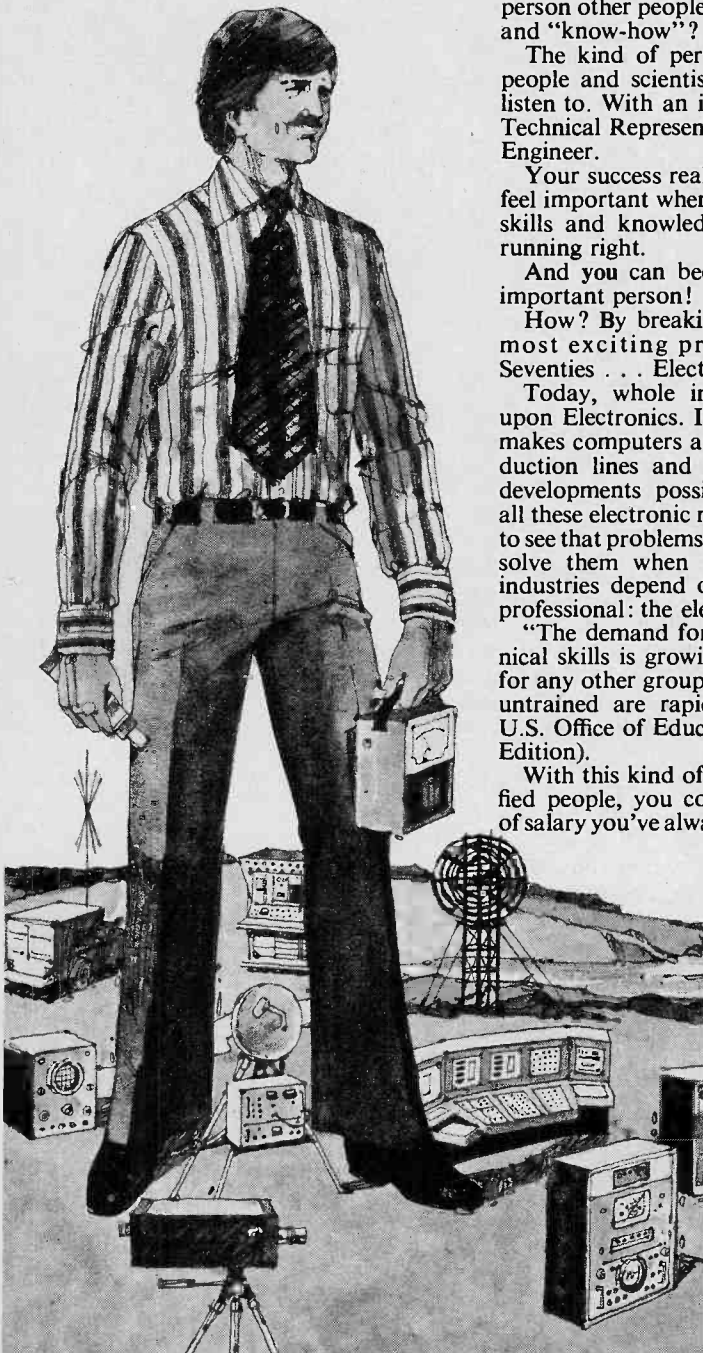
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# Stop Wasting Energy!

## BUILD TIME TALLY

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

by Thomas R. Fox

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

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

The circuit, (see Fig. 1), centering around the 555 timer, emits half-a-second negative pulses once every 60 seconds. This short, power-stingy pulse triggers the electromechanical counter whose memory requires no power whatever. The 555 output is sufficient to

drive the counter directly, which simplifies things quite a bit.

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

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

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

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

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

In negative ground systems, connect a wire to a terminal on the key switch (not a terminal that is connected

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

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

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

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

$$D = \frac{W(0.05) m}{60,000}$$

where

W is wattage of appliance

m is minutes in use

D is dollars per month

The above equation is based on an

(Continued on page 98)

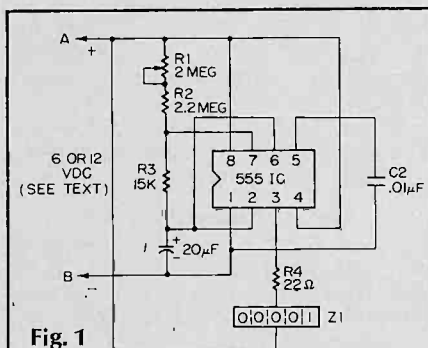


Fig. 1

### PARTS LIST FOR TIME TALLY

C1—20-VDC or better, 20- $\mu$ F Tantalum capacitor.

Note: Common electrolytic capacitors may be used with some loss of timing accuracy.

C2=0.01- $\mu$ F capacitor, any type, 12 VDC or better

IC1—555-type timer

R1—2-Megohm potentiometer, linear taper

R2—2.2-Megohm, 1/2-watt resistor

R3—15,000-ohm, 1/2-watt resistor

R4—22-ohm, 1/2-watt resistor

Z1—Electromechanical counter, 6-VDC, 5-digit, surplus type

Note: Author used ITT type CE50BN5014U. These units are available for \$4.95 each plus postage for 10 oz. from BA, 3199 Mercer, Kansas City, Mo 64111.

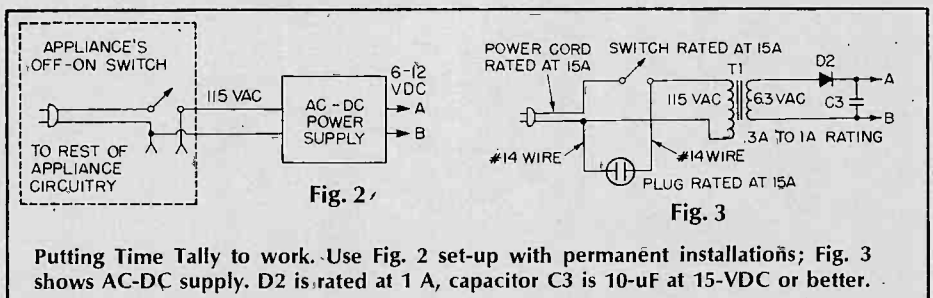


Fig. 2

Fig. 3

Putting Time Tally to work. Use Fig. 2 set-up with permanent installations; Fig. 3 shows AC-DC supply. D2 is rated at 1 A, capacitor C3 is 10- $\mu$ F at 15-VDC or better.

# Fun and Money with ANTIQUE RADIOS

One man's junk may be your piece of cake! Wheeling and dealing, fixing and selling may be the part-time job/hobby for you!

by Buck Grabbe

**A**RE YOU temporarily unemployed? Has inflation got you in its iron grip? Do you have the expense of a new baby with your wife no longer working, or does your paycheck just not go far enough anymore? If you have the ability to work with your hands and are naturally ambitious this story will show you a way to add to your family income and at the same time enjoy a feeling of satisfaction as you turn discarded radios into valuable decorator items and help satisfy the nostalgic feeling that people have today.

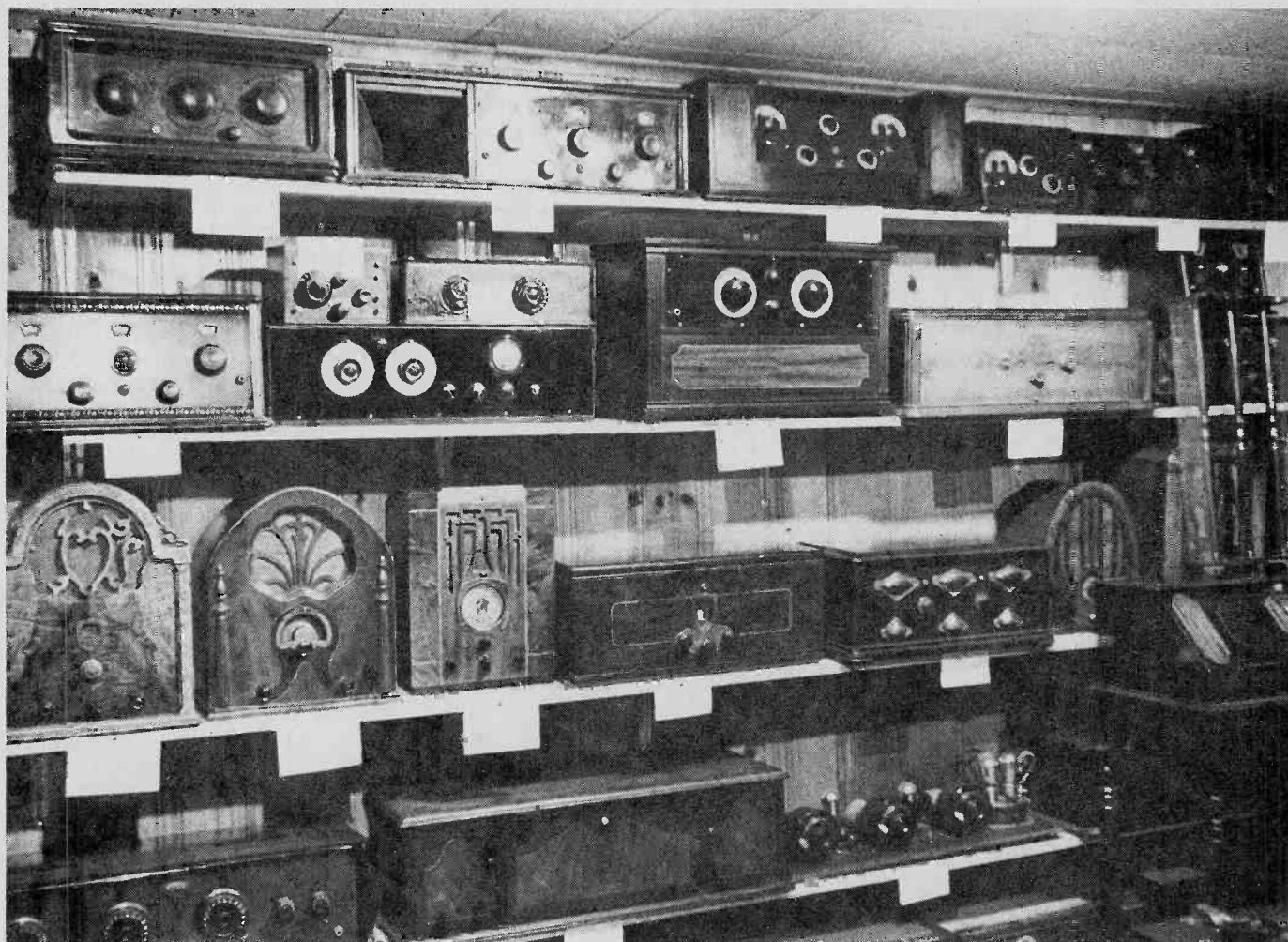
Many interior decorators, young people, and older people are clamoring for the Philco cathedral radios, Majestic consoles, Scott, Silver-Marshall, and other radios of the 1930s. The period from 1928 to 1942 will provide you with the opportunity to find what is left of the millions of radios built during that era. We are going to tell you where and how to buy radios, how to cosmetically restore them, where to buy tubes and parts, and finally where and how to sell them to make those needed dollars for yourself.

**Where to Find Old Radios.** There are many sources for old radios and we shall explore them one by one. Flea markets are very good places to find old radios. Some flea markets are permanent affairs located inside large buildings. I find the best flea markets for bargains are the temporary one- to three-day kind that set up once a year in the smaller towns. The sellers usually are nonprofessionals who like to sell at flea markets because they like to meet new people and like to make a quick buck.

A variation on the flea market is the tag sale or the garage sale. This sale may be conducted by an individual or a group of people. Usually the sale is held in the garage, yard, or basement. You will find everything from radios to horse collars. Usually prices are extremely low and by dealing with the owner you can sometimes bargain prices down even more.

Auction sales are good places to buy radios. Auction sales are especially numerous during the period from April to October. The best kind of auction is one held on a farm that hasn't been widely advertised. There will be fewer dealers there to run up the prices.

*(Continued on next page)*



# ANTIQUE RADIOS

Another type of auction is one that is held in an auction house. The auctioneer usually owns the building and has a truck to move estates into the building for weekly sales. Individuals may also consign merchandise to these sales.

Other places to find radios are antique stores, junk shops, and second hand stores. Avoid the high rent, high styled antique stores. The dirtier the windows the more likely you are to get a bargain.

The last but not least place to look is in the local sanitary landfill. It used to be called the city dump. A friend I know picked up several car radios for \$1.00 each, house radios \$1.00 to \$5.00 each, and nearly 100 tubes and several speakers free. The first thing to do is to make friends with the landfill operator. They are usually happy to save out items that people want. I know another fellow who got a Philco cathedral radio, 3 plastic cabinet table radios, and two car radios for \$7.00 at a landfill.

**What to Spend.** The difficult thing to tell you is how much to pay for a radio. First, pay as little as possible. Perhaps the first few radios you buy you may pay too much for, but after a week or two you will get the feel of it. At a flea market, shopping center antique show, junk shop, or second hand store look the merchandise over carefully and make up your mind what you are willing to pay before talking to the owner of the items you are interested in. When he tells you his price consider it carefully, comparing it to the price you are willing to pay. Most sellers expect a counter-offer one-third to one-half less than they ask initially. In fact some like to haggle over the price so well that they will be disappointed if you pay their asking price. Sometimes making a lower offer will not work. This is when you walk away with a polite "Thank you."

You have probably heard of bidders at auction sales who bid by a raised eyebrow, a crook of a finger, or a wink of the eye. Don't try to imitate them. Chances are you have never seen the auctioneer before and he won't recognize these signs from you. Shout loud and clear, wave your arm and hand at him, get his attention, because he will not sell to you unless he sees you and hears your bid. After you attend a number of sales the auctioneers will begin to remember you. They will know you are looking for bargains in used radios.

## What to Do with the Radios.

Since most of you readers will not be technicians or retired radio repairmen, we will stick to tube, fuse, and line cord replacements and to cosmetic face-lifts to the cabinets. In the "Where-to-Buy" table you will find names and addresses of people with thousands of old radio tubes to sell, sources for cabinet repair materials, books to help you in restoring radios, and companies who offer needed repair services on speakers and transformers.

Let's say you have just bought your first radio. What do you do next? First inspect the electric cord and plug. Nothing is so embarrassing as to plug in a radio and put out all the lights in the house. To prevent this, make the following device: Buy an extension cord with a cube tap on one end, a porcelain lamp socket, and a 100-watt light bulb. Mount the socket on a piece of wood about six inches square. Separate the two wires in the lamp cord without damaging the insulation. Next, cut one wire in two about a foot from the cube tap. Clean the insulation off the two cut ends and fasten the ends under the screws of the electric lamp socket and screw in the bulb. Plug the cord into the wall outlet and the radio into the cube tap. Turn on the radio. If the bulb glows dimly the radio may be okay, and it will be safe to plug it directly into the wall outlet. If the lamp lights to full brightness you probably have a short in the radio. If the line cord is okay, there is probably a short in the transformer or filter capacitors. Take it to your nearest old-time radio repairman for an expert's opinion. Unless you are an experienced



Fig. 1. This Atwater Kent cathedral radio needs cabinet work, matching knobs, several tubes, and the chassis is in bad shape. It looks like there was a component on fire there.



Fig. 2. This Philco cathedral radio came from a landfill. The veneer and finish have peeled, making it difficult to restore. Perhaps it will end up as a parts radio instead.

radio troubleshooter don't try to work on the set yourself.

If the lamp bulb lit dimly plug the radio line cord into the wall outlet. Turn on the set and look at the tubes to see if the filaments are lighted. Any tube that does not light must be replaced. A metal tube will show no light, so wait several minutes and feel it; it should be warm or hot. You will not be able to take the tubes to the corner drugstore to test because their tube tester will not have your tubes listed. So you will have to consult your old-time radio repairman. If you need new tubes, write to the tube sellers listed in the table.

If you intend to pursue the old radio hobby to increased income you should invest in an inexpensive volt-ohmmeter (VOM). Lafayette Radio, Radio Shack and Olson, as well as countless other retail outlets, sell a simple VOM for under \$10.00. This meter will enable you to check tube filaments, line cords, pilot light bulbs, speakers, and headphones.

**Good Wood.** In order to get a good price for your radio it must look good as well as play. Look the cabinet over carefully. Is the wood veneer coming loose? Is any of the veneer missing? The table gives the names and addresses of mail order sellers of wood veneers, finishing materials, and other supplies necessary for repairing cabinets. Are there deep cuts, scratches, gouged places, etc.? Perhaps the cabinet needs to be stripped and refinished. Is the grille cloth clean and in good condition? Can the numbers on the dial be read, or have they been rubbed off? Nothing will remove the dirt and grime accumulated over the years like soap and warm water. Be sparing, though, with water



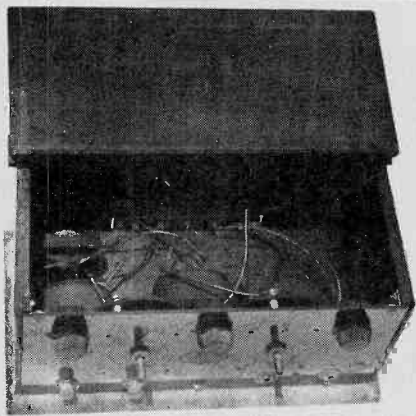


Fig. 3. This was a 2-tube radio before someone removed the tubes and sockets. The Kodak radio was purchased at an auction. Of course, it would be necessary to replace the sockets and tubes before the set would play.

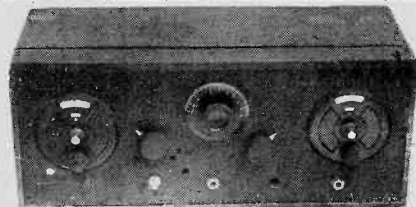


Fig. 4. It is very obvious that this is a homemade radio that was originally something else. To restore this radio you would need a new front panel, and you would have to refinish the cabinet.

**Grille Cloth.** Once the cabinet is spick and span take a look at the grille cloth. Is it torn, does it sag, is it dirty or soiled? The replacement grille cloth must have an open weave to let the sound come through. Synthetic fabrics like nylon, dacron, etc. just won't do. Monk's cloth, drapery material, and upholstery cloth are best. Visit a fabric shop in a shopping center, or a Wards, Sears, or Penneys store. As a last resort consult the mail order catalogs.

The best grille cloth adhesive I've found is white shellac. Remove the speaker mounting board and the speaker. Remove the old grille cloth and sand the board to remove glue and remnants of the old cloth. Apply a coat of white shellac and let it dry completely. This will seal the wood. Now brush on another coat of shellac. Let it dry until it is tacky to the touch. *Do not* put grille cloth over wet shellac as it will soak through and make a dark spot. When the shellac is tacky carefully place and stretch the grille cloth over the speaker opening. Press it down and let it dry. Remount the board and/or the speaker back in the cabinet.

**Finishing Touches.** You are almost finished and are ready to sell your radio. How are the knobs and dials? The older radios will have engraved and white-filled numbered and lettered knobs and dials. Carefully wash them with warm water and soap, and use an old toothbrush to remove dirt and grime from the printing. If the white filling is in bad shape use a sharp tool to remove all the white filling. Now fill in the re-

cessed lettering with a white lacquer stick. See the table for a source for the lacquer stick. How about the plastic dial scale with the frequencies printed there? Either the printing may be gone or you may wash it off while cleaning the dial. To do a complete restoration you will have to reletter the dial either freehand or by using press-on letters. Spray the dial with a clear spray that won't attack the plastic.

Now your radio looks like new, or maybe even better than new. If you haven't fallen in love with the radio and decided to keep it, you are now ready to sell it and make some of that money I told you about at the beginning of this story.

**How to Sell a Radio.** Now I'll tell you how to find a buyer for those radios you have just restored. There are many ways to attract attention to your radios. The obvious ways we will mention, but not explain, because we talked about them when we told you where to find radios. These ways are: garage or tag sales, flea markets, antique shows and sales, and newspaper advertising.

If you can find an empty store window in a cigar store, laundromat, beauty shop, dry cleaner or similar store the owner will probably let you put radios and speakers in the window with prices. If you keep the windows washed and the window area clean he may not charge you a cent for using the window. Be sure to include your telephone number so buyers may call you.

In many parts of the country there are Shoppers Guides, and publications that are full of *For Sale* advertisements. One I know of has 32 pages each week solidly filled with items for sale. This publication will advertise your merchandise for four weeks at no charge. If you sell the item advertised you pay a commission of \$1.00 and up depending on the selling price and the paper's policy. I have sold several items this way.

On the west coast there are open air "swap meets" every weekend. Here the sellers sell from their car, truck, or station wagon. Sellers are usually admitted free while buyers pay fees of 25¢ and

on wood veneered cabinets because too much water will loosen the old glue.

First re-glue any loose veneer and replace missing pieces with new veneer. Select matching wood for patching. If you do a careful job the patch will go unnoticed by nosy buyers. Carefully sand and fill the wood with wood filler after the glue is dry. Use a small camel hair brush and the proper colored stain to color-match the patch to the rest of the cabinet. Scratches, nicks, and cuts may be filled with stick shellac. See table for sources. A good coat of paste wax followed by rubbing with a soft cloth will do wonders for an aging cabinet.

You will note that we have not mentioned stripping and refinishing the cabinet. We believe that cabinets should be stripped and refinished only as a last resort. The expense and hard work just won't be repaid when selling most radios. One exception would be if you had a Scott or Silver-Marshall radio. Most radios you will buy and sell will not bring more than \$75.00 to \$100.00, so refinishing them just wouldn't pay. You can do wonders to most cabinets with the suggestions given above.

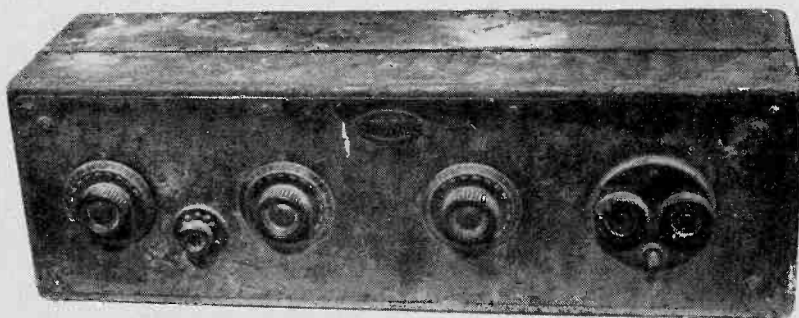


Fig. 5. This is an Atwater Kent Model 20. It too came from a landfill and needs just about everything: It has no tubes, it's dirty inside, and the cabinet and front panel both need refinishing. Fortunately it didn't cost much!

# ANTIQU RADIOS

Fig. 6. Here's a real checkbook-breaker! It is one of the very first sets completely assembled at the Atwater Kent factory. Earlier Atwater Kent radios were sold as kits to experimenters. Completely restored, this radio looks good enough to play—and it does!



up to get in. I have heard that thousands attend swap meets every weekend.

There are also bulletin boards in many places where you may put *For Sale* notices at no charge. I have seen them in barber shops, drug stores, grain elevators, and factories. Here again you can reach many people at no cost to you.

Perhaps the most profitable market of all is an interior decorator. This surprises you, doesn't it? You are about to ask, "What do interior decorators want with antique radios?"

If you read the expensive women's magazines or Sunday newspaper supplements you may have noticed antique or old radios in the rooms pictured. As you know, nostalgia is a marketable commodity. Everyone remembers the

good old days. Older citizens remember that their parents had certain kinds of radios that the whole family would gather around every evening to listen to. The young people remember visiting grandfather and grandmother and seeing an old radio in their homes. Many people are looking for the old radios they remember so well. Other people are building bars in their basements or recreation rooms. I have heard of one man who has purchased two cathedral radios because they fit in with the decor of his room. Previously we covered the places medium-income people might buy your reconditioned radios; we must now try to reach the more affluent people

These people rely on the advice given them by interior decorators. In addition

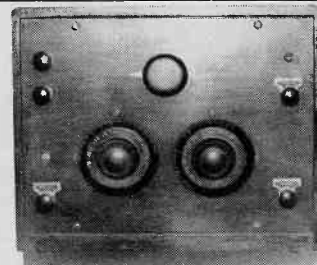


Fig. 7. This fine example of a one-tube homemade radio might be found at an auction or a flea market. The unit was assembled from mail-ordered parts in the early 1920s.



Fig. 8. This Radiola Model 17 was not in terribly good condition when purchased at an auction. The dial needed repairing and the tubes needed to be replaced. It is an early AC model.

## WHERE-TO-BUY

### Wood and Wood Finishing Materials

Craftsman Wood Service Co., 2729 S. Mary St., Chicago, IL 60608  
Constantine, 2056 Eastchester Rd., Bronx, NY 10461

### Lacquer Sticks

Alan Douglas, Box 225, Pocasset, MA 02559. \$1.50 postpaid.

### Literature and Circuit Diagrams

Antique Radio Press, Box 42, Rossville, IN 46065  
Historical Radio Services, P.O. Box 15370, Long Beach, CA 90815  
Vintage Radio Books, Box 2045, Palos Verdes Peninsula, CA 90274

### Tubes and Parts

Antique Radio Parts, P.O. Box 42, Rossville, IN 46920  
Historical Radio Services, P.O. Box 15370, Long Beach, CA 90815  
Steinmetz Electronics, 7519 Maplewood Ave., Hammond, IN 46324  
Puett Electronics, 3008 Abston Drive, Mesquite, TX 75149  
George Haymans, P.O. Box 468, Gainesville, GA 30501

### Speaker and Transformers Repaired

Lloyd V. Williams, Route 5, Frankfort, IN 46061  
Antique Radio Restorers, P.O. Box 42, Rossville, IN 46065

● Note: Most of the people listed above are in the antique radio field as a hobby only. Please include a stamped, self-addressed envelope when sending an inquiry.

tion most decorators have contracts with all the suppliers they work with that pay them a commission on their purchases for clients. You may have to pay an interior decorator a fee for each radio he sells for you. Your profit will be so much greater selling this way that you won't really lose anything.

Well, I must bring this story to an end. I have told you of the profits to be made dealing in old radios, I have told you where and how to buy radios, how and where to buy parts needed for the radios, and finally how and where to sell them. Properly used this information could add \$50 to \$75.00 additional to your family's income for each radio. So what are you waiting for?



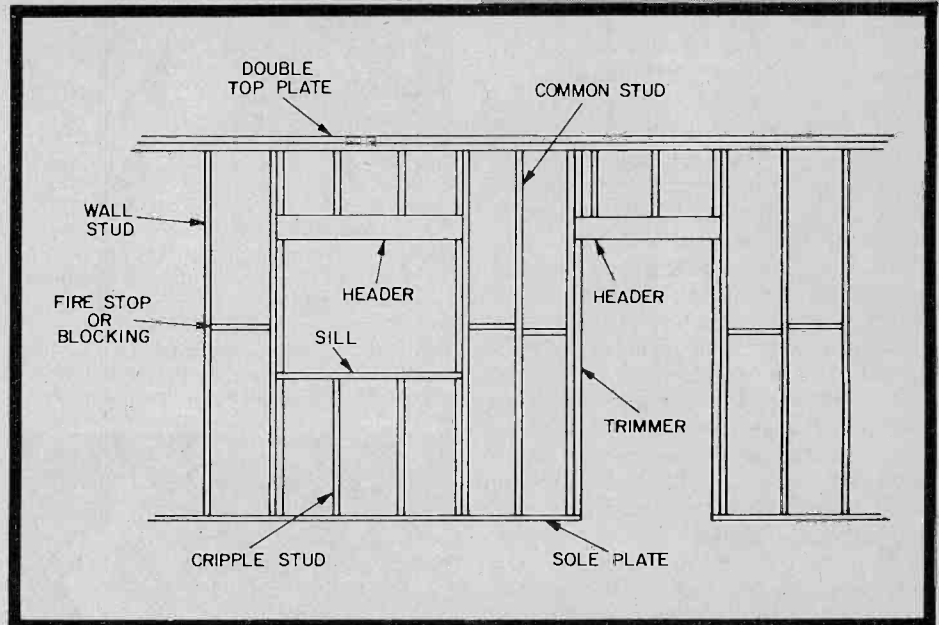
# Radio-Intercom Installation for Inflation Fighters

by Jay Jackson

**H**OW WOULD YOU like a radio-intercom system in your home that has a master station, up to 20 remote stations (if you want that many), built-in record player or 8-track tape deck, electronic chimes, patio speaker, and security alarm system? Sure you would, but the professional installation price is brutal compared to the price of the system itself. So, too many people like yourself say "no" without realizing that it's possible to install a home radio-intercom system themselves in a craftsman-like manner. The author did just that with a little bit of advice from a professional installer. He took pictures as he went along so you could see that it is possible for you to do the installation yourself and save hard-earned cash.

You can buy home radio-intercom units from most electrical supply houses at a savings. Look in the yellow pages for the one nearest you or ask a local electrician where he buys his supplies. The author installed a NuTone system that is available nationally and the editors highly recommend it and other systems available from electrical suppliers—they are less apt to be the slipshod merchandise found in low-cost retail outlets. Also, electrical supply houses sell only material that is within the scope of the National Electrical Code and "UL" approved.

**What It Does.** The new home radio-intercom systems are actually in-home communication systems with built-in convenience, entertainment, and security features. With the intercom feature, the



lady of the house can call the family to dinner, check on the baby or answer the door, just by flipping a switch, from any speaker location. The intercom can pipe radio programming throughout the home . . . even on the patio. A built-in AM/FM radio in the master unit brings background music to every room in the house. Some radio-intercom systems have the option of adding a record player or 8-track tape player so your favorite recorded music can be heard anytime, at any remote station in the home.

Most of all, the home radio-intercom

Fig. 1. Typical wall frame as seen by the carpenter before the wall is plastered or dry wall (sheet rock) added. To drop a cable from the attic above, it may be necessary to drill through a double top plate. A stiff wire lowered through the hole will detect a fire stop and indicate exactly how far down it is. If a speaker or remote unit is installed near here, cut into the wall above the fire stop—about two or three inches—and drill a hole through the fire stop. This way you can, if you need to, drop the cable down to the baseboard and run it along the baseboard laterally along the wall.



# Radio-Intercom

gives peace of mind. You can listen-in to be sure baby is asleep; check in with the "patient" while preparing meals; supervise children playing in the backyard; and you need never again open the door to a stranger. Also, inside and outside sounds can be monitored day and night from any speaker. Some of the better radio-intercom systems can include, as an option, an electronic door chime that sounds throughout the remote units. Also, an add-on security/fire alarm system alerts you to forced entry as it is occurring and to fire at its beginning stage before the heat and fumes can kill.

**You Can Do It.** The scope of this article is to show you how easy it is to install a simple radio-intercom system in your home. One basic thought is kept in mind—you are living in a home that is decorated and furnished and the installation technique illustrated is preferred because it does not upset the decor, make dirt, damage walls, or cause any discomfort to those living in the home—particularly the housewife.

Before you actually drill holes into a wall, know something about its construction. (See Fig. 1.) Wall studs rise the full length of the wall from the sole plate at the bottom to the top plate above. Fire stops, or blockings, are 2 x 4 pieces of wood, the same material used for wall studs, placed horizontally halfway up the studs to stiffen the wall. They also serve to stall the sweep of a fire up the interior of a wall for a short period of time. The sole and top plates are also 2 x 4s sometimes doubled up either at the top, or bottom, or both. You can see that it takes some doing to drop a wire down the inside of a wall from the attic above.

Note that doors and windows take advantage of one and sometimes two wall studs as part of their natural frame. This is your hint for locating studs. Also, studs are located 16 inches apart on their centers. Builders are usually true to this specification requirement. When you find one stud, you can be sure the next one is only 16 inches away.

Cables can be run through any house much the same way telephone installations are done, along wall corners, baseboards, under rugs, along walls—almost any convenient way. However, you want to do a better job than that by installing as much of the wiring as possible in the wall, attic, and along basement or crawl space. Here are some ideas on running cables through walls.

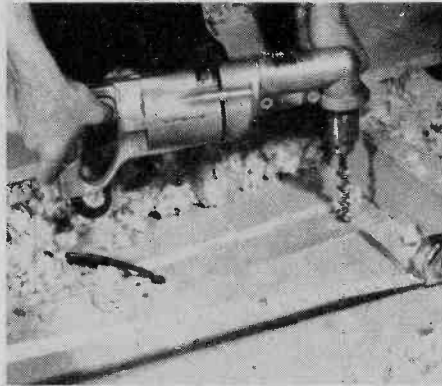


Fig. 2. A heavy-duty electric drill makes the job easier, but a standard workbench  $\frac{1}{4}$ -,  $\frac{3}{8}$ - or  $\frac{1}{2}$ -in. chuck electric drill will do the job. Here, the author is drilling from the attic into a wall below through the top plate. Studs are easy to spot from above because nailheads holding studs in place appear every 16 inches.



Fig. 3. Once in a while you'll run into a tough one. A fire stop in an unusual location may require a shifting of location of a remote station, or the renting of special tools to do the job. This homeowner rented an extension drill to go through a fire stop in the wall below that was troublesome.

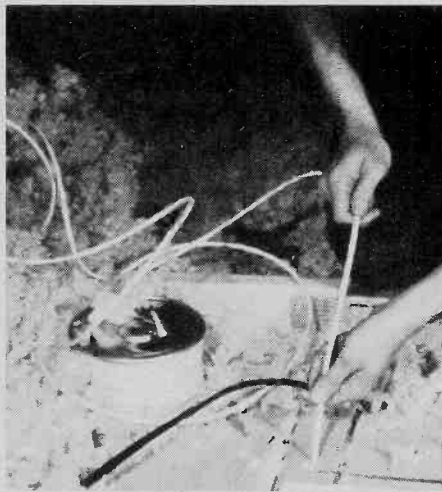


Fig. 4. Drop the cable down the holes to where the wall units should be located. Don't skimp on cable length. Leave about 2 feet slack for working room below.

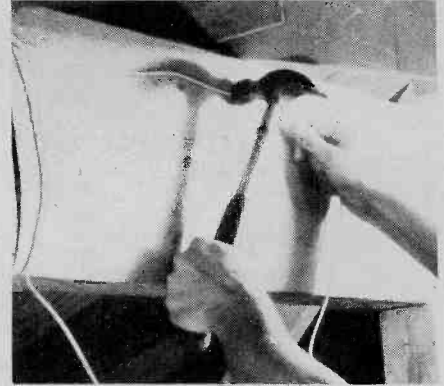


Fig. 5. Thumb tacks or staples can attach the FM/AM antenna to the rafter. Be sure not to make contact with the copper in the antenna by passing the tacks or staples through the plastic part of the antenna.

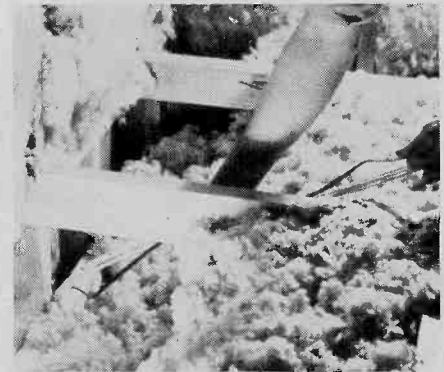


Fig. 6. The lead-in wire from the antenna is dropped inside the wall to the master control unit of the radio-intercom system in the same manner as the interconnecting cable, but not through the same hole. Keep the antenna lead-in wire several inches to a foot away from other cables in the wall. FM signals are sapped by adjacent metallic objects and wires.

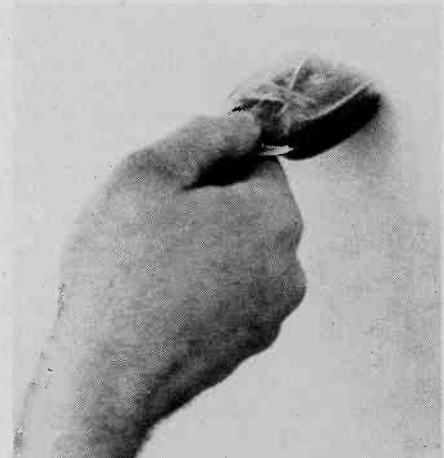


Fig. 7. Here the author uses a magnetic stud detector to locate a wall stud to which a rough-in frame will be installed. If you don't own a detector, or can't borrow one, there are other ways to get the job done.

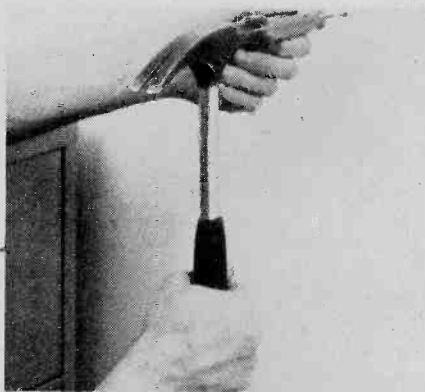


Fig. 8. Use a nail or punch to probe for the stud. Since the cable has been dropped inside the wall, you should have a good idea where the stud should be. A few punched holes will locate the stud with the failure holes falling into the area of the cutout.



Fig. 11. If you did a good job cutting out the hole, the rough-in frame should fit snugly. Tap the frame in place, then nail one edge to the wall stud.

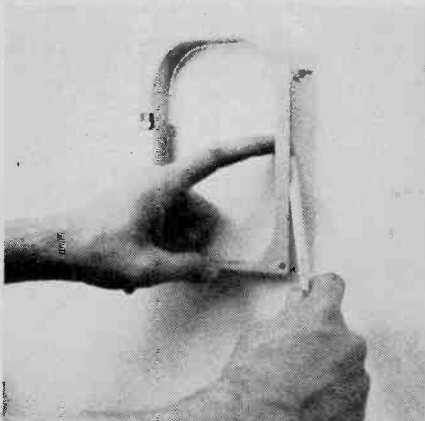


Fig. 9. The rough-in frame is placed against the wall and its outline traced. This is the edge of the hole that will be cut.

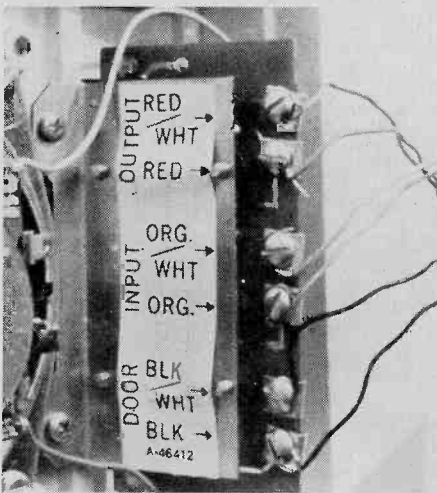


Fig. 12. Wiring is the easiest part. Just follow the simple instruction that comes with the radio-intercom system. Cables are color coded for foolproof installation.



Fig. 10. Use a key saw through wall board, dry wall (sheet rock), and the like. Pilot holes drilled in the corners give the key saw a starting point. Saber or jig-saws may be used. Plaster walls require special treatment as described in text.

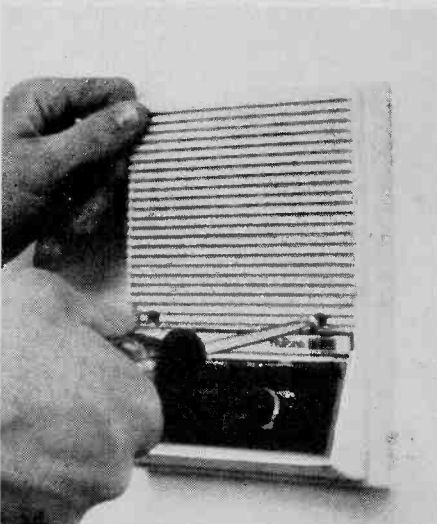


Fig. 13. The radio-intercom wall unit fits onto the rough-in frame easily, and in most cases one screw holds it in place. If a neat job was done, none of the construction marks would be seen on the finished wall.

**Start on Top.** Working from the overhead, the attic, cables are dropped into the walls below. Scrape away the attic insulation in the area you are working in and locate the wall below. Look for the studs that terminate on a ceiling top plate. If you can't see the studs, look for the nails that hold them in place. Nailheads will be popping up every 16 inches. (See Fig. 2.) The chances are, there will be no fire stops to block your path to the hole in the wall you will knock out in the room below. However, should you run into a fire stop, use a long extension drill to drill through the fire stop. (See Fig. 3.) If you can't borrow an extension drill, rent one. Possibly the fire stop will be immediately above the hole you wish to cut in the wall below; if so, drill through the fire stop at this hole. The cables are fed down the holes to the approximate positions of the wall units below. (See Fig. 4.) Allow two extra feet of cable for installation and connection of wall unit.

While you are up in the attic, install the dipole FM antenna on a rafter. (See Fig. 5.) Tack it in place being sure the tack pierces only the plastic portion of the antenna. These FM antennas are usually supplied with intercom systems that include AM and FM radio receivers. Feed the antenna lead-in wire down to the master control unit below. (See Fig. 6.)

In every installation you will run into some problem that will prevent you from dropping a line. Don't give up. One trick is to drop a cable down into a nearby closet, tack the cable to a rear closet corner, and then run the cable along the baseboard to a point underneath the location of the wall unit. Now run the cable up to the wall box. If you must, break through the plaster carefully to install a particularly difficult cable run, but remember, a paint job will follow. Where wall panelling is installed, it can be lifted carefully so that the wall may be broken and a cable installed. Be sure to plaster the holes before the panelling is installed again. You can run wires from one floor to another, through closets, or along corner wall seams. To hide cables in corners, install 1½-in. corner molding in all four corners of the room after the cables have been run, and no one would suspect that one of the moldings is hiding a cable for your home radio-intercom.

**Hole in Wall.** The first trick in installing an indoor wall unit is to find the wall stud. The hole to be cut in the wall is butted up against the stud so that the rough frame of the radio-intercom unit can be attached to the stud. Units hav-

# Radio-Intercom

ing no rough frame are best located over a stud for firmer mounting. You can use a magnetic stud finder if you have one and if it works in your house. (See Fig. 7.) Tapping the wall gets some results, but hollow walls can fool the professional, and you too! One technique that's foolproof is to remove the floor trim molding and see if you can spot the bottom of the wall studs. They are sixteen inches apart, as we've noted earlier. Wall outlets are usually hung on studs, so measure 16 inches from stud to stud because most builders are true to this measurement.

Once the approximate location on the wall stud is known, punch through the wall with an 8-penny finishing nail or punch designed for this purpose. (See Fig. 8.) Find the exact *edge* of the stud. From this *edge*, the cutout hole is traced from the rough-in frame of the unit to be installed. (See Fig. 9.) Holes in dry walls are easily cut out with a key saw. (See Fig. 10.) Holes drilled at the corners make sawing easier.

Solid plaster walls are tougher and require some finesse. Use an old 1/4-in. chisel or fine blade screwdriver and hammer to chisel out the edge of the rough hole. Work carefully making 1/8-in. deep indentations one at a time. Working too fast and cutting too deeply will result in cracked walls. After the plaster is cut clean around, pry it up. Gentle tapping in the center of the cutout will help. Wood or plasterboard lath behind the cutout can be cut with a key saw. Use sheetmetal snips to cut through wire lath used in older homes. Now install the rough-in frame and nail it to the stud. (See Fig. 11.) Pick up the radio-intercom cable in the wall and connect it to the wall unit, (See Fig. 12) then slip the unit into the rough-in frame and screw in place. (See Fig. 13.) This installation procedure is identical for both small and large units. (See Fig. 14.)

The radio-intercom master station installation may be a bit difficult compared to remote wall units. It is considerably larger and many cables come to it. The master station requires a larger wall hole, increasing the possibility of in-wall obstructions. Begin by finding a wall stud as before. Then trace in the rough-in frame on the wall and remove the plaster. (See Fig. 15.) If you run into a fire stop (horizontal piece of wood between two studs, an additional stud, or both), remove the studs or chisel wood away to make room for the rough-in frame. (See Fig. 16.)

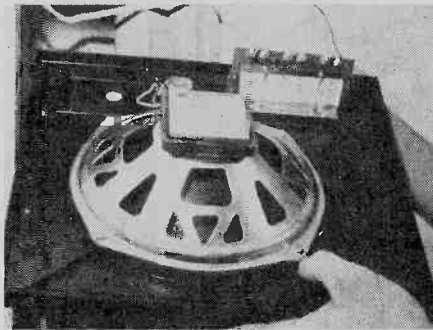


Fig. 14. Here is a large wall remote unit with an 8-in. speaker being installed. Cut-out and installation are identical to small wall remote units.

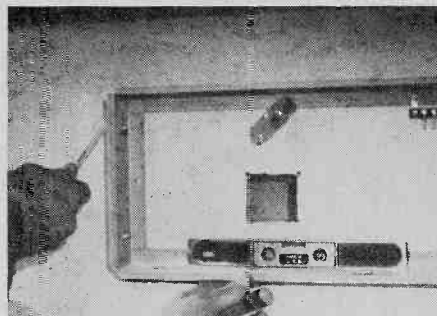


Fig. 15. The master station rough-in is installed just like the other inside unit frames. The wall stud is located and the frame is used as a template for cutting the hole.

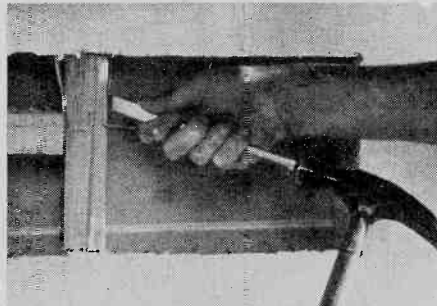


Fig. 16. Here is a problem the author ran into. Since the master control unit is the largest unit installed, it will sometimes run into obstacles like this wall stud and fire stop. Use key saw, drill and chisel to remove the wood to the depth required. Avoid excessive force. Wall may crack on either side of stud if forced to vibrate or shake.

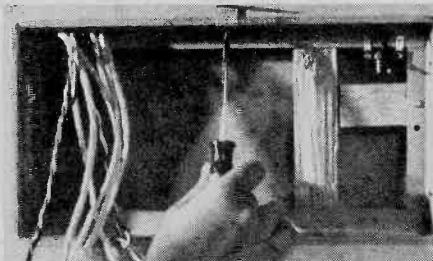


Fig. 17. With the rough-in frame for the master control unit installed, pull through all the cables from indoor and outdoor remote units, power line, and antenna.

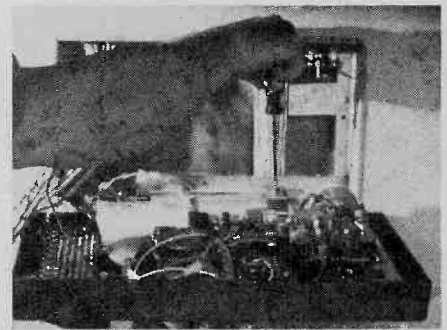


Fig. 18. The master control unit is mounted on its rough-in frame and the cable connections are then made. Follow the simple instructions supplied with the radio-intercom system and nothing can go wrong.



Fig. 19. The master control station is flush-mounted on its rough-in frame and secured in place. What was once a hole in the wall is now the mark of a professional-like installation you can do.

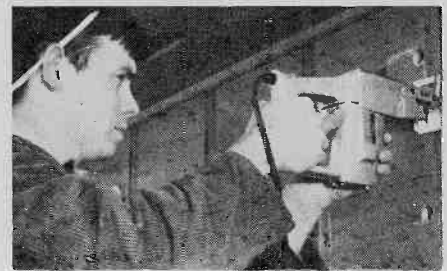


Fig. 20. Outdoor units are installed in the same manner as indoor units. Here, a saber saw makes fast work cutting the building's outer face from drilled holes for a fast and sure square hole. The patio speaker rough-in frame was used as a template.



Fig. 21. An extension drill is used to drill a hole into the attic. This drilling procedure was necessary because it was difficult to drill a hole down from the attic. Once hole is made, pull down cable from attic.



Be sure there's room for the installed unit to fit into the wall. Don't worry about reducing the thickness of a stud. It will not weaken the wall if it is the only stud cut. Pull all the wires through and secure the rough-in frame to the wall. (See Fig. 17.)

The wires, power line, and antenna cable are connected to the master control station. (See Fig. 18.) The master control unit is then slid into the rough-in frame and fastened in place (See Fig. 19.)

**On the Outside.** The mounting of outdoor units for the radio-intercom system such as the door announcer, electronic chime button, patio speaker or whatever, poses problems not unlike those of interior wall mounted parts of the home intercom. The outdoor speaker is mounted somewhat above normal eye level under the eaves of the building to protect it from the weather. First cut a small 2- or 3-in. hole where you want to place the speaker. Then, probe with a stiff wire to find the studs on either side of the hole. With the location of the studs known, decide where the cutout should be made. Drill four corner holes to make cutting with a key saw or saber saw easy. (See Fig. 20.) Then drill a hole into the rafter with an extension drill. (See Fig. 21.) As an alternate, you can drill a hole near the top of the wall near the eave, pull a cable through this hole, staple the exposed cable along the eave-wall line until an eave ventilator is reached. Snake the cable through the ventilator into the attic and make your connections there. Of course, if you can drill from the attic down, do so—it's easier.

Now drill down through the fire stops, if any are in the way, to permit the cable to be pulled out at a point about 40 inches above the porch floor level. (See Fig. 22.) Drill a hole in the wall and snake out the cable with a hook made from a wire hanger. (See Figs. 23 and 24.) Mount the patio remote control wall unit on top of the hole and connect the wires. (See Figs. 25 and 26.)

Insulation in an outer wall will make the snaking of cable difficult. At first, it would appear easier to remove the insulation, but try first with the insulation in place. Be sure to replace any insulation you remove. Use putty to seal open edges and block holes.

Now with the patio speaker remote control unit mounted, the patio speaker may be installed. Place the rough-in frame into the cutout and fasten in place. (See Fig. 27.) The speaker wires are connected, and the speaker and grille are then inserted into the rough-in frame and screwed in place. (See Fig.

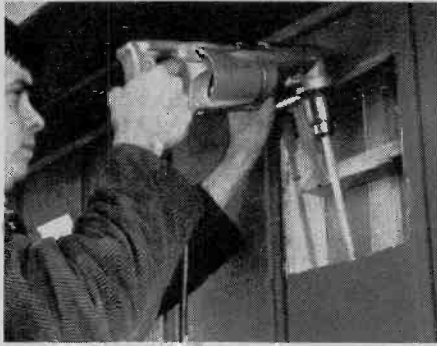


Fig. 22. Patio speaker remote control was positioned below the speaker on the same wall, so author drilled hole through fire stop to allow cable to pass through.



Fig. 23. A hole is drilled immediately below the patio speaker at the site of the remote control unit.

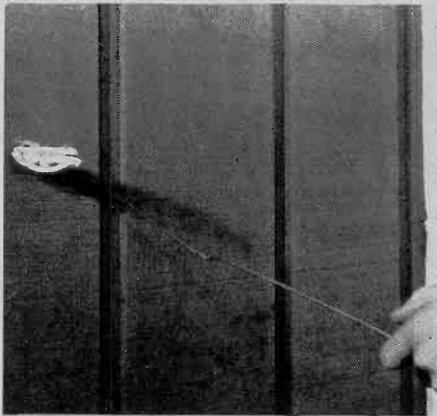


Fig. 24. A bent wire hook made from a wire coat hanger pulls out cable from inside the wall. This wire snaking trick may be used anywhere in the house to pull cables through small holes or from above or below fire stops.

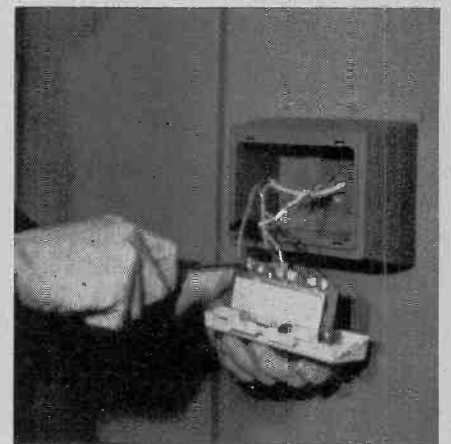


Fig. 25. The remote housing is flush mounted to the building wall without the need of a rough-in housing. Simply screw-mount the weather shield to the wall.

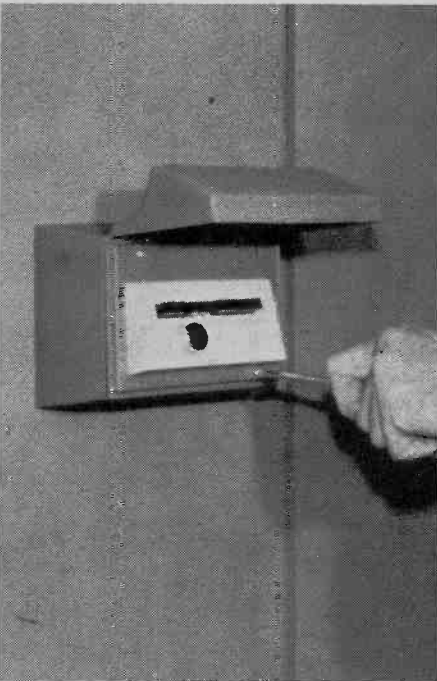


Fig. 26. After the cable is connected to the patio speaker remote control unit, the control bezel is fastened to the weather shield's housing.

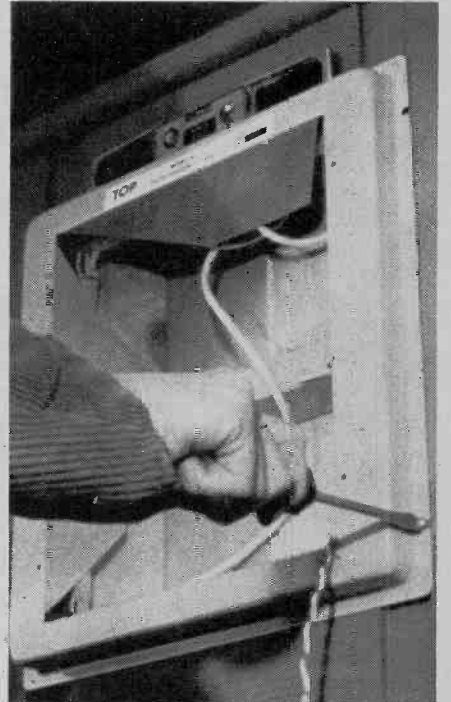


Fig. 27. Patio speaker rough-in frame is slipped into place and fastened with four screws, one in each corner.

# Radio-Intercom

28.) Other outdoor units such as the front-door remote unit are installed in this manner. Make a careful study of your house's exterior-wall stud location before you cut or drill any holes. Mistakes inside the house can be patched up with plaster and paint, or even a picture frame. Outside the home, re-facing is difficult and expensive.

**Transformer Power.** The newer radio-intercom systems are operated from a standard 16-volt bell transformer. If your intercom system is so designed, the transformer may be mounted at any convenient electrical point and ordinary plastic-covered wires can be used to connect the transformer to the intercom. Use the wire size and transformer recommended by the manufacturer of the intercom unit. The author installed the transformer on an electrical box previously installed by

the house builder in his basement. This same box supplied power to the work-bench light. No electrical codes will be broken if you follow the simple instructions supplied by the manufacturer. (See Fig. 29.)

**Some Pointers.** Here are some home radio-intercom system installation tips

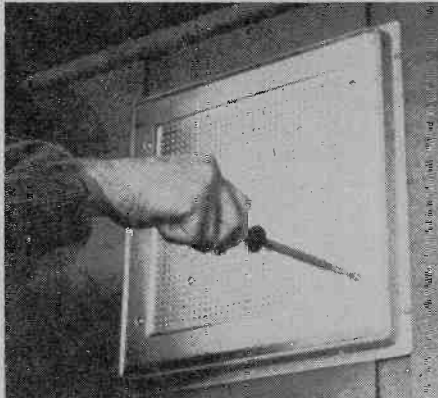


Fig. 28. After cable is connected to patio speaker's terminals, the entire assembly with grille is installed.

you should keep in mind. If you have a choice of walls, use interior walls without insulation. These walls are easier to run cables through. Locate wall units about 60 inches from floor to top of unit. To avoid acoustical feedback between units, never mount two intercom stations back-to-back on a common wall.

Make a wiring plan of your installation. Try to limit unnecessarily long cable runs. Be as direct as possible. Plan wisely the number of remote stations you need—otherwise the price goes up and installation time increases.

If economy insists, plan for a minimum radio-intercom system but plan ahead for future additions. A few extra cables from the master control unit to the attic is a wise move. Pulling a few extra cables through during the initial installation will make future additions an easy go during installation.

Above all, do it yourself! Here is an installation you can do and pocket the savings.



Handsome styling and high-quality performance characterize the newly designed radio-intercom systems. Master station is finished in golden elm, having panels to cleverly conceal up to 10 seldom-used switches. System can

accommodate up to 20 remote speaker locations. Station "all call/all listen" allows intercom calls to be answered hands-free. Auxiliary jacks accommodate record changer, 8-track tape player, electronic chimes and security alarm systems.

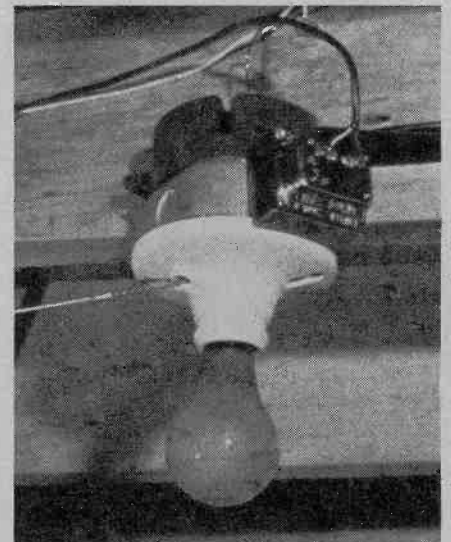


Fig. 29. The transformer mounts directly onto an electrical box. To connect, first turn the power off. Remove one of the round electrical "knock-outs" that are pre-punched in the metal box. The transformer mounts on this hole. Make the necessary electrical connections and replace the lamp socket or metal plate—whatever covers the metal box. Turn the power on. You can receive no deadly shocks from the 16-volt output of the transformer, but it may cause an unpleasant reaction and you may move quickly or violently causing injury to yourself. Therefore, do not connect the power cable to the transformer till the installation is finished. A dead short across this transformer will not cause the wire to burn or the transformer to overheat—it has been designed with this built-in protection.

NuTone offers an interesting radio/intercom catalog you can obtain by circling No. 24 on the Reader Service Coupon on page 17

# BUILD IT FAST AND CHEAP... AUDIO FUN-DAMENTALS WITH THE 741

## TELEPHONE VOICE

□ The "telephone voice" effect is usually created by passing a voice signal from a high quality microphone through a bandpass amplifier—a device that attenuates the frequencies on both sides of a selected frequency. Bandpass amplifiers are also effective at providing mid frequency boost—presence, as it's called in hi-fi terms.

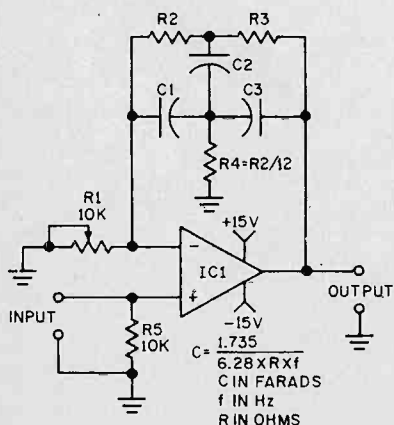
The center frequency of this bandpass amplifier is determined by the values of C1, C2, C3, R2, R3, and R4. The exact frequency can be determined from the formula shown. To start, assign a value of 100,000 ohms to R2 and R3 (use ½-watt resistors). To avoid hum pickup, the unit should be assembled in a metal cabinet. Potentiometer R1 serves as the Q-control; it determines the degree of boost at the center frequency.

R5 connects to the non-inverting (+) input of the IC, R1 between ground and the inverting (-) input. No pin connections are given because the IC is available in many different configurations.

Of course, you could find a carbon microphone "button" and matching transformer to create the effect naturally, but that's not how it's done in the big city, bub!

### PARTS LIST FOR TELEPHONE VOICE

- C1, C2, C3—(C1 equals C2 equals C3, see formula)  
IC1—Type 741 opamp  
R1—10,000-ohm pot  
R2, R3—(R2 equals R3, see text)  
R4—R4=R2/12  
R5—10,000-ohm, ½-watt resistor



## MAG TAPE AMP

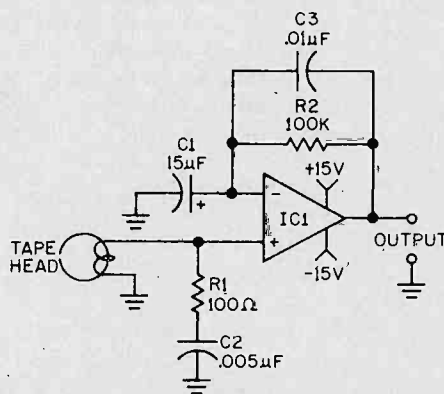
□ From time to time surplus dealers offer complete tape or cassette mechanisms—everything ready-to-go except for the electronics, and at rock-bottom prices of \$10, \$15 or \$20. Often, all the mechanism needs is this equalized tape head preamplifier.

Though the power supply is rated at ±15 VDC, almost optimum results will be obtained with supply voltages as low as ±7 VDC. Two ordinary 9-volt transistor radio batteries will power the preamp for many hours.

As with all these projects, the 741IC is internally compensated and no special wiring practices are needed; the preamp can be built in just about any enclosure.

### PARTS LIST FOR MAG TAPE AMP

- C1—22-μF electrolytic capacitor, 25-VDC or better  
C2—0.005-μF disc capacitor, 25-VDC or better  
C3—0.01-μF capacitor, 25-VDC or better  
IC1—Type 741 opamp  
R1—100-ohms, ½-watt resistor  
R2—100,000-ohms, ½-watt resistor



## RC FILTER OSC

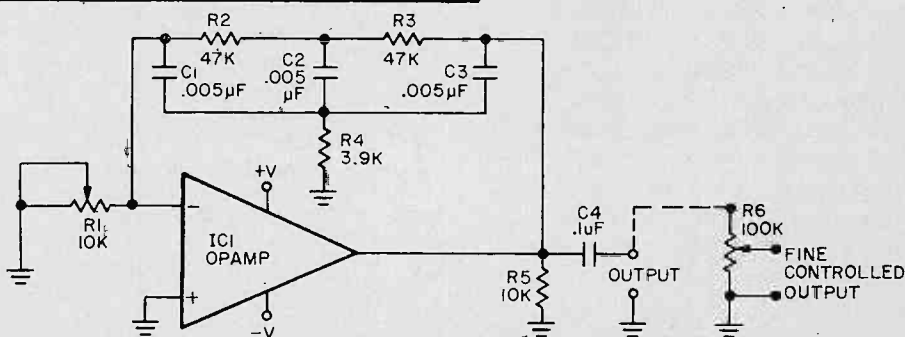
□ An experimenter has many uses for a basic 1000-Hz oscillator. If you're an experimenter you know how many and can make up more. Even audio buffs find an increasing interest in test signals for speaker balance and phasing. In this circuit, a resistor/capacitor filter tuned to 1000 Hz is connected between input and output of IC1 to sustain selective (1000 Hz) feedback. It's suitable for testing audio equipment, signal tracing or tape recorder bias adjustments.

The 1-kHz "notch filter" from the amplifier output to the inverting or negative (-) input determines the output frequency. Non-inverting or positive (+) input is grounded. The power supply is bi-polar; use any voltage up to ±15 VDC. While resistor R5 is not needed, in many instances its use insures your project's success.

If fine output control is desired, add potentiometer R6. When your oscillator is connected to a DC circuit, connect a DC blocking capacitor in series with R6's wiper arm. If the oscillator is to drive circuits of less than 10 k-ohm impedance, substitute a 1 μF non-polarized capacitor for C4, rated to the power supply's voltage.

### PARTS LIST FOR RC FILTER OSCILLATOR

- C1, C2, C3—0.005-μF, 75-VDC (Radio Shack 272-130 or equiv.)  
C4—0.1 μF (see text)  
IC1—741-type operational amplifier (Radio Shack 276-010 or equiv.)  
R1—10,000 ohms pot  
R2, R3—47,000-ohms, ½-watt  
R4—3,900-ohms, ½-watt  
R5—10,000-ohms, ½-watt (see text)  
R6—Potentiometer, 100,000-ohms, audio taper (see text)





# RADIO HISTORY

by Art Trauffer

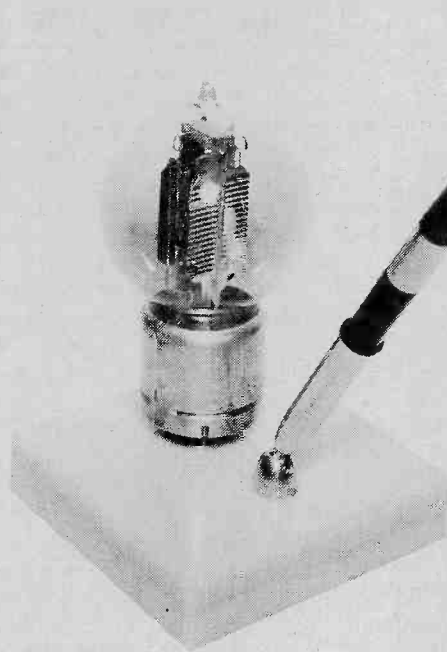
□ Here are some ideas suggesting how to make novel pen sets that bring back fond memories to old-timers in wireless and radio. The pen sets also fascinate newcomers in radio and electronics, and they make nice gifts.

As shown in the illustrations, an early wireless or radio item such as a vacuum tube, crystal detector stand, or spark gap is mounted on a block of marble, onyx, or wood, and then a funnel and pen is added to complete the desk pen set.

Old-timers in radio might want to use the crystal detector they made or bought for their first crystal set, or the first tube they used when they graduated to tube sets, or the spark gap they made or bought to use with their Ford spark coil transmitter. Newcomers in radio and electronics can purchase the above early items from antique radio collectors, or they can make their own crystal detector stands and spark gaps using the illustrations as guides.

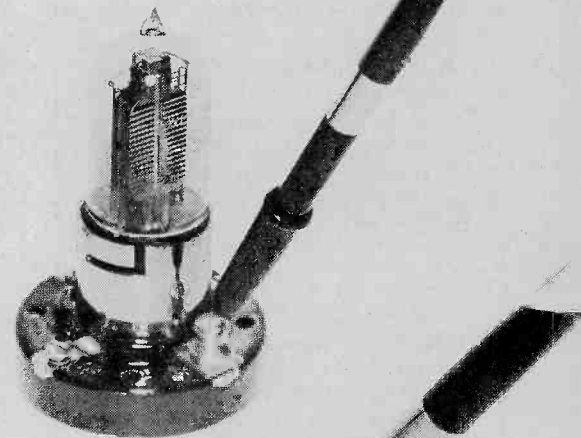
Marble and onyx blocks can sometimes be found at sales, or they can be purchased from large electric lamp supplies firms, or from firms that make sports trophies. Funnels and pens can be purchased from the larger hobbies and crafts dealers. The table gives some purchasing tips.

To mount items on marble and onyx blocks you can either drill holes using high-speed drills (at slow speeds), or masonry drills, or you can simply cement the items on the blocks using epoxy glue or the new industrial "wonder glues." ■

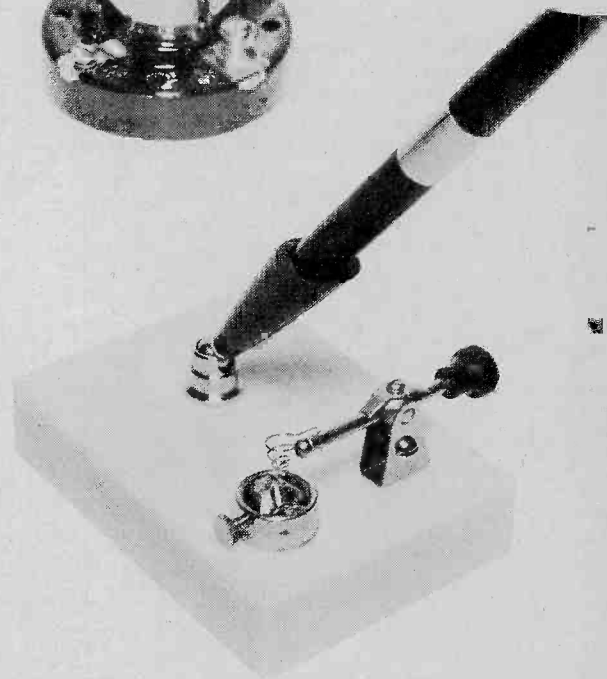


*Here is a Western Electric 216-A triode tube mounted on a block of onyx purchased at a sale for a few cents. The four pins on the bottom of the tube base were soldered to a small brass disc and then the brass disc was cemented to the onyx block with epoxy glue. The ball joint of the pen funnel was also glued to the onyx block.*

*A novel pen set idea is a Western Electric 203-D triode (similar to a VT-1) mounted in an RCA UR-542 porcelain bayonet-type socket. One of the binding post screws was removed from the socket and a 6-32 x 3/4 in. flat-head machine screw was passed through the hole to hold the ball joint of the pen funnel. If desired, you can cement the pen funnel to the socket using epoxy, or "miracle glue." Four small felt pads were added to the bottom of the socket.*

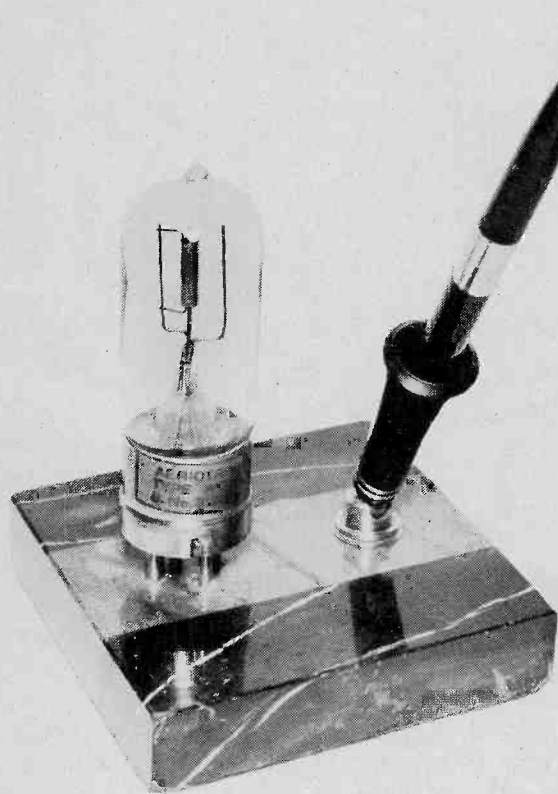


*The author used a marble block removed from a discarded basketball trophy purchased for 75¢ at a Salvation Army store. The hole in the block was used for mounting a funnel and pen. The crystal detector parts were glued to the block with epoxy glue.*



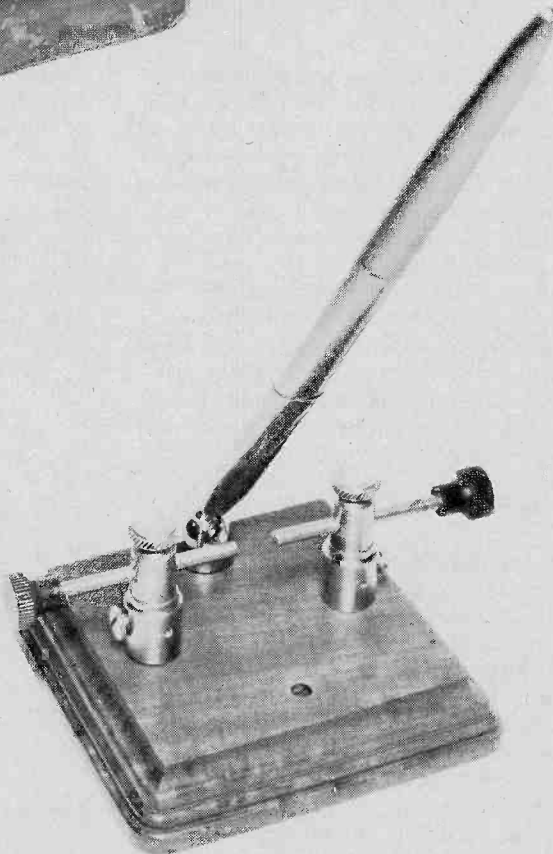
# ON YOUR DESK

Bring back the days of wireless glory with these low-cost, easy-to-make souvenirs!



*Here we have the famous Westinghouse Aeriotron (WD-11) triode tube which made a big hit in the early 1920s because you could heat the filament (1.1 volts) with a 1½-volt drycell instead of using a 6-volt storage battery. In this case, the author used a desk pen set purchased at a rummage sale for 50¢, and drilled four small holes for the tube base pins to fit in, and then used epoxy glue to hold it fast. Green felt was glued to the bottom of the marble to protect polished desk surfaces.*

*Here is a home-brew stationary spark gap, such as used in the early days of radio—known then as “wireless.” Many of you old-timers will recall using a Ford Model-T spark coil to provide the high voltage for the spark! Assembly is easy. Simply pass a machine screw through one of the mounting holes in the base of the spark gap to hold the ball joint of the pen funnel. Glue felt to the bottom of the base to protect polished desk surfaces.*



## POSSIBLE SOURCES FOR DESK PEN SET MATERIALS

### Marble and Onyx Blocks

Salvation Army, Goodwill Stores, auctions, rummage sales  
Gilbert & Miller, Inc., 239 New Main St., Yonkers, NY 10701. (This company supplies marble and onyx blocks, as well as pens and pen funnels. Write for catalog.)

### Pens and Pen Funnels

Gilbert & Miller, Inc. (see address above) Large hobbies and crafts supplies stores

### Green Felt

Notions and yard goods departments of department stores

### Early Vacuum Tubes

Antique radio collectors (The following two antique radio newsletters also might be helpful: *Antique Radio Topics*, published by Antique Radio Press, P.O. Box 42, Rossville, IN 46065—50¢; and *The Horn Speaker*, published by Cranshaw Publications, P.O. Box 12, Kleberg, TX 75145—also 50¢.)

Watch ads in *Collectors News*, *Antique Trader*, etc. for antique radio collectors and dealers wanting to sell early radio vacuum tubes.

### Crystal Detector Stands

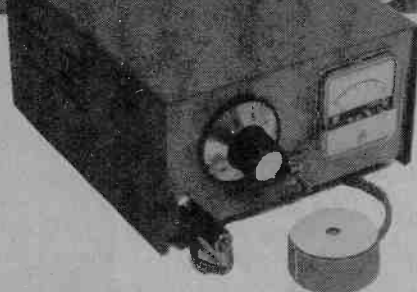
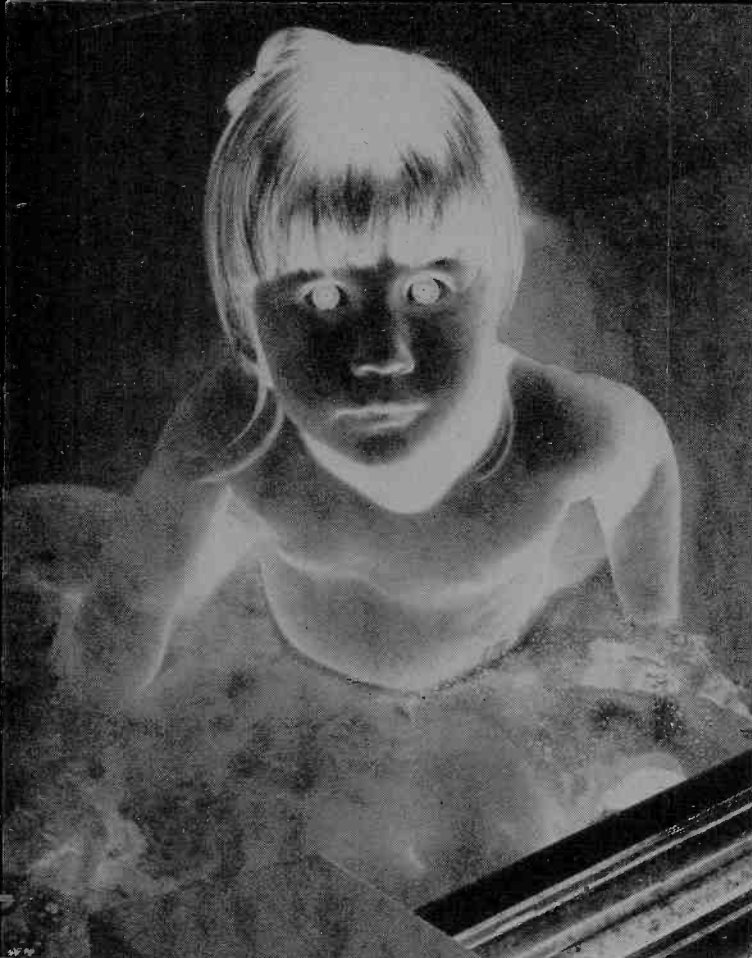
Modern Radio Labs., 1477-G, Garden Grove, CA 92642  
Bill Baker, Route 3, Box 1134, Troutdale, OR 97060 has some Kilbourne & Clark crystal detector stands (circa early 1920s) to sell. Write him for prices.

### Crystals

Modern Radio Labs. (see address above) sells various types of crystals. Write for details and prices  
Art Trauffer, 120 Fourth Street, Council Bluffs, IA 51501 sells genuine MPM (Million Point Mineral) unmounted galena crystals in original factory boxes (circa early 1920s) at 50¢ each, plus postage.

### Spark Gaps

Buy from antique radio collectors and dealers.



# DARKROOM PRINTING METER.

Print-paper saver gives you fine B&W prints sooner!

by Herb Friedman

**T**RY TO grind out wallet-size prints or enlargements from a full 36-exposure roll in only one evening and you'll know just how frustrating life can be. Every change in magnification and negative density means a different exposure. And if you use test strips or exposure guides to hit the correct exposure you're making at least two prints for every one you need.

The way to take all this drudgery out of your darkroom work is to use an electronic printing meter, a device that takes only seconds to indicate the correct exposure, regardless of whether the enlarger is at the top or bottom of the rack, or whether the exposure and negative development is over or under.

A quick example will illustrate how easy it is to make prints with a printing meter. Let's assume you have just chocked the negative in the enlarger and have cropped the picture exactly the way you want it. Now you take the probe from a printing meter—which you have previously calibrated for a 10 or

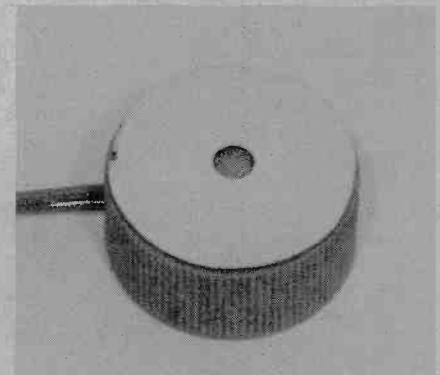
20-second exposure—place it on the easel at the point of maximum light transmission through the negative (the black reference in the print—deepest shadow) and adjust the lens diaphragm until the printing meter's pointer indicates some reference value you have previously selected.

That's the whole bit. Expose the paper for your normal 10 or 20-second exposure and the first print will be a good print. Maybe even a great print. If you're grinding out wallet-size jobs for the whole family, each print from each frame will have the same excellent quality.

**A Hint.** The key to successful use of a printing meter lies in the fact that, except for some particularly artistic work, any print will look decent to excellent if there is some deep black, even if it's just a spot of black; for the black to highlight or border-white contrast gives the visual appearance of a full contrast range, even if the greys are merged. For those who do portraiture, a printing meter can be user-calibrated for "flesh tones."

The printing meter shown in the photographs has been especially de-

signed for construction and use by the typical e/e photographer/electronics hobbyist. It features a calibration—called "speed"—adjustment to accommodate slow to fast enlarging papers (such as Polycontrast and Kodabromide) and readily available parts, many of which will be found in the typical experimenter's junk box. The layout is non-critical—any cabinet can be substituted; there are no critical shielded



The sensor is really a large tuning knob with photoresistor PR1 embedded in epoxy, plastic or RTV rubber adhesive.



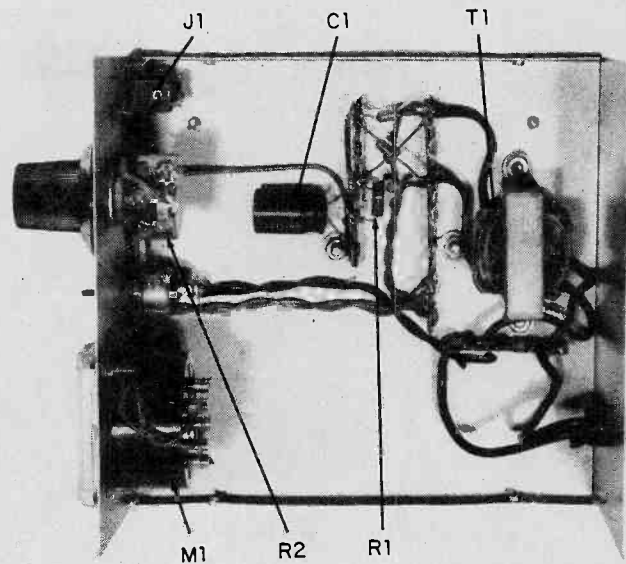
circuits (not even shielded wire is used); and except for the photoresistor sensor, just about any component quality will do. There is absolutely no sense in building the project with the best components money can buy because the best components won't affect the final performance one iota.

**Construction.** The unit shown is assembled in a 5¼ x 3 x 5⅞-in. metal utility cabinet. Connecting jack J1 is optional as the photoresistor sensor, PR1, can be hard-wired into the circuit. If you use a jack, note that it must be the three-terminal type such as is used for stereo connections; the ground connection is not used since neither PR1 lead is grounded. Do not use an ordinary phone or phono jack as they will ground one of the PR1 leads. Plug P1 must similarly be a matching three-terminal stereo type. Either miniature or full-size jacks and plugs can be used.

Power switch S1 can be anything you care to use—lever, slide, or toggle. Use the least expensive slide switch if you're trying to keep the cost down.

The meter, M1, is a Lafayette Radio 99-26262 illuminated 0-1 mA S-meter. This meter was selected because it has built in pilot lamps with 6 and 12-volt connections. When 12-volt-connected to T1, which is 6 volts, the pilot lamps are dim enough not to affect the sensor and bright enough so that you can see the pointer in the darkroom. Meter M1 mounts in a 1½-in. hole, which can be cut with a standard chassis punch (if you have the punch).

**Sort Them.** The meter scales are jammed with numerals that can be confusing in the darkroom so the best bet is to paint out the unwanted "calibrations" using Liquid Paper or Liquid KO-REC-TYPE, products used to correct



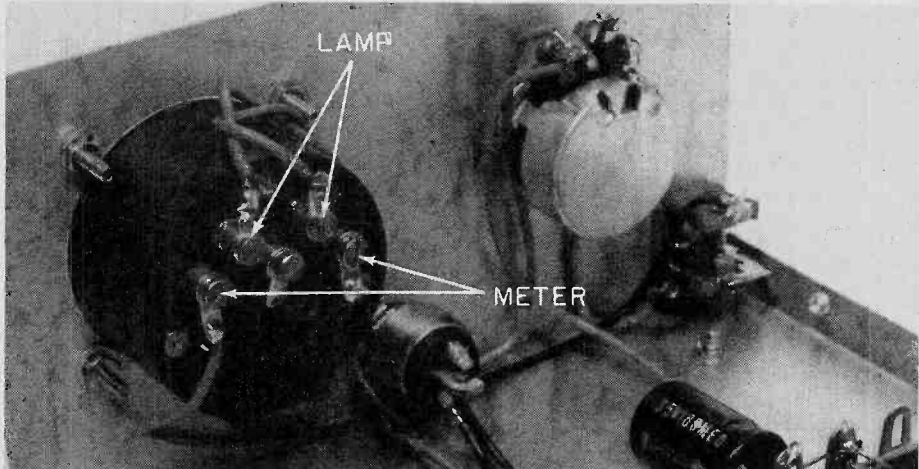
Nothing is critical so don't crowd the layout. Two parallel terminal strips provide the tie points for the rectifier diodes and power supply

typewriter errors (available in stationery stores). First, snap the plastic cover off the meter. It might feel secure but it's not. Grasp the top of the cover and force the cover outward and down, taking care that when it snaps free the pointer isn't damaged. Next, remove the scale by taking out the two small screws and sliding the scale out from under the pointer. Do not attempt to paint the scale while it is mounted in the meter as a single drop of the fast-setting correction fluid can ruin the meter if it gets into the pivot bearing. When re-installing the scale, hold the screws with a tweezer or long-nose pliers until you "catch" the first few threads. When the scale is secure, snap the meter's cover into position. (On the unit shown all scales and markings other than 0-to-1 have been painted out, as the 0-to-1 scale is the most convenient to see under dim lighting.)

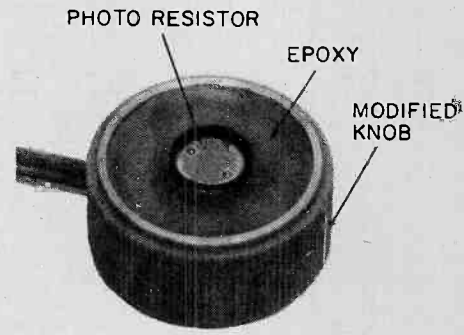
Note that meter M1, power switch S1, and jack J1 have been positioned on the front panel so as to provide the maximum room for the speed control's calibrated knob. Use the largest possible knob as the greater the calibrations the easier it is to reset the control to a desired paper speed.

Power transformer T1 can be any 6.3-volt filament transformer rated 50 mA or higher. (A 6-volt transformer scrounged from a portable cassette recorder will work just fine.)

**Power Filter.** If the line voltage in your home is known to be reasonably constant, assemble the unit as shown in the schematic. If your local utility likes to bounce the line voltage, or if appliances cause your line voltage to vary (indicated by dimming lights), install zener diode D5 across points A and B. The zener will provide a regulated 6 volts, with the slightly lower circuit



The specified meter has five terminals. The two on the bottom row are for the meter movement. The top row terminals are for the 12-volt lamp connection. The remaining terminal is for a 6-volt lamp connection and is not used.



After the sensor is completed, punch a hole in a matching cardboard disc and cement the disc over the sensor. The hole provides a smaller sensitive area required for prints 4 x 5 or smaller. Better results with larger prints are also obtained with the mask.

# DARKROOM PRINTING

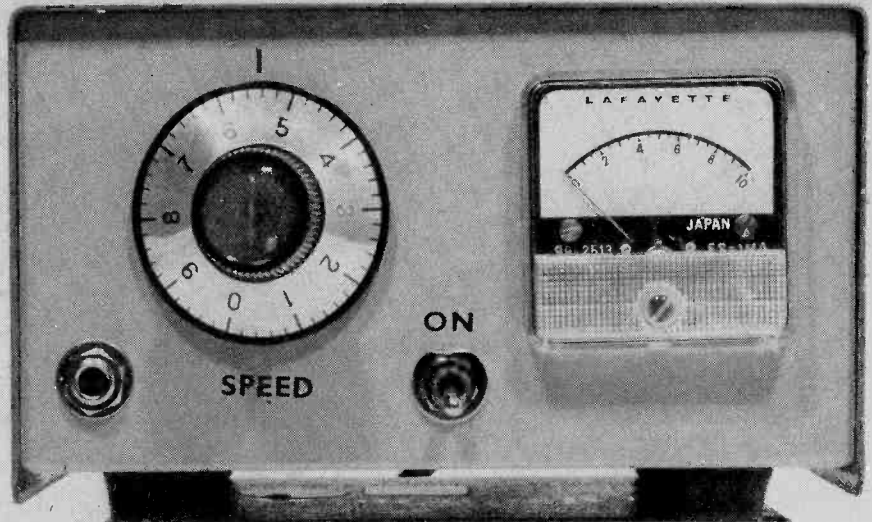
## — a Print-Paper Saver

voltage (6 VDC rather than 9 VDC) providing slightly reduced sensitivity. Normally, you will not need D5, so there's no need to get it unless you're certain you need it.

In order to get speed control R2 to increase sensitivity in the expected clockwise direction, its ground terminal is opposite to the usual volume control ground. Facing R1's shaft with its terminals sticking up, the ground terminal is the one on the left.

Meter M1 has five terminals. The one designated "+" and the one adjacent to it are the meter terminals. The three terminals above the meter terminals are the pilot lamps. The extreme end pilot lamp terminals are the 12-volt connections. The center terminal is not used for the 12-volt connection.

**The Eye.** The only assembly that requires some care is the sensor. The sensor itself is a photoresistor; however, the photoresistor doesn't have enough heft to maintain its position on the easel, so it must be mounted in a support that can maintain its position without falling over. The sensor assembly shown consists of PR1 epoxy-cemented into a relatively large knob. The knob must be plastic—not metal, though it can have a metal decorative rim—and it's best if there is a recess on the top even if the recess is produced by a rim. Remove the set screw and drill out the set screw hole with a bit approximately 3/16-in. (not critical). Then, using a 3/8-in. bit, drill through the shaft hole clear through the top of the knob. If the shaft hole has a brass (or other metal) bushing make certain the drill bit removes all the metal.

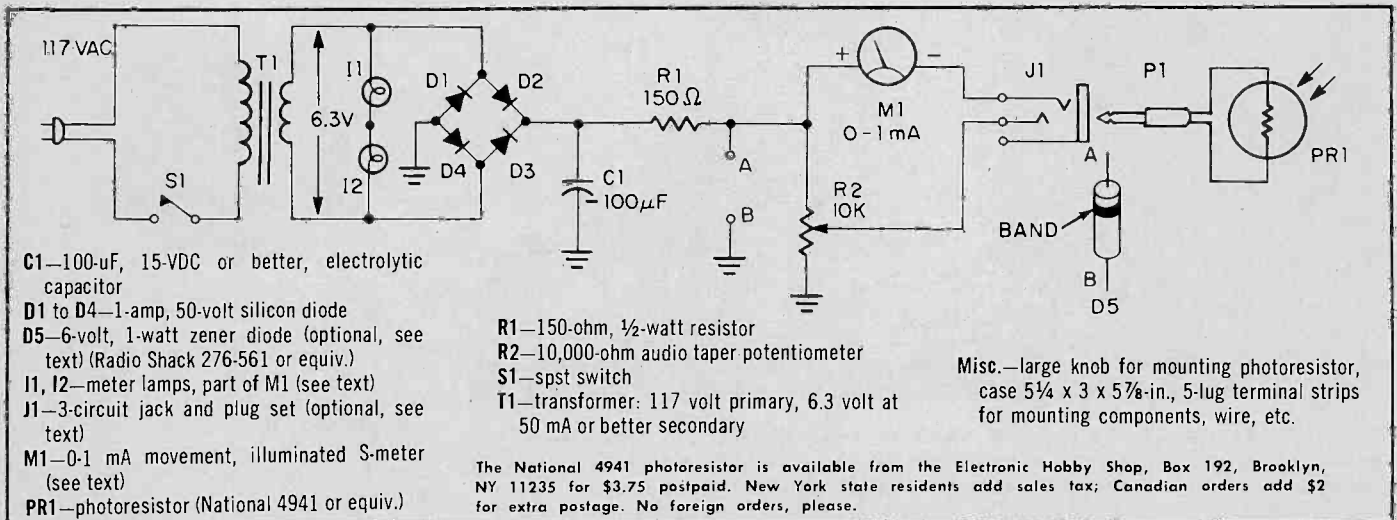


Use the largest calibrated knob you can install without interference by other panel components. The greater the calibration area on the knob the easier it is to preset the paper speed with accuracy.

Pass the PR1 leads through the hole in the knob from the top. Tape it in position. Feed a section of linecord or speaker wire through the setscrew hole and solder the wires to PR1 as close as possible to the knob. Trim away the excess PR1 leads; they should not protrude below the knob. Remove the tape holding PR1, get PR1 as close to the center of the knob as possible, and then pour in a quantity of fast-setting epoxy or liquid plastic from a knob repair kit or plastic modeling kit, and let it set a few minutes until the plastic hardens. Keep the level of the epoxy or plastic below the top of PR1—use less rather than more. If you can't get epoxy or plastic you can use G.E.'s silicon RTV rubber (adhesive, caulk, window sealer, etc.); but the RTV rubber must cure for at least 24 hours. Similarly, pack the bottom of the knob with epoxy, plastic or rubber.

**Mask Down.** Now, the surface area of the photoresistor is too large for small prints—4 x 5 or smaller—and even some 8 x 10s. So cut a disc the diameter of the knob from shirt cardboard or a manila file folder (but not oak-tag) and using a standard hand punch (such as used in schools) punch a hole in the center of the disc. Apply rubber cement to the rim of the knob and the inside rim of the disc. When the cement is dry drop the disc on the knob so the hole exposes a small part of the photoresistor's surface. It's not all that critical; the hole doesn't have to be precisely over the center of the photoresistor. However, the unit is calibrated for a punch-size hole and might not work properly if the disc is not used, or if the hole is a hand made "pinhole." Use the punch.

**Using the Meter.** The first step  
(Continued on page 98)



This Plain Jane occasional table conceals...

# SOUND FORCE

a 3-way speaker system with downward facing woofer!



by Herman F. Johnson

**R**EMEMBER that old saying once in common use, "Children should be seen but not heard!" A loud-speaker should be the direct opposite, it should be heard but not seen. A speaker system need not look like one of the "common box" variety, either. This one is a box system, but it was designed to fit into a popular piece of furniture—the small occasional table known as a "parsons table." By employing one of these tables to house a speaker system, the enclosure can be made of unfinished

material; wood joints and jointing screws are hidden from view; and for convenience in assembly, the screws are driven from the outside, into the enclosure.

This is a high performance 3-way system that employs speaker components available at Radio Shack. The enclosure is designed to provide outstanding bass performance from a small system. The bass output is enhanced by locating an 8-inch high compliance woofer facing downward toward the

floor. A 5-inch midrange driver and a super tweeter face forward to provide the all important midrange and high frequencies. The woofer is rolled off at 500 Hz. The tweeter picks up the highs from 3300 Hz and up. Of course, the midrange unit operates from 500 Hz to 3300 Hz. This frequency division is supplied by a 3-way crossover network that contains sound level controls for the treble and highs. The power handling capacity is rated at 60 watts.

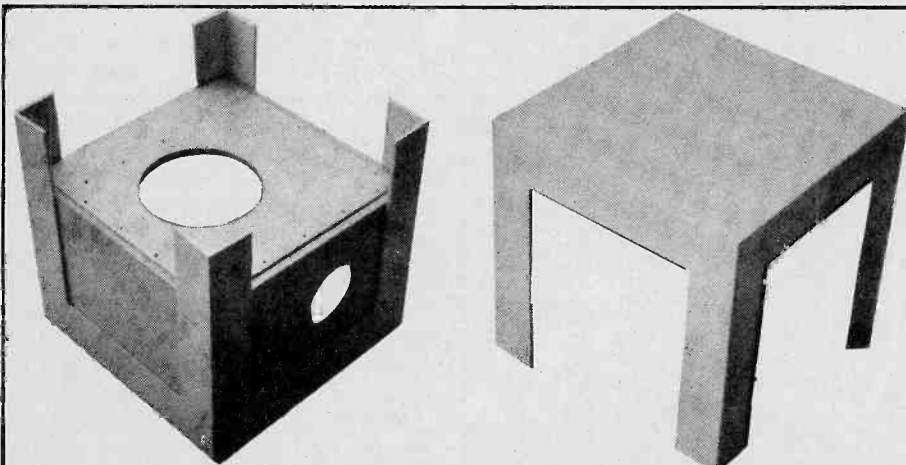
**Construction.** Before you purchase the speakers, locate a 16-in. cube-shaped occasional table. They are made of high gloss plastic in black, yellow, red and gray colors. Take a good look at the construction of the table before you decide upon the color. The table legs must be right angle shaped, not square, and it should be of one-piece construction rather than the kind with removable legs. These tables are usually found in stores that feature unfinished furniture.

When you have obtained the table that suits your decor, check the inside dimensions between adjacent legs at the under side of the top. This dimension should be 15½-inches in both directions. The dimension 15¾-in. at the top of the drawing labeled front Elevation allows for 1/16 of an inch at all sides of the top panel for grille cloth covering of the front and both sides of the enclosure. If the dimensions are less than 15½-in. between legs, the square dimensions of the top panel should be reduced accordingly. The dimensions of the top determine the overall dimensions of the other panels.

View "A-A" in the drawing (top removed) indicates the location of all the panels, supporting cleats and glue blocks. Details "A" and "B" locate the cleats. Round dots indicate the location of brads that secure each cleat and glue block to a panel. Details "C" and "D" provide the locations of screw holes (round dots) in the top and bottom panels.

**Construction Sequence.** You will need a half sheet (48 x 48-in.) of plain particle board, ½-inch thick. Half a sheet is more than enough to build one enclosure, but it is not enough for a stereo pair. When the panels have been cut to size as indicated in the drawings, lay out the center locations for the speakers as shown in the front elevation view and in view "A-A." Carefully cut the midrange and woofer openings with a sabre saw. The 1¾-in. diameter opening for the tweeter is best cut by a hole saw chucked into an electric drill.

Ten feet of ¾-in. square pine is required for cleats and glue blocks. See

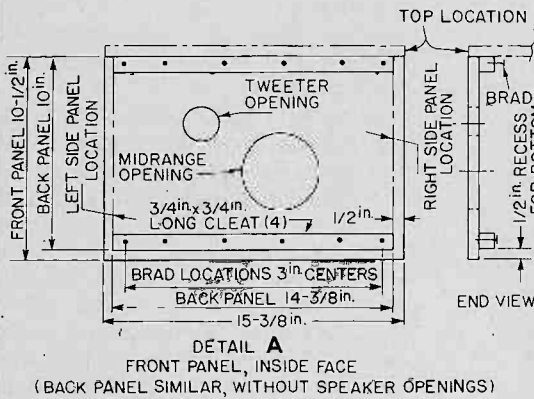
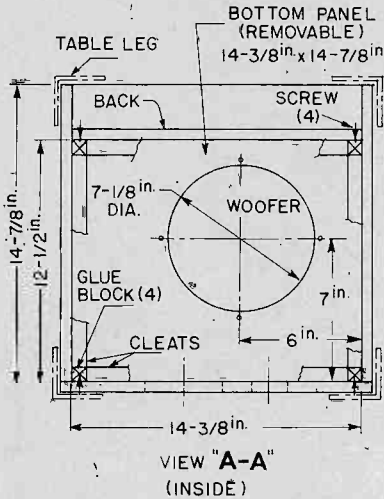
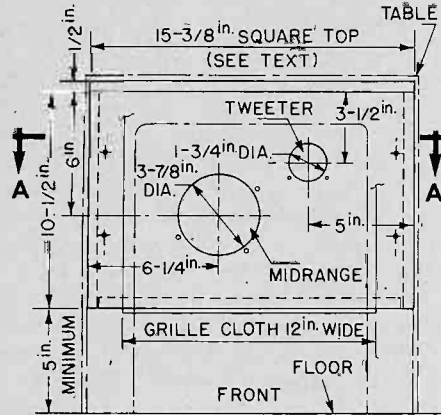


Check the Bill of Materials appearing on the last page of this article. Of course, you must have one set of materials for each speaker you wish to build. You should always use "zip" cord for speaker connections on moderate and high power installations; never that thin stuff sometimes sold on spools as "speaker hook-up wire." Use it for connecting intercoms, if you must, but stick to the #18 for hi-fi.

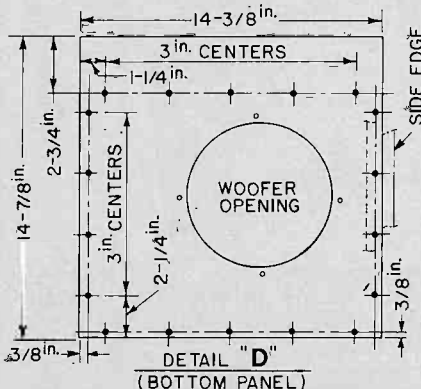
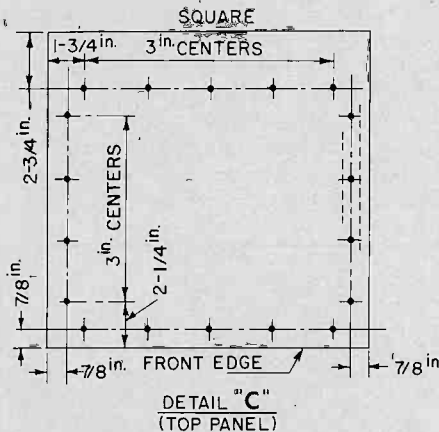
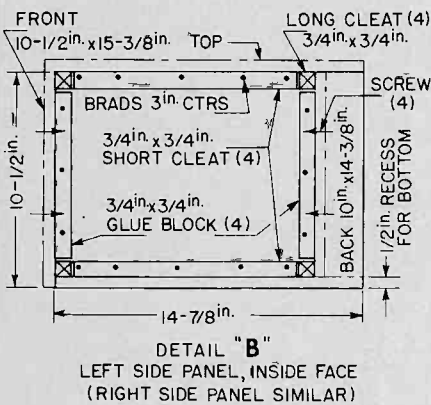


# SOUND FORCE

—a sound bargain



A look at the front and rear (top and bottom, left) of the forward-facing speaker panel. Inside view A-A (above) is a drawing of what you would see if you could look down from the top into the speaker enclosure. The bottom panel which supports the downward-facing woofer is held to the four cleats with screws which are positioned as shown in detail "D" at right.



To complete your "box within a box" you will require panels for the left and right sides as detailed on B above; you will also require the top piece shown in detail C. This can be planed or filed as necessary to fit the inside characteristics of your table. Remember, the back panel is similar to the front panel (detail A) but without the speaker openings.

the Bill of Material for the lengths. The glue blocks are the vertical corner reinforcements, all others are labeled cleats. Pencil-outline the location of each cleat and glue block on one side of each front, back and side panel. Start on the back panel where two long cleats are aligned along the panel edges as indicated in Detail "A". These lines serve as guides when glue is applied. One inch brads secure each cleat and glue block to the panels. Countersink the brads about 1/8-in. below the surface. The use of cleats assists in the assembly and insures construction of an air tight enclosure (air tightness is a basic requirement to obtain good bass performance).

Next, lay out the screw hole centerlines on the top and bottom panels as shown in Details "C" and "D". Center punch each screw location and drill 1/16-in. holes as indicated. Then, assemble the front, sides, and back panel in the position shown in view "A-A" and align the top panel. You are now ready to mark screw locations into the top side of the cleats with the 1/16-in. drill. At this point you should examine the screw locations to see if any screw is likely to hit a brad when it is driven. If a screw location appears to be too close to a brad, it is best to drill another hole 1/4 or 1/2-in. away from the brad. When you are satisfied that all screws will clear, reassemble the same panels, down side up, and repeat this process for the bottom panel. When you are satisfied that all screw holes are in the clear, re-drill all of the holes 3/64-in. diameter and countersink for No. 6 screws. It is to be noted that four (4) screw holes are required in the front and back panels for screwing into the glue blocks. All of the panel edges should be given a coating of resin sealer to prevent flake off.

You are now ready for the final assembly—except for the preparation of screw holes to mount the speakers. This data follows under speaker component installation, below. Coat all mating surfaces with white glue between the panel and the cleats; then, screw the top down firmly. Do the same for jointing the front and back panels to the glue blocks you have installed on the sides.

### Speaker Component Installation.

All of the speakers are mounted to the inside face of the panels. However, the diameters indicated in the drawings will allow the two cone drivers to be "backed in" to their respective openings on the inside faces of the panels, so each driver will be centered in the opening. In this position, center punch all four (4) mounting holes from the frame of each unit. Remove the speakers and drive 1/2-in. No. 8 sheet metal

screws into the panels about 1/4-inch deep. Then, remove the screws and scrape off the displaced wood around each screw hole. This procedure will prevent damage to the cone of a speaker should a screwdriver slip when driving a screw. The woofer and the tweeter should be mounted with screws. The hole locations you have marked for the mid range unit should be drilled 11/64-in. or 3/16-in. in diameter for 8-32 machine screws.

The back of the midrange cone must be isolated in the enclosure from the woofer. This is readily accomplished by bolting a plastic cover over the back side of the midrange driver. A dessert bowl was used by the author. Any bowl that is quite stiff and has a flanged edge all around will do the job nicely. There is no need for a gasket. The edge of the bowl can be clamped to the smooth back surface of the speakers frame by the mounting bolts.

The recessed space behind the back panel is convenient for mounting the crossover network. Draw a horizontal pencil line on the back panel at 4 1/4-in. from the bottom edge and center mark the location for two 1/2-in. No. 6 pan head sheet metal screws 4 7/8-in. apart. Drive these screws in about half way. Slotted openings are provided on the back of the network for hanging it on two screws. The network is a self contained unit. Hence, three sets of connecting wires must be brought through holes in the back panel for connections between each speaker and a 12-screw terminal strip on the network. Drill holes through the back panel at 1 1/2-in. from the bottom edge for a snug fit to the hookup wires. Follow the instructions attached to the network for connection to the speakers with jumper wires between designated terminals to engage the installed tweeter and midrange level controls that are located on the front of the network.

Cut the speaker hookup wire (zip cord is fine) in about 24-in. lengths. Solder one of these to the woofer terminal lugs, one to the midrange lugs (through a snug fit hole in the side of the plastic cover), and the third to the pull-type binding posts located on the tweeter. Red dot terminals on the speakers should be connected to their respective plus (+) terminals on the network (2, 8, and 10). Unmarked terminal lugs should be connected to the negative (common) terminals on the network (1 and 6). Since two wires must be connected to terminal 6 in a 3-way system, it is a good idea to use spade connectors. The input terminals are located adjacent to terminals No. 1 and 2. The input terminal adjacent to

terminal No. 2 is the plus (+) terminal.

**Sound Damping.** A minimum amount of damping material is recommended to be installed inside the enclosure to absorb reflections from the inside surfaces, back to the woofer. Cut two pieces of one-inch thick fiberglass to fit over the cleats and glue blocks at the back and on one side. And, cut a third piece to fit over the cleats at the top. Staple or thumb tack the damping material to the cleats.

Your enclosure is now complete except for the final installation of the bottom panel containing the woofer. Install four (4) lengths of 3/8-in. by 1/4-in. self-stick foam weather strip tape on the face of the bottom cleats along the inside edge of each cleat to insure air tightness under the bottom panel. Then, screw it down in place.

Grille cloth provides an attractive method of covering the exposed unfinished front and side panels. It is sold by most electronic parts stores by the foot from rolls 32 or 36-in. in width. Three 12-in. wide strips about 14-in. long will cover the front and both sides when centered so that the edges are between the panels and the table legs as indicated in the front elevation view. Pick out a soft, cloth-like, grille material that will take a smooth right angle bend. Coat the edges with rubber cement, about 1/2-in. wide, with a paint brush to prevent fraying. Staple or tack an end edge of the material to the bottom edge of the front panel (a paper

stapler will do the job if held firmly), then draw it up over the edge of the top panel and staple it to the top. Repeat this process for covering both side panels. It is also a good idea to cover the woofer should a pet crawl under and damage the cone. Staple an 8 1/2-in. square piece of grille cloth to the bottom panel.

Before inserting the enclosure into the table, examine the inside skirt edges of the table below the top. If these edges are a sharp right angle, round them over with a file to avoid abrasion of the grille.

With the table in an upside down position, lower the enclosure down between the legs. Then drill two holes 5/16-in. diameter through the table legs and into both side panels in a low position about 11-in. below the top of the table and at about 1 1/4-in. from the outside right angle corner of each leg. Drive 3/4-in. No. 6 round head, plated, wood screws in until the table leg is drawn snug to the enclosure. These four screws are all that is required to support the enclosure in the table.

**Operation.** As stated earlier, the bass response is robust. If the lows are too strong for your ears, cut back on your bass control at your receiver. It is of considerable advantage to have variable output for both the midrange driver and the tweeter. The midrange control should be advanced more than half way and the tweeter control to about one-quarter turn for most rooms. ■

#### BILL OF MATERIAL FOR SOUND FORCE

Quantity	Name	Size	Material
1	top panel	15 3/5-in. sq.	1/2-in. particle board
1	bottom panel	14 3/8-in. x 14 7/8-in.	
2	side panel	14 3/8-in. x 14 7/8-in.	1/2-in. particle board
1	front panel	10 1/2-in. x 15 3/8-in.	1/2-in. particle board
1	back panel	10-in. x 14 3/8-in.	1/2-in. particle board
4	long cleats	3/4-in. sq. x 14 3/8-in.	pine
4	short cleats	3/4-in. sq. x 11-in.	pine
4	glue blocks	3/4-in. sq. x 8-in.	pine
44	flat head wood screws	1-in. No. 6	—
4	machine screws	1 1/4-in.	—
7	sheet metal screws	1/2-No. 8	—
60	wire brads	1-in.	—
1	occasional table	16-in. x 16-in. x 16-in.	plastic
1	woofer	8-in. (Radio Shack 40-1341)	—
1	mid-range	5-in. (Radio Shack 40-1292)	—
1	tweeter	1 3/4-in. (Radio Shack 14-1274)	—
1	network	3-way (Radio Shack 40-1339)	—

Misc.—Grille cloth, rubber cement, glue, speaker cord, connectors, 4-sq. ft. of 1-in. fiberglass, etc. (Author used Sycro "Parsons Table" from Sycro division, Dart Industries, Inc., Syracuse, NY 13201)

# BGNRS FET IC BCB AM RCVR\*



\*beginners field effect integrated circuit broadcast band amplitude modulation receiver

**T**HE BEST WAY for the newcomer to radio to learn about receivers is to build one! The easiest type of receiver to build that will be reasonably selective and sensitive is the type that grandad built back in the golden days of radio—the regenerative receiver. But this one has been brought up to date. Instead of old-fashioned tubes, this receiver uses a field effect transistor (FET) regenerative detector and an integrated circuit (IC) for the audio amplifier.

Our model tunes the broadcast band from 550 kHz to 1600 kHz; it provides very reliable reception for the beginner. The receiver is built in a handy metal cabinet, runs on two dry cells, and is designed for simplified construction with perf board mounting of components. The receiver can be used with earphones for digging out the broadcast band DX, and it will operate a speaker when tuned to strong local stations.

**Circuitry.** Signals from the antenna at J1 are coupled via the antenna trimmer capacitor C1 to the tuned circuit L1-C2 and then detected and amplified by the gate-leak detector Q1. Some of the RF energy is fed back from Q1 to L1-C2 via the tickler coil L2, then detected and re-amplified again by Q1. The amount of RF energy feedback is adjusted by the REGEN control, R1, in shunt with the tickler coil L2. When there is too much feedback, the gate-leak detector Q1 circuit will oscillate, an undesirable condition.

Detected signals from Q1 are coupled through C7 to the integrated circuit and amplified. The amplification is controlled by R7, and the audio output is coupled to J3 for an external speaker (8 to 45 ohms), or earphones. A 3-volt battery or DC power supply is connected to J2 to supply the necessary electrical power for the receiver circuits.

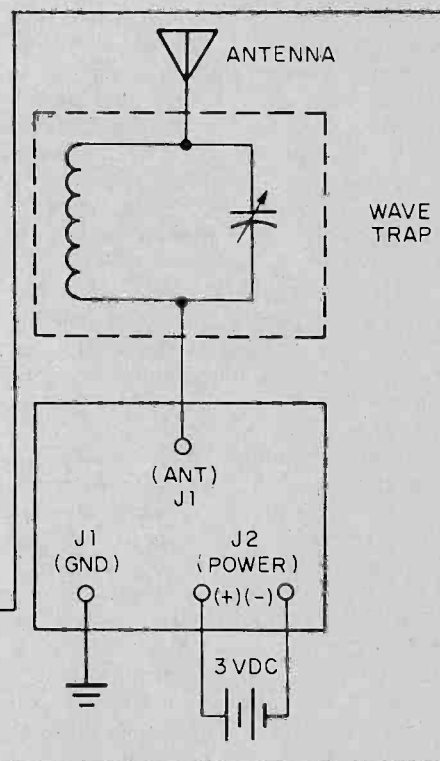
**Construction.** The FET-IC receiver is built in a 5¼-in. deep by 3-in. high by 5⅞-in. long metal cabinet. Most of the components are installed on a 4¼-in. by 4½-in. perf board section. The remaining parts are mounted on the front and back panels of the cabinet. The parts placement is not critical, but for best performance follow our component layout and wiring placement.

The RF coil L1 is wound on a 2-in. long section of ¼-in. (outside diameter) plastic tube. A type of plastic tube used for protecting golf clubs—obtainable in sporting goods stores—is used for our coil form. But a cardboard mailing tube ¼-in. in diameter can also be used.

Begin construction by tightly winding #28 enameled copper wire in a single layer over 1½-in. of the coil

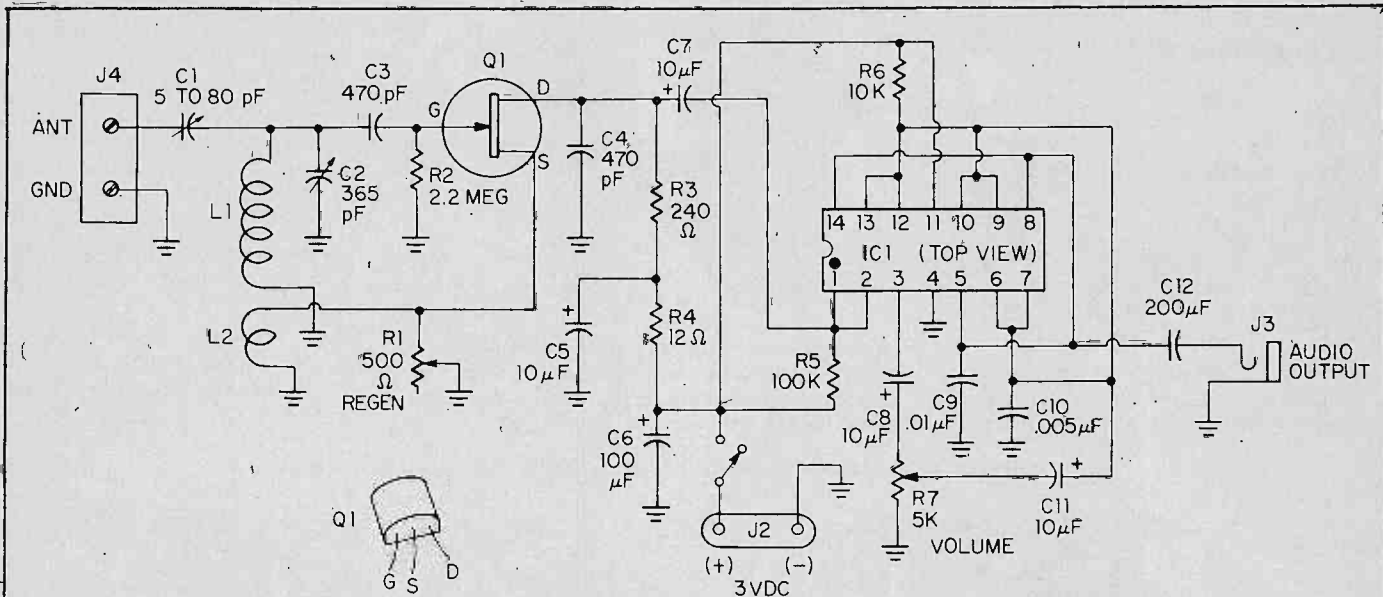
form. It's not necessary to count the turns, as the coil may have to be modified to fit your particular antenna. Connect the wire ends through holes at each end of the coil form and connect the wires to two solder lugs mounted at one end of the coil form (see photos). Set the coil aside.

Install the front and rear panel com-



Simple diagram of wavetrapped antenna as it is connected to the receiver. Simple parallel tuned circuit provides an extra measure of selectivity.





**PARTS LIST FOR BEGINNER'S  
FET-IC CBB RECEIVER**

- C1—5 to 80-pF trimmer capacitor (see text)
- C2—365-pF variable capacitor
- C3, C4—470-pF ceramic or mica capacitor
- C5, C7, C8, C11—10-μF, 3-VDC or better electrolytic capacitor
- C6—100-μF, 3-VDC or better electrolytic capacitor
- C9—0.01-μF capacitor
- C10—0.005-μF capacitor
- C12—220-μF, 3-VDC electrolytic capacitor
- IC1—quad 2-input gate, RTL-type (Motorola HEP570 or equiv.)

- J1, J2—screw-type terminal strip
- J3—phone jack
- L1—RF coil: #28 enamel wire wound 1½-in. on 1¼-in. dia. coil form (see text)
- L2—tickler coil: 2 turns hookup wire wound on L1 (see text)
- Q1—FET (Motorola HEP802 or equiv.)
- R1—500-ohm linear-taper potentiometer with spst switch
- R2—2.2-megohm, ½-watt resistor
- R3—240-ohm, ½-watt resistor, 5%

- R4—12-ohm, ½-watt resistor, 5%
- R5—100,000-ohm, ½-watt resistor
- R6—10,000-ohm, ½-watt resistor
- R7—5,000-ohm audio-taper potentiometer

Misc.—metal cabinet 5½ x 3 x 5⅞-in., perf board and push-in clips, 1¼-in. dia. coil form (see text), metal spacers, hookup wire, knobs, 3-volt battery or 3-VDC power supply, high-impedance earphones or speaker (see text), wire, solder, etc.

ponents as shown in the photos. Capacitor C2 is mounted on two ½-in. metal spacers on the box bottom and as close as possible to the front panel. Mount the 4¼-in. by 4½-in. perf board on the box bottom with a ⅜-in. spacer at each corner.

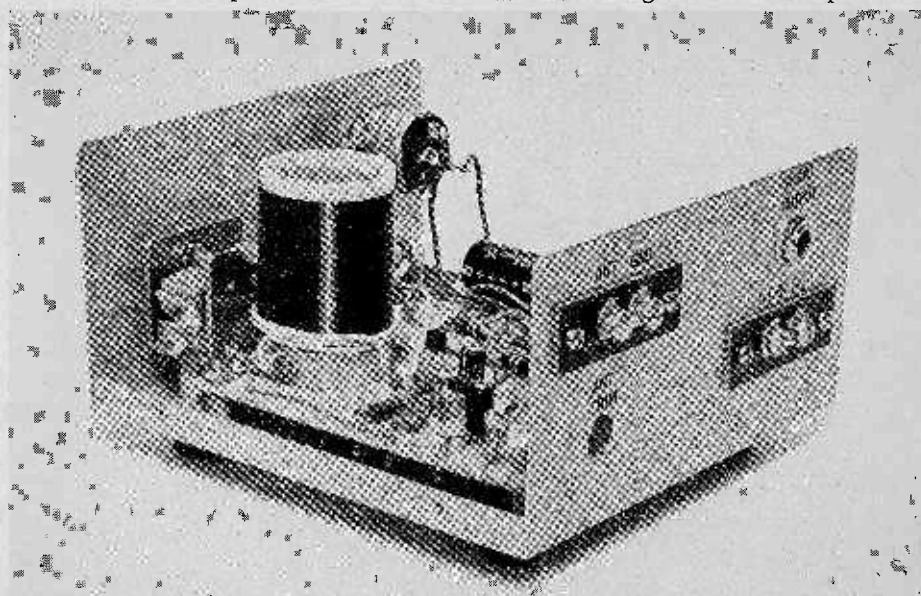
**To Continue.** Temporarily position the trimmer capacitor, C1, at the rear corner of the perf board (located as shown in the photos) and mark and drill a ⅜-in. access hole in the rear panel for the C1 adjustment screw. Mount the RF coil L1 on the perf board near C2 by soldering one of the coil lugs to a ground lug installed on the nearby corner mounting screw, and solder the other coil lug to a push-in clip on the perf board. Wind two turns of hookup wire around the base of L1 (in the same direction as the L1 winding) and connect the start of the winding to the ground lug, and the finish of the winding to a push-in clip on the perf board. This winding is the tickler coil L2, and may have to be adjusted for best operation.

Lay out and wire the perf board components as shown in the photos and schematic drawing. In our model, the leads of IC1 are flattened out and soldered to push-in clips for connec-

tions to the circuit. Of course, an IC socket can be used if mounted on the board by soldering its contacts to push-in clips.

Connect the front and rear panel components to the perf board circuits

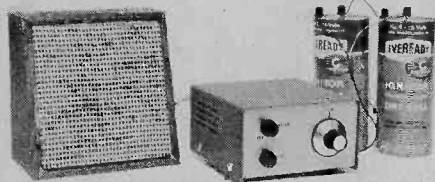
as shown in the schematic. Make sure that the connecting leads to C1, L1, L2, R1, C3 and the "gate" lead of Q1 are as short and direct as possible. Keep these leads up in the air and away from all the wiring of IC1. Complete the



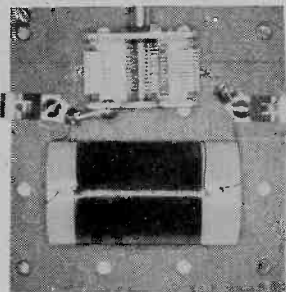
Use perf board and push in clip construction for your receiver. It's simple and avoids the pitfalls of loose components and shorting wires. Solder lugs are bolted to opposite sides of the coil form and then soldered to two push in clips.

# FET RECEIVER

—a beginner's economy project



Alternate method of listening to your radio. Although audio power output is low, strong local stations produce a reasonable sound.



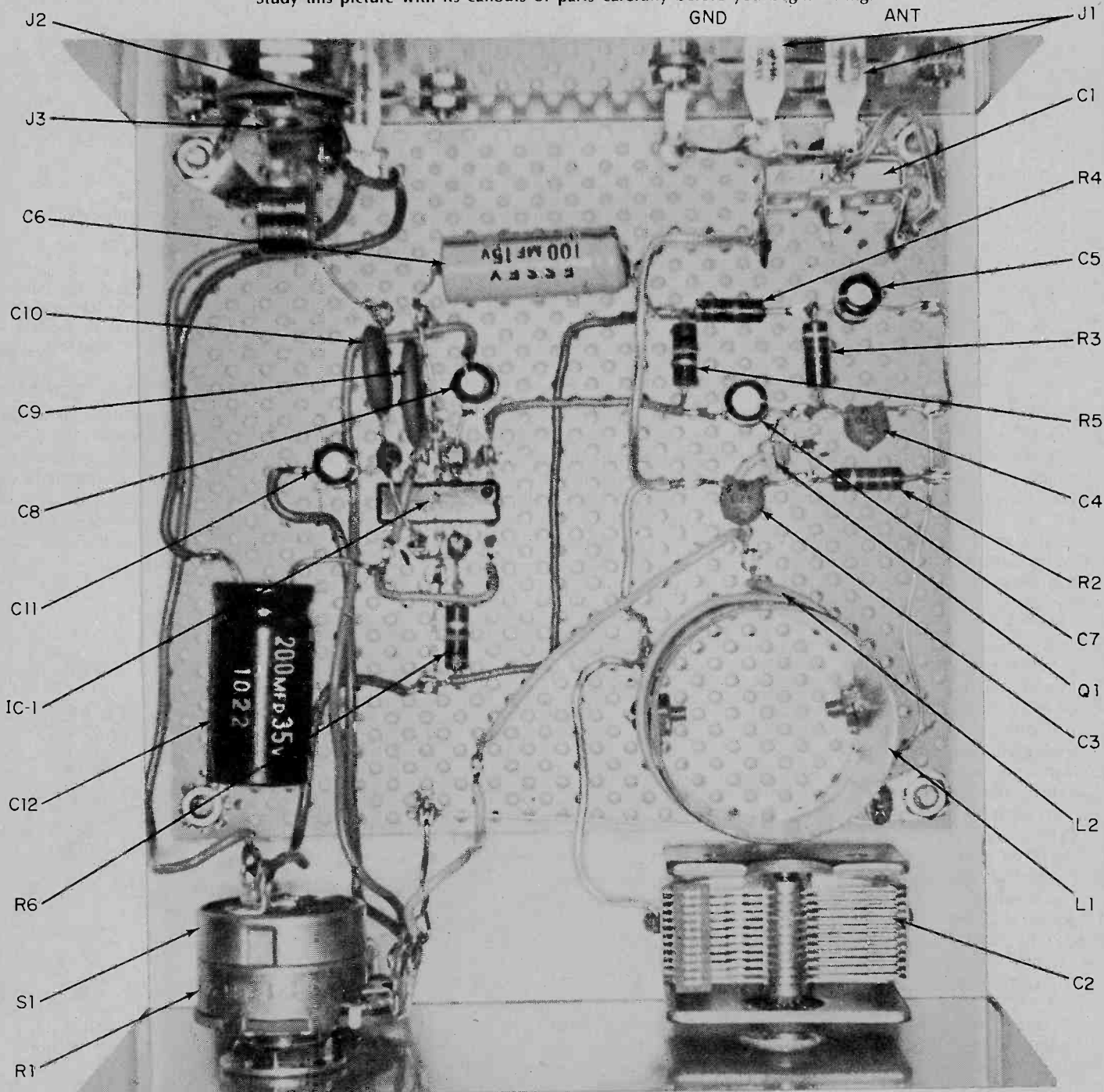
Use a short piece of wire to connect one terminal of the wave trap to the radio. Clip your longwire antenna to the other wave-trap terminal and tune out interference.

wiring of the receiver. Make sure that all wiring is fastened so that it will not move about.

**Operation.** For best reception, an outside long wire antenna and a good ground (fastened to a cold water pipe) are required. The antenna should be as long as possible and mounted high up in the air. The mail order houses have antenna kits available which come complete with the necessary insulators and lead-in wiring.

Connect the antenna lead to the ANT terminal of J1 and connect the ground lead to the J1 GND terminal. Connect  
*(Continued on page 98)*

Study this picture with its callouts of parts carefully before you begin wiring.



# ROCK BOTTOM COST HIGH BAND MONITOR



Getting bored by the temp-humidity index? Slide an inexpensive weather monitor up or down for some exciting signal hunting!

**B**ECAUSE they're priced so low, generally from \$10 to \$20, the "weather monitor" has been a hot gift item for the electronics experimenter, so you probably have one. Tuning the weather station frequencies of 162.40 and/or 162.55 MHz, these small, inexpensive radios are supposed to keep you up to date on the latest weather conditions. But as you've probably discovered yourself, unless you're a boat owner with need for tide and sea conditions, you get a more up-to-date report from your local news station—AM or FM.

Also, reception is probably not all that great. The recommended receiver sensitivity for weather station reception is 0.6  $\mu$ V for a 50-mile range, and these inexpensive weather receivers can't get anywhere near this kind of sensitivity.

But there's no need to let an unused weather receiver sit on the shelf. Fortunately, very few models use crystal control tuning, and they are easily converted to a police or fire monitor, or even a sound channel receiver for the higher VHF TV stations. But remember, there won't be any super-sensitivity. TV stations might be received some 30 or 40 miles from the transmitter, but you'll have to be within 2 miles or so of the average police or fire transmitter to pick them up. If you live near an airport you might get coverage of the aircraft frequencies above 108 MHz, but with sharply reduced sensitivity.

The weather monitors are generally similar in electronic design, though the packaging might be anything from a cube to a desk-top pen holder. The circuits are bare-minimum superhet receivers with a local oscillator tuned over a limited range by a panel control. Generally, there are two panel controls, one for *volume* and one for *fine tuning*. The fine tuning knob might have calibrations for *both* weather frequencies, or no calibration at all. It doesn't make

any difference as long as the local oscillator is tunable.

To change the weather monitor tuning range, all you need do is connect a small external trimmer capacitor across the oscillator tuning capacitor—the fine tuning control. The value of capacitor will determine which frequencies are tuned. Keep in mind that as you tune lower in frequency the sensitivity is sharply reduced, particularly below about 160 MHz. A capacitor with a maximum value of 7 pF will get you down to the police/fire frequencies. A 60 pF maximum trimmer will get you about to the top of the FM band, but tuning will be extremely critical and sensitivity will be very low.

A 60 pF trimmer will also get you some of the TV sound carriers above 162 MHz. How can you receive signals above 162 MHz if the tuning range is lowered? Simple. The harmonics of the local oscillator are used to receive the TV stations. For example, if you lower the monitor's oscillator to, say, 100 MHz, the oscillator's harmonic output is also 200 MHz, and a very weak 300 MHz. (The monitor's front end appears to pass the frequencies above the design-range, 162 MHz, with greater sensitivity than lower frequencies.)

**Tear It Down.** To experiment you must first get the circuit out of its cabinet. Keep in mind these weather monitors are inexpensive and designed to be assembled quickly by unskilled workers. Don't go looking for tricky or difficult assembly sub-systems. Generally, one or two screws are all that's holding the cabinet together. If necessary, unsolder the speaker wires, battery wires and on-off switch wires, and remove the circuit board from the cabinet. Locate the trimmer capacitor used for the fine tuning and its two solder terminals. Solder a 3-in. length of solid, insulated wire to each terminal.

Check how the board fits the cabinet and mark the outside of the cabinet nearest the fine tuning. Drill two small

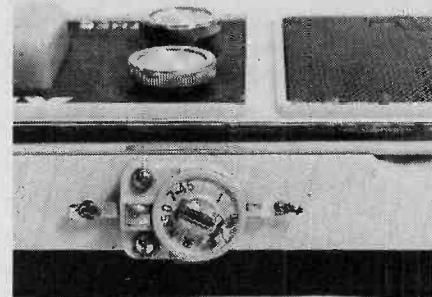
holes at the mark and then install a trimmer capacitor on the cabinet near the holes. Or, you don't have to secure the trimmer if you feel you will experiment with different capacitor values, but it will be difficult to tune the stations with a "floating" trimmer. You can't hand-hold the trimmer because the capacitance from your hand will affect the tuning adjustments.

Slip the wires from the fine tuning control through the holes you've drilled in the cabinet and seat the trimmer on the board. Then reassemble the monitor.

Connect the wires protruding through the cabinet to the trimmer capacitor using the shortest possible leads (cut off the excess).

That's the whole bit. Use an insulated alignment-type screwdriver to adjust the trimmer. You'll probably be able to tune a few TV stations immediately. Tuning police/fire calls or anything else will be more difficult because transmissions in these services are short and fast. You can preset the tuning by using a signal generator or a well calibrated grid dip oscillator.

Remember, this is a fun project. Don't hope for more than acceptable reception. But then who knows, you might be able to tune your favorite TV channel and keep track of the program while working in your shop. ■



Install a small trimmer on the cabinet at a point just outside the internal trimmer.



## Time Tally

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average utility cost of \$.05 per kilowatt hour.

There are two ways of connecting the Time Tally to the appliance being timed. The simplest way, in theory at least, is to connect a 6 or 12-volt power supply directly to the appliance on-off switch as shown in Fig. 2. However, because the switch is often in a tight corner,

this approach is sometimes difficult. Another approach, which makes the Time Tally even more versatile, is shown in Fig. 3. With this set-up, one merely plugs the appliance into the Time Tally plug. The appliance switch is left *on* so that the appliance can only be turned on or off by using the Time Tally switch.

**Other Uses.** The Time Tally can also be used in an auto to time the length of driving time for a trip. Here the Time Tally should be connected as

described in the outdoor-engine use section.

The indoor version of the Time Tally, if used with the power supply shown in Fig. 3, can be used as a digital cooking timer. Just flick the switch the minute an egg goes into boiling water or a TV dinner goes in the oven, and watch for the recommended minute to show up. Here a resettable 6-volt counter would come in especially handy, but you can mentally note the present reading and watch for the desired one. ■

## FET Receiver

(Continued from page 96)

either a 3-volt DC supply or two 1½-volt dry cells in series to J2. Make sure that the positive supply lead is connected to the (+) terminal and the negative lead is connected to the (-) terminal. Plug in a pair of high impedance earphones (1000 ohms or more) to J3.

Set the volume control R7 to maximum amplitude position (fully clockwise), and adjust REGEN control R1 to mid-range. Tune C2 until you hear a station in your earphones; it may be received as a "whistle" or beat note. This is the undesired condition mentioned before and is caused by the oscillation of the gate leak detector circuit of Q1—the result of too much RF feedback. Therefore, adjust R1 until the whistle disappears and the station is heard. Retune C2 for best reception. Practice will be necessary for good results.

The most sensitive and selective point

of the R1 adjustment is just below the point of oscillation. After tuning in a station, use R7 for comfortable audio volume; R1 should not be used since it reduces selectivity as well as audio volume.

Adjust the antenna trimmer C1 for best sensitivity over most of the band. This setting may have to be changed for best results at the band ends. If necessary, the value of C1 may have to be changed to a different maximum capacity to better match your particular antenna length. Also, you may have to adjust the position of the L2 tickler coil, or add or subtract turns to cover the entire band. Do not be afraid to experiment with this coil. If you do not hear any signals that "whistle," reverse the circuit connections to L2. Also, try moving the tickler coil further up L1.

Speaker operation for personal listening can be achieved with strong local stations. A 45-ohm speaker (the type that is used in intercom systems) is best for this receiver. Other lower impedances down to 8-ohms will result in

lower audio volume.

**A Modern Wave Trap.** The regenerative type of receiver is sensitive, but since it only uses one tuned circuit (unlike a multi-stage superhet receiver), it is subject to overload by strong local radio stations. To overcome this effect back in the golden days of radio, grandad used a device called a "wave trap." This consisted of a tuned circuit in series with the antenna that attenuated the interfering station's signal and allowed weaker signals to be received.

If there is a strong local station interfering with your reception, construct a duplicate of L1 and connect it in parallel with a variable capacitor of the same value as C2 to serve as a wave trap (see drawing and photo). Tune the wave trap variable capacitor to the same frequency as the interfering station. The easy way to do this is to first tune your receiver for *maximum* received signal of the *interfering* station; then tune the wave trap (connected in series with your antenna lead) for *minimum* received signal. ■

## Darkroom Printing Meter

(Continued from page 90)

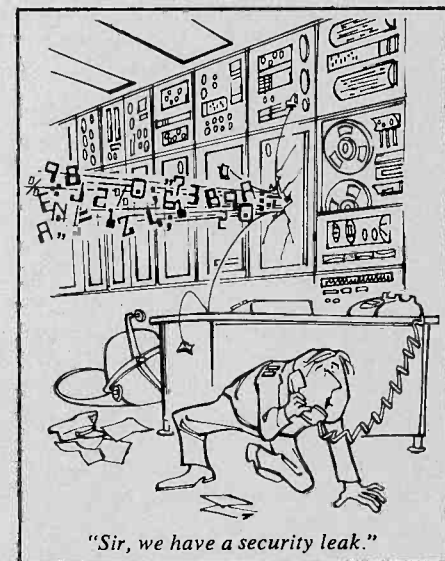
is to select a decent reference negative and make a good print using a 10, 15, or 20-second exposure. We suggest 20 seconds as it will become your standard exposure, and will be sufficiently long to allow moderate dodging. When you are certain you have a print exactly the way you want it, and without disturbing the enlarger's controls, place the printing meter's sensor under the *brightest* light falling on the easel—it produces black (maximum shadow) on the final print. Now turn on the printing meter and allow about five seconds for warm up. Adjust speed control R2 so the meter pointer indicates any meter reading you want to use as a reference. It doesn't matter what the reading is as long as you always use the same reference for the standard exposure time. For example,

0.2 on the meter scale is a good choice because it is well illuminated by the meter lamps. But you might just as easily select mid-scale as the reference meter reading. It doesn't make any difference; just be consistent.

Once you have adjusted the speed control for the reference meter reading note on a piece of paper or in a notebook the dial reading from the speed control's calibrated knob. This is the reference speed value for the particular printing paper. For example, let's say you made the test print on Polycontrast using the #2 filter, and the speed knob indicates 5.6. Next time you want to print using Polycontrast with a #2 filter you simply set the speed knob to 5.6, put the sensor under the darkest shadow area and adjust the lens diaphragm for a reference meter reading. Everything will be set for your standard exposure time.

**Changing Filters.** Kodak provides a speed rating for all their papers and

you can easily work out the correct (or close) speed control settings without making a "perfect" test print for each type and grade of paper. For example,



changing from a #2 to #4 filter usually means increasing the exposure by a 3.5X factor. If your #2 exposure is 10 seconds, the #4 exposure will be 35 seconds—somewhat long. You can, however, open up the lens diaphragm for a 3.5X light increase (close enough value) and adjust the speed control for the reference meter reading. The new speed control setting is the speed value for the #4 filter. You can do this with variable contrast filters or numbered printing paper.

While the most pleasing print usually has some black, there are times

when there can be no black, such as snow scenes, portraits, etc. You can peg the speed control's calibration to a grey corresponding to a skin tone, or any other degree of grey you might desire. The only thing you cannot do is calibrate the meter for highlights, since the meter might not have enough sensitivity for slow papers, and highlights can completely fool the meter.

If desired, you can take a speed control calibration reading for each type of paper (using your standard negative) for both shadow detail and intermediate grey. This way, you can quick-

ly set up for typical snapshots, scenics, or portraits.

**Keep In Mind.** The sensor has a slight light memory, so we suggest the sensor be turned face down when not being used and the power switch be turned on and off in the dark, though you can keep the darkroom illuminated by a safelight with the power switch on. Meter readings, however, must be taken with all room lights off; only the enlarger should be on and the print meter should be positioned so that its meter lamps do not illuminate the sensor (even slightly). ■

## Electronics Schools

(Continued from page 36)

has been sent to you. A typical condition involves the payment of \$50 or 10 percent of the total tuition charge (whichever is the smaller amount) as a "registration fee," if you drop out after the initial free examination period but before any assignment has been graded by the school. If less than a quarter of the program is completed, you pay the registration fee plus 25 percent of the total tuition. If you've completed more than 25 percent but less than 50 percent of the program, you pay the registration fee plus 50 percent of the tuition. If you have completed more than half of the program when you decide to quit, you are obligated to pay the full tuition. Also bear in mind that you would be obligated to return any unused equipment and pay for the insurance and shipping charges.

Be sure to check out the actual contract conditions specified by the school you choose. Also bear in mind that even when a school uses a refund plan much like this one for most of the offered courses, the refund may be substantially less if you happen to enroll in one of certain "introductory" courses having relatively low tuition fees.

Some schools will give a full refund even after you have completed one of the courses designed to prepare you for an FCC First Class license. If you fail to pass the government examination, after graduation from the school, you may be entitled to a full refund. But watch the conditions because they are not the same for every school. The time in which you can take advantage of the refund opportunity may be as short as 90 days or as long as six months. One school insists that you try again, after undergoing additional no-charge training specified by the school, at a location also specified by the school. If you still

can't pass the FCC exam, you get the refund.

**No Job Guarantees.** Aside from the just-mentioned warranty concerning the acquisition of an FCC license, offered by some schools but not all, there is no guarantee that you will automatically get a well-paying and exciting new job. No one could possibly guarantee anything like that. The only reasonable assurance you can expect is that your school will prepare you to compete effectively for the jobs that may be available in any given location at a given time, or prepare you to go out and establish your own business with adequate technical preparation (you would still have to acquire management and other business skills if you work for yourself).

Although we will be living in an "electronic age" for a very long time, it does not follow that job opportunities will be equally good in all areas of electronic technology. So you should do some thoughtful crystal-balling to determine where your best opportunities might lie about the time you complete a correspondence course. For example, even if you figure that there already are plenty of TV servicemen around, it does not follow that there are enough really competent servicemen in all localities; if you excel in this type of work, you will probably find work. And think also about the new technologies that are opening up. There are expectations, for example, that within a few years millions of people will be buying movies on discs much like phonograph records to play them through their TV sets. Someone will have to service all that equipment. Computers are finding new applications constantly. Many libraries now check out books and keep track of book inventories with computers. And Supermarkets are fast moving to use of computerized food checkout systems. So perhaps your best opportunities lie in electronic fields far different from the one you might now imagine. Reading course descriptions contained in the

brochures distributed by correspondence schools can be a real eye-opener.

**Better Than a Pen Pal.** You'll need a friend now and then as you work your way through your chosen electronics course. You may already have discovered that one of the most frustrating ways to spend your time is to attempt carrying on an intelligent conversation with someone else's computer. So even if the school of your choice uses computers to check out the answers on your examination papers, be sure that there are real, living and breathing human beings you can turn to for advice when you get bogged down on some technical problem. You may be asked to send your questions to the school by letter; however, at least one school has a toll-free telephone number you can call from anywhere in the U.S. when you want a quick answer to a problem.

One school offers "Saturday Help Sessions" at eight or more locations in the U.S. which could be very useful if you live near enough to take advantage of them. Or you may be offered "after graduation" classroom training at no extra cost. One school allows you to attend such classes as often as you wish over a period of one full month. You of course must pay your own transportation and living costs if you must travel to another town for the extra training.

In order to attract more students, one school offers to pay you ten bucks for every "friend" you can talk into taking a correspondence course in the same school. It's pointed out that if you and a friend take a course at the same time, you can bounce ideas back and forth to clear up technical points and increase the fun of learning. There's much to be said for this work-with-a-friend idea, even if the friend insists on taking a course offered by another school. In fact, there might even be some advantages to the different-school approach because if school A doesn't make a particular concept crystal clear, school B might do better—and vice versa.

Throughout your training you will be

filling out periodic examination papers to test your learning progress. You will do this at home where you can refer to your study materials. For this reason, a future employer isn't likely to be too impressed by the grades you get on the tests, and will want some additional proof that you really do know your stuff. So if your school provides an opportunity to take a *supervised* final examination after completion of the course, by all means take advantage of it if at all possible. Not only do you have something more meaningful to show a prospective employer but, even more importantly, *you* will have a clearer measure of your personal achievement.

**Do You Have the Drive?** Many students drop out of correspondence training programs for many different reasons. But one of the main causes has to be the failure of some students to objectively evaluate their own personalities and drive. You should be enthusiastic and inspired by real hopes of a better life; but you should not kid yourself, because it will cost you both time and money.

Will you be able to settle down and work on a regular daily basis for many months to achieve your ends without having someone else pressure you constantly? If the lure of the beer parlor or movie theatre is greater than the lure of a new profession, save your money. If you just aren't sure how you would hold up, look around for a school that will allow you to transfer to a regular classroom program if you find that you are weak on self-discipline. Check out

where the classes are held, and how much extra you would have to pay to attend them.

On the other hand, you may be a completely different sort of individual. Maybe you didn't make out too well in your former schooling because classroom work made you restless. It could be that if you can choose your own working hours, and concentrate on the kind of subject that really turns you on, you may turn out to be a far better student than you ever dreamed possible. You might have been completely bored and confounded by Byron and Keats in your English class, yet be a whiz at analyzing the invisible migrations of electrons through complex circuits.

Some individuals learn quickly. Others only seem to learn quickly because their learning is superficial. But it's the slow learner, even one who nonetheless learns thoroughly, who can be really handicapped in a conventional classroom. Given adequate time, he may in fact become more competent in a given job than a fast learner.

This is why you should not only consider the "average" times schools say students require to complete various courses, but also how much extra time you are given if you can't breeze through because of difficulties with the course, or because wholly unrelated personal problems force you to suspend study temporarily.

By the same token you should not be held back because some computer isn't in the mood to correct your examination paper or send the next lesson on time. Find out how promptly the school

will send back your test papers. It's important. If you goof on some concept covered in lesson ten, you need to know this before you get too far into the next lessons because that misconception could lead you to further errors. Don't be satisfied with a vague promise that "Your papers will be graded and returned as promptly as possible." Try to get a more definite normal time period—in writing. If it should turn out that you are forced to terminate the study program because of confusion caused by some individual in a school failing to do his job properly, you should be required to pay less than the usual penalties. If you intend to become a businessman in electronics or any other field, now is the time to learn how to protect your rights.

Actually, the intense competition among schools for new students makes such laxity rather unlikely because satisfied students are the best salesmen for the schools. In any case, you should be sure to choose a school that has been accredited by a reliable accrediting agency. Accreditation means simply that the agency has examined the way the school is operated and has judged it to be all that it's represented to be. State education boards sometimes provide accreditation of schools chartered within their states. Approval by the Veterans Administration is also a good sign. But the agency that is usually considered to be the top accrediting agency in this field is the National Home Study Council because the NHSC itself has been approved by the U.S. Office of Education. ■

## Amateur Radio

(Continued from page 54)

suspended from an upper-story window.

Although the simple dipole antenna shown in Fig. 1 is a single-band affair, the 7-MHz version can also be used on 21 MHz. One simple scheme for multi-band operation is shown in Fig. 2. Here the upper dipole is cut for operation on 80 meters and the underslung dipole is used for 40 and 15. Other simple antennas for Novice operation are discussed in some of the previously mentioned books.

In addition to the copper wire for the antenna (number 14 or larger hard-drawn copper), you will need three antenna insulators, a length of 75-ohm coaxial transmission line such as RG-11/U, and a PL-259 coaxial connector. Most of these materials can be purchased from your local Radio Shack or Lafayette Electronics store.

**Setting Up Your Station.** When you have purchased your receiver and transmitter, and installed your antenna, the only remaining items you need to get on the air are a lowpass filter, a telegraph key, a pair of headphones, and *your license*. You probably picked up a key and a set of headphones when you were working on your code, so the only remaining purchase is the lowpass filter.

The lowpass filter is installed between the transmitter and the transmission line to your antenna (as close to the transmitter as possible) and provides good insurance against television interference (TVI). One of the better filters on the market is the Drake TV-100-LP which sells for \$5.95. The Drake TV-CB-LP, while designed for CB use, is also an excellent choice and sells for \$6.95.

When you set up your station strive for single-switch control when switching from receive to transmit. If you have to throw more than one switch you may forget one in the excitement of

a contact and find you've been talking to yourself. Most receivers have connections on the rear panel which can be wired to the transmit-receive (T-R) switch to mute the receiver when you go on the air. Some transmitters include a built-in antenna changeover relay, but if yours doesn't, you may want to include one in your layout as shown in Fig. 3.

If you are very budget minded, have cut out all the frills, and have carefully planned your purchases, you can put a very presentable Novice station on the air for something in the neighborhood of \$100. If you happen to find a Novice who recently graduated to the General class, you may be able to buy a complete Novice setup for something less than this, but \$100 is about the minimum if you have to buy everything. That's not too bad for today's inflated economy, and if you're like most amateurs, you'll get more than that much enjoyment out of it during the first few months of operation. ■



## DXer's First Shack

(Continued from page 67)

10003 for \$1.35. And, CW's sister pub-

## Electronic Parts

(Continued from page 26)

tentiometers, mini-pots, trimmers, etc. You name it and they have it for pennies on the dollar. Just as an example, you will pay at least \$1.75 for a "new" SPST mini-switch. You can buy ten brand-new SPDT mini-switches for a dollar from a surplus dealer. Many of the surplus dealers that handle odd-ball components also handle surplus manufacturer's sub-assemblies which can be easily stripped for valuable components.

You can get just about any hobbyist and/or experimenter component from the *general* surplus dealers such as Poly-Paks. A recent catalog issued by one of these dealers listed readout devices of all types, IC sockets, timers, relays, microphones, mini-motors, complete sub-chassis amplifiers, tuners and tape decks, fiber optic accessories, calculator keyboards and supplies, and even mini-computer chips.

Even some of the major electronic mail order supply houses offer big values in outdated, surplus, and oddball equipment. For example, Burstein-Ap-plebee (known as B-A) not only has a "bargain section" in their general catalog, several times a year they put out flyers with extra special bargains in basic tape transports (such as a cartridge mechanism), meters, relays, speakers, CB transceivers, sockets, bells, gongs, wire, capacitors, etc. Similarly, Lafayette Radio also puts out several flyers a year with special bargains in experimenter and hobbyist components.

McGEE is another outfit specializing in surplus and over-runs, with particular emphasis on speakers. Get on their mailing list and you'll get offers for speakers which were formerly used in very high priced high fidelity equipment, but you'll now get them for just a few dollars. And don't overlook EDI.

## Costly TV Repairs

(Continued from page 50)

ever, if this knob has been pulled *out* too far, or if the ear is broken off, this type can be adjusted far from the correct frequency. In tube-type TV sets,

lication, ELEMENTARY ELECTRONICS (also on your news dealer's shelf six times a year, or available by subscription from the same address) has a regular column, DX Central Reporting, and numerous feature articles of inter-

They handle everything from a full stereo system to parts you didn't believe existed anymore.

For the dyed-in-the-wool experimenter who believes in turning junk into gold there's Fair Radio Sales, which specializes in surplus military gear, though they often have some excellent buys in surplus industrial instrumentation such as an audio distortion meter. Much of Fair Radio's military gear can be converted to excellent civilian transmitters and receivers—often all that's needed is a power supply, and there are several "surplus conversion manuals" on the market. Fair Radio has control boxes, transformers, special microphones, and just about everything else the military used. Their catalog is another *must have* for the true experimenter.

**Keep Informed.** If there's a common thread that runs through "how to save money on parts" it's catalogs, catalogs, catalogs. Send away for every one you can find. Remember, one dealer's list price standard stock is another dealer's budget priced surplus. Most important, don't be afraid to order only what you need; don't add extras into your order just to make up a minimum priced order. For example, one of the best solid state device supply houses in terms of "everything is in stock" has a \$25 minimum fee. Many hobbyists order unnecessary items they *think* they might need in the future (not what they *know* they will need) just to make up the minimum fee. This is throwing money out. Find some other dealer with a \$1 or \$5 minimum fee. Even if you must pay a handling charge of, say, 50¢ or a dollar, on small orders you're still way ahead of the game.

Our final tip on saving money is to order via UPS C.O.D. whenever possible. Stay away from the charge cards and prepayment. Here's why: A C.O.D. fee is under \$1. Now consider some hard facts. Most of the mail order dealers and distributors will ship an entire order if your prepayment is a few

this normally doesn't do any damage unless it's screwed out so far that the oscillator stops. If this happens, the screen will go dark. If it does, turn the set off instantly. You can damage up to three expensive tubes by leaving the set on in this condition. Turn the horizontal hold control several turns in the opposite direction, and turn the set on

est to DXers.

And now that you have your basic DX shack in operation, a lot of enjoyable time at your receiver's dials will also quickly broaden your DXing know-how. ■

cents under; they will send you a note asking for the small price differential. Some dealers, however, will not trust you for a penny. One or two items will be indicated as "out of stock" and you will get credit slip for what the company now owes *you*. Firstly, you might lose or never have need for the credit slip. Secondly, the component that's "out of stock" might be the most important or critical one in the entire project. Without it all your expenses might be thrown out; or, you might have to obtain the part locally at a considerably higher price. Our experience has been that, in general, you get most of what is ordered when it's shipped C.O.D.

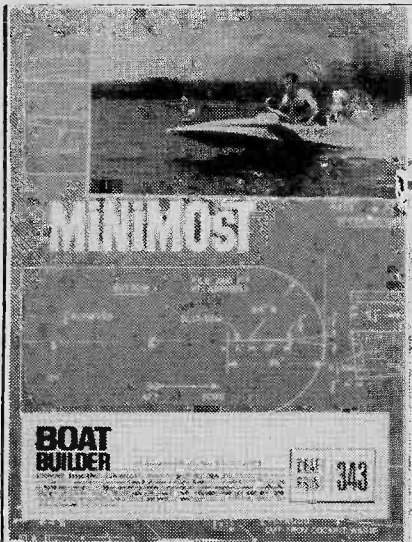
As for charge cards, if the shipment gets lost on its way to the bank doesn't want to know from anything; you *must* pay up. It might take you months to get a refund from the insurer, post office, or even the distributor. In one instance it took four months to trace a lost parcel. Meanwhile, you must pay the bank's charge. If you protest that you did not get your equipment the bank couldn't care less. Every billing cycle (less than one month) they will tack on a finance charge which you will end up paying. The postage you waste on letters to the bank and telephone costs protesting the interest charges will just add to your final bill. It is unfortunate that a few distributors who cause the insurance and bank charge problems are not representative of the industry. But you never know when you'll get stuck. If you've got a big order, or one involving many different components and you don't know the exact costs including shipping, it pays to have it shipped C.O.D., and UPS will be the most convenient (if you have UPS delivery in your area).

**Summing Up.** We can say that the way to save money on parts and projects is to take the extra few minutes to determine *who* sells *what* at the lowest possible cost, and then make certain you get everything you pay for. ■

again. If the screen does not light within 30-45 seconds, turn it off again fast. When this has happened, you'll see a great many very thin lines; always turn the control toward the point where the lines get fewer and thicker.

Turning a horizontal hold control way off frequency, in many solid-state

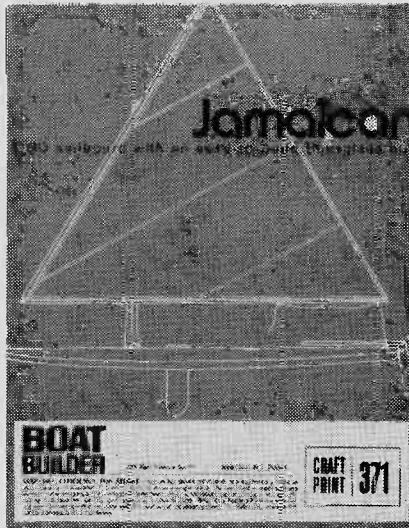
(Continued on page 104)



## BUILD the REAL THING & SAVE, SAVE!

343. MINIMOST is an 8' outboard sports hydro you can build in just 15 hours, and at a cost of less than \$25 for materials. Its advanced underhull design makes speeds in the 30 mph range possible with a 10 hp motor. L.O.A., 8'.  
 Full-size pattern set 344 \$5.00  
 \$15.00

371. JAMAICAN is a sailing surfboard of unique construction. Fiberglass and Dynel cloth are stretched and stapled in place over a wooden framework, then resin is applied. No special building jigs or forms are needed. Foamed-in-place polyurethane adds stiffness. L.O.A., 12'; beam, 3'. \$5.00



**BUILD IT WITH CRAFT PRINTS**

BE76

Boat Builder, 229 Park Ave. S., NY, NY 10003

Enclosed is \$ \_\_\_\_\_ SATISFACTION GUARANTEED.

Craft Print #343, \$5  Craft Print #371, \$5

#344 full-size pattern set \$15 (add 50¢ for postage and handling to each print)

NAME \_\_\_\_\_ (please print)

ADDRESS \_\_\_\_\_

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

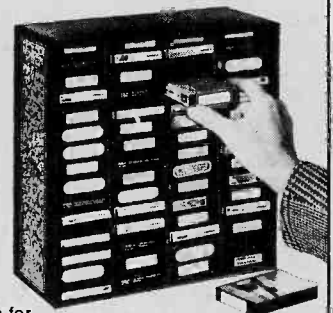
## HOW TO SOLVE YOUR STORAGE PROBLEMS WITH A TOUCH OF STYLE

- #J-TA—Tape Album (holds 6)
- #J-R7—45's (holds 20)
- #J-R10—10" Records (holds 20)
- #J-R12—12" Records (holds 20)

**RECORD AND TAPE CASES**



Decorative, sturdy, in rich leatherette. Exclusive design on back is gold tooled on Black, Brown, or Green—sides black. Center divider separates records up to 20 in original jackets. Tape Cases hold 6 tapes in their original boxes.



**DELUXE CASSETTE STORAGE CASES**  
 (Includes presensitive labels for titling)

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#JC-30 holds 30 Cassettes. 5½" high, 6½" deep, 5½" wide. Same color choices.



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(Continued from page 101)

sets, can cause damage to quite a few transistors. This can happen quite rapidly, so always be sure that you do have light on the screen; if it goes out, turn the set off as fast as possible.

Here is a final hint for color TV sets, especially some of the older types. If you have a problem with intermittent loss of the color, and you also see some horizontal instability, try adjusting the horizontal hold control *just a little bit*.

## Tuning the Cops

(Continued from page 42)

When you decide to buy, you'll be faced with an initial decision: Shall it be a tunable receiver or a crystal-controlled model? Following close on its heels, another decision: Which band or bands, VHF and/or UHF, should it be capable of tuning?

A tunable receiver allows you to continuously tune from one end of a band to the other. It permits you to cover all the channels in a particular band and is the answer for the fellow who likes to randomly tune for whatever may come his way.

A crystal-controlled receiver, on the other hand, will bring in signals only on certain predetermined channels, normally those on which stations in your area operate. A crystal-controlled set—so-called because the particular frequencies selected for tuning are controlled by precision ground pieces of quartz crystal—usually has provisions for a fixed number of crystals: four, often eight, and recently in some sets, sixteen.

You determine which frequencies are used by police departments in your locale, buy crystals for those channels, and plug them into the receiver. Instead of dialing a desired frequency, you switch to the appropriate signal and you are right on frequency, ready to monitor. To tune other channels you must buy additional crystals.

The crystal-controlled design is ideal for the monitor who has interest in a relatively few local channels and doesn't want to be bothered by tuning a dial to hunt for the signals he desires. There are compromise designs, however. A few models are basically the tunable varieties, but they also have provisions for a crystal or two for instant reception of a favorite channel or channels.

**Scanners.** Very popular these days are the crystal-controlled "scanner" monitoring receivers. Scanners have all the benefits of any crystal type model,

If this control is set "right at the edge" of its holding range, this can cause the color to drop out now and then. You'll often see color drop out just a little before the picture itself falls out of horizontal sync.

**Just the Beginning.** So there you are. These are the normal reactions of the hold controls. If you have trouble, the first thing to do is check these to see if they are reacting the way they ought to. In a great many cases, you'll find that this is all that you need. If you can

with an additional plus. Instead of having to switch manually from channel to channel to find out what's happening, they electronically and automatically sweep across the four, eight, or sixteen pre-selected frequencies. The scan stops automatically when it comes to a frequency on which there is a transmission. When the message ends—and that's the way it is with police communications, since transmissions are not continuous—the scanning automatically resumes until the next "occupied" channel is encountered.

The scanner is just the ticket for the monitor who is mainly interested in a few channels (depending on the model, up to 16), one or several police frequencies, the fire department's frequency, sheriff's department communications and the like, without missing any of the action. The scanning circuitry makes it possible to keep tabs on a series of frequencies with the assurance that when one of them comes to life, his receiver will be locked in on the right channel.

Another device featured on all of the more costly VHF/UHF receivers is the squelch. In fact, even some of the relatively inexpensive monitor receivers have this useful feature. A squelch is a receiver audio silencing device. The speaker is activated only when a transmission is received. At other times, between transmissions, the speaker is silent. The switching in and out is automatic. Thus you hear only the communications and none of the annoying band noise and static in between actual communications.

**What Price Reception?** Cheapest of the VHF/UHF receivers are the tunable variety. For about \$30 you should be able to buy an oriental import portable with several bands, including AM medium wave and probably the VHF high band. Better quality models range up to about \$80.

There are plenty of tunable models, some with one or two of the VHF police bands, some with various combinations of bands including the UHF frequencies. There are kits which allow

readjust the controls, and the set works normally, fine! You don't need to call a service technician. However, if you can't get a normal reaction, or make the picture stand still by adjusting these controls, then it's time to ask for some professional help. You can help the technician find the trouble faster by telling him exactly *how* the set is acting: "Falling out of horizontal sync," "vertical rolling," and so on. This helps him get to the cause of the trouble in a little less time. ■

you to save money by doing the construction work yourself.

There are scanner models with four-channel provision for as little as \$70, though several better known brands market four-channel pocket scanners for around \$120. And 16-crystal scanners with provisions to monitor frequencies in both the high and low VHF range and UHF and assorted other circuitry goodies begin at something over \$200.

Many of the available receivers, regardless of price, come with their own built-in telescoping whip antennas, which are usually more than adequate for local-type reception. However you may wish to invest in an antenna you can mount outdoors, preferably as high as possible. A ground plane antenna, designed for use on both the high and low VHF ranges can be had for about \$20; a similar design suitable for the UHF and VHF 150-174 MHz frequencies will cost about half that.

If you have a tunable receiver you can chart your own frequency "roadmap." A few nights of listening will teach you the frequencies on which you can find your local and area police departments' communications. And, of course, you'll find other types of public service transmissions as well: the fire-fighters, highway crews, forestry services, power and light utility communications, railroad communications, radio paging stations, and more.

You may also be interested in acquiring a listing of those public service frequencies used in your area and the types of agencies and firms that use them. Lists of police and other types of stations on VHF/UHF for various areas of the United States are available from Communications Research Bureau, P.O. Box 56, Commack, NY 11725. A stamped, self-addressed envelope to that address will bring you details and prices.

Getting in on the action of the public service VHF/UHF bands is easy . . . and better yet, you can do it even if you are on a tight budget. So what are you waiting for? ■

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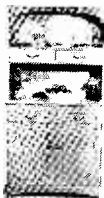
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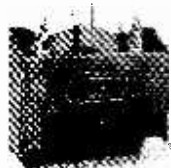
**D-10**  
**Trestle Table Set**  
This Early American table and bench set sells for well over \$250 in fine furniture stores, but you build it for about \$60, even less! Carefully select lumber, choosing boards that are fairly flat and avoid those with sap streaks.



**D-23**  
**Elegant Bar**  
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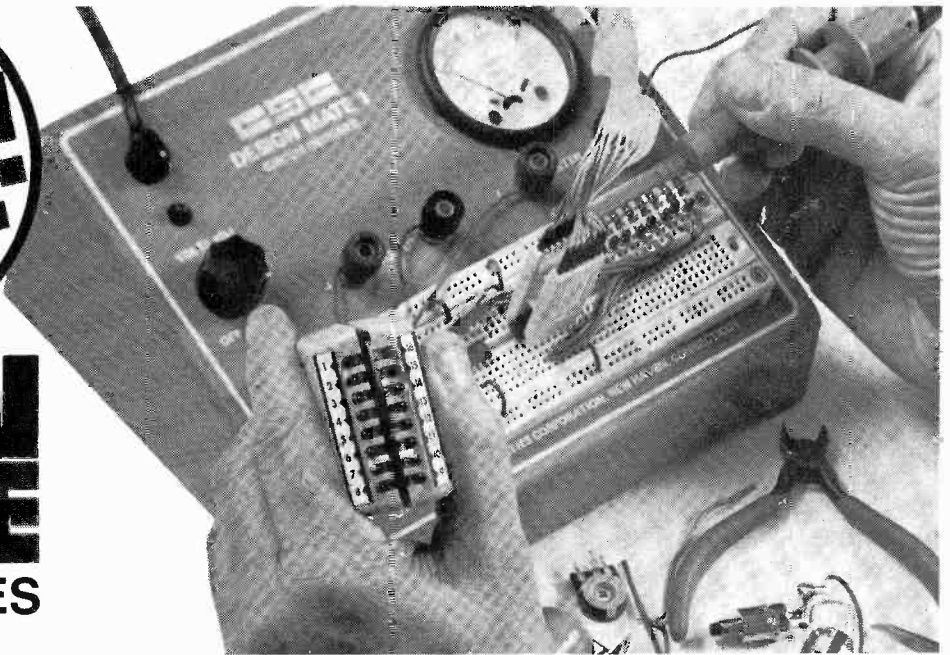
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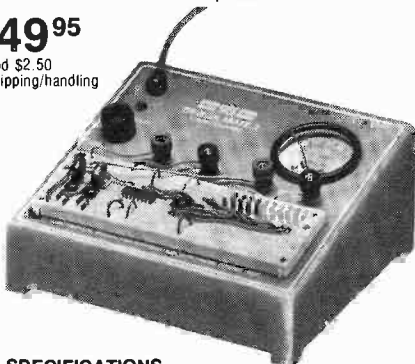
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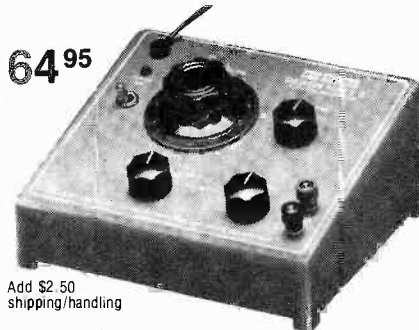
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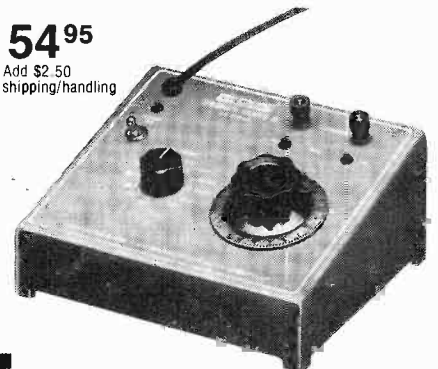
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