BONUS PROJECTS

- Electric Fence Charger
- Put Tree Lights to Music
- Slim Hi-Fi Speaker System
- Motor Speed Controller

MINIATURE SUPERHET POCKET RECEIVER

Voltmeter predicts auto battery failures

(page 53)
BONUS PROJECTS

Electric Fence Charger
Put Tree Lights to Music
Slim Hi-Fi Speaker System
Motor Speed Controller

MINIATURE SUPERHET POCKET RECEIVER

Voltmeter predicts auto battery failures (page 52)
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Prepares you to install, maintain, service aircraft communications equipment. Covers direction finders, ranges, markers, Loran, Shoran, Radar, landing systems. Earn your First Class FCC License with Radar Endorsement.

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Our 50th Year of Leadership in Electronics Training

December, 1964
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MARINE COMMUNICATIONS*
Covers transmitters, direction finders, depth indicators, radar, sonar, other equipment used on commercial ships and pleasure boats. Prepares you for First Class FCC License with Radar Endorsement.

MOBILE COMMUNICATIONS*
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*NOTE: You must pass your FCC License exams (any Communications course) or NRI refunds in full the tuition you have paid.

Our 50th Year of Leadership in Electronics Training
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Strange things happen at 450° below zero:
Circuits get quieter, super magnets and cryogenic computers
become possible, and electric currents flow forever

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Men 17-55
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EXCITEMENT!
MONEY!

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- Radar
- Automation Electronics
- Communications
- Computers
- Broadcasting
- Industrial Electronics
- Electronic Control

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City: ___________________________ Zone: ______ State: ______

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CHICAGO • TORONTO

December, 1964
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For Connoisseurs of Sound

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*price slightly higher in Canada

CIRCLE NO. 5 ON READER SERVICE PAGE
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- Industrial Electronics  - Electronic Communications
- Broadcast Engineering  - Advanced Engineering

Your present occupation__________________________Age__________________________

Address__________________________County__________________________

City__________________________State__________________________Zip__________________________

December, 1964
For are at these eighth inch aluminum rods. To tighten proof again, note strength than the aluminum element. Radials terminate into a high strength "Cycaloc" base, which again, has more strength than the aluminum element. The Coax female connector is part of the (weather-proof) radial support assembly. Antenna mounting is accomplished with loops of one eighth inch aluminum rod.

The Traveling Companion of the DEVANT "1" is the All New DEVANT "2"

This stainless steel mobile antenna has the world famous Mosley performance. A slim line beauty with built-in durability, take a look at these outstanding engineering efforts wherever Mosley antennas are sold.

For detailed specifications and performance data on the DEVANT "1" and/or DEVANT "2" write .

Compressor-Expander Laundered

At last you’ve done it—an excellent project for us hi-fi bugs. Of course I’m referring to the hi-fi compressor-expander (“Build a Hi-Fi Volume Compressor-Expander,” October, 1964) which I’m in the process of building. Now, how about a real good reverberation unit, one which could be used on 117 volts a.c., or adapted to 6 or 12 volts d.c. for auto radio use?

Cpl. Stephen M. Hilsen
Virginia Beach, Va.

I must commend you on the special hi-fi construction feature, “Build a Hi-Fi Volume Compressor-Expander.” It was sensational! One suggestion: I’d like to see more hi-fi articles in POPULAR ELECTRONICS.

Bill Riderhuber
Groves, Texas

The volume compressor-expander makes my system sound like a million. How about an SCA background music adapter and a reverberation unit for the future?

Tim Coneway
Upland, Calif.

Thanks very much for all your comments. We’ll certainly see what we can do on those ideas for more hi-fi projects.

CB Rules Changes Defended

The primary purpose of CB radio is to provide deserving citizens with a legitimate means of supplementing other modes of necessary communications which might not at all times be adequate. This ham and CB'er fully supports FCC Docket 14843 and will be one of the very first to compliment the Commission when it (1) tightens up licensing requirements to require positive proof of need; (2) instigates some form of around-the-clock monitoring of CB stations, and (3) provides instant withdrawal of licenses for infractions of the rules. A great portion of the total CB activity could be eliminated at this moment without detrimental harm to “citizens’ rights,” the FCC, or anyone else. No one has a “right” to any portion of the radio spectrum; use of it is a privilege granted to the worthy.

Walter R. Yearly, K4ABL, K5HZG, 10W3D05 Louisville, Ky.

The Editor’s Note on the recent CB rules changes (“New Rules to Govern CB,” October, 1964) is not in accordance with my way of thinking. I feel the new Rules and Regulations are not overly suppressive, and that interstation communications should be given only five channels rather than seven. As a radio-TV service-man, I got my sets to check on incoming calls while in the mobile. Unfortunately, there has been so much rag-chewing going on that my wife has refused to leave the
Are you standing still in electronics while this man advances?

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Letters

(Continued from page 6)

base set turned on. Perhaps I will now be able to get some use from my equipment.

GEORGE H. LINDSLEY
19W7068
Decatur, Mich.

Stereo TV Sound: A Possibility?

Concerning the letter on the feasibility of stereo TV sound (“Letters from Our Readers,” October, 1964), may I point out that it has been done. Robert B. Dome of GE, Syracuse, N.Y., holds the patents on a stereo TV sound system which uses the same sum-and-difference principle employed in the FM band. Of course, the system is not precisely the same due to the lesser swing of TV sound. It also differs in that it makes provision for, and minimizes beats with, both the horizontal scanning frequency and the color subcarrier. I think that before long we will see the establishment of stereo sound in TV—someone will simply have to sell the public on it.

THOMAS R. HASKEET
Cincinnati, Ohio

Bargain Page Amplifier

I enjoyed constructing Dan Meyer’s “Bargain Page Amplifier” (October, 1964). Using junk box parts, I substituted a pair of 2N1381’s for the 2N404, a 2N306 for the 2N1302, and a pair of 2N301’s for the 27K1230 power transistors. One addition I made was the emitter follower shown in the diagram to make it possible to feed the amplifier from a high impedance source. Incidentally, I feel that the regulated d.c. supply is a luxury—any low-impedance 12-volt power supply with a current capacity of 1 to 2 amps will suffice to power the amplifier.

NORMAN H. BUETTNER
Chicago, Ill.

“Great Debate” Great, He Says

I have just finished reading “The Great Debate” (October, 1964). My hearty congratulations to Mr. Bensen for this fine bit of timely satire.

WILLIAM ZECHMAN
McMinnville, Tenn.

“C Bridge” Tip

I have just constructed the capacitance bridge (“C Bridge,” November, 1963) and am very satisfied with its operation. Incidentally, sharper nulls can be obtained by increasing the 6.3 volts a.c. to 60 or 70 volts— I used a variable transformer. Nulls can best be

(Continued on page 10)
The commanding presence of Sony sound

Now enter the world of the professional. With the Sony Sterecorder 600, a superbly engineered instrument with 3-head design, you are master of the most exacting stereophonic tape recording techniques.

Professional in every detail, from its modular circuitry to its 3-head design, this superb 4-track stereophonic and monophonic recording and playback unit provides such versatile features as: • vertical and horizontal operating positions • sound on sound • tape and source monitor switch • full 7" reel capacity • microphone and line mixing • magnetic phone and FM stereo inputs • 2 V.U. meters • hysteresis-synchronous drive motors • dynamically balanced capstan flywheel • automatic shut off • pause control and digital tape counter—all indispensable to the discriminating recording enthusiast. Less than $450, complete with carrying case and two Sony F-87 cardioid dynamic microphones.

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CIRCLE NO. 31 ON READER SERVICE PAGE
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Letters

(Continued from page 8)

Two-Meter Transmitter Wanted

I was very interested in the "The Companion 6-Meter Transmitter" (September, 1964). How about a "Companion 2-Meter Transmitter" for us aspiring Novices? It sure would go great with P.E.'s "2-Meter Simple Superhet" (September, 1963).

Bob Layton, WN6MCY
Napa, Calif.

There's a 2-meter transmitter in the works, Bob. Look for it in one of our upcoming issues.

Game Hunting with Tubular Mike

I'm enclosing a photo of my tubular mike ("Build the Shotgun Sound Snooper," June, 1964) which I put together with 56 feet of .350 x .031" wall thickness aluminum tubing originally intended for use as percolator stems in large 600 cup coffee makers. Its range is about 300 feet in the city, and almost double in the country. I have picked up conversations behind closed windows at 75 feet when background noise was favorable. As shown in the picture, I carry the lightweight unit as a "gun" for use in locating deer, birds, and other game. Thank you for a very interesting project.

Wayne L. Stebbins
Merrill, Wis.

Thank you for the photo, Wayne. As you suggest in your letter, background noise can be reduced somewhat by building a sound-absorbent housing for both the tube and mike housing—the thicker the better.

Reader Service Page of Value

I'm very pleased with Popular Electronics' Reader Service Page. The information I secured through it made it possible for me to purchase my CB equipment.

Ronnie Ross, KLN2868
Detroit, Mich.

Glad to be of...well, service, Ronnie (no pun intended). You'll find the Reader's Service Page on page 15 of every issue, including this one.

Here's Looking At You!

I have enjoyed many of the projects that have been published in Popular Electronics, especially the "Meterless VTVM" and the "C Bridge" (November 1963). Since I'd like to see some more "magic eye" (Continued on page 20)
AN EXCEPTIONAL, "ALL LIGHTS GREEN" VALUE TO INTRODUCE THE BRILLIANT NEW RAYTEL TWR-5 ALL-TRANSISTOR C-B RADIO

THE 10-54 BONUS

10-54, SIMPLE AS A, B, C...

A)- Buy the power-packed performer, TWR-5 at only 179.50......

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C)- Take along Bonus merchandise worth 54.00!!!

THE 10-54 BONUS PACKAGE...
TWR-5 Transistorized C-B Radio with crystals for Channel 11 .....................179.50
Gimbal-type Mounting Bracket ..................N/C
CB6MA Base-loaded Antenna with stainless steel whip, universal cowl-mounting bracket and 15' RG-58/U coax cable ..............27.50
6-months Subscription to S-9, the Citizens Band magazine .........................3.75
TWR-5 Installation Manual .........................N/C
1-Extra set crystals. (Channel 9) ..................6.95
DP-200 Noise Suppression Kit .................24.90
Noise Suppression Booklet .................. .25
Litter Bag, durable plastic with 10-code imprinted on one side .....................1.00
Total value 243.85
Your cost . 189.50

*ALTERNATIVE BONUS DEAL, the 5-34. Pay only 5.00 more than the 179.50 price of the TWR-5 and receive the above merchandise (less the DP-200 Noise Suppression Kit) worth 34.00.

Mail coupon today for full information on TWR-5 transistorized radio and 10-54 Bonus details

NAME

NUMBER STREET

CITY ZONE STATE


December, 1964
Now hear this—SPECIAL CHRISTMAS from HALLICRAFTERS!

This high performance, quality-engineered headset... worth $5.00... absolutely FREE!

The world is at your fingertips via amazing short wave—and now you can have the professional touch of your own headset for private listening ABSOLUTELY FREE!

The world's great events... news in English from hundreds of foreign stations... the thrill of emergency communications... radio amateurs... military and marine—all with a twist of the dial on your fabulous new Hallicrafters S-120!

Act now! Order your S-120 and FREE HEADSET today. Limited offer.

Your private "listening post" for world events

"Hear radio 'hams' melt the Iron curtain!"

S. O. S. !

You're truly in tune with the whole world through your Hallicrafters. On-the-spot news broadcast in English from over 200 foreign stations... and there's nothing like the real thing for foreign language study!

No tyrant in history has yet been able to crush the free exchange of good will that occurs every day among the radio amateurs of the world. "Hams" are our first line of communication in time of disaster, too. Hear them on your Hallicrafters!

When emergency strikes, you may be on the scene with your Hallicrafters World Range radio. Marine... fire... civil defense channels... all at your fingertips.
World's most popular Communication-type Receiver!

Three short wave bands (1.6-30 Mc.) cover foreign, amateur, marine, some aviation plus emergency broadcasts. Extended range AM band, too. Electrical bandspread; BFO for code; headphone jack; easy-to-read slide-rule dial.

...when you buy the **S-120** professionally-styled, **4-band short wave (plus AM)** communications receiver for only **$69.95!**
If, in 1631, you went to rent a horse from Thomas Hobson at Cambridge, England, you took the horse that stood next to the door. And no other. Period. Hence, Hobson's Choice means No Choice.

And, as recently as 1961, if you went to buy a true high fidelity stereo phono cartridge, you bought the Shure M3D Stereo Dynetic. Just as the critics and musicians did. It was acknowledged as the ONLY choice for the critical listener.

Since then, Shure has developed several models of their Stereo Dynetic cartridges—each designed for optimum performance in specific kinds of systems, each designed for a specific kind of porte-monnaie.

We trust this brief recitation of the significant features covering the various members of the Shure cartridge family will help guide you to the best choice for you.

**THE CARTRIDGE**

- V-15
- M55E
- M44
- M7/N21D
- M99
- M3D

**ITS FUNCTION, ITS FEATURES...**

The ultimate 15° tracking and Bi-Radial Elliptical diamond stylus reduces tracing (pinch effect), IM and Harmonic Distortion to unprecedented lows. Scratch-proof. Extraordinary quality control throughout. Literally handmade and individually tested, in a class by itself for reproducing music from mono as well as stereo discs.

Designed to give professional performance! Elliptical diamond stylus and new 15° vertical tracking angle provide freedom from distortion. Low Mass. Scratch-proof. Similar to V-15, except that it is made under standard quality control conditions.

A premium quality cartridge at a modest price. 15° Tracking angle conforms to the 15° RIAA and ITA proposed standard cutting angle recently adopted by most recording companies. IM and Harmonic distortion are remarkably low... cross-talk between channels is negligible in critical low and mid-frequency ranges.

A top-rated cartridge featuring the highly compliant N21D tubular stylus. Noted for its sweet, "singing" quality throughout the audible spectrum and especially its singular recreation of clean mid-range sounds (where most of the music really "happens") budget-priced, too.

A unique Stereo-Dynetic cartridge head shell assembly for Garrard and Matsford automatic turntable owners. The cartridge "flats on counterbalancing springs... makes the stylus scratch-proof... ends tone arm bounce..."

A best-seller with extremely musical and transparent sound at rock bottom price. Tracks at pressures as high as 6 grams, as low as 3 grams. The original famous Stereo Dynetic Cartridge.

**IS YOUR BEST SELECTION**

If your tone arm tracks at 1 1/2 grams or less (either with manual or automatic turntable)—and if you want the very best, regardless of price--this is without question your cartridge. It is designed for the purist... the perfectionist whose entire system must be composed of the finest equipment in every category. Shure's finest cartridge.

If you seek outstanding performance and your tonearm will track at forces of 1 1/2 to 2 1/2 grams, the M55E will satisfy—beautifully. Will actually improve the sound from your high fidelity system! (Unless you're using the V-15, Shure's finest cartridge) A Special value.

If you track between 1 1/2 and 2 1/2 grams, the M44-5 with .0007" styli represents a best-buy investment. If you track between 2 1/2 and 3 grams, the M44-7 is for you. If you track between 3 1/2 and 4 grams, choose the M44-C. All have scratch-proof retractile stylus.

For 2 to 2 1/2 gram tracking. Especially fine if your present set-up sounds "muddy." It is built on an outstanding buy. [Also, if you own regular M7-D, you can upgrade it for higher compliance and higher tracking by installing an N21D stylus].

If your vibration is a problem, saves your records. Models for Garrard Laboratories Type "A", A3-6, A3-40 and Model 50 automatic turntables and Matsford Model 10 or 15 cartridge. Includes head shell, .0007" diamond stylus.

If cost is the dominant factor. Lowest price of any Stereo Dynetic cartridge... with almost universal application. Can be used with any changer with 4-pole motor. Very rugged.

**HIGH FIDELITY PHONO CARTRIDGES... WORLD STANDARD WHEREVER SOUND QUALITY IS PARAMOUNT**

Shure Brothers, Inc., 222 Hartley Ave., Evanston, Illinois

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You can get additional information promptly concerning products advertised or mentioned editorially in this issue.

1 Circle the number on the coupon below which corresponds to the key number at the bottom of the advertisement or is incorporated in the editorial mention that interests you.

2 Add up your total number of requests and fill in the box in the upper right-hand corner of the coupon.

3 Mail the coupon to the address indicated below.

4 Please use this address only for Product Service requests.
Choose Your Tailor-Made Course in
N.T.S. “PROJECT METHOD” ELECTRONICS

Now! N.T.S. — one of America’s oldest leading home-study and resident technical schools—offers you GREATER CAREER OPPORTUNITIES IN ELECTRONICS.

You can install and maintain electronic circuitry in missiles and rockets ... specialize in microwaves, radar, and sonar.

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You can service and repair the electronic “brains” of industry — computers, data processing and other automation equipment.

You can become a highly-paid TV-Radio Technician, an electronics field engineer, or succeed in your own sales and service business.

CHOOSE YOUR FIELD — INSURE YOUR FUTURE!

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   A basic course thoroughly covering fundamentals of electronics, radio, TV servicing and communications.

2 MASTER COURSE IN ELECTRONICS-TV-RADIO, ADVANCED TV AND INDUSTRIAL ELECTRONICS
   Qualifies you as a Master Electronics Technician — the Man in Demand.

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   Preparation for this government license essential for many interesting jobs in radar, radio, television, communications, guided missiles, many others. Upon completion of this course, if you do not pass the FCC exam, your tuition will be refunded in full.

4 RADIO SERVICING (AM-FM-TRANSISTORS)
   Train for radio sales and service with dealer or distributor.

5 TELEVISION SERVICING (INCLUDING COLOR)
   Covers installation, adjustment, repair and servicing of black and white and color television ... prepares you for your own sales and service business.

6 STEREO, HI-FI AND SOUND SYSTEMS
   A growing field. Prepares you to build, install and service modern sound equipment for home or industry.

7 BASIC ELECTRONICS
   Gives you the fundamentals you must know to build on for a future Electronics career. Also offers an excellent background for Salesmen, Purchasing Agents, and others in Electronics.

8 ELECTRONICS MATH
   Simple, easy-to-follow instructions in the specialized math you need in many electronics jobs.

INDUSTRY WELCOMES N.T.S. STUDENTS AND GRADUATES
N.T.S. HOME TRAINING: QUICK, PRACTICAL WAY TO HIGHER PAY, LIFELONG BENEFITS

N.T.S. "Project Method" Courses can help you get a new and better job — or move up to higher pay in your present one.

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You Enroll by Mail — and Save Money. No Salesmen: This means lower tuition for you. Accredited Member N.H.S.C.

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If you wish to take your Electronics-TV-Radio training in our famous Resident School in Los Angeles — the oldest and largest School of its kind in the world — write for special Resident School catalog and information, or check coupon.

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The personal guidance you receive during your training can be very helpful to your progress. Many N.T.S. students are able to earn more money within a few months. You can pick and choose your career. Work in industry or go into business for yourself. Your services will always be in demand wherever you go — and you can pick your spot!

N.T.S. Graduate Advisory Service can help you answer technical questions in establishing your own business and in countless other ways after you’ve completed your training.

MAIL CATALOG

FOREIGN ADDRESS FEE $1.00

December, 1964
In any CB application...you'll outperform 'em all with a MESSENGER.

Your own 2-way radio for Business or Personal use!

"PERSONAL MESSENGERS"—Compact, hand-held 100 milliwatt or 1½ watt units! Rugged and reliable—11 transistors, 4 diodes. Twice the sensitivity and 40% more range than similar units with conventional circuitry—more output than similar units with same rated inputs!

Cat. No. 242-101...100 Milliwatts...$109.50 Net
Cat. No. 242-102...1½ Watts...$129.50 Net

"MESSENGER"; "MESSENGER TWO"
For mobile, base station. High efficiency makes full use of maximum allowable legal power. Excellent receiver sensitivity and selectivity. Automatic "squelch" control, 5 crystal controlled channels on the "Messenger" and 10 crystal controlled channels plus tunable receiver on the "Messenger Two".

"MESSENGER" — $114.95 Net
Cat. No. 242-127........115 VAC/6 VDC
Cat. No. 242-128........115 VAC/12 VDC

"MESSENGER TWO" — $169.95 Net
Cat. No. 242-162........115 VAC/6 VDC
Cat. No. 242-162........115 VAC/12 VDC

"MESSENGER III"—Everything you want in a CB transceiver—a husky signal, extreme sensitivity, razor-sharp selectivity—and complete flexibility for base station, mobile, public address, or battery powered portable use! Double conversion receiver—set-and-forget "Volume" and "Squelch" controls—11 channel coverage—"Tone Alert" Selective Calling System available as accessory.

Cat. No. 242-150
12 Volts DC Messenger III... $189.95 Net
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117 Volt AC Power Supply... $29.95 Net

The nation's most popular Citizens Radio equipment line!
Rated BEST by Distributors
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WRITE TODAY for full color brochure, or see your Dealer/Distributor and ask for a demonstration!

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® 2442 TENTH AVE. S.W., WASECA, MINNESOTA
CIRCLE NO. 15 ON READER SERVICE PAGE

Letters

(Continued from page 10)
tubes staring at me from my bench, how about a "meterless ohmmeter" and a "meterless ammeter?"

T. J. MOCHORUK
Prince George, B.C., Canada

We'll have a "magic eye" inductance bridge for you in the near future.

Project Award Supported

I certainly think the P.E. project award proposed by Robert "Bob" Brandon ("Letters from Our Readers", October, 1964) is a good idea. I'd be proud to have such an award on my construction projects.

GEORGE SUHY

How about a 'project of the month' award? Those who do a perfect job on a specified project would win it, and would be listed in a subsequent issue.

BIL WHITNEY, WA4ESH
Hialeah, Fla.

The idea of P.E. project awards is A.O.K. I have a number of projects, both new and old, that I would be more than glad to have certified.

THOMAS A. SHAVER
Columbus, Ohio

Reader Strikes It Rich

Knowledge gained over a period of time from P.E.'s excellent articles has enabled me to build a small magnetic assembly which will react to a magnetic field inside an ore sample. This will cause a gold nugget with a positive or negative magnetic field to cling to this device.

GENE YAWN
Nelson, Ga.

Well, congratulations, Gene, but it sure is news to us. How about letting us in on the secret?

Out of Tune

The Stereo S'Lector (September, 1964, page 75). In the paragraph of text describing how to connect the jacks, J4, J5, and J6, J7 have been transposed. Jacks J4 and J5 should connect to the multiplex adapter, J6 and J7 to the stereo amplifier inputs.

Fido's Whistle-Controlled Flivvers (October, 1964, page 49). The modified PK-522 amplifier (shown in the schematic as a box outlined with a heavy black line) will have the connection broken between the top of the primary of the output transformer and the wire labeled "NC." The "NC" designation on this wire is incorrect, as it is connected to the amplifier circuitry. This modification is properly shown in the photos and described in the text.
NEW!
An Electronics Slide Rule
with Self-Training Course

Here's the first truly professional slide rule designed especially for electronic engineers, technicians and students. No longer must you struggle along with a general purpose slide rule... this new CIE Electronics Slide Rule will enable you to solve electronic problems quickly... accurately. It's an all-metal 10" measuring instrument that can be used for conventional computation, too.

This patented Electronics Slide Rule is made to our rigid specifications by Pickett & Eckel... has special scales for solving reactance and resonance problems... locates decimal points... has widely used electronics formulas and conversion factors on the back of the rule for instant reference.

An illustrated self-training course comes with each rule... includes clear diagrams and step-by-step explanations to make learning fast, easy. Several hundred practice problems deal with widely occurring situations in electronics... teaches many short cuts... lists the best settings for solving complex problems. Slide rule, instruction course and handsome top-grain leather carrying case... all yours for just $14.95. Cleveland Institute of Electronics, Dept. PE-103, 1776 E. 17th St., Cleveland, Ohio 44114.

THIS SPECIAL ELECTRONICS SLIDE RULE IS AVAILABLE ONLY FROM CLEVELAND INSTITUTE AND IS GUARANTEED AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP. ORDER YOURS TODAY.

SEND COUPON TODAY

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☐ Please send me your Electronics Slide Rule with illustrated self-training course. I am enclosing $14.95 (If not fully satisfied after 10 day trial, CIE will refund payment).

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Name_____________________(Please Print)  Address__________________________ County______

City_________________________State_______Zip_____

December, 1964
New Products

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon which appears on page 15.

ROTOR SWITCH VARIATIONS

More than two million different variations of semi-custom rotor switchescan be assembled using a new concept in rotor switch design and fabrication developed by the Oak Manufacturing Company. “Moduline” switches are obtained by means of a unique catalog and easy-to-use order card. The design characteristics of a switch are designated by a series of eight numbers (16 digits), which are selected from the catalog and written on the order card. When the order card is received by the company, prefabricated components already in stock are brought together for assembly. A delivery time of seven days after receipt of an order is claimed.

Circle No. 75 on Reader Service Page 15

STEREO CONTROL AMPLIFIER

Whitecrest Industries, Inc., has introduced a new stereo integrated control amplifier that is said to use oversize components working at a fraction of their ratings—in combination with proven circuitry design and rugged construction—to insure distortion-free performance, long life, and trouble-free operation. The frequency response of the APS-100 is 10 to 20,000 cycles ± 1 db; peak power output (both channels) 100 watts; music power output (IHFM, both channels) 60 watts; power output (r.m.s., per channel) 27.5 watts; sensitivity 300 mv. At rated output, harmonic distortion is .25%, intermodulation distortion .75%. Hum and noise level is 80 db below rated output. Price of the APS-100, $159.95; grained oil walnut cabinet, $19.95.

Circle No. 76 on Reader Service Page 15

ALL-BAND AMATEUR RECEIVER

Operating on 10 through 160 meters, the Hammarlund HQ-88 covers all popular amateur bands, MARS frequencies, the Citizens Band, station WWV, and the marine band. Highly selective (2.2 kc. and 5 kc.) circuits with skirt ratios of better than 3 to 1, and separate AM and SSB detectors make it an excellent unit for SSB, c.w., AM and RTTY. Sensitivity is a measurable 0.75 µv. for a 10 db AM signal-to-noise ratio, and better than 0.4 µv. for SSB and c.w. The HQ-88, a dual-conversion unit, features a “drift-free” crystal front end design. Price, $299.00.

Circle No. 77 on Reader Service Page 15

COMPACT SPEAKER SYSTEM

Intended for use where space and/or budget is limited, the H. H. Scott S-5 is a two-way speaker system employing a specially designed low-resonance woofer and high-frequency tweeter. It’s extremely compact in size—just 10” wide by 16” high by 6½” deep—but is capable of giving full wide-range performance. Its response is ± 5 db from 60 to 15,000 cycles; impedance is 8 ohms. Other features include a crossover network and a high-frequency level control. Price, less than $60.00.

Circle No. 78 on Reader Service Page 15

AUDIO FLAT CABLE SYSTEM

With “Scotchflex” audio flat cable No. 800, introduced by the 3M Company, amplifiers and speakers can be quickly mounted in any room or series of rooms at predetermined positions. Audio flat cable No. 800 has four conductors, each consisting of No. 22 AWG stranded wire, embedded in a flat vinyl strip, with an adhesive backing that will adhere to any clean, relatively smooth, firm surface. A series of accessories for termination, splicing and transition connections come with the wire. “Scotchflex” No. 800 is said to make possible
RCA, a pioneer in the development of citizens' band radio, has been providing quality equipment since the inception of the Class D Citizens' Radio Service in 1958. Now, these years of experience culminate in the great new RCA Mark Nine.

Look at some of the new features...

NEW! Combination “S” Meter and Relative RF Output Meter
“S” Meter indicates the relative strength of incoming signal in “S” units. RF Output Meter (EO) indicates relative strength of the signal being transmitted.

NEW! Spotting Switch
Permits precise manual tuning of receiver without use of receiver crystals. Receiver can be tuned (or “spotted”) quickly to any incoming channel. This means, when you buy crystals for extra channels, you can (if you wish) omit the RECEIVE crystals and buy only TRANSMIT crystals.

NEW! External Speaker Jack
Lets you connect an external speaker to the set, so incoming calls can be heard in remote locations.


- 9 fixed crystal-controlled TRANSMIT/RECEIVE channels, separately controlled
- All-channel continuously tunable receiver
- Illuminated meter and working channel indicator
- Push-to-talk ceramic mike with coiled cord

ONLY $134.75*
AC UNIT
*Optional User Price

RCA ELECTRONIC COMPONENTS AND DEVICES
Commercial Engineering Dept. L133R
415 South Fifth Street, Harrison, N. J.
Please send more Information on the RCA Mark Nine CB Radiophone

Name ____________________________
Address __________________________
City __________________ Zone ________ State ________
New Products

(Continued from page 22)

esthetically appealing sound system installations in a matter of minutes and hours rather than days and weeks, without defacing wall surfaces.

Circle No. 79 on Reader Service Page 15

TRACKING ERROR "READER"

A device that shows visually the amount of tracking error in record players and makes it possible to position the tone arm for optimum performance has been developed by ALARD Products. Made of Lucite, "TRU-TRAK" consists of a pointer assembly that attaches to the cartridge and a calibrated scale that fits over the turntable spindle. As the tone arm is moved across the turntable, the pointer indicates the tracking variations of the arm. The mounting position of the arm that produces the minimum amount of movement on the scale is the proper one for greatest fidelity with the particular tone arm and cartridge being tested. Price, $6.95 postpaid.

Circle No. 80 on Reader Service Page 15

HIGH-ACCURACY FREQUENCY METER

The new solid-state frequency meter announced by Electronic Research Company is suitable for a wide variety of applications. It provides direct linear reading of frequencies from 20 cycles to 200 kc. in six ranges, with each individually adjustable for calibration. The accuracy is ±1% from 20 cycles to 100 kc., and ±2% from 100 to 200 kc. Input impedance is 100,000 ohms. An output jack, designed for use either with an oscilloscope or headphones, provides a 15-volt, peak-to-peak square wave into a 50,000-ohm load. Price, $149.50.

Circle No. 81 on Reader Service Page 15

ELLIPtical STYlus CARTRIDGE

Shure Brothers, Inc., has announced a new 15° stereo dynetic cartridge with an elliptical diamond stylus developed especially for use with the new light-tracking automatic turntables. Called the M55E, it operates at tracking forces of from ¼ to 1½ grams, well within the tracking capability range of most of the new higher-priced automatic turntable models. The M55E has a frequency response of 20 to 20,000 cycles; output voltage is 6 mv. per channel at 1000 cycles at 5 cm/sec; channel separation is nominally over 25 db at 1000 cycles. If excessive forces are applied to the stylus, it will momentarily retract, and a soft plastic safety bumper will come in contact with the record. Price, $35.50.

Circle No. 82 on Reader Service Page 15

FOUR-WAY SPEAKER SYSTEM

The "Tanglewood" four-way speaker system is the latest addition to the Sherwood hi-fi line. With six speakers, and a 200-, 600-, and 3500-cycle crossover, the system has an overall response of 29 to 17,500 cycles, ±2½ db. Two 10" woofers have staggered 17½- and 18½-cycle resonances, and the low-frequency response is claimed to be 8 db greater than that available with any two-cubic-foot "bookshelf" system. The other speakers consist of a carefully matched 8" midwoofer, an 8" midrange, and two 3½" ring-radiator tweeters. All speakers are individually chambered and baffled to eliminate intermodulation distortion. Price of unit in walnut-veneered enclosure, $219.50 ($224.50 on the West Coast).

Circle No. 83 on Reader Service Page 15

ALLEN-TYPE SCREWDRIVER SET

Having trouble reaching those deep-set or awkwardly placed screws? The PS-99-40 compact Allen-type screwdriver set available from Xcelite Incorporated simplifies assembly and service work involving Allen hex recess set screws and cap screws. Included in the interchangeable blade set is a regular-size "Servicemaster" handle, nine blades, and a 4" extension shaft. The handle and extension shaft have a new positive-locking device—the blades fit snugly, are held firmly for turning, yet are easily removed. Price, $11.25.

Circle No. 84 on Reader Service Page 15
REVOLUTION IN CB BASE ANTENNAS

ROTATE THE SIGNAL NOT THE ANTENNA

The Unique New Model M-119 Electronic Sector Phased Omni-beam antenna

- Electronic focus and beam rotation for maximum distance—No mechanical rotator needed
- Change signal direction instantly
- Full-circle scan coverage—No blind spots
- Compact—17½ ft. vertical elements arranged on 3 ft. radius circle
- Resists over 100 mph winds
- Easy one-man installation
- 7.75 db directional gain
- 23 db front to back ratio
- Priced 30% below old fashioned beam arrays

Scan Control Unit, with indicator lights, instantly changes signal direction—just flip the switch.

The antenna specialists co.
12435 Euclid Ave., Cleveland, Ohio 44106
64-14 Woodside Ave. Woodside 77, N.Y.

Write for complete data including radiation patterns.

December, 1964

CIRCLE NO. 1 ON READER SERVICE PAGE
Now add tape

to your music system, add recording to a playback system, add stereo to a monaural system, or make special effect recordings on these new monaural or stereo tape transports with hyperbolic heads—no old fashioned pressure pads

**MODEL 87 TRANSPORT** (shown above)

with exclusive “Edit-Eze” feature
Two Motors • Two Speeds • Flexible Head Arrangements • Tape Lifters • Run-Out Switch • Counter • Erase-Protek Interlock from $138.00

**RP83 AMPLIFIER** (shown above)

Matching Record/Playback Preamplifier from $92.50

**MODEL 78 TRANSPORT**
One Motor • Two Speeds • Flexible Head Arrangements • Single Tape Motion Control from $85.00

You can always change or expand your system with tape components.

**MADE BY SKILLED AMERICAN CRAFTSMEN**

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Please send me free information on:

☐ 87 Tape Transport ☐ Complete Tape Recorders

☐ 78 Tape Transport ☐

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**Operation Assist**

THROUGH THIS COLUMN we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a post card direct to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, use a post card; we can handle them much faster than letters. Don't send a return envelope; your response will come from fellow readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS reserves the right to publish only those requests that normal sources of technical information have failed to satisfy.

**Schematic Diagrams**

**Tone Master** BC-s.w. receiver, chassis B232207. (Jimmy Freeman, Box 224, Whitley City, Ky.)

**Communications Co.** Model DAV-2 walkie-talkie, Navy surplus. (Thomas E. Davis, 914 Wilson Ave., Johnson City, Tenn.)

**Atwater Kent** Model 4310 receiver using 5 01A's, circa 1923. Stellite 1-band, 7-tube receiver, about 1930. (James Sreen, 2411 Tillman Rd., Ft. Wayne, Ind. 46806)

**McMurdo Silver** Model 906 'Silver' signal generator, early 1940's. (Michael Yurke, 4729 Leia Ave., Tampa, Fla. 33616)


"Black Hawk" Model 735 3-band, 7-tube receiver, about 1935. (H. Lux Film, 721 Wright St., Skokie, Ill. 60076)

**Radio City Products Co.** Model 345 VTVM. (Wendell White, 3134 S. 9 St., Abilene, Texas)

**Stromberg Carlson** BC-s.w. radio-phon combination, serial 590846, circa 1940. Has push-button tuning. 8 tubes. (Dick Rohrer, 224 Calabasas Rd., Thousand Oaks, Calif.)

**RCA Model 29K radio, ser. 038072.** Tunes BC and s.w. bands. Has 8 tubes and push-button tuning. (J. W. Hynds, 721 West Kyle, Clute, Texas)

**Atwater Kent** Model 20 radio, ser. 493161. (A. U. Burnett, 1949 Bowie Drive, Corsicana, Texas)

**Majestic** Model 100-B radio-phon combination. Tunes BC and s.w. bands. Has 12 tubes. (Thomas Dugantano, 22 Chino Ave., Worcester 5, Mass.)

**Stromberg-Carlson** Model 1121 circa 1940 AM, FM and s.w. radio-phon combination, series 14. Has 11 tubes and push-button tuning. (David Stanowski, 108 Wilshire Dr., Wheeling, Ill.)

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(Continued on page 28)
For the Stereophile with an Eye...

As Appreciative as His Ear...

New Heathkit Deluxe Transistor Stereo!

Luxurious New Walnut Cabinet Styling!
Do you consider appearance as carefully as performance when choosing stereo components? If you do, then you'll delight in this new look of Heathkit Deluxe Transistor Stereo. Sleek, richly warm walnut cabinets. Clean, uncluttered charcoal gray upper front panels. Soft refracted panel lighting. Hinged lower front panels (to neatly conceal all secondary controls and avoid accidental system setting changes). Beautiful enough to capture the spotlight in any room!

And the Sound?
As modern and beautiful as the new styling, Transistor sound with its broad, crisp, clean, unmodified response... no compromising here! Add cool, instant operation, simplicity of assembly, and Heath's low prices... you have the best value in transistor stereo today!

Inside These Beautiful Cabinets...
In the magnificent Heathkit AJ-43 Stereo Tuner, you'll find advanced solid-state circuitry... 25 transistors & 9 diodes in all! You'll find wide-band AM, FM, FM Stereo... automatic switching to stereo... filtered left & right channel outputs for direct, beat-free stereo recording... automatic stereo indicator... separate AM & FM tuning meters... automatic frequency control... automatic gain control... adjustable FM squelch... and stereo phase control for maximum separation, minimum distortion.

The matching Heathkit AA-21 Stereo Amplifier features 26 transistor, 10-diode circuitry to produce 70 watts continuous, 100 watts IHF music power at ±1 db from 13 to 25,000 cps... complete freedom from microphonics, effortless transient response, cool, quick operation. In addition, there are complete controls, plus all inputs & outputs to handle any program source and most speaker impedances. With its encapsulated, epoxy-covered circuit modules and five stable circuit boards, assembly is fast, simple and fun... requires no special skills or knowledge!

Please Your Ear, Your Eye & Your Sense Of Value! Choose this matched Heathkit Transistor Stereo pair now for better appearance and better performance at lower cost!

Kit AJ-43C, tuner, 19 lbs... $129.95
Kit AA-21C, amplifier, 29 lbs... $149.95

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CIRCLE NO. 12 ON READER SERVICE PAGE
SOLDERING TIPS
FOR HI-FI KIT BUILDERS

AVOID TOO MUCH HEAT
High heat can damage components. Use low heat for soldering, and a pair of long-nose pliers to hold the wire. Pliers act as a heat sink and prevent overheating.

USE A DUAL HEAT GUN
A Weller Dual Heat Gun has 2 trigger positions. One provides low heat for electronic connections; the other gives high heat when needed. You switch instantly to the right temperature for the job.

The greatest time-saver in hi-fi kit building is a Weller Dual Heat Gun. Tip heats instantly... no waiting. Spotlight illuminates your work. Long reach tip gets into tight spots and permits soldering with pinpoint accuracy.


Operation Assist
(Continued from page 26)


Hallicrafters Model S-35B receiver. Tunes 550 kc. to 30.5 mc. Has 9 tubes (Rashin Mohamed, 93 Mowbrays Rd., Madras 18, South India)

Morrow Model 2BC 80-10 meter converter. (D. C. Brown, 149 N.W. 30th Ave., Ft. Lauderdale, Fla.)


Hallicrafters Model S-72L portable receiver, and Philips Lamps Ltd. Model PCR made in England, circa 1914. (George Kapsokavadis, Chemical Laboratory of the State of Corfu, Greece)

Zenith Model 6G001Y "Long Distance" receiver. (Kenneth Lang, 310 15th St., Union City, N.J.)

PYE table-model TRF receiver. Has 1 tubes. Tunes BC and 1 s.w. band. (N. Rushner, RCAF Stn., Sydney, N.S., Canada)

E. H. Scott Model 505 receiver. Has 30 tubes on 2 chassis. (Gury Rickert, 4121 Blancham Ave., Brookfield, Ill. 60013)


Kellogg Model 516 receiver. Uses tapped vari-couplers. (J. N. Clapp, 1518 Elm St., Davenport, Iowa 52803)

Zenith Model 3118605 receiver, circa 1935. Tunes 3 bands. Has 8 tubes. (Mike Claron, 65 Richard St., Clark, N. J. 07069)

Zenith Model 7HS222 AM-FM receiver, circa 1940. Has 7 tubes. (Ronald Brown, 7336 Ives Lane, Baltimore, Md.)

RCA Model 262 receiver, circa 1935. Tunes 140 kc. to 36 mc. Has 10 tubes. (Robert Kando, 3 Carmen St., Dorchester, Mass. 02121)

Keystone Model K-100 tape recorder, circa 1955. (Joseph Freijlich, 13431 Ave. M, Chicago 33, Ill.)

Crosley Model 634 receiver, circa 1934. Has 6 tubes. Tunes AM and s.w. bands. (Jim Costov, 6005 Carew, Houston, Texas)

Philco Model 35-10 receiver, circa 1941. Tunes AM and s.w. bands. Has 5 tubes. (E. L. Whitesearer, Box 1012, Palestine, Texas)

Morrow Model 3BR-5 converter. Tunes 3 bands. (Jim Peterson, 823 S. Hall, Fort Scott, Kan. 66701)

Philco Model 16-1209 radio-phonograph combination, circa 1946. (John Kue, 193 Hampshire St.,Indian Orchard, Mass. 01051)

RCA Model AR-936 receiver, circa 1937. Has 7 tubes. (Gerald Welch, 34 Estabrook Rd., Weymouth, Mass.)

King Model MT666 motor tester, ser. 2555A. (Gene Picou, 1513 N. Ave. Q, Palmdale, Calif. 23550)

Sola Model CF "Examiner." (Leo E. Smith, RD1, Box 376, Sandy, Utah 84070)

Motorola AM-FM-FM-s.w. receiver, circa 1943. Model not known. Has 7 tubes. (James Swank, RD1, Apollo, Pa.)

R.M.E. Model 4305 CB transceiver. (Michael Cook, 7 Johnson St., Hart, Mich.)

EICO Model 470 osciliscope. Has 7" screen. (Robert G. Pearson, 117 Elmar Drive, S.E., Vienna, Va.)

Zenith Model 5H110 "Trans-Oceanic" portable receiver. Tunes 7 bands. (Antonio P. Facendo, 136 Jacob St., Naga City, Philippines)

Executone Model P-14 audio amplifier. (Tim Quill, 2975 Oaklawn St., Columbus, Ohio 43224)

Freed-Eiseman Model 52 radio-phonograph combination, circa 1918. Tunes FM-AM and s.w. Has 15 tubes and magic eye. (Albert W. Alley, 130 N. Keystone, Chicago, Ill. 60611)

(Continued on page 30)
Regardless of what you pay for other Color TV it can't perform as well as this one...

and yet a Heathkit set costs as little as $399!

Exclusive Heath Features For Unequalled Performance!
That's right. No matter how many of your hard-earned dollars you pay for another brand of color TV, none can equal the performance of the Heathkit All-Channel, High Fidelity 21" Color TV! Why? All color sets require minor periodic adjustments to maintain peak picture performance. The Heathkit GR-53A is the only set with a "built-in service center" that provides facilities for perfect picture adjustments. Heath's simple-to-follow instructions and detailed color photos show you exactly what to look for and how to achieve it... quickly, easily! You become the expert! Results? Beautiful, true-to-life color pictures day in and day out... and no costly color TV service calls for simple picture alignment.

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THE ONLY COLOR TV YOU CAN INSTALL 3 WAYS!

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This is the cartridge that holds the tape that feeds the recorder

that handles like a camera and sounds like a million dollars

The really big thing about this little three pound machine—NORELCO's all-new Carry-Corder™ '150'—is the way it combines professional performance with over-the-shoulder, portable convenience.

The convenience of one-hour snap-in cartridges; of one-button operation; of small-size and light weight; of flashlight battery power; of remote start/stop and of a built-in speaker.

Now add the professionalism of its broadcast-quality dynamic microphone, its solid state circuitry, its constant-speed motor and capstan drive, and its multi-function battery/modulation visual meter. Frequency response is 120-6000 cps ± 3 db.

The Carry-Corder '150' comes complete with fitted carrying-case, microphone, direct-recording/ playback patchcord and four tape cartridges.

See it, hear it, try it... at your favorite radio parts distributor or camera store, or write for Brochure R-12 to: North American Philips Company, Inc., High Fidelity Products Division, 100 East 42nd Street, New York, New York 10017.
Every Organ Feature You've Ever Dreamed Of!
- 17 beautiful organ voices... Diapason 16' & 8', Bass Clarinet 16', Trumpet 16', English Horn 8', Violin 8', Oboe 8', Bourdon 16', Flute 8', Flute D'Amour 4', Quint 5-1/3', Saxophone 8', French Horn 8', Cello 8', and Chimes — all at the simple touch of a tab!
- Two full-size 44-note keyboards • Built-in 2-speed rotating Leslie plus 2-12" Main speakers • 28 notes of chimes • 13-note heel & toe pedal board, range C thru C • New Stereo chorus for exciting "stereo" effects • Color-tone attack, repeat & sustain percussion... the only organ to give you all 3 • Treble accent tab • Reverb • Manual balance • Pedal volume • Expression pedal • Headset outlet for private play • All-transistor 75-watt EIA music power amplifiers • Transistor tone generators... warranted for 5 years • Pre-tuned Tone generator... for easily tuning organ, no special "ear" needed • Luxurious Hardwood Cabinet & bench... hand-crafted with walnut finish.

No Extras, Nothing More To Buy! Everything you need for complete playing versatility is included. There are no speakers, amplifiers, no other "hidden necessities" to add as with other organ kits. It's all there at one price... even the bench!

**World's Best Buy In Electronic Organs!**

**GD-983**

$849.00 including bench $125.00, as low as $27.00.

**Full Features...**

**No Extras To Buy...**

**Saves Hundreds of Dollars**

**New Heathkit®/Thomas**

"Coronado" Transistor Organ!

Saves Hundreds Of Dollars! Save more than $400 over the factory assembled version. And you could pay as much as $1000 more for other brands, and still not enjoy as many features!

It's Truly A Professional Organist's Dream With A Beginner's Simplicity! And yet, you don't have to be an electronic wizard to build it, nor a professional organist to play it. Famous Heath "Engi-нуть" has reduced assembly to simple steps that require no special talents, tools or knowledge. And the famous Thomas "Musical Fun Book" is included to start you playing many favorites fast! A special recorded 48-lesson course is also available that lets you learn at your leisure... regular $50 value, only $19.95!

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Kit GD-983, organ & matching bench, 290 lbs.... $125.00, as low as $27.00................. $849.00

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- 10 true organ voices • Variable Repeat Percussion • Two 37-note keyboards • 20-watt peak power amplifier • 13-note heel & toe bass pedals • Walnut cabinet Kit GD-232A, organonly, 158 lbs........ $349.95

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December, 1964
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CIRCLE NO. 38 ON READER SERVICE PAGE

An Important Message for CB'ers

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Forever with QUIETRON

NEW TRANSISTORIZED VIBRATOR
For Easy Plug-in Replacement
- Boosts Efficiency
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Available in two types (P or N) to cover all 12V CB sets; no set modifications necessary. Ask your dealer which type fits your set or write RaeCo direct for complete information.

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CIRCLE NO. 26 ON READER SERVICE PAGE

Tips and Techniques

CAP AEROSOL "WILDCATS" TO AVOID MESSY ACCIDENTS

Don't discard the protective cap on the next can of aerosol tuner cleaner you buy—it can keep the contents of the can from being accidentally released, particularly when the can is carried from job to job. As slipping the cover on and off and attaching and detaching the extender for each job would be a nuisance, you can neatly trim out the top of the plastic cover with a small knife. Then drill or punch a hole on the side of the cap for the spray extender tube. When the can is empty, the modified cap can be transferred to a new can.

—Elmer C. Carlson

SPAGHETTI DRILL STOP PREGAUGES HOLE DEPTHS

Drill stops are usually found on drill presses to control the depth of holes. With a hand-held drill, it is a time-consuming operation to stop and check the depth, and chances of obtaining equal depths are not good. An inexpensive solution to this problem is to force-fit a small length of spaghetti over the drill bit—the tighter the better—exposing as much of the bit as is needed. Several layers of tape wrapped around the bit at the proper place can serve the same purpose.

—Don Lancaster

(Continued on page 38)
first all-transistor stereo receiver kit!

Heathkit AR-13A All-Transistor Stereo Receiver Kit ... Only $195.00!

Two power amplifiers plus two preamplifiers that produce 40 watts continuous, 66 watts 1HF music power ... wide-band AM, FM, FM Stereo tuners ... all beautifully housed in one compact, "low-silhouette" walnut cabinet. Add cool, instant operation plus the clean, unmodified sound of its 43 transistor, 18 diode circuit, and you have the exciting Heathkit Stereo Receiver. The first all-transistor stereo receiver kit! And it costs just $195.00!

Advanced features include automatic switching to stereo; inputs for mag, phono & two other sources; filtered tape recorder outputs; high-gain RF stages; squelch control; AFC; effortless flywheel tuning; external antenna terminals; and preassembled FM "front-end" and 4-stage AM-FM I.F. strip. Just add two speakers, and you have a complete stereo system. "Transistor sound," designer styling, advanced features, and unmatched savings & performance ... more than enough good reasons to move up to the Heathkit AR-13A Stereo Receiver. Tear out the coupon & order yours now! Kit AR-13A, 34 lbs. . . . . . . . . . . . . . . . . . . . $195.00

FREE 1965 HEATHKIT CATALOG See the latest products in Heathkit's wide, wonderful line. Over 250 do-it-yourself kits for stereo/hifi, marine, TV, electronic organ, amateur radio, test instruments, educational and home and hobby items that will save you up to 50%. Send for your free copy today!

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Price and specifications subject to change without notice. HF-175

December, 1964 CIRCLE NO. 12 ON READER SERVICE PAGE
RCA TRAINING
can be the smartest investment you ever made!

Start building a profitable career in electronics now!
New RCA "AUTOTEXT" programmed instruction will help you
learn faster and easier!

If you're considering a future in electronics, now is the time to start!
A great new teaching aid—"AUTOTEXT" programmed instruction
developed by RCA and introduced by RCA Institutes will help you
master the fundamentals of electronics almost automatically. Even
people who have had trouble with conventional home training methods
are finding it easier and more fun to start their training in Electronics
Fundamentals the RCA way. Prove it to yourself as others throughout
the country are now doing. An interest or inclination in electronics
is what you need. RCA "Autotext" helps you to do the rest. You'll be
ready to go on to advanced training sooner than you ever thought possible!
The future is unlimited; the jobs are available. The important
thing is to get started now.

Founded in 1909, RCA Institutes is
one of the largest technical schools in the United States devoted princi-
pally to electronics. The very name
"RCA" means dependability, integ-
rity, and scientific advance. RCA In-
stitutes offers the finest facilities of
home training. A Service of the
Radio Corporation of America, RCA
Institutes gives you the technical
instruction you need to plan, build
and realize the career you want in
today's fastest growing field.

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Liberal Tuition Plan. All RCA Institutes Home Study courses are available under a Liberal Tuition Plan. This plan affords you the most economical possible method of home study training. You pay for lessons only as you order them. If, for any reason, you should wish to interrupt your training, you can do so and you will not owe a cent until you resume the course. No other obligations! No installment payments required.

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now there are 3
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double duty sets

New PS88 all-screwdriver set rounds out Xcelite's popular, compact convertible tool set line. Handy midgets do double duty when slipped into remarkable hollow "piggyback" torque amplifier handle which provides the grip, reach and power of standard drivers. Each set in a slim, trim, see-thru plastic pocket case, also usable as bench stand.

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10 color coded nutdrivers

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Please send free literature N563.

Tips

TWO HANDY TIPS ON
SUBSTITUTION BOX LEADS

Substitution boxes frequently come equipped with long leads. In many circuits the length of these leads is unimportant, but long leads can upset i.f. and r.f. circuits. And even when the circuits are less critical, long leads can create a bench cluttering problem. The logical solution is to shorten the leads and attach the alligator clips that usually come with a substitution box to the shortened leads. Another good idea is to substitute Minigator clips for the alligators—they permit easier connection into miniature circuits.

—F. H. Frantz

PLASTIC CASES HOLD
METERS OR SPEAKERS

Discarded plastic TV booster or antenna rotor control cases of the type shown in the photo make excellent mounts for meters or for a miniature speaker. Strip the parts and chassis from the case, and, if you're lucky, the meter or speaker will fit in the hole left by the dial without further modifications. If necessary, enlarge the mounting hole with a hacksaw blade, and drill holes for mounting screws around the perimeter.

—Carleton A. Phillips

FELT-LINED
ALLIGATOR CLIPS

Felt-lined clips will serve as non-scratch clamps for panels or etched circuit boards, and when saturated with water they act as excellent heat sinks for use in soldering transistors or diodes into circuits. All you need to make them is an old felt hat, a razor-blade or hobby knife, some general-purpose cement, and several alligator clips. Trim the felt to fit within both jaws of the clips and cement it in place with a minimum amount of cement (so the cement doesn't saturate the felt). Two or more layers of felt can be applied if necessary. Allow the cement to dry thoroughly before you use the clips.

—Eugene Richardson
Share great moments with other great guys

Get a new set of wheels in the Army. Ten feet across or scooter size, there are more wheels in the Army than in any other organization in the Free World. Some are an adventure to drive, others take you to adventure—and, if you want, you can learn what makes each one roll.

Experts are made, not born. And the Army makes the best. Army schools teach hundreds of different specialties. If you qualify, you can sign up for the one you want before you enlist.

It's different from your home town. And who wouldn't expect it to be? After all, one of the reasons you join the Army is to see the world of differences.

You're not alone in today's action Army. Every experience you have is shared with other great guys. Regular guys who are learning, earning, growing, going, serving our Country, developing themselves. Just as you are.

But the wonder of these experiences is yours alone. No one can tell you how great it feels to master a difficult specialty like computer programming, missile repair, electronics, or construction. No one can live the excitement of landing in a foreign country for you. No one can know what your great moments in the Army will be. But you can be sure your life in today's Army will be full of great moments. Enough to add up to a great life.

Talk to your local Army recruiter. Let him tell you what the Army can do for you... and what you can do for the Army. Let him help you to that great moment, the moment you realize that... if you're good enough to get in, a proud future can be yours in today's action Army.

December, 1964

CIRCLE NO. 34 ON READER SERVICE PAGE
EICO

BEST VALUES IN KITS and wired equipment

3566 SOLID STATE FM MPX AUTOMATIC STEREO TUNER/AMPLIFIER
Finest all-transistor kit value, equal to $500-600 class instruments. Kit comes with pre-wired and prealigned RF, IF & MPX circuit boards plus transistor sockets. Outstanding 2 UV IF sensitivity, automatic FM stereo mono switching, muting, 40 db FM stereo separation. Total 66 watts IHF music power, only $229.95 semi-kit (recommended to beginners); optional walnut cabinet $14.95—all $349.95 factory wired including cabinet.

RP 100 SOLID STATE TRACK STEREO TAPE DECK
Top professional quality— independent record and play —transistor electronics— used by industry in computer and communications systems • 3-motor drive including hysteresis synchronous capstan motor • 3 high-performance heads • Kit only $299.95. Wired $450.

ST 70-WATT INTEGRATED STEREO AMPLIFIER
Best buy of highest ranked stereo amplifiers according to independent testing. Kit $99.95. Wired $149.95. ST40 40-WATT INTEGRATED STEREO AMPLIFIER. Kit $79.95. Wired $129.95.

435 DC WIDEBAND 3" SCOPE
Sensational performance in a compact 15-lb. package. Flat-face 3-inch CRT with V and H trace expansion. Flat from DC to 4.5 Mc/s. useful to above 10 Mc/s. Zener diode calibrator. Equal to scopes costing many times more. Kit only $99.95. Wired $149.95.

232 PEAK-TO-PEAK VTVM
For color and B&W TV servicing, experimenters and laboratories. 7 non-skip ranges on every function. Measures AC peak-to-peak and RMS as well as DC. Response 30 Cps to 3 Kc/s with HVP probe. Kit $29.95. Wired $49.95.

667 TUBE/TRANSISTOR TESTER
Dynamic conductance tube tester • 14 combinations of 3 plate and 3 screen voltages & 3 ranges of grid voltage • Interelement leakage readings in ohms. Checks all new tube types • Two step transistor test • Kit $79.95. wired $129.95. Model 682 Emission tube tester • Checks all new tube types • Kit $44.95. wired $59.95. Model CRU—adapts 667 or 628 for testing B&W & Color TV picture tubes. Wired $59.95.

2536 FM MPX STEREO TUNER/AMPLIFIER
Superb FM stereo-MPX tuner, plus a 36-watt stereo amplifier. “In tuning ease, general handling, and sound quality... leaves little to be desired.” HIRCH-HOUCK LABS IN ELECTRONICS WORLD. Kit only $154.95. Wired $209.95.

HF-90A FM TUNER, Pre-wired and aligned FM front end. Most popular FM tuner kit ever made—“Without question an extraordinary value,” American Record Guide. Kit $44.95. Wired $69.95.

HF-12A 12-WATT MONO AMPLIFIER. 18 watts IHF power. “Packs a bigger wallop than is apparent from the specifications.” POPULAR ELECTRONICS. Kit $39.95. Wired $59.95.

324 RF Signal Generator
Covers 150 Kc/s to 435 Mc/s • 1.5% frequency accuracy. Internal 0-50% 400-cycle modulation. Kit $28.95. Wired $39.95.

369 SWEEP/POST INJECTION MARKER GENERATOR
For the “pro” service engineer, experimenters and laboratories. For aligning TV, FM and communications receivers. Sweeps cover 3-220 Mc/s. Markers cover 2-225 Mc/s. Kit $89.95. Wired $139.95.

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40 CIRCLE NO. 6 ON READER SERVICE PAGE POPULAR ELECTRONICS
Resistance vanishes, and electricity flows effortlessly forever at 450 degrees below zero.

The electronic technician, asbestos-gloved (the gloves protecting him from cold, not heat) un-stoppers a thermos-like container. A cloud of vapor belches from its open end. Carefully, he tips the thermos. A sizzling cold, clear liquid spills—wriggling as though alive—onto the concrete floor. For a moment it bubbles and boils. And suddenly it's gone—vaporized into thin air.

"Liquid helium," he says. "Its temperature is $-450^\circ F$, a whisker above absolute zero, $-459.6^\circ F$. The most revolutionary stuff in electronics."
Resistance vanishes, and electricity flows effortlessly forever at 450 degrees below

The electronic technician, asbestos-gloved (the gloves protecting him from cold, not heat) unstoppers a thermos-like container. A cloud of vapor belches from its open end. Carefully, he tips the thermos. A sizzling cold, clear liquid spills—wringing as though alive—onto the concrete floor. For a moment it bubbles and boils. And suddenly it's gone—vaporized into thin air.

"Liquid helium," he says. "Its temperature is \(-450^\circ F\), a whisker above absolute zero, \(-459.6^\circ F\). The most revolutionary stuff in electronics."
Although lead ball appears to be floating, it is actually riding on a cushion of magnetic force set up by the loop of wire below it in liquid helium. This opposition to any magnetic field is known as diamagnetism.

In fact, however, neither liquid helium (coldest of the so-called cryogenic supercold fluids), nor liquid nitrogen (–320°F) or even liquid oxygen (–297°F) are in themselves "revolutionary." They're merely quick and handy refrigerants.

What is revolutionary is how cryogenic "supercolds" affect electronic circuits and their components: chilled to near absolute zero, some conductors (tin and lead, for two examples) lose all resistance. They become superconductors. Set a dab of electricity coursing their chill, no-resistance circuits, and the current flows effortlessly—and forever.

Near absolute zero lies the weird world of superconductivity—a realm of zero resistance where current flows without hindrance (or heat); where a circuit's internal noise (caused by the random vibration of the very atoms which comprise its components) is hushed—and sometimes stilled; where magnetism behaves like an electronic faucet (turning current on and off); and where a new breed of printed circuits ("thin films") threaten to obsolete transistors and their solid-state brethren. But the realm of superconductivity is more than merely an abode of electronic deep-freeze. It is a lilliputian world of micro-miniaturization—its components measured not in centimeters or millimeters, as in room-temperature electronics, but in microns (a mere ten-thousandths of a centimeter) and in angstrom units (a microscopic one-hundredth-millionth of a centimeter).

In this weird world of supercold, "perfect" is a word even cautious scientists use. For perfect conductivity is one property of superconductors. It's the reason, in fact, they're called "super." Another is perfect diamagnetism—opposition to any magnetic field. If you place a superconductive lead ball atop a cryogenically chilled loop of wire through which current is flowing, the ball—repelled by the wire's magnetic field—will float in midair, riding a cushion of magnetic force. You've created a frictionless bearing—a ball (it can be made to spin) "lubricated" by air.

General Electric is developing a cryogenic gyroscope, its supercold rotor suspended within a magnetic field. Such gyros should suffer none of the bearing-
Although lead ball appears to be floating, it is actually riding on a cushion of magnetic force set up by the loop of wire below it in liquid helium. This opposition to any magnetic field is known as diamagnetism.

In fact, however, neither liquid helium (coldest of the so-called cryogenic supercold fluids), nor liquid nitrogen (−320°F) or even liquid oxygen (−297°F) are in themselves "revolutionary." They’re merely quick and handy refrigerants.

What is revolutionary is how cryogenic “supercolds” affect electronic circuits and their components: chilled to near absolute zero, some conductors (tin and lead, for two examples) lose all resistance. They become superconductors. Set a dab of electricity coursing their chill, no-resistance circuits, and the current flows effortlessly—and forever.

Near absolute zero lies the weird world of superconductivity—a realm of zero resistance where current flows without hindrance (or heat); where a circuit’s internal noise (caused by the random vibration of the very atoms which comprise its components) is hushed—and sometimes stilled; where magnetism behaves like an electronic faucet (turning current on and off); and where a new breed of printed circuits (“thin films”) threaten to obsolete transistors and their solid-state brethren. But the realm of superconductivity is more than merely an abode of electronic deep-freeze. It is a lilliputian world of micro-miniaturization—its components measured not in centimeters or millimeters, as in room-temperature electronics, but in microns (a mere ten-thousandths of a centimeter) and in angstrom units (a microscopic one-hundredth-millionth of a centimeter).

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Many superconductive materials, as niobium-tin, can't be bent or shaped—they're just too brittle. Bell Labs solved the problem by enclosing the raw ingredients in a pure niobium tube, drawing tube into a thin wire (see above) and shaping it into a coil, and then putting it into a 1000°C furnace to fire it.

Superconducting Magnets. Not too long ago, researchers at Bell Telephone Labs friction "drift" which causes inaccuracy in ordinary gyros—because the only "bearing" is frictionless air. And since the rotor is superconductive, it has no electrical resistance.

The Jet Propulsion Laboratory, which is also working with supercold gyros, hopes to use them to guide spacecraft to the moon and planets with pinpoint accuracy.

Some even foresee superconducting motors (for spaceships, or possibly even for locomotives). And, in the future, a transcontinental throughway (a superconducting trough) over which superfast vehicles will ride on frictionless magnetic bearings. For a compressed magnetic field, its force increasing as the square of its field strength, can support great weight—perhaps (as that lead ball) hold a fully loaded train a fraction of a frictionless inch above a superconductive rail.

But superconductivity is fragile. Two things can destroy it: (1) any rise in temperature much above absolute zero and, oddly, (2) strong magnetic fields, applied either externally or created internally by passing too much current through a frigid superconductor.

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It's just cold logic: At right is one of the first cryogenic associative memories for computers, this one developed in 1962 by General Electric. It contained 81 cryotrons and had a storage capacity of three three-bit words. Just two years later, the superconducting memory plane at left, below, can store 16,384 bits of information. The other device (both were made by RCA) is superconductive logic.
CRYOGENICS

Since 1953, 24 elements, alloys and compounds capable of becoming superconductive have been discovered—most by Bell Labs' Dr. B. T. Matthias (left). Here, he and Dr. J. E. Kunzler point to niobium on the periodic table.

Laboratories succeeded in building miniature electromagnets with field strengths as high as 70,000 gauss (the field strength of a toy horseshoe magnet is about 200 gauss). Turned superconductive in a liquid bath of near absolute zero helium, the magnet's no-resistance magnetic windings needed only enough current to establish the magnetic field. Since there was no resistance, the current flowed continuously—self-sustaining the field.

In February of this year, Westinghouse announced the first superconducting magnet with a field strength of 100,000 gauss—roughly 200,000 times the average magnetic field strength of the earth—with a one-eighth inch bore (the hole through the center where the field exists). Then, in May, RCA reported a magnet which would develop 107,000 gauss—with a bore of one inch. Once immersed in a superconducting bath, either of the magnets can be started by momentarily connecting six-volt storage batteries.

By contrast, a veritable powerhouse (more than 1.6 million watts) is needed to sustain a 100,000-gauss field in an enormous, but otherwise conventional, electromagnet. Most of this huge—and costly—energy is dissipated; wasted in the resistance of the magnetic windings. So great is the resistive heat, in fact, that 1000 gallons of water per minute are needed just to cool the windings.

The huge and inherent resistive losses through magnetic windings explain why today few commercial electromagnets are rated at more than about 20,000 gauss. Yet it's predicted that superconductive magnets can be built with strengths of 400,000—or even 1,000,000—gauss.

Their uses are myriad: as particle accelerators in cyclotrons, as tools of production (their powerful field strengths—a 300,000-gauss field would exert 50,000 pounds of pressure per square inch—could extrude hot steel as though it were spaghetti), and in controlling the hitherto uncontrollable. In this latter category fall the unbelievably hot 100-million-degree-centigrade gases from atomic fusion power plants which no known metal today can contain. Superconductive fields, arranged to form "containers within containers," will guide and bend the super-hot (and atomically lethal) ionized gas streams, preventing them from ever touching the pipes through which they flow.

Similarly, superconductive magnets in bores of one to two feet will be used to shape the plasmas of plasma jet propulsion engines for powering expeditions deep into outer space. Other magnets, many feet in diameter, may well serve as electromagnetic safety devices, shielding space travelers from the extremely hazardous high-energy protons emanating from solar flares. Although superconductive magnets of this size are still well in the future, they can be expected to follow improvements in materials, cryogenics, and space technology.

One of the problems with materials is to find superconductive metals that can withstand huge magnetic fields and still remain perfect conductors. That—and materials that can be worked into electronically useful shapes, such as (Continued on page 86)
Add a new dimension to your holiday lighting—just use any radio or record player and the "Rhythmicon"

HERE'S a little project we have dubbed the "Rhythmicon," for with it you can make your Christmas lights twinkle in time to the music from your radio, phonograph, hi-fi or p.a. amplifier. The possibilities the Rhythmicon offers are endless: Use it to control tree lights, floodlights, spotlights, or conventional electric bulbs—indoors or out.

Simply connect the two clip leads from the Rhythmicon to the loudspeaker leads of the sound source, and play carols or other seasonal material through it. The lights plugged into the socket on the box will automatically fol-

Christmas Lights Twinkle to Music

By LEON A. WORTMAN

December, 1964
Add a new dimension to your holiday lighting—just use any radio or record player and the "Rhythmicon"

Here's a little project we have dubbed the "Rhythmicon," for with it you can make your Christmas lights twinkle in time to the music from your radio, phonograph, hi-fi or p.a. amplifier. The possibilities the Rhythmicon offers are endless: Use it to control tree lights, floodlights, spotlights, or conventional electric bulbs—indoors or out.

Simply connect the two clip leads from the Rhythmicon to the loudspeaker leads of the sound source, and play carols or other seasonal material through it. The lights plugged into the socket on the box will automatically fol-
The Rhythmicon makes use of the ability of a silicon controlled rectifier to act as a "rheostat," controlling large amounts of current in a circuit in response to pulses applied to its "gate" electrode. Unijunction transistor Q2, in combination with Q1, acts as a pulse generator to turn SCR1 on. The pulse frequency (and, consequently, the brightness of the lamps controlled by SCR1) depends on the amplitude of the audio signal applied to T1 (see "How It Works," page 48).

A 3" x 4" x 5" Minibox holds all of the circuitry and components for the Rhythmicon. The SCR and the four silicon rectifier diodes must be mounted on a heat sink. First, fabricate the heat sink from a piece of 1/8" aluminum, cutting it to 2 1/2" x 3 3/4". A 1/2" flange is bent along the 3 3/4" dimension for mounting the heat sink, and five holes are drilled in it for mounting SCR1 and D2-D5. The holes must be large enough for complete clearance of the mounting studs.

Referring to the photos on page 47, mount D2 and D3 directly in the two center holes without insulating washers. A solder lug is placed under the mounting nut of D2 to connect the cathodes of D2 and D3 directly to the lamp socket. SO1. Diodes D4 and D5 (as well as SCR1) must be electrically insulated from the heat sink with mica washers on either side. Between the mica washers and the bodies of these three semiconductors, use solder lugs as shown in the upper photo on page 47. Use heavy metal washers between the outer mica washers and the mounting nuts. When SCR1 and D4 and D5 are mounted, check with an ohmmeter to insure that their cases are not shorted to the heat sink.

The heat sink must be electrically isolated from the Minibox. In the author's unit, 6-32 holes for machine screws were drilled and tapped into opposite sides of a 3 3/4" x 1 1/2" x 1/2" bar of Bakelite. The heat sink was mounted on the Bakelite through holes in the 1/2" flange made previously, and the Bakelite was then secured to the inside of the Minibox in the same way. Polystyrene or any similar insulating material can also be used for this, or the heat sink can be mounted with machine screws using extruded shoulder washers to insulate it.

As shown in the top photo, most of the remaining components are mounted to a 2 1/2" x 3 1/2" piece of perforated circuit board (with the exception of S01, F1, T1, S1, and R1, which are mounted at the ends of the box). "Flea clips" are inserted into the perforated board at suitable points to provide rigid terminals for connecting the transistors and other components. The perforated circuit board is mounted to the box with several machine screws and 1/2" stand-
Christmas
Lights
Twinkle
to Music

low the sounds, going from off to full on, getting instantly brighter and dimmer as the music gets louder and softer; going off completely when the music stops. The music plays, and the lights dance automatically.

Construction. Basically, the Rhythmicon makes use of the ability of a silicon controlled rectifier to act as a "rheostat," controlling large amounts of current in a circuit in response to pulses applied to its "gate" electrode. Unijunction transistor Q4, in combination with Q1, acts as a pulse generator to turn SCR1 on. The pulse frequency (and, consequently, the brightness of the lamps controlled by SCR1) depends on the amplitude of the audio signal applied to T1 (see "How It Works," page 48).

A 3" x 4" x 5" Minibox holds all of the circuitry and components for the Rhythmicon. The SCR and the four silicon rectifier diodes must be mounted on a heat sink. First, fabricate the heat sink from a piece of ⅛" aluminum, cutting it to 2½" x 3¾". A ¼" flange is bent along the 3¾" dimension for mounting the heat sink, and five holes are drilled in it for mounting SCR1 and D2-D5. The holes must be large enough for complete clearance of the mounting studs.

Referring to the photos on page 47, mount D2 and D3 directly in the two center holes without insulating washers. A solder lug is placed under the mounting nut of D2 to connect the cathodes of D2 and D3 directly to the lamp socket, S01. Diodes D4 and D5 (as well as SCR1) must be electrically insulated from the heat sink with mica washers on either side. Between the mica washers and the bodies of these three semiconductors, use solder lugs as shown in the upper photo on page 47. Use heavy metal washers between the outer mica washers and the mounting nuts. When SCR1 and D4 and D5 are mounted, check with an ohmmeter to insure that their cases are not shorted to the heat sink.

The heat sink must be electrically isolated from the Minibox. In the author's unit, 6-32 holes for machine screws were drilled and tapped into opposite sides of a 3¾" x ½" x ½" bar of Bakelite. The heat sink was mounted on the Bakelite through holes in the ½" flange made previously, and the Bakelite was then secured to the inside of the Minibox in the same way. Polystyrene or any similar insulating material can also be used for this, or the heat sink can be mounted with machine screws using extruded shoulder washers to insulate it.

As shown in the top photo, most of the remaining components are mounted to a 2¼" x 3½" piece of perforated circuit board (with the exception of S01, F1, T1, S1, and R1, which are mounted at the ends of the box). "Flea clips" are inserted into the perforated board at suitable points to provide rigid terminals for connecting the transistors and other components. The perforated circuit board is mounted to the box with several machine screws and ½" stand-
offs to provide clearance for the tips of the "flea clips" which protrude through the board.

Before mounting the circuit board and heat sink, drill holes in the Minibox for the remaining components. At one end of the box, mount SO1, F1, and T1; at this same end, drill holes for the a.c. line cord and audio clip leads (these can also be made with a.c. lamp cord), and line them with rubber grommets. Drill holes for S1 and R1 in the opposite end of the box.

Final Wiring. Because some of the components of the Rhythmicon are at the potential of the a.c. line, it is essential that no part of the circuit makes electrical contact with the Minibox. The one exception to this is the audio lead which is connected to the bottom end of R1; connect this lug of R1 to the box by placing a solder lug on the control shaft. Also, connect the ground terminal of C1 directly to the box (rather than to the lower terminal of R1) using a lug under one of the nuts holding the perforated circuit board.

Transformer T1, a universal push-pull-plates-to-voice-coil audio output type, is used to couple the audio source to the Rhythmicon. It is connected so that the secondary or voice coil side becomes the input. Connect the center lug of R1 and the positive terminal of C1 to the transformer terminals that give the highest impedance—with the author, terminals 1 and 6. Connect the push-pull plate side as shown in the schematic: the bottom tap is not used and can be cut short.

Since transistors Q1 and Q2 are soldered into the circuit, be sure to use alligator clips rather than screw clips, to avoid heat damage. Observe similar precautions with the diodes D1 through D6. Component values aren’t critical, and may vary plus or minus 10%; it is desirable to select a resistor for R8 that is within 5% of 3000 ohms.

Operation. It takes less than half a watt of audio at 4 ohms impedance to operate the Rhythmicon, and since a transistor radio car, be used to demon-
Rhythmicon consists of bridge rectifier, audio pulsing circuit (Q1-Q2), and power control (SCR1)

**PARTS LIST**

- C1—100 μf., 50-volt electrolytic capacitor
- C2—20 μf., 25-volt electrolytic capacitor
- C3—0.047 μf., 200-volt paper capacitor
- D1—1N34A germanium diode
- D2-D3—Silicon diode rectifier (GE-X4 or Lafayette Stock No. 190-4208 or equivalent)
- D6—20-volt, 1-watt zener diode (GE2X120 or equivalent)
- FI—5-ampere, 125-volt "slow-blow" fuse and fuse-holder (Littlefuse Type 3AG or equivalent)
- Q1—GE-X9 pnp transistor
- Q2—2N2160 unijunction transistor (GE)
- R1—10-ohm, 1/2-watt wire-wound potentiometer
- R2—4700-ohm, 1/2-watt resistor
- R3—3300-ohm, 1/2-watt resistor
- R4—330-ohm, 1/2-watt resistor
- R5—30-ohm, 1/2-watt resistor
- R6—3000-ohm, 5-watt wire-wound resistor, 10% or better
- S1—latching toggle switch
- SCR1—Silicon controlled rectifier (GE-X1 or equivalent)
- SO1—Panel-mounting a.c. socket
- TI—Universal push-pull output transformer (Lafayette 33G7503 or equivalent—see text)
- Misc.—Sheet of 1/4" aluminum for heat sink; perforated circuit board; Red clips; Bakelite bar for mounting heat sink; mica washers for mounting SCR1, D4 and D5; solder lugs; 0-32 hardware; 1/2" spacers; alligator clips; line cord; grommets; wire; solder, etc.

4.7-ampere rating of SCR1 gives a total of 450 watts of power handling capability—that's a lot of dancing, twinkling, decorative light!

**HOW IT WORKS**

Audio is applied to T1, and rectified and filtered by D1-C2; the resulting polarized voltage appearing across R2 biases Q1, following audio amplitude variations. Unijunction Q2, C3, R4, and R5 comprise a pulse generator. The frequency of the pulses depends on the d.c. potential applied to Q2's emitter by Q1. The greater the audio amplitude, the higher the pulse rate. Resistor R6 and zener diode D6 form a voltage divider across the output of the bridge rectifier (D2-D3), and provide stable, low potentials for Q1-Q2. The SCR begins conducting when a pulse is applied to its gate; current flows until the pulsating d.c. delivered by D2-D3 reaches zero. At that point, another pulse from Q2 is required to again start conduction. The greater the pulse rate, the higher the average current through SCR1 and the lights connected to SO1.
Modern electronics module concept gets more elements into less space and greatly reduces number of tie points. Two i.f. amplifiers and detector take up only 0.375 cubic inch.

Round-the-clock listening pleasure will be your reward for doing a good building job on this modern transistor superheterodyne broadcast-band radio. It is a complete unit and can be put into your pocket. It can also give your phonograph or tape recorder the ability to sound off with broadcast-band programs. No test or alignment equipment is needed to construct the radio.

A pre-aligned i.f. amplifier module only 1 1/2" x 1/2" x 1/2" in size speeds construction and simplifies wiring. The module contains 24 parts, including a ceramic filter, two transistors, two transformers and a diode detector.
Miniature I.F. Module
Superheterodyne
Pocket Receiver

By CHARLES CARINGELLA

Modern electronics module concept gets more elements into less space and greatly reduces number of tie points. Two i.f. amplifiers and detector take up only 0.375 cubic inch.

ROUND-THE-CLOCK listening pleasure will be your reward for doing a good building job on this modern transistor superheterodyne broadcast-band radio. It is a complete unit and can be put into your pocket. It can also give your phonograph or tape recorder the ability to sound off with broadcast-band programs. No test or alignment equipment is needed to construct the radio.

A pre-aligned i.f. amplifier module only 1 1/4" x 1/2" x 1/2" in size speeds construction and simplifies wiring. The module contains 24 parts including a ceramic filter, two transistors, two transformers and a diode detector.

COVER STORY
Except for the antenna loopstick, variable capacitor and phono jack, all components including the i.f. module are mounted on a small board, measuring just 2 7/16" x 1 17/32", as shown in Fig. 2. This is not a printed circuit. All the components are hand-wired.

How It Works. Transistor Q1 serves as an r.f. amplifier, local oscillator and mixer. (See Fig. 4.) The input circuit, consisting of a variable capacitor (C1a) and an antenna ferrite loopstick (L1), tunes the broadcast band. Local oscillator coil L2 is tuned by variable capacitor C1b to a frequency that is always 455 kc. above the frequency of the incoming signal. Capacitors C1a and C1b are ganged.

The incoming r.f. signal and the local oscillator signal are mixed in transistor Q1. Sum and difference frequencies as well as the r.f. and oscillator signals appear at the output of Q1. The miniature i.f. transformer (L3) is tuned to 455 kc., and allows only the difference frequency to pass on to the next stage. The primary of L3 is part of the collector load circuit of Q1; the tap on this winding is not used.

The next two i.f. stages are in the module, as is the detector stage, as shown in Fig. 6. Bandwidth is fairly narrow, thanks to the ceramic filter between pin 2 and the 390-ohm resistor, but not narrow enough to prevent good reception of music. The bandwidth is about 8 kc. at −6 db. It is therefore possible to obtain good selectivity. The 455-kc. i.f. signal is amplified by each of the two pre-tuned transistor stages and then demodulated by the crystal diode detector. The audio signal goes through a low-pass filter to pin 7 and then to the top of the volume control, potentiometer R6. From the volume control the signal is fed directly to an earphone jack. Additional transistor stages can be added, if desired, to drive a loudspeaker. A patch cord could be used to connect the radio earphone jack to the input of a tape recorder or phonograph. A feedback loop from the detector to the base of the first transistor in the module provides a.v.c. action. Overall gain of the i.f. module is about 55 db.

A loudspeaker is usually preferred, but there are several advantages to using an earphone: fewer transistors are needed, battery life is longer because power consumption is lower, and you can listen without disturbing anybody. An earphone can also provide exceptionally good fidelity—bass notes, which can not be reproduced by a small speaker, can be heard in an earphone, because the earphone is directly coupled to the ear and does not have to move a large vol-
B1—6- to 9-volt transistor radio battery (NEDA 1606 or equivalent)  
C1a/C1b—Miniature 2-gang variable capacitor:  
117.1-pf. r.f. section, and 74.4-pf. osc. section  
C2—0.02 µf., 3 volts  
C5—0.01 µf., 3 volts  
C4—0.05 µf., 10 volts  
C3—10-pf., 12-volt electrolytic capacitor  
J1—Phono jack, subminiature type  
L1—Ferrite antenna loopstick (Miller 2010 or equivalent)  
L2—Oscillator coil, miniature (Miller 2062 or equivalent)  
L3—I.f. transformer, miniature (Miller 8901 or equivalent)  
Q1—2N1987 transistor  
R1—15,000 ohms  
R2—10,000 ohms  
R3—1500 ohms  
R4—R5—1000 ohms  
R6—5000-ohm potentiometer with s.p.s.t. switch (Lafayette 99 G 6019 or equivalent)  
S1—S.p.s.t. switch (on R6)  
L1—i.f. amplifier module (Miller 8902)  
L2—3000- to 7000-ohm dynamic earphone  
L3—4 3/4" x 1 3/4" x 1" plastic box  
*The Miller 8902 module and the Miller 8901 transformer are available together as the 8903  

Fig. 4. Optional 0-1 ma. meter at point X serves as tuning indicator. Superhet circuit can give AM broadcast "voice" to tape recorder or record player.

Fig. 5. Tuning dial can be mounted under knob on finished radio. High-impedance earphone provides good audio frequency response.

The volume of air as a loudspeaker does. Earphone impedance should be anywhere from 3000 to 7000 ohms. Do not use a low-impedance phone, as it will load down the output circuit excessively.

If you wish, you can add a tuning meter to the circuit. Insert a 0-1 milliampere meter in series with the lead going to terminal 10 on the i.f. module.
B1—6- to 9-volt transistor radio battery (NEDA 1606 or equivalent)
C1/C1b—Miniature 2-gang variable capacitor; 117.1-µf., r.f., section, and 74.4-µf. osc. section
C2—0.02 µf., 3 volts miniature ceramic
C3—0.01 µf., 3 volts disc capacitors
C4—0.05 µf., 10 volts
C5—10-µf., 12-volt electrolytic capacitor
J1—Phono jack, subminiature type
L1—Ferrite antenna loopstick (Miller 2010 or equivalent)
L2—Oscillator coil, miniature (Miller 2062 or equivalent)
E3—I.f. transformer, miniature (Miller 8903 or equivalent)*
Q1—2N1987 transistor
R1—15,000 ohms
R2—10,000 ohms
R3—1500 ohms
R4, R5—1000 ohms
R6—5000-ohm potentiometer with s.p.s.t. switch (Lafayette 99 G 6019 or equivalent)
S1—S.p.s.t. switch (on Ro)
J1—I.f. amplifier module (Miller 8902)*
1—1/4" x 1/4" phenolic or laminated board
1—3000- to 7000-ohm dynamic earphone
1—4-1/4" x 4-1/4" x 1" plastic box

*The Miller 8902 module and the Miller 8901 transformer are available together as the 8903

**Fig. 4. Optional 0-1 ma. meter at point X serves as tuning indicator. Superhet circuit can give AM broadcast “voice” to tape recorder or record player.

Fig. 5. Tuning dial can be mounted under knob on finished radio. High-impedance earphone provides good audio frequency response.
Fig. 6. Miniature i.f. strip is pre-aligned and pre-packaged. A detector stage is also included. A ceramic filter limits i.f. response to improve receiver selectivity without damaging audio quality. Overall gain is 55 db and output is sufficient to direct-drive an earphone. Bandwidth is 8 kc at—6 db. Photo at right shows how actual components were fitted into can.

(See point X in Fig. 4.) The radio draws only 3 milliamperes.

Construction. The completed broadcast radio is shown in Fig. 5. It was built to fit into a small plastic box, which is readily available. You can choose any size box, as long as all the parts fit and are arranged in an orderly manner—the best thing to do is follow the photographs. Do not use a metal case. A shielded antenna usually develops into a situation of apparent radio silence.

Mount C1 directly to the case. L1 can be held in place by a dab of cement or just allowed to “float.” The black and white wires from L1 are soldered directly to the capacitor frame. The clear wire is soldered to C1a, the capacitor with a greater number of plates. The green lead is attached to C2 on the circuit board later.

The circuit board assembly is shown in Figs. 2 and 3. Parts location is not critical, but here again it is best to follow the layout as shown. Keep the leads short and avoid overheating the transistors when soldering. Notch out the board to allow the volume control (R6) to be mounted without undue stress or strain. Enough of the knob should protrude so that it can be easily reached when the assembly is finally placed into the case.

A 3/4” x 1/2” slot is cut out on the side of the case to allow the knob to stick out about 1/4”.

Connect all the metal cans to a common ground line. This line is also connected to the frame of the variable capacitor. Short leads can be soldered directly to the battery. Next to the slot in the case, install the miniature phono jack.

Position the board in the case when completed. Connect the green wire to C2 and two wires from the volume control to the phono jack.

Alignment. If all is well with your radio, you will hear background noise or, hopefully, a radio station or two when you first turn it on. The alignment and peaking adjustments are made from off-the-air signals. All you need is a non-metallic screwdriver. Do not force any of the screws or slugs; they should turn easily. Try to get any station and adjust L3 for maximum. In the absence of a station, adjust for maximum noise.

Rotate the knob until the plates are almost fully meshed. This is the low end of the broadcast band. With the aid of another radio, as a “standard,” locate a station at the lowest end of the band. Adjust the slug in oscillator coil L2 until

(Continued on page 97)
Keep tabs on your charging system—catch battery failures before they happen

By JOSEPH TARTAS

EVER stop to wonder what your automobile battery voltage is? "Why twelve volts, of course," you say (unless you have a 6-volt system and answer "six"). It seems like a silly question—until you examine it closely. The fact of the matter is that battery voltage varies over a range centered around 12 (or 6) volts: Exactly what it is, and when, are facts that can tell you a great deal about the health of your car's electrical system.

If your car or boat is equipped with an ammeter or indicator light, you might automatically assume that you need only be concerned when the "Battery" light stays on, or if the meter shows discharge when the engine is running. While it is important to know, as these devices indicate, that your generator is supplying a charging current to the battery, it is equally important to know the battery voltage under load and no-load conditions, as well as the voltages actually available at the starter, ignition system, etc. Voltage drop across cables can be enough to cause trouble. The voltmeter can tell you where your trouble is without "cutting" into any of the circuits. It can also alert you to potential trouble.

Storage Battery Theory. Let's review, for a moment, the typical characteristics of a lead-acid storage battery. It consists of several cells each having a potential of about 2 volts. The exact voltage of each cell will depend on the proportion of acid to water in the electrolyte, and the condition of charge or discharge of the cell.

One standard method of checking a lead-acid cell is to measure the specific gravity of the electrolyte. This electrolyte is a mixture of sulphuric acid and distilled water with a specific gravity of 1.260 at 77° F for automotive service, and ranging from 1.275 for heavy industrial uses to 1.210 for batteries in standby or emergency service. The specific gravity is measured by means of a hydrometer. The open-circuit voltage of the cell is directly related to its specific gravity:

\[ \text{Voltage} = \text{specific gravity} + .84 \]

A voltmeter, therefore, can be used to continuously monitor the specific gravity of the battery as a whole.

Because the proportion of water to acid is increasing as the cell discharges, the specific gravity is gradually reduced (water alone has a specific gravity of
1,000) and the relative state of charge will be indicated by the hydrometer reading. For the sake of accuracy, the correct specific gravity is designated at 77° F, with a small correction factor of about 15 points for temperature variations over the usually encountered range of 32 to 110°. Some hydrometers have a built-in thermometer with the necessary correction indicated.

As a cell discharges, the terminal voltage begins to drop due to internal resistance. The heavier the current, the greater the internal voltage drop and the lower the terminal voltage due to the heating effect on the battery resistance. If there is excessive resistance in the battery cables due to broken strands in the conductors or poor terminal connections (due to loose or corroded joints), there is a further drop under high current drain conditions, and little voltage appears at the starter terminals or at other equipment such as the radio or lights.

One voltage appears at the battery terminals under no-load conditions, a lower voltage under starting conditions (or with the lights, heater, or radio on) and a still lower voltage at the starter or equipment due to the normal cable drop. When an ammeter is used as the indicator, it will show at a glance whether or not there is a load on the battery by its discharge rate, but it does not give any indication of the battery voltage or its condition of charge, nor does it indicate excessive IR drops.

The “idiot light” does not even give this amount of information, but usually tells no more than the fact that there is an output from the generator. When it is lit, the generator output is nil or inadequate. When the light is out, the generator output exceeds some preset current level at the generator terminals. Neither the ammeter nor the light necessarily show battery condition.

Enter the Voltmeter. A d.c. voltmeter connected directly to the battery terminals will tell you at a glance the charge condition of the battery, the condition of your voltage and current regulator, and if the generator is functioning properly.

A typical 6-volt battery will read 6.3 volts with no load when fully charged. If it reads below that, the percentage of charge left will depend upon current drain, the length of time the discharge occurs, and the final voltage acceptable (the point at which the battery is considered discharged but not damaged). The final voltage, below which the cells are considered exhausted, depends upon the time and discharge current rate. This final voltage may vary from 1.0 to 1.85 volts per cell, but the most used value is 1.75 volts for typical applications.

Any of several voltmeters can be used in an automobile or boat. An 8- or 10-volt d.c. voltmeter is suitable for a 6-volt system, and a 15-volt meter for a 12-volt system. There are a number of special meters available from automotive supply and electronics parts houses, some types already mounted in brackets, with or without a panel light, and some types that include trouble-shooting charts. These meters have expanded scales to make it easy to read battery voltage while driving.

One type that includes both illumination and trouble-shooting information is the Lafayette Radio “Volt-Test” (Stock No. 11 G 8001); another is the Stewart-Warner “Volt-Guard.” The latter is advertised as a voltmeter and electrical system analyzer, which, in effect, is what it really is. The Stewart-Warner meter has a meter bracket and light socket, but these are sold separately as accessories.

Unlike the regular d.c. panel voltmeter, the automotive types draw about 50 ma. of current, but this small drain is insignificant compared to the current capacity of a car battery. The normal leakage across the top of the battery
due to dirt and acid probably equals or exceeds this drain. The meter is wired directly to the battery terminals with small-gauge insulated wire (#20 is more than adequate); alternatively, the ground lead can be connected to the engine block where the battery is connected. In either case, the meter leads should be soldered to solder-lugs and connections to the battery or block should be clean and tight.

It is a good idea to check voltages at the various terminals (battery, engine block, voltmeter on panel) with a portable voltmeter or VOM to determine if there are any undesirable voltage drops in the cables or connections after the meter is installed. You may avert trouble later on.

What the Readings Mean. Each time you start your car you should check your indicator lights and watch the voltmeter for abnormal indication. Remember that the battery drain is heavier in winter and the battery voltage (if you keep your car outside) will be lower to start with.

(Continued on page 84)

## BATTERY VOLTAGE TABLE

<table>
<thead>
<tr>
<th>BATTERY VOLTS</th>
<th>ENGINE OFF OR IDLING</th>
<th>ENGINE STARTING (Battery Condition)</th>
<th>ENGINE RUNNING (Generator Condition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 5.0</td>
<td>Below 10 or no reading</td>
<td>Dead or disconnected battery, meter disconnected or not wired properly</td>
<td>Disconnected, defective, or improperly wired meter. If the engine will start, or run, the battery is not at fault</td>
</tr>
<tr>
<td>4.5-6.0</td>
<td>9-12</td>
<td>Undercharged battery; engine might not start</td>
<td>Normal range for winter and summer Generator not charging, regulator not working, or current drain from equipment (lights, radio, etc.) exceeds generator output</td>
</tr>
<tr>
<td>6-6.4</td>
<td>12-12.8</td>
<td>Fully charged battery. Generator and regulator operating properly</td>
<td>Battery fully charged, but generator or regulator not working properly</td>
</tr>
<tr>
<td>6.7-7.6</td>
<td>13.5-15.2</td>
<td>Normal for short period after driving due to battery &quot;surface charge,&quot; or meter reads high</td>
<td>Normal when battery, generator, and regulator are working properly. Meter reading varies with charge in battery, engine speed, temperature, and regulator setting</td>
</tr>
<tr>
<td>Above 7.6</td>
<td>Above 15.2</td>
<td>Voltage regulator contacts stuck together, or voltage regulator set too high. File and clean contacts and check battery fluid for level and specific gravity</td>
<td></td>
</tr>
</tbody>
</table>

1. The minimum voltage reading possible will depend upon the type of meter used.
2. Idling speed below that which causes the cut-out relay to pull in.
3. Normal driving speeds.

All voltages are approximate, and will vary with temperature, condition of regulator contacts, accuracy of meter, and other conditions.
DISTINCTIVE cuff links for the electronics buff and ear rings and other accessories for the YL or XYL are easy to make with bits of printed circuit board and colorful resistors and other components from the junk box. "Electronic Jewelry" is both attractive and an interesting conversation piece—and you'll enjoy making it for yourself or as a gift.

As a foundation, secure copper-clad laminate with copper on both sides. One side is used for a decorative pattern, while a cuff-link stud, ear-ring loop or other fastener is soldered to the back. The materials used to etch a pattern in the copper are the same as those used in making printed circuits: etchant, resist tape, resist circles, and liquid resist. If you would like to gold-plate your jewelry, also obtain a bottle of plating solution such as “Liqua Gold” (available from Lafayette Radio, Stock No. 14G2902, $1.66).

Design possibilities are limited only by your imagination. Cut out pieces of laminate in the form of circles, oblongs, diamonds, etc. using a fine-tooth coping saw. Dress edges with a fine file. Carefully clean the top copper surface with steel wool and apply a pattern to it with resist tape and circles, and resist paint. Use tape of varying thicknesses for lines, and add spots, dots, and circles as required. For a really way-out pattern, thin the resist paint with some turpentine and use it with a small brush or a pen.

Before etching, turn the laminate over and mark areas with resist paint for anchoring components and soldering on a cuff-link stud or other piece of jewelry hardware. Etch the copper in a glass dish—without agitation to hasten the process it should take no more than half an hour. Wash the pieces in cold water and remove the tape; paint can be removed with turpentine.

Drill small holes for component leads and deburr them. You can use resistors, glass diodes, capacitors, transistors, etc. Run the leads through the holes and solder on the back of the board. Trim off excess lead wires and file down the solder blobs for a neater appearance.

Mix the gold plating solution according to the instructions, and heat it on a stove as described. Add your jewelry, and you will have a lovely gold-plated surface over all metal, including the copper, lead wires, and solder.

—Byron G. Weis

POPULAR ELECTRONICS
FENCE CHARGER

Marauder monitor curbs canine capers. Stop garden invasions and garbage can inspections at four o'clock in the morning

By LYMAN E. GREENLEE

Keep your disposition from going to the dogs by charging up a few things. You can build a small fence charger that will deliver a wallop big enough to make any self-respecting dog or cat think twice before investigating the contents of your garbage can a second time. The punch is a high-voltage shock of short duration and is harmless to man or beast. Cost of construction is low—you may already have most of the parts on hand.

How It Works. A small isolation transformer (T1) isolates the fence charger from the house power line for safety, as shown in the schematic diagram. A 1/8-ampere “slow-blow” fuse carries the small normal load of the charger and also withstands the initial current surge which may occur when the unit is first turned on. This is normal for equipment having capacitor input filtering in the power supply.

Capacitors draw relatively large current as they go from 0-to-operating voltage levels. The output from the transformer secondary goes through a current limiting resistor (R1) to the silicon rectifier (D1). Resistor R1 protects the rectifier from starting current surges. The rectifier’s pulsating d.e. output is smoothed by capacitors C1 and C2 and by resistor R3. The NE-2 neon light (II) serves as a pilot light—it not only shows whether
the charger is on or off, it also tells you if the B+ power supply is working up to this point in the circuit. Resistor \( R_2 \) limits the amount of current that can be passed by the neon light. Output from this half-wave rectifier power supply is approximately 140 volts.

The relay coil \( (K_1) \) is a normally-closed s.p.s.t. type with a coil resistance of from 3000 to 8000 ohms. Upon application of power, the relay tends to become energized almost immediately and to open the circuit through itself and transformer \( T_2 \). Since enough time must be allowed for the current to build up, and, in turn, for the magnetic field to go to maximum in transformer \( T_2 \), capacitor \( C_4 \) is used to hold the relay armature down for about one second. Timing depends upon values of the capacitor and the coil resistance, as well as the characteristics of the relay. Spring tension on the relay armature can be changed to increase or decrease the on-off time. Relays with coil resistance varying from 1000 to 10,000 ohms have been tried by the author and all of them have worked. Variations in hold-down time ranged from about 0.1 to 3 seconds.

When the relay points open, current ceases to flow through \( T_2 \), the magnetic field collapses and induces a voltage across what is now the transformer's secondary winding, and the voltage appears at terminals \( BP_1 \) to \( BP_3 \). The quicker the magnetic field collapses and the higher the turns ratio of the transformer, the higher the voltage produced.

Small unit teaches hounds to behave. Short duration pulses are harmless.

Note that this transformer was originally intended for audio output work and is used in the reverse manner in this project. Therefore, what was originally the primary winding is now the secondary.

Capacitor \( C_3 \) serves the same purpose as the capacitor across the points in a conventional automobile ignition system. It overcomes the inertial effects of the current, minimizes arcing across the points, and takes on a charge which series-adies the voltage from the power supply when the contacts close.

The second neon light \( (I_2) \) connected across the secondary of \( T_2 \) flashes momentarily with each pulse applied to the fence if all is well. Resistors \( R_4 \) and \( R_5 \) are current limiters for \( I_2 \). The spark gap protects the transformer against damage from internal arcing and also from electrostatic or lightning charges that might be picked up on a long length of fence wire connected to the charger.

The shock pulse generated is completely safe due to its short duration. Any possibility of a dangerous or lethal voltage being applied to the fence because of component failure is remote. Transformer \( T_2 \) can pass only a small current and is isolated from the house power line. The B+ component is "chopped up" by the relay. If the relay contacts stick open or closed, no high voltage can be developed on the fence.

When the relay points open, current ceases to flow through \( T_2 \), the magnetic field collapses and induces a voltage across what is now the transformer's secondary winding, and the voltage appears at terminals \( BP_1 \) to \( BP_3 \). The quicker the magnetic field collapses and the higher the turns ratio of the transformer, the higher the voltage produced.

Construction. The charger should be built in a Bakelite or plastic box, or at least on an insulated board, as shown in the illustrations. Provide a good ground connection for terminal \( BP_1 \). All parts are mounted on the cover. Keep in mind the 2½" space between the cover and the bottom of the case when
Mount all parts before wiring and keep depth of case in mind when mounting them. The panel fits into case when completed.

PARTS LIST

BP1—Black binding post
BP2, BP3—Red binding post
C1, C2—40-40 µF, 150-volt electrolytic capacitor
C3—0.05 µF, 600-volt micro capacitor
C4—40-µF, 150-volt electrolytic capacitor
D1—7N1765, 400-PIV, 500-nanosecond silicon zener
F1—1/8-amp, Pilot-blown fuse
I1, I2—4K-2 neon light
N1—5-pin plug, normally closed relay with 5000-ohm coil (Potter & Brumfield 1/B5 oh equivalent)
R1—100-k ohm, 1-watt resistor
R2—100,000-ohm, 1/2-watt resistor
R3—2000-ohm, 1-watt resistor
R4—100-ohm, 1/2-watt resistor
R5—500-ohm, 1/2-watt resistor
T1—Isolation transformer, primary 117 volts, secondary 25 volts @ 1/5 ma (Stanley PS8475 or equivalent)
X2—25w universal output transformer, Allied Radio 3103Q or equivalent
3—2 33/32" x 5 5/32" x 1 1/16" Bakelite instrument case
X3—Line switch, 1/4" diameter, silver holder, 4-terminal strip, neon-light socket, hookup wire, machine screws, nuts, etc.
Mount all parts before wiring, and keep depth of case in mind when mounting them. The panel fits into case when completed.

PARTS LIST

BP1—Black binding post
BP2, BP3—Red binding post
C1, C2—0.4-40 µF, 150-volt, electrolytic capacitor
C3—0.05 µF, 600-volt, mica capacitor
C4—40 µF, 150-volt, electrolytic capacitor
D1—1N403, 400 V, 500-μA, silicon rectifier
P1—3-terminal "slow-blow" fuse
I1, I2—1/2-watt light
K1—S.p.s.k. normal closed relay with 5000-ohm coil (Potter & Brumfield, R3, of equivalent)
R1—100-ohm, 1-watt resistor
R2—700,000-ohm, 1/4-watt resistor
R3—2000-ohm, 1/4-watt resistor
R4, R5—2500-ohm, 1/4-watt resistor
S3—S.p.s.t. toggle switch
T1—Isolation transformer, 117 volts, 250-watt, 125 volts @ 35 ma (Stanco PS8475 or equivalent)
T2—5.5/32" x 5/32" x 3/32" x 3/32" aluminum instrument case and cover
P3—Line cord, 1/4" copper, 3/4" holder, 4-terminal strip, neon-light socket, hookup wire, machine screw and nuts, etc.

Relay acts like points in a conventional automobile ignition system. Circuit is isolated from the a.c. power for the safety.
ELECTRIC FENCE CHARGER

Spring tension on normally-closed relay should provide good contact. Tighten to increase "on" time.

Spark gap protects the transformer. Adjust size to prevent continual firing with no load attached.

mounting the various parts. The cover has to fit into the case when the instrument is completed.

Prearrange the parts in the cover, as shown in the photos, and mark the position of the various mounting holes. All parts should be mounted before wiring. The 6-volt filament wires from the isolation transformer are not used; the ends of these wires should be taped and folded around the transformer and tucked out of the way.

The output transformer has a series of taps for impedance matching. Locate the two outer ends of the tapped winding and wire them into the circuit. One way to identify the outer ends is to use an ohmmeter. Select the two terminals that have the most resistance between them.

The high-voltage side of the output transformer has three insulated wires which may be colored red for the center tap, blue for one end, and brown or green for the other end of the winding. Connect the brown or green wire to the black binding post (BP1), the red wire to the middle red binding post (BP2), and the blue wire to the end red binding post (BP3).

You can construct a spark gap by soldering a fairly stiff wire about 2" long to each lug on the outer binding posts. Shape the two wires so that their ends are about \( \frac{1}{10} \)" apart and suspended in air away from other terminals and cabinet, as shown in the pictorial.

Check the wiring when completed. If you're satisfied with it, place the cover in the case, plug in the unit, and flip the switch. If all is well, the relay will start pulsing. Don't screw down the cover until you have checked the spark gap to see that it is not firing. Normally the gap should be just big enough to prevent no more than occasional arcing. You may also want to vary the armature tension by adjusting the spring to get the right timing cycle. Spring tension should be strong enough to insure a good contact when the relay trips out. The relay should stay closed for about 0.1 second.

Operation. Connect the black binding post to a suitable ground connection, and connect the fence to be charged to one of the red binding posts. Use the middle binding post for wet weather and the outer one for dry weather. On a dry day a higher voltage is needed to force current through dry ground. In wet weather a high voltage could be a disadvantage because the current would tend to leak across the insulators. The higher the voltage, the higher the leakage. When the ground is wet, a low voltage is just as effective. Approximately half the voltage and twice the amperage is available from the black and middle red post. Maximum high voltage is obtained from the black and outer red post.

To test for leakage in the fence circuit, connect a NE-2 neon light in series with the fence and the red binding post being used. The higher the intensity of the flashes, the greater the leakage. To (Continued on page 99)
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FIRST CLASS PERMIT NO. 534 BOULDER, COLO.
WANT to know how to pack good, strong bass, as well as clear, sparkling highs, into a speaker cabinet measuring just 10” x 10” x 36”? Interested in economy? Would you like to have a speaker system that can proudly take its place among your living room furniture, or on a convenient bookshelf? If your answer is “yes” to these questions, “The Slim Twosome” is for you.

A combination of filters and a decompression chamber increase air column length and enhance bass response without detracting from the highs. Two full-range 8” speakers pumping in phase can move as much air as a larger speaker. The filters dampen speaker action without a build-up of excessive back pressure. The ports relieve the cabinet of internal pressures and, when properly tuned, can improve bass response, as in a bass-reflex enclosure.

Construction. Ordinary 1/4” plywood can be used for the front, back, sides, and ends. However, you may choose—as did the author—to use hardwood or veneered plywood for the “sides” (top and bottom if the cabinet is laid flat). The remaining exposed surfaces are covered with grille cloth.

First cut the two 10” x 36” side panels, taking care not to mar the outside surfaces. The cleats used to hold the
Construction of enclosure is detailed at left. All panels can be made from \(\frac{1}{2}\)" plywood, with \(\frac{1}{2}\)"-square stock making up the cleats. Cut all pieces exactly to size; place cleats as shown for easy assembly.

Final Assembly. The ports are made of three \(6\)" pieces of mailing tube \(2\)" in diameter. First give them several coats of shellac, then glue them in place, filling any openings around them with sawdust and glue. Line the speaker chambers with a \(\frac{3}{4}\)" layer of acoustic padding on the ends, sides, and the back panel area that will cover the speaker chambers; no padding is placed on the filters or in the decompression chamber.

The front and ends of the author’s cabinet were finished by covering them with grille cloth after the bare wood was painted flat black so that shadows would not show through the cloth. The side panels can be finished to your liking.

If plywood is used for the sides, you can finish the edges very easily by covering them with “flexible wood trim” available from most lumberyards. The trim is simply glued in place with contact cement. Fit grille cloth between the sides, stapling it to the rear edge of the ends and near the edges around the front. Gold cording or molding will conceal the staples.

While the exact type of speakers you choose for your “Slim Twosome” is not overly critical, be sure to get wide-range types such as the Lafayette Radio 21 G 4722, priced at \$6.25. There are other similar units which can be used.

Install the speakers, and wire them to a terminal strip on the rear panel, taking care to connect them both in the same phase—i.e., so both cones move in or out together. Small both in terms of size and the investment required, “The Slim Twosome” can be counted on to give big listening pleasure.
The same transformer is employed in each circuit on this page but the windings are connected differently to provide a variety of output voltages. In every case the primary winding and input voltage is 117 volts. Secondary windings are: 5 volts, 6.3 volts, and 250 volts center-tapped. The dots indicate the relative polarity of the windings. By carefully observing the additive or the subtractive effects of the windings it is possible to calculate the output voltage of each circuit. Can you?

1   5   
2   6   
3   7   
4   8   

(Answers on page 97)
The same transformer is employed in each circuit on this page but the windings are connected differently to provide a variety of output voltages. In every case the primary winding and input voltage is 117 volts. Secondary windings are: 5 volts, 6.3 volts, and 250 volts center-tapped. The dots indicate the relative polarity of the windings. By carefully observing the additive or the subtractive effects of the windings it is possible to calculate the output voltage of each circuit. Can you?

1 5
2 6
3 7
4 8

(Answers on page 97)
TV SCREAMS

“A cold solder joint? Well, it doesn’t surprise me . . . there’s been a draft in here all day.”

“It belonged to a little old lady schoolteacher who used it only to watch ‘Romper Room.’”

“I hate substitute teachers.”

“How many times must I tell you not to kick the set when it gives trouble?”

“With your diploma, you’ll each find a list of snappy answers to use when your customers say they want their TV set the same evening!”
ALTHOUGH the price of speed controllers for power tools has dropped from $25 to $10 in the past two years, you can still build your own at a very substantial saving. The “secret ingredient” is a brand-new silicon-controlled rectifier with a 5-ampere rating which sells for $1.62. It is the RCA Type 2N3228 and is now commonly available either by mail order or from many local electronics stores.

The circuit shown below was taken from the RCA “Application Note” SMA-34. Technically, the circuit is that of a half-wave motor speed control with regulation. Users of SCR speed controllers will find regulation of value, since it varies the amount of current fed to the motor (at a particular speed setting) according to the load. Motor speed is initially controlled by adjustment of the gate bias of SCR1. Counter voltage generated by the motor is rectified by diode D1 and used to further control (feedback arrangement) the firing of the SCR. As the load increases, less counter voltage is generated and more current is permitted to flow into the motor.

The speed control illustrated in the photos was carefully fitted into an aluminum box measuring 2 1/4” x 2 1/4” x 5”. The line cord grommet, fuse F1 (in holder), and switch S1 are mounted in one end of the box cover. Speed control

**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1, D2</td>
<td>Silicon diode, 200 PIV, 125 ma. (RCA IN3755 or equivalent)</td>
</tr>
<tr>
<td>F1</td>
<td>4-amp, 3AC fuse in holder</td>
</tr>
<tr>
<td>R1</td>
<td>5600-ohm, 2-watt resistor</td>
</tr>
<tr>
<td>R2</td>
<td>1000-ohm, 2-watt potentiometer</td>
</tr>
<tr>
<td>S1</td>
<td>S.p.s.t. toggle switch</td>
</tr>
<tr>
<td>SCR1</td>
<td>Silicon-controlled rectifier (RCA 2N3228)</td>
</tr>
<tr>
<td>Misc.</td>
<td>Aluminum box, 3-prong, a.c. outlet socket, 6’ three-conductor heavy-duty a.c. line cord, small heat sink, 4-terminal tie strip, solder, a.c. cap, knob, ceramic standoff insulators, etc.</td>
</tr>
</tbody>
</table>

The heat sink in the speed control must be insulated from the aluminum box; use H. H. Smith Type 2645 ceramic insulators. Position sink so that it will not short out to the metal back of the outlet.
potentiometer $R_2$ and a three-prong outlet socket are mounted on top of the cover.

Attached to the U-shaped bottom of the box by means of ¾” insulated spacers is a small heat sink. The center of the heat sink is reamed out to pass the gate and cathode terminals of $SCR_1$. The case of $SCR_1$ is bolted to the heat sink—possibly making it “hot” since it is connected to one side of the a.c. line.

Although a variety of three-prong outlet sockets are available in radio supply houses, the cheapest socket you can use is an Eagle 817, with the ears clipped off and the socket attached to the box with 6-32 machine screws. If you position the heat sink carefully, the parts will fit snugly into the box and not short out.

Be sure not to stall the motor by operating at a very slow speed and high load. A stalled motor will draw excessive current and within a matter of two or three seconds the SCR may be permanently damaged—if the fuse has not blown. If the motor does stall, quickly turn off the speed controller. Lessen the load and try again at a higher speed setting of potentiometer $R_2$.

You’ll be surprised at the number of uses you can find around the shop for this small amplifier—as the audio section of a simple receiver, as a test amplifier, as an audio or r.f. signal tracer, or as a basic preamp for test instruments or power amplifiers.

Any small chassis will serve for mounting the components of the “Utiliamp,” a simple two-stage $pnp-npn$ complementary unit utilizing a bare minimum of parts. No special precautions need be taken with layout or wiring other than to keep input and output leads isolated from each other. Sockets were used for $Q_1-Q_2$, but can be dispensed with if you employ heat sinks when you solder the transistors. The input and output terminals are Fahnestock clips mounted with screws and insulated from the chassis with fiber washers.

Any power supply or battery delivering 3 to 9 volts will power the Utiliamp. If for any reason you want to interchange $Q_1$ and $Q_2$, simply reverse battery polarity. Capacitor $C_1$, which should have a 50-volt rating, may be larger or smaller; a fairly large capacitance is necessary for good low frequency response. Use an audio-taper potentiometer for $R_1$, mounting it below the chassis as shown.

Any of several output loads can be used. If the Utiliamp is employed as a preamp, use either a resistive or matching transformer load as shown at “A” and “C”. Moderate-impedance phones (2000 ohms) can be direct-coupled (“B”). —E. G. Louis
SHALL NOT reveal how I met Pheobus Sharney, nor why I have chosen to distinguish him from the many others of his ilk by writing about him. Suffice it to say that I am acquainted with a gentleman who is, believe it or not, a typical radio nut.

During the day he is employed in a computer foundry. There has always been some question as to whether he simply tolerates the incessant pound, pound, pound of square waves on the shore, or just considers it something that any red-blooded American ham should do. For his spare time is spent in a like manner—sweating over a hot cathode, oblivious to anything but ham radio.

Recently, I spent a soul-wrenching Sunday morning with him before the cyclotron he sardonically calls his "linear amateur radio rig." "Let's try fifteen first," he said competently, although why he picked that particular number I will never know. He twisted the dials, read the cyclotron's meters, and then a speaker began to emit weird chirps and snorts. Finally, I began to distinguish voices speaking some odd language that seemed to make sense to Pheobus.

"There's a contest on," he explained, "a big phone contest."
I've heard of endurance contests where people line up outside a phone booth to wait for some teen-ager with a pocket full of nickels to get off the phone, but this phone contest was a horse of a different color. Some loud-mouth was shouting something that sounded like "Seek you the axe, seek you the axe!", but this seemingly strange advice was actually given in a Brooklyn accent that came out "Seek you de axe!" I waited patiently for an explanation.

"You see," Pheobus began, "every so often an organization called the American Radiator Delay League notifies all the gang that a phone contest will be held on a certain date between such and such hours. There's one this weekend, and hams all over the world are trying to contact other hams. The one who makes the most and best contacts gets top honors. Some contacts count more than others, especially de axe. Sometimes a real operator wins, but there are a lot of accomplished fakirs in the ham world."

"What do they talk about?" I asked innocently. "They sound like they're fresh out of the funny factory."

"Just listen," Pheobus commanded. "I'll explain as we go along."

He twisted something called a "gain control" and another knob that was supposed to multiply the Q, and a voice with a Spanish accent began shouting through the speaker.

"My number two you oh man is five zero, my report is are nine plus. Do you copy? Do you copy? See oh eight are hell with kay eight bloozy, doozy, choosy... Come in oh man!"

Pheobus turned off his standby in order to comment. "That's a Cuban ham talking with a ham in our eighth district. He gave a contest number and signal report. Notice how fast he's working. Wants to make as many contacts as possible before the show is over."

He turned on the kilocycle control, only to find the Cuban still spouting. "O.K. oh man. Thank you werry much. So long and best of lock in de contast. See oh eight are hell is cue are zed on de band looking for any possibles. Kay somebody please."

Pheobus broke over in the noise. "He's telling any possible listeners who might want to contact him that he's now ready to talk with them. That's what cue are zed stands for. Now let's get up on the American part of the band and listen to the lids up there..."

"Scratch, squawk, zzzzz... fine business zed ess two able baker. I'm running 50 watts on homebrew with a zepp outside the shack. How do you copy? Double you four umpty bumptsy whiskey over two zed ess two able baker victor."

Pheobus turned down the kilocycle control again and shook his head in disgust. "That joker is running with damn near a full keg. He always pulls that crud on some poor, unsuspecting foreigner. Last week he was bragging about his full keg and tribander on an eighty-foot mast."

All I could envision was some guy living in a shack and drinking home-brew—a whole keg of it—but what was a zeppelin doing parked at the eighty-foot mast outside?

"... I'm writing out your cue ess hell card right now old man, be sure to send yours. Pea a zero alpha better papa. Your number is seventy-nine and your sigz are nine plus. Do you copy? Kay a seven papa please America two pea a zero alpha better papa. Come in oh m."

"That louse," Pheobus muttered, "hasn't got any cue as hell cards. Never had any, but tries to collect all the foreign cards he can get. I heard him explain it on the air last week. Thinks it's funny but it gives the rest of us American hams a bad name."

The stand-near switch was thrown again, and Pheobus fiddled with the dials. Suddenly a voice, speaking in an obscure Choctaw dialect grated through the speaker. "Single Sideband," Pheobus observed.

I nodded in wonderment and awe, for how could he tell just by listening whether Mr. Sideband was married or single? The voice became intelligible, interrupting my thoughts.

"Seek you, seek you. This is whiskey baker two yellow banana peel. Kay somebody plz."

"I'll just give him a shout to see if (Continued on page 112)"
THE EXALTED POT

Sometimes even the simplest of electronic gadgets can save you countless hours of needless effort

By FORREST H. FRANTZ, Sr.

THE VERSATILE "Exalted Pot" is so simple you'll wonder why you didn't think of it yourself. All that's required to build the unit are two ganged potentiometers, a d.p.d.t. switch, assorted connectors, and a small aluminum box.

You can use it as a 1000-ohm and a 10,000-ohm resistance adjustable divider, as a substitution adjustable resistor for any value up to 10,000 ohms, or as a substitute volume control in transistor circuits. In combination with a VTVM and an audio signal generator, you can even use it for measuring capacitance and inductance.

Construction Details. The unit is housed in a 2½" x 3" x 5½" Minibox. The dual potentiometer (R1-R2) is made up using a 10,000-ohm linear unit (IRC-CTS Q11-116) and an add-on multi-section (IRC-CTS M11-108) which is a linear 1000-ohm unit. After cutting the shaft of R2 (the 10,000-ohm unit), attach R1 to the back of R2, but be careful that the wiper arm finger of R1 is properly seated in the wiper slot of R2 before bending the tabs and sealing the units together.

Now attach this ganged pot to the Minibox cover, and place the knob on the shaft, repositioning the potentiometer as necessary to maintain the same overshoot at each end of rotation.

Terminal posts B, C, T and GND are available from Lafayette Radio in a kit of 10 pieces (MS-566), and each requires a ⅜" hole. The GND post is grounded to the Minibox, but the other three are insulated with fiber washers. Subminiature phone jack J1 is a Lafayette 99 G 9905, and needs a ⅜" hole also. Switch S1 is a d.p.d.t. miniature toggle switch and requires a ⅛" hole. Mount all components and wire them as shown in the diagram on the next page.

Calibration. The "Exalted Pot" dial scale can be calibrated by measuring resistance at various knob settings with an ohmmeter of known accuracy. The inner scale will be calibrated from zero at one extreme to 1.0 at the other, and interpreted to mean 1000 ohms full scale or 10,000 ohms full scale, depending on the setting of switch S1.

The outer (capacity) scale is calibrated from 1.9 to 30µf. These capaci-

If you have an audio signal generator and a VTVM you can use the "Exalted Pot" to determine capacitor values fairly accurately. The unit will also perform many other functions as described in text.
Simple instrument measures values of coils and capacitors. Adjust pots to match voltage across unknown parts.

Capacitor markings actually correspond to capacitive reactance at a test frequency of 100 cycles. Potentiometers $R_1$ and $R_2$, as well as the test frequencies of 100 and 10,000 cycles, were selected to provide a wide range of measurements without having to resort to many scales. Capacitance values of 0.0019 to 30 µf. can be measured.

While not shown in the photo, the dial can also be calibrated to read values of inductance. For the values of the resistors and frequencies selected, the instrument’s range is from 1 mh. to 15 h. (15,000 mh.).

First calibrate the resistance scale. Set $S_1$ in the 1K position. Rotate the control and mark the dial at each 100-ohm point. Do this carefully and use a good ohmmeter to measure the resistance as you proceed around the dial. No further calibration is needed for resistance. The other range is essentially now cali-

(Continued on page 98)
THE Department of Transport (Canada's equivalent to our FCC) has taken the first step in opening the door to Canadian/U.S. reciprocal CB licensing. The General Radio Service (similar to our Citizens Radio Service) was authorized for Canadians in April, 1962, almost four years after the FCC authorized CB here in the same 11-meter band. The two systems parallel one another to the extent that both are low-power, short-range communications services, and both services were established for use in necessary business or personal communications. The operational regulations of the GRS are much the same as our CB rules and regulations, but operating frequencies are available on only 19 of the 23 channels used for CB in this country—ranging from 27.005 to 27.230 mc. (U.S. CB channels 4 through 22).

The similarity of the two services gave a few CB operators living along the border in both Canada and the United States the impression that the General Radio Service and the Citizens Radio Service were related. As we explained in the March, 1963, edition of this column, hopes were high then that the FCC and the DOT (Department of Transport) would soon come to some sort of agreement authorizing CB'ers and GRS operators to communicate across the international boundary. Now, millions of transmissions and two years later, the DOT has introduced a new service to be known as the "Tourist Radio Service," making any legally licensed U.S. CB'er eligible for a temporary license to use his CB gear while in Canada.

There is no fee for this service but the license is not transferable and must be in the operator's possession at all times while he is in Canada. It remains valid for a period of one year, at which time it must be renewed by the U.S. citizen who expects to continue having a need to use his CB equipment over the border.

Persons in this country interested in using the "TRS" must apply to the Regional Superintendent of Radio Regulation, Department of Transport, 25 Sinclair Ave., Ontario, Canada, at least 30 days prior to their entry into the country. The DOT requires the U.S. CB'er's name, address, CB call-sign, and the period of time he intends to be in Canada. Each CB'er will be permitted to use only the Canadian GRS channels 4 through 22, and will be bound by the regulations of the DOT as established for the General Radio Service.

Canadian CB'ers are quite happy about the "lifting of the gate," so to speak, and their big question is "now that we've made the first move, when is the U.S. going to follow through with similar privileges for us Canadians?" Soon, we hope! Canadian

The efforts of CB-XM, Canada's national CB monthly newspaper, may have been instrumental in making it possible for U.S. CB'ers to use their gear there.

December, 1964
GRS users have already requested that U.S. CB'ers petition the FCC for reciprocal authorization to be issued to those in need of communication facilities while visiting this country.

Two Canadian CB publications, the Modulation, news monthly of the Metro CB Club, Toronto, and CB-XM, the national CB monthly newspaper, feel that their editorial comments over the last several months have played a part in making the new service available to U.S. CB'ers. We have lauded Jim DeZorzi, XM41-085, in the past for his editorial efforts in the Modulation, a clean-cut, well-written CB news vehicle for Canadians. Bob Watson, XM41-241, publisher of CB-XM, is now in line for an equal amount of kudos for the job his paper has been doing news-wise throughout Canada. Each issue of CB-XM appears to cover just about anything that has, is, or will be happening among GRS users. And hardly an event goes by that isn't covered by the CB-XM photographer, Harold Merton, XM44-042.

Other rule changes that involve the use of Citizens Band equipment in Canada have been announced in favor of walkie-talkies or any CB equipment with a final input of 100 mw. or less. Kits, home-brewed or manufactured units that had previously been banned, may now be used on any frequency between 26.97 and 27.27 mc. The units need not be licensed and are exempt from the use of call-signs, DOT approval and age restrictions.

Stacked Shack. Meet CAP Captain Don G. Kinne Sr., pictured here with his gear. Don is about as "radio-active" as you can possibly get! Starting on the rooftop, Don employs five different types of antennas:

- ground plane, base-loaded vertical, 329KC
- radio aviation weather, super beacon CBB-1, and a BQ1206-C. As for equipment, Don uses gear made by Hallicrafters, Metrotek, and Heath. He is active in EAR Emergency Services for the U.S. Air Force and the Civil Air Patrol in the eastern portion of South Carolina. Combining all of his "communicativities," Don is on 11 meters (CB); 2 meters (VHF); 80 meters (HF); 10 meters (26.620 HF); and 145.26, 145.50, 147.09 (VHF).

CB Rescue in New York. SWL Axel W. Berggren, Jamestown, N.Y., has reported another life-saving credited to Citizens Band radio. A Jamestown man lying flat on his back trapped in a mud-filled drainage ditch, unable to move, was spotted by a youngster named Jerry Movio who had been out looking for worms. Realizing there was nothing he alone could do for the man, he returned home to tell his uncle, Howard C. States, about it.

States and the boy returned to the scene with a flashlight but were unable to reach the man since the ditch was close to ten feet wide. At this point only the man's face showed above the mud. With no telephone nearby, States placed a plea for help on his mobile CB rig which was picked up by Joseph A. Russo. Russo relayed the information to the police.

In short order a rescue team of seven men arrived on the scene to find that a group of on-lookers had collected in an attempt to help, but without success. By this time only the man's mouth and nose remained above the surface of the mud. The rescue group put a ladder across the ditch but the man was unable to grab hold of it in his exhausted state.

Patrolman George Thompson then crawled out on the ladder and succeeded in grabbing the victim and pulling him to safety. He was taken to Jamestown General Hospital, treated for exposure and released. The man is undoubtedly alive today due to one quick-thinking boy and two Citizens Band operators!

1964 OTCB Club Roster. This month's listing of new CB clubs which follows completes the 1964 round-up of information that has been sent in by new and active organizations across the country and Canada. In an early 1965 issue we will publish the results of this year's campaign to find out how many clubs are actually CB-active, how many members the average club has, total of clubs by state, types of rescue groups, and any additional pertinent information of interest to the Citizens Band clan.

(Continued on page 100)
Across the Ham Bands

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

AMATEURS AID IN SEARCH AT SEA

EARLY on the afternoon of August 4, 1964, VEØMU, maritime-mobile on the thirty-foot motor sailer John Peer in the Atlantic Ocean, broke in on WA4ECY on 20-meter SSB asking for help. The operator, Eric Lamberg, VO1FL/VP9FM, reported that he and his wife, Joan, en route from Bermuda to Newport, R.I., were exhausted from continuously battling a severe storm for three days, and they could not hold out much longer without relief. Making the picture still more grim, the storm had blown them far off course, and Eric had only the haziest idea of their position.

WA4ECY, located at the Jacksonville, Fla., Naval Training Station, immediately notified the U.S. Navy and Coast Guard of the John Peer's plight. Coast Guard "weather" gave WA4ECY a course to relay to Eric that would get him out of the storm area, and by nightfall the John Peer was in an area of calmer seas and lower winds—but still lost. In the meantime, a huge search and rescue operation directed by the Commander of the U.S. Second Fleet got under way.

All communications with the John Peer were via amateur radio on 14,265 kc., because of the limited range on the commercial frequencies on which the John Peer could operate. WA4ECY, manned by WAØBDM, K4YCW, and several other hams, stayed on the air continuously for 27 hours and acted as the net control station for the emergency net that was organized. A few of the many hams who participated in the net were: K1WTI/MM (USS Purdy), W2BO, WAOBDM, K4YCW, and several other hams.

Amateur Station of the Month

No, you're not seeing double—or quadruple! W. Rex Sterling, VO1HF, St. John's, Newfoundland, owns FIVE receivers—ranging from a National SW-54 to an NC-188—each with its own antenna. His transmitter is a Heathkit DX-60 and his main antenna is a 75-meter dipole. Alaska is his best DX—not bad for such low power on 75 meters! VO1HF will receive a one-year subscription to POPULAR ELECTRONICS for submitting the winning photo in the Amateur Station of the Month contest for December. If you would like to enter the contest, just send us a clear picture of your station—preferably with you at the controls—along with some information about yourself, your equipment, and your operating achievements. All contest entries should go to Herb S. Brier, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Indiana 46401.
WA2WLA, WA4GHA/Aeronautical Mobile, W4SAW/MM (the aircraft carrier Enter-
prise), K4UOT, W8NGO, W8ZKN, W9EGQ, WA9AKM, KP4BQV, and VP9BN. The
latter kept Eric's mother and son informed of the progress of the search operation.

One thing that made communicating with VE0MU on the John Peer difficult was that
when signals were weak the ignition noise from his auxiliary motor prevented Eric
from hearing stations that heard him. But his emergency batteries were good for only
15 minutes with the motor off. When the 15 minutes were up, Eric had to shut down
and start the motor to charge the batteries, which took a minimum of 30 minutes.

Shortly after noon on August 5, Coast Guard and Navy search planes finally criss-
crossed close enough to the boat to obtain accurate position fixes in the 2-mc. marine
band. Minutes later, they were circling the John Peer, and it was only a matter of time
until the nearest rescue ship reached Eric and Joan. Thus, the operation ended after
27 hours with the rescue of the Lambergs who were worn out but otherwise OK. Their
boat was also OK except for its almost empty fuel tanks.

Hams and Local Laws. Several hams have
recently been involved in extensive proceed-
ing to protect their legal rights—and, by
implication, those of all hams. In summary,
here are the highlights of what we consider
the most important cases.

Two years ago in Elizabeth, Pa., Charles
"Butch" Seaman, K3IOP, a 15-year-old
Technician operating on the 50-mc. band,
received so many TVI complaints that the
FCC forced him to take his General Class
examination under FCC Amateur Regulation
97.25, even though his transmitter checked
out "clean." He was issued a General Class
license with the restriction that he could
not operate on 50 mc. After protracted
hearings and negotiations, Butch (now 17)
has voluntarily given up 50 mc., so the case
is virtually closed. The ARRL, however,
is still attempting to have the 50-mc. restric-
tion removed from Butch's license for legal
reasons.

When Mace, W0JQR, purchased his
home in Denver, Colo., he signed a covenant
not to erect outside antennas. But he has
had an outside antenna for several years.
Recently, four new neighbors sued him for
$8000, claiming that W0JQR's tri-band
beam on a 47' tower depreciated their prop-
erty values. The signed covenant makes this
a particularly difficult situation from the
ham standpoint; as this is written, the
case has not yet been decided.

Last winter, the city of Chicago, Ill.,
ordered Jerry, K9GRH, to dismantle his
antenna and tower which were deemed to be
in violation of the city's zoning laws. Jerry
complied with the order on the advice of his
attorney, but challenged its legality; this
matter also is still in the courts. As
written, the city ordinance actually forbids
all outside TV receiving antennas, CB
antennas, and amateur antennas in Chicago
residential areas. Since Jerry's case was
started, the city has ordered approximately
25 hams and CB'ers to dismantle their an-
tennas and cease all radio operations. But
the Chicago City Council is now considering
an amendment to the zoning code that will
permit outside antenna installations as a
"special use" upon the payment of a $100
fee! The Chicago Area Radio Club Council
and the ARRL are vigorously fighting this
case on all fronts.

Other amateurs involved in similar an-
tenna cases include Dr. Sam Rosen, WA2-
R AU, New Rochelle, N.Y.; Peter McManus,
K3DSF, Farless Hills, Pa.; and the Weber
(Continued on page 95)
The Holiday Season brings with it the annual practice of selecting gifts for friends. Books make excellent gifts. If you select interesting and useful books, you will be well thought of long past gift-giving time. As with any gift, keep your friends' interests in mind.

Our mail indicates that a great many hobbyists enjoy working with transistors and that they have completed dozens of projects. They are interested in how semiconductors operate, and they are constantly looking for more and more transistorized circuits to build. They like to work from easy-to-read, and easy-to-understand instructions, pictorials and schematics. Quite a few books on transistors have been published recently which would make fine gifts.

The books on transistors which were recommended in 'POP'tronics Bookshelf' this past year are listed here for your convenience together with the month in which they were reviewed: RCA Transistor Manual, Second Edition, published by RCA Electronic Components and Devices (October); Transistorized Miniature Amplifier and Tuner Applications, by Rufus P. Turner (July); The Transistor Radio Handbook, by Donald L. Stoner and L. A. Earnshaw (June); How to Build Tiny Electronic Circuits, by Morris Moses; Transistor Ignition Systems Handbook, by Brice Ward; Diodes and Transistors, by G. Fontaine; Transistor Specifications and Substitution Handbook, published by Tech Press Publications (all in May); and Getting Started with Transistors, by your Semiconductor Editor (March).

There are many other good books on transistors available, of course, including the various transistor handbooks put out by most of the leading manufacturers of semiconductor products.

Reader's Circuit. There are a number of control and alarm installations where a latching or "self-holding" action is required, that is, a circuit which—when momentarily energized—will apply and maintain power to such loads as a lamp, signaling device, solenoid or small motor. This type of action may be obtained by using a mechanical or electrical latching-type relay, by using a SCR or Trigistor, or, as reader, experimenter and author Ronald L. Ives has suggested, by using a relatively simple two-transistor circuit.

An npn (Q1) and a pnp (Q2) transistor in a direct-coupled hookup are shown in Fig 1. Transistor Q1's base bias is initially supplied by B2 through R2 and R3. The base bias of Q2 comes off a voltage-divider, R4 and R6, and includes Q1's emitter-collector circuit. Resistors R2 and R3 serve as

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**Fig 1.** Reader Ronald L. Ives employs transistors to latch relays and other control devices. Circuit stays off until triggered by momentarily closed switch S1. Circuit stays on until switch S2 is temporarily opened or until the power is removed.
base current limiters. The output load in this case is a standard relay coil shunted by C1 and D2. Operating power supplied by B1 is controlled by normally closed S2 and by circuit action.

Neither Q1 nor Q2 conduct appreciably until the circuit is energized by closing S1 momentarily. When this happens, Q2's base becomes forward-biased by B1 and permits collector current to flow through the relay, causing it to close. The voltage developed on Q2's collector appears across zener diode D1 and causes it to conduct, applying more forward bias to Q1's base through R1 and R2. This, in turn, causes Q1 to conduct and apply forward bias to Q2's base through R5. Transistor Q2 is held in a conducting state which, in turn, holds Q1 in a conducting attitude and everything stays "on" until power is interrupted, as by momentarily opening S2, at which time the entire circuit reverts back to an inactive condition.

Transistors Q1 and Q2 are a 2N326 and a 2N307A, respectively. Diode D1 is a 1N1589, 4.7-volt, 3.5-watt zener diode and D2 a 1N-1693 diode. The relay (K1) is a Potter and Brumfield MR-11-D with a 6-volt coil. Resistor R4 is a half-watt unit while all other resistors are rated at one watt. Capacitor C1 is a 25-volt, 25-μF electrolytic. Both S1 and S2 are push-button s.p.s.t. switches, with S1 a "N.O." (normally open) and S2 a "N.C." (normally closed) type.

Operating power can be supplied either by batteries or, if preferred, by a line-operated supply as shown in Fig. 2. Switch S1 is a s.p.s.t. toggle or slide switch, R1 a 100-ohm, 2-watt resistor, and C1 a 2000-μF, 30-volt electrolytic capacitor. A 1-ampere fuse (F1) is used. Transformer T1 is a 117-to 25-volt, 1-ampere filament transformer (Stancor P-6469 or equivalent). The bridge rectifier, D1, D2, D3, and D4, is made up of four Sarkes-Tarzian M-500 diodes. Finally, D5 is a 3.8-volt, 10-watt 1N1599 zener diode.

With neither parts arrangement nor lead dress critical, the entire circuit, including the suggested power supply, can be assembled on a conventional chassis and placed in a small case or cabinet as desired. Good wiring practice should be observed, or course, with leads kept short and direct, and ample separation provided between power handling components.

Circuit Modifications. Several modifications may be made in the basic circuit of Fig. 1 for special applications. For example, a solenoid, a lamp bulb, or a suitable signaling device can serve in place of the relay as Q2's load. A thermostat or microswitch might be used in place of S1—the former for, say, fire protection, and the latter for a burglar alarm.

If increased sensitivity is needed, a simple preamp can be added to the basic design. Typical circuits are illustrated in Fig. 3. In each case, Q3 is a 2N34 or equivalent pnp transistor. Resistors R1 and R3 are half-watt

(Continued on page 94)
SPECIAL PROGRAM FOR DX'ERS

The Association of North American Radio Clubs (ANARC), a federation of all major listeners clubs in the U.S. and Canada, has arranged with the staff of Radio Gambia, Bathurst, Gambia, to broadcast a special program for DX'ers from 1500 to 1545 EST on December 15. The program, consisting of music and announcements in English, will be transmitted on Radio Gambia's regular 4820-kc. frequency. All reception reports will be answered and correct loggings will be verified. Reception reports, and inquiries concerning the broadcast, should be directed NOT to Radio Gambia but to: Special Broadcast, Association of North American Radio Clubs, Box 372, Kenosha, Wisconsin. Eventually, all reports that are received by the ANARC will be forwarded to Radio Gambia for the station's files.

VICTOR SYLVESTER AND HIS ORCHESTRA

The first broadcast made by Victor Sylvester and his Ballroom Orchestra took place in 1937. Since that time, he has been on the air regularly, topping every dance music poll taken by the Listener Research Department of the British Broadcasting Corporation. His extremely popular "Music for Dancing" program, in which he plays requests for listeners all over the world, has now run every week for 16 years.

Said to be the leading authority on strict-tempo dance music, Victor originally taught dancing at a time when very few recordings of the proper tempo for dancing were available. He was able to convince the Columbia Gramaphone Company that strict-tempo records would prove a worthwhile venture. They turned out to be an immediate success, and in 1963 Columbia presented Victor with a platinum disc denoting the sale of 30 million single records.

Victor started a "Television Dancing Club" in 1946; during these telecasts he conducts the orchestra and gives brief dancing lessons. Well over a million copies of his book, "Modern Ballroom Dancing," have been sold. In 1961, Victor was made an Officer of the most excellent Order of the British Empire by Her Majesty the Queen for his services to ballroom dancing. He is currently president of the Imperial Society of Teachers of Dancing, the largest dancing organization in the world—it has over 9000 members.

When chatting to his listeners, Victor's manner is friendly, his voice persuasive and


## ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>STATION</th>
<th>FREQUENCY (kc.)</th>
<th>TIMES (EST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Buenos Aires</td>
<td>11,780, 9690, 6090</td>
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<td>(also 15,285 at 2030; 11,990 at 2230)</td>
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After some three years of DX'ing, Warren Nordgren, WPE9DGI, Waukegan, Ill., has 78 countries logged, 51 verified. His receiver is a Hammarlund HQ-180. Encouraging, his details clear, his instruction expert and concise. The gentlemen who make the music, according to Mr. Sylvester, are Charles Pude, Jack Phillips, Oscar Grasso, Edward Pogson, Tony Mozr, Victor Parker, Bob Falloon, Bob Roberts, and Ben Edwards.

As we go to press, one of the best times to tune in Victor Sylvester is at 1815 EST on Mondays on 9510, 9580, 11,750, 11,780, 12,095, 15,070, 15,140, 15,260, 15,300, or 15,410 kc. Both the time and frequencies change occasionally, however, so it's a good idea to check the BBC program previews for upcoming schedules.

(Continued on page 102)
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Genoa Illinois 60135

Quality by design in sound reproduction

CIRCLE NO. 2 ON READER SERVICE PAGE

December, 1964
Some plain talk from Kodak about tape:

**physical testing and tape performance**

Magnetic tape is subject—day-in, day-out—to a wide variety of stresses and strains. That's why we are more than casually interested in its tensile properties. Tape is much like a rubber band. Put under tension, it will stretch. When the tension is released, it will snap back to its original shape. It will, that is, unless you've stretched it beyond its yield point. For if over a certain amount of longitudinal stress has been placed on a tape, the tape will lose its ability to recover and will, in fact, remain permanently elongated. Stretch it even further and, naturally, the tape will break.

Deformed tape will not reproduce sound faithfully. And tape that breaks too easily is just a plain nuisance. So we set our sights high and developed a special triacetate—called Durol base—that's exceptionally tough, yet breaks clean without “necking down.” In order to prove its worth and keep it that way, we developed a tight set of specs for our quality-control boys—specs which were a direct outgrowth of the conditions under which a tape is to be used. For example, the shock of going from fast wind to fast rewind. Or the shock generated on a running recorder when the supply spool jams.

We think that tape should be able to take this sort of punishment routinely. So, of course, we double, triple, even quadruple the requirements! And just to make sure that the tape performs we build torture tests that would have delighted Attila the Hun.

Here is one tester that is outstanding in its fiendishness. It’s called the High Speed Tensile Tester and is designed to break tape under load.

But like any good one-man band, it does a lot more than just one job. It not only breaks tape but gathers scads of very useful data as well—data which completely describes a tape’s tensile properties. Here’s how it works. It’s built like a tape deck with the tape attached to one half of a split-ring electrical strain gauge. We run the deck and then jam on the brakes on the supply reel but keep the take-up reel going. The strain gauge takes the full load and the split ring spreads and deforms. This deformation causes the gauge to change resistance and causes the DC voltage on it to pulse. We monitor the pulse on a scope and measure the duration. This gives us a figure of merit in terms of tensile strength.

Just how good is Durol base? Well, consider this data. Yield strength for Durol base is 47% greater than regular triacetate and 70% greater than diacetate (the two most common plastic support materials). Break strength is 43% greater than triacetate and 80% greater than diacetate. And this is the kind of test that almost duplicates actual use conditions on your tape equipment.

But any torture test one engineer can devise, another engineer can improve upon. Take the Toughness Tester, for example. This is an instrument designed to determine a tape’s strength (toughness) by measuring the force required to break a sample. A measured length of tape is held securely between two clamps. Then it is struck and broken by a falling pendulum. Because it has been raised to a fixed height, the pendulum always delivers a precise and repeatable amount of impact. The energy absorbed by the tape at impact controls the height of the
pendulum's backswing. Thus, a measurement of backswing height is a direct measurement of toughness. The strain rate that this device imposes is on the order of magnitude of 200,000% per minute—enough to break any acetate-based tape. How does Durol base compare to conventional acetates? Well, it comes through this test, too, like an Olympic star. In test after test, Durol base proves to be about 40% stronger. This toughness test also provides a valuable measure of permanent elongation. Durol base's unique "shear-pin" action lets it break clean with minimum elongation (less than 1% compared to 10% for other acetates). These are only two of the more interesting physical tests routinely performed on random samples of Kodak tape. There are dozens more, of course. And we haven't even gotten into electronic testing yet. But we'll save those for another day.

Choose Kodak Sound Recording Tape, Type 31A, for all general-purpose and low-print applications. Or Type 34A whenever you need high-output or low-noise characteristics. For extended playing times try our extra or double-play tapes...or try the new triple-play tape, so thin you get 3600 feet on a 7-inch reel. Kodak Sound Recording Tapes are available at electronic supply stores, camera shops, specialty shops, department stores...everywhere.

EASTMAN KODAK COMPANY
Rochester, N.Y.
Auto Voltmeter
(Continued from page 55)

Once the engine is running, the voltage should rise to full charge at higher speeds, gradually coming down to the lower running limit, which indicates that the battery has fully recharged from the starting drain. The final regulated voltage varies with temperature due to the temperature-sensitive elements built into the voltage regulator itself, so it's a good idea to consult the service manual for your own car to acquaint yourself with the range of voltages for the expected range of temperatures normally encountered by the accessories under the hood. Temperature could vary from 20° below zero to 150° F when you start off on a subzero morning and then drive in the early afternoon sun with a 180° thermostat in the cooling system. An occasional idling period at a long traffic light or busy intersection could send the temperature up quite high, even in cold weather.

Acquaint yourself with the high and low voltage limits for a good battery with the engine running, for both summer and winter, as well as the meaning of abnormal indications and how to recognize them. The battery voltage table shows typical voltage ranges for both 6- and 12-volt systems. Note the relationship between the two sets of figures: The values for a 12-volt system are approximately double those of the 6-volt system. This is understandable, when you consider that both are made up of the same type of individual 2-volt cells.

Because of normal deterioration in the plates of the battery, small particles flake off and fall to the bottom of the cell. As this process continues, the resistance of the battery goes up, and it is often possible to predict failure of a battery long before it dies. Under the usual starting conditions, the battery drain is not too excessive, and the battery will charge up normally. However, the time that it takes to regain the charge will increase as deterioration gets worse.

When the first cold weather comes, the demand upon the battery is considerably greater, and due to the large internal resistance, the voltage at the battery terminals is small. The battery must dissipate the power expanded in its internal resistance in the form of heat. If this heat is great, the plates buckle and the cell shorts and breaks down. It is interesting to note that most battery troubles show up during the first cold spell of winter.

A thorough check of a doubtful battery can be made as follows:

1. Check the liquid level, and measure the specific gravity of each cell before adding any water. Regardless of the state of charge (as indicated by the specific gravity), they should all read about the same. (The gravity will vary with the level of liquid.)

2. Unless the battery is discharged or near the lower limit voltage, measure the voltage across each cell while turning the engine over by means of the starting switch. (Disconnect the high-voltage lead from the coil to prevent the engine from starting.) This puts a heavy load on the battery and simulates actual starting conditions. If, under these conditions, each cell reads low but there is less than .1 volt difference between any two cells, the battery is good. If the voltage is low, the battery needs charging. If the cell measurements differ by more than .1 volt, the battery should be replaced.

3. Reconnect the high-voltage lead to the coil and start the engine. Measure the voltage across the battery with the engine idling. Now race the engine. The voltage should rise sharply from open-circuit voltage to normal charging voltage (depending on the state of charge of the battery) and drop back again as the engine slows down.

If the voltage does not increase sharply, the fault lies in the charging system (either the generator or voltage regulator). If it increases but remains high when the battery is known to be fully charged and good, the voltage regulator contacts are stuck closed. Prolonged running under these conditions can damage the battery. One symptom of this trouble is the need for excessive refilling of the cells with distilled water.
The lack of charging may indicate nothing more than worn generator brushes (or open rectifiers in alternator circuits), a dirty commutator, or burned or pitted contacts in the voltage regulator (the voltage regulator consists of a cutout relay, a current regulator element, and a voltage regulator unit, all with contacts). The correct method of cleaning and adjusting these contacts is outlined in the manufacturer's service manual. Quite often, a gas-station attendant will replace the whole unit rather than attempt a minor adjustment or cleaning of the contacts in a voltage regulator.

A convenient gadget for turning over the engine while working under the hood consists simply of a momentary-contact push-button switch, a pair of wire leads long enough to reach across the car (about 6 feet should be adequate) and a small battery clip on the end of each lead. The leads are connected across the starter control terminals of the starter solenoid. The push-button then does the same job as the ignition switch, but the engine will not start with the ignition switch in the off position. With this gadget, the high voltage lead need not be disconnected from the ignition coil.

The Payoff. You may be interested to hear that, as this article was being written, the author discovered that his charging system was not functioning—with the help of a panel-mounted voltmeter. The "Charge" panel light would come on, but as the engine speed increased with the car rolling along the highway, the light became very dim and appeared to have gone out. As a matter of fact, everything seemed normal—except the voltmeter reading, which was slightly under 12 volts.

Naturally, the charging system failed on a Saturday when the auto service department was closed (according to "Murphy's Law"). However, close and continuing checks of battery voltage showed that there was adequate charge left in the battery to last the weekend if all driving was done during the day, and if accessories were not used. By Monday, the voltmeter had more than earned its keep!
coils and windings. For most of the exotic superconductive metals and alloys (24 have been discovered to date) are too brittle, even at room temperature, to bend or shape without breaking.

Niobium-tin—a superconductive alloy that remains superconductive in high fields (as high as 200,000 gauss, researchers believe)—went into the Bell and RCA magnets. Westinghouse used another exotic—niobium-zirconium—for its device. Vanadium-gallium—a superconductive newcomer—shows promise of withstanding 400,000 gauss or more.

As for forming the too-brittle? Bell researchers turned the trick by enclosing the raw ingredients of superconductive niobium-tin (finely powdered niobium and tin) in an easy-to-shape pure niobium tube, then "drawing" the tube into a wire, winding it into a coil, and popping it into a 1000°C furnace to chemically unite the tin and niobium. The RCA process involves depositing a pure crystalline compound of niobium and tin on a moving substrate of stainless steel alloy.

Hushing Circuit Noise. Cryogenic cold can vastly improve the signal-to-noise ratio in many high-frequency receivers (100 mc. and above) by quieting the random and "noisy" collision of atoms within circuit components.

For example, NASA's great worldwide net of space-signal receiving antennas (the same antennas which tracked the fleeting transmissions from our recent lunar and Venus probes) owe their sensitivity in large part to cryogenics. The ruby "heart" of each antenna's ruby maser (tuned to the spacecraft's transmitted frequency) is immersed in a tank of liquid helium. The supercold helium (−450°F) freezes to immobility the ruby's usually "noisy" (and vibrating) atoms—noise which, if not hushed, might drown out the weak signals from distant space. Cryogenic cold cuts in half the ruby's internal noise, and thus in effect doubles the receiver's signal-over-noise ratio. Result: with their signal-detecting
rubies quieted, NASA's antennas can detect almost unbelievably weak signals.

Hughes Aircraft's "electronic ear"—the synthetic ruby of its 25-pound maser amplifier chilled to -452°F—was designed to increase by ten times the sensitivity, and thus the "hearing range," of Army electronic systems, particularly anti-ICBM radar.

Cryotron Supercold Switches. In 1956, a young MIT professor—Dudley A. Buck—put two and two together (the fact that superconductors have zero resistance, yet this perfect conductivity can be destroyed by a magnetic field) and came up with the wire-wound cryotron, a superconductive switch in which a small current in one wire (the cryotron "control") creates a magnetic field that shuts off a larger current in an adjacent wire (the cryotron "gate") by turning the gate wire resistive.

Crude as Buck's switch was (he actually wound a thin niobium-tin "control" wire around a thick tantalum "gate" wire), it was the forerunner of today's "thin film" computer memory and calculating cryotrons. It also proved that cryotrons behave like amplifiers—they exhibit "gain," a small current controlling a larger, and thus no further amplification is needed.

Thin Film Cryotrons. Hottest breakthrough in electronics is supercold "thin film" circuits, some so small that ten million individual switching devices (cryotrons and their components) can be crammed into a single cubic foot, the thin film switches operating at the fantastic speed of nearly one-billionth of a second (a nanosecond).

Thin film circuits—a giant advance over simple printed circuits or Buck's wire-wound cryotron—are made by depositing metal films (often only a few hundred angstrom units thick) on an insulator, such as glass. As many as 20 or more circuits can be wafered (a layer of insulation and film, then another layer of insulation and film), one atop another. Not only are thin film circuits faster than conventional computer ferrite-core "memories" (a number can be read from a core memory in about 1000 nanoseconds, but in 100 to 200 nanoseconds from thin film), but the computer's whole thinking process is (Continued on page 91)
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CIRCLE NO. 41 ON READER SERVICE PAGE

December, 1964

89
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POPULAR ELECTRONICS
speeded. Reason: electrical energy can travel only 1 foot in a billionth of a second. So in conventional computers signals spend more time traveling from core to core than being worked upon. Densely packed thin film circuits reduce transit time, speed up data processing, and capsule the size of computers.

Thin-film cryotrons depend, just as do simple wire-wound cryotrons, on the fact that zero resistance superconductivity can be destroyed (turned resistive) by a magnetic field.

Do-It-Yourself Cryogenics. Electronics' fantastic new frontier—cryogenic superconductivity—needn't be relegated to the commercial laboratory. You can, right now, put superconductivity to the test—and perhaps even to use—at your own workbench. With a minimum amount of equipment, you can devise a number of fascinating experiments, either for your own enjoyment or as the basis for a science fair project.

All you need is some cryogenic refrigerant and an insulated container (a good thermos will do) to hold it. A sizzling-cold quart of \(-450^\circ F\) liquid helium (available locally from cryogenic manufacturers or lab suppliers) costs as little as $15, and while it lasts (its life is measured in minutes or days depending on how well its container is insulated), lets you experiment with the electronic McCoy: superconductivity.

Lower-cost liquid nitrogen \((-320^\circ F\) ), while not cold enough to wring all the resistance from conductors (nor to turn them superconductive), is often cold enough to quiet the vibration of their atoms, hushing noise which nothing but supercold can quiet. Liquid nitrogen—about $1.50 a quart—is becoming available from many local truck-stop service stations (hundreds of refrigerated trucks now chill their cargoes with cryogenic cold). Bring your own container, such as a Dewar flask or an unstoppered thermos bottle.

A simple way to demonstrate the threshold of superconductivity is to merely place any carbon resistor in a container with a bit of liquid nitrogen. Bring leads out to an ohmmeter: The resistor's resistance will demonstrate a fantastic drop. A similar experiment can be performed by connecting a resistance in series with a small flash-
light bulb and battery, using a resistance high enough to keep the bulb from lighting brightly. Place only the resistor in the liquid nitrogen and watch the bulb grow brighter.

In the event that you would like to experiment with supercold components or circuits, keep the following precautions in mind: (1) Although liquid gases are not dangerous in small quantities, they tend to boil away rapidly. Work in a well-ventilated area. (2) Low-temperature burns may result if a liquid gas comes in contact with your skin—wear a pair of gloves and a long-sleeved shirt for protection. (3) Certain materials become brittle and may shatter when exposed to cryogenic cold. For this reason, always wear a pair of goggles or a face mask. (4) DO NOT try to seal a container of liquid gas; never allow the liquid to become trapped in a closed area.

Superconductivity: Past and Future. To put superconductivity to work, you’ve got to throw away your Fahrenheit thermometer—and some of electronic’s basic rules.

Let’s begin with that thermometer. In the chill world of cryogenic superconductivity, it’s the Kelvin scale you use. On Lord Kelvin’s low-low temperature thermometer, zero is absolute zero (−459.6°F). The higher up the scale you go, the warmer it gets. But in cryogenic supercold, it’s always unbelievably cold—always below −200°F, or about 144°K. By contrast, on the coldest day ever recorded (in the Antarctic), the temperature plummeted to a mere −100°F.

Actually, the realm of zero resistance superconductivity lies near the bottom of Kelvin’s scale ... roughly, between 0°K (absolute zero) and about 20°K.

To understand why, peek over the shoulder of Dutch physicist Heike Kam- erlingh Onnes as, one day in 1911, he tested—at increasingly lower temperatures—the conductivity (thus resistance) of mercury. Achieving temperatures within reach of absolute zero was, in itself, a feat in 1911. But Onnes managed the trick ... he was, at least, able to reach temperatures a few degrees above absolute zero. Now a sample of mercury (frozen solid, of course), shivered in his chill-chamber.
Things were going predictably: as he lowered the chamber’s temperature, the mercury’s conductivity grew better, its resistance less (but still measurable), and the metal itself grew ever more hard and brittle.

Suddenly, as Onnes dropped the temperature but another \( \frac{1}{10} \) degree, all electrical resistance vanished. Onnes didn’t believe his eyes, much less his instruments. Perfect conductivity—zero electrical resistance? Impossible!

Onnes had indeed stumbled upon a phenomenon—and he called it superconductivity. Somewhere near \( 0^\circ \text{K} \)—usually a few degrees above absolute zero—the resistance of some metals and materials doesn’t simply grow less; it vanishes completely. The material becomes a perfect conductor. The drop-off point—the precise degree \( K \) at which a material turns superconductive—is called its critical temperature.

For each of the 24 elements, alloys and compounds discovered, since 1953, to possess superconductivity (notably by Bell Telephone Laboratories), the critical temperature is slightly different: Tin becomes a perfect conductor at \( 3.7^\circ \text{K} \) (just a whisper above absolute zero); mercury, at \( 4.2^\circ \text{K} \); lead at \( 7.2^\circ \text{K} \); compounds of vanadium-silicon at \( 17^\circ \text{K} \) and niobium-tin (the compound with the highest known critical temperature) at \( 18^\circ \text{K} \).

Onnes’ elation—for he envisaged his superconductive mercury as capable, since it possessed no resistance, of carrying huge and nearly unlimited current—was short-lived. Shortly he discovered a second phenomenon which, though it punctured the dream of supercold wires carrying supercurrents, makes superconductivity today’s hottest electronic tool; namely, that the flow of high current through a superconductive wire kills superconductivity. More correctly, a material—no matter how cold-reverts to its resistive state at a certain current flow. Current itself is not the culprit—magnetism (caused by the current) is.

For each of the superconductive materials thus far discovered, there’s a critical field strength—the maximum magnetic field in which the superconductor can operate and still remain superconductive. Happily, this critical field strength is high (at least as high as 600,000-gauss) for some superconductive materials—vanadium-gallium, for one.

Moreover, the discovery only in 1962 that super-pure molybdenum was superconducting (the first new superconducting element found since 1953) has reopened research on many other materials previously tested and discarded. The answer is unbelievably purity. A trace of impurity (as little as one part per million) can conceal a material’s ability to become superconductive. Now many metals once believed non-superconductive are being looked into again . . . in their purest state. It is likely that some will prove able to withstand greater current flow, stronger magnetic fields and higher temperatures (above the present \( 18^\circ \text{K} \)) than any known superconductive material.

For the frontiers of the weird world of cryogenic supercold have hardly been explored. More—much more—awaits the electronic researcher there near the bottom of the bulb: absolute zero.
Transistor Topics

(Continued from page 78)

units. A 500,000-ohm potentiometer (R2) serves as a sensitivity control. Switch S3 is a s.p.s.t. normally open push-button type and PC1 a Clairex CL-3 photoconductive cell. Point "X" connects to the junction of R4, R5 and R6 and point "Y" to Q1's emitter. Remove SI.

In practice, the circuit shown in Fig. 3(a) is used where a very small control current is needed—less than 1.0 ma. through S1 as compared to approximately 15 ma. through S1 in Fig. 1. The circuits given in Figs. 3(b) and 3(c) are used where light-sensitive operation is desired, as in machine control, smoke detection, and burglar alarm applications.

Transitips. Many readers have asked for tips on identifying pnp and npn transistor types when the type numbers are either illegible or missing entirely, as in some "bargain" assortments. This is not a difficult job.

First, identify the emitter, collector and base leads. Most of the popular handbooks contain this information—typically, either the RCA or GE Transistor Manuals.

Next, using a low-voltage ohmmeter, connect the negative lead to the unknown transistor's base terminal and the positive lead to its emitter as shown in Fig. 4, and note the reading. Reverse the test leads and note the second reading. If the transistor is in good condition, an appreciable difference in readings will be observed when the leads are reversed.

If a lower reading is obtained with the negative test lead on the base, the transistor is a pnp type. If the reading is higher, the transistor is an npn unit. This technique is similar to that used to determine the front-to-back resistance ratio of a diode.

Best wishes for the happiest of Happy Holidays...—Lou

Fig. 4. To separate npn from pnp transistors when markings are missing, measure front-to-back resistance ratio between emitter and base. Readings are lower when the n element "sees" a negative voltage.
Across the Ham Bands

(Continued from page 76)

family, K6GHU, K6KCI, and WA6IBR, in Santa Barbara, Calif.
Fighting these legal battles requires a lot of money. If you'd like to supply some ammunition, you might want to contribute to one of these embattled hams. Personally, your Amateur Radio Editor thinks that the Chicago case is of the greatest fundamental importance, so that is where he sent his contribution—to the CARCC Tower Fund, 318 Adams St., Chicago, Ill. 60606.

Notes from Club Bulletins. Have we passed the low point of the current sunspot cycle? WØHJL says "yes" in the August, 1964, issue of Round Table, which is put out by the Denver (Colorado) Radio Club, Inc. He interprets the CRPL, U.S. Bureau of Standards Radio Propagation Predictions, as predicting a smoothed sunspot number of 17.5 for September, 1964—a half point better than for the preceding month. Others, using the same propagation charts, come up with a smoothed number of 12 for September, and estimate that the low point may not be reached until April, 1965. Whoever is right, many hams will be refurbished their 10- and 15-meter beams next summer.

According to the HARC News, W5FJS, an experienced electronics instructor, has opened a "do-it-yourself" electronics business in Houston, Texas, where hams can go to work on their equipment. A complete stock of tools and test equipment is available, with W5FJS on hand to give necessary instruction in the use of the test equipment.

If you hear about the public hanging of an Indiana ham, the victim will probably be a member of the Indiana MARS program. At last report, the 52 members had compiled a record of 100 percent participation for 11 consecutive months. Reading the Indiana MARS bulletin gives one the distinct impression that the member who spoils this record will be lucky if the other members do nothing more drastic than hanging him.

News and Views

John Babbitt, WN2LUX, Houghton, N.Y., also known as "Mr. Clean," transmits on a Knight-Kit T-150 held down to 75 watts. He receives on a Hallicrafters SX-98, and an 80-, 40-, and 15-meter dipole antenna is the go-between. Twenty states and two Canadian provinces worked plus a regular sked with California prove that the combination works. John Anderson, W8DZ, 5050 Collins Ave., South Pasadena, Calif., announces the formation of the California CW Club. Check with him for December, 1964
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DEtails . . . If he wasn't on the wrong coast, Bix Doolittle, K1EPX, would be a good prospect for membership. His code speed is 55 wpm.

Dave Warden, WN6LSZ, 15982 Del Prado Dr., Hacienda Heights, Calif., runs 75 watts to a Heathkit DX-60 transmitter feeding a 40 meter dipole, 5½' high. He receives on a Heathkit HR-10. Dave has 15 states, all worked on 40 meters . . . Buddy Kimsey, W4ANIV, 1707 Stuart St., Cleveland, Tenn., keeps his Hallicrafters HT-40 transmitter, SX-110 receiver, and Gotham V-80 vertical antenna busy. He is a net control station for two nets, likes to "rag chew" (he holds an R.C.C. certificate), and has QSL cards from 40 states and three countries. As a Novice, Buddy won the 1963 Novice Sweepstakes certificate for Tennessee . . . Ronald E. Telsch, WN3BFR, 153 Colonial Drive, Warminster, Pa., started out his ham career in overdrive. He made 24 contacts in 13 states his first two days on the air. He forgot to mention his present states worked total. But Ronnie uses an EICO 720 transmitter running 75 watts, a Hammarlund HQ-100 receiver, and a home-built brew, multiband dipole on the lower frequency bands. On 144 mc, his Heathkit "Twoer" feeds a 10-element beam atop a 30' stick. His 2-meter DX is 55 miles.

Jerry Haley, W64KTI, McMinnville, Tenn., started out as a ham by working 21 states and Canada in 21 days—not bad for an old Heathkit AT-1 transmitter running 10 watts! Since then, Jerry has been on the air only on weekends but has added another six states to his total. His receiver is a Lafayette HE-30, and his antenna is a doublet 38' high . . . Charles F. Lombert, WA4EPH, 314 Jamestown Rd., Williamsburg, Va., divides his time between 80- and 20-meter c.w. and 75-meter SSB. He receives on a Heathkit "Mohawk" and uses a Johnson "Viking II" transmitter on c.w. Charles didn't mention what transmitter he used on SSB, but his antenna is 40' high. He has 45 states and 320 different U.S. counties confirmed . . . From the W4CA Log via Auto Call, a ham was told that his c.w. signal had an undesirable keying chirp. When asked how his transmitter was keyed, he promptly replied "Through a hole in the front." . . . In our last batch of mail there was an interesting letter commenting on AM vs. SSB on 20 meters. The letter was not signed "for obvious reasons." For even more obvious reasons, it was promptly dropped in our wastebasket.

Gerard Van Loh, WN6JCV, Box 204, Lennox, S.D., will probably be signing his General call by the time you read this, but he will be glad to ask any ham who still needs a South Dakota QSL card on either 80 or 40 meters. Jerry's home-brew 40-watt transmitter has fed his signal into 27 states with the help of a vertical antenna and an inverted-V antenna. He receives on an old National NC-46 pepped up with a Q-multiplier and a home-built preselector . . . Have you been to the post office yet to stock up on the special commemorative stamp honoring amateur radio? Using these stamps to mail your QSL cards will add a note of distinction to your cards . . . Jim Evans, Jr., W9KLW, 8724 Parkway Drive, Highland, Ind., believes in this axiom: "Use low power if you must, but get the best receiver you can
afford." He receives on a Hallicrafters SX-117 and transmits on a Heathkit DX-40. A 40-meter dipole does the radiating—into 31 states, France, and Mexico so far.

Mike Rhodes, WN8NBO, R.R. 5, Box 305, Celina, Ohio, uses a National HRO-7 receiver that is far older than he is. But his transmitter is a new EICO 720. The combination has agitated the loudspeakers of hams in 32 states and Canada in six weeks of operation... Without knowing the results of the presidential election (which has not yet taken place as this is written), we wish to compliment the great majority of the hams that call and work Barry, K3UIG/K7UGA. Although he is always in great demand on the air, the ill manners often displayed by a few hams chasing a rare station are almost completely absent when Barry is being called or worked. Of course, Barry's own tact and good operating have much to do with this happy condition. May it long continue!

We are looking for your "News and Views," photos, and club bulletins. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, Popular Electronics, P. O. Box 678, Gary, Ind. 46401. 75,

Herb, W9EGQ

Module Pocket Receiver
(Continued from page 52)

this station is heard at maximum level. Now find a station at the high end of the band on the standard radio. Rotate the knob until the plates are fully open.

(Note: whether the plates should be fully open or less than fully open depends upon the actual position on the dial occupied by the station. The same is true for the position of the plates and the radio station at the low end of the band. If the standard radio has, say, 10% rotation from maximum, adjust

the radio you have just built to 10% from maximum in a similar manner. Unless you are working with a pre-marked tuning dial, the exact position of the variable capacitors is not critical, so long as you can tune in all the stations.) When the plates are fully open, the trimmer capacitors on C1a and C1b have their maximum effect. Adjust the trimmer on C1b until the station on the upper end of the band comes in, then adjust the trimmer on C1a for maximum volume.

Now go back to the low end of the band and repeat the entire procedure. "Rock" and peak all the adjustments. You can align the set in less than five minutes. If desired, either the case or a small dial mounted under the tuning knob can be marked to show the location of the stations in your area.

As the volume level goes up during the alignment procedure, reduce the level with the volume control to enable you to more easily detect variations in signal level.

Transformer Quiz Answers
(Quiz on page 65)

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CIRCLE NO. 23 ON READER SERVICE PAGE
Exalted Pot

(Continued from page 72)

brated also, because both pots are of the linear type. Simply switch S1 to 10K and multiply readings by 100. With S1 in the 1K position, you would of course multiply the readings by 100.

To calibrate a capacitance scale, find the capacitance value and mark the appropriate resistance point. At 836 ohms, mark 1.9; at 800 ohms, mark 2; etc. No further calibration for capacitance is required. The other three ranges of capacitance fall into line because the controls are linear. With a 100-cycle test signal, the C or C/10 scale applies, depending on S1's position. With a 10,000-cycle signal, the ranges become C/100 and C/1000. Simply flip S1 to the desired range. Consult the calibration charts on page 72 as you work.

An inductance scale is calibrated similarly. At 62.8 ohms, mark 1; at 125.6 ohms, mark 2; etc. Refer to the first two columns in the calibration table. Here again, because the controls are linear, the other ranges do not require further calibration. With a test signal of 10,000 cycles, and with S1 at position L, you can read 1 to 15 mh, directly. With S1 in the Lx10 position, multiply readings by 10 and read 10 to 150 mh. The ranges at 100 cycles are: Lx100 for readings from 0.1 to 1.5 henrys, and Lx1000 for values from 1 to 15 henrys.

Operation. Connect the generator output to jack J1 and the unknown component to terminals C and Gnd. Connect your VTM first to C and Gnd, and then to B and C. Adjust the knob to obtain the same voltage readings. When the voltages are equal, the scale can be read. Keep in mind that the applicable scale depends upon using the correct test frequency and position of the range switch. Also remember that electrolytic capacitors are polarized and are designed for d.c. operation—you may not be able to determine their values with this technique.

To use the "Exalted Pot" as a variable resistor, terminals B and C are employed. For 0-1000 ohms, set S1 to the
Electric Fence Charger

(Continued from page 60)

find out if the fence is being charged, connect the neon tester between the ground and the fence. The higher the intensity of the flash, the greater the charge. To minimize the possibility of shock, first connect the tester's lead to ground.

To keep a garbage can from being raided, place a small sheet of thin plastic material (the kind that plastic bags are made of) under the can. The plastic sheet should be just large enough to insulate the garbage can from the ground.

If the can is to be placed on a dry cement or gravel walk, first lay down a piece of metal screen, about 2' x 2', to serve as a ground. It should be big enough so that a dog will have to stand on it when he reaches out a paw for the can. Cover the screen with a piece of cardboard, then place the sheet of plastic over the cardboard, and then place the can over this “sandwich.” The cardboard keeps the screen from puncturing or tearing the plastic. Both the cardboard and the piece of plastic are just a little bit bigger than the can but not big enough to prevent the dog from standing on the bare screen.

Run an insulated wire from the garbage can to the red post on the charger, and either a bare or insulated wire from the ground to the black binding post. (Better turn off the charger before the garbage collector arrives, or he may decide to take you in along with the garbage.)

One shock per invader should be enough. You will probably see some of the most surprised poohers you ever saw in your life.

December, 1964
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On the Citizens Band
(Continued from page 74)

If you have not forwarded information regarding your club this year, chances are you may not be included in the actual tabulation, which, of course, will not give us accurate results. All clubs are now requested to forward the latest officers’ names, club address, activities engaged in or planned, photographs, etc., regardless of whether they have been sent prior to 1964.

Since this material will not be analyzed until after Jan. 1, 1965, those of you who are not as yet represented by information sent to the roster this year should forward the details before Dec. 31, 1964, to: 1964 OTCB Club Roster, Popular Electronics, One Park Avenue, New York, N.Y. 10016.

- Parksburg Area CB Club, Parksburg, W.Va. Officers: M. H. (Windy) Mercer, KLM6947, president; Carolyn Griffith, KJH-6055, secretary. Recently organized, this club holds meetings on the first and third Tuesday of each month.
- Conemaugh Valley Communication Association, Johnstown, Pa. Officers: Robert Yeager, KID2795, president; H. K. Rummel, KLP2147, vice president; Donald Hamilton, Sr., KLP6213, secretary; James L. Lear, KIC7911, corresponding secretary; Gustav Simanski, KID9068, treasurer; Harry Caufield, KLP6044, control director. Meetings are held every first and third Wednesday at 7 p.m.
- Ten-Ten CB Club, Eastland, Texas. Jessie True, KKL6189, secretary. Jessie should be contacted at 114 N. Seaman, Eastland, by those in the area interested in joining this group.
- New York City Citizens Band League, New York, N.Y. This club is a reorganization of a club in Queens that was disbanded. Kenneth Doerbecker, KBI7329, requests interested parties to call him by landline at V17-7531.
- Northern Rhode Island REACT, Woonsocket, R.I. Composed of five divisions covering emergency CB service to nine towns, this group consists of 80 REACT members and 14 directors and deputy directors, with Peter E. Brancenon acting as control director.
- Town & Country Radio Club, Lakeville, N.Y. Officers: Don Richards, president; Clifford Cisco, vice president; Carl Gilbert, secretary; Peg Richardson, treasurer. There is also an executive committee of five, plus five directors, an editor-in-chief, an advertising manager, and seven contributing editors to the club paper, The Whip.
● Hopkins County Radio & Rescue Association, Madisonville, Ky. This emergency group conducts searches, establishes lines of communication, handles traffic control and recovery of drowned persons. A county directory listing CB’ers by calls is published, cross-referenced by alphabetical listings. Officers: Justice Rhodes, president; Charles Jenkins, vice president; Joe McWhorter, secretary/treasurer. The Association monitors channel “9.”

● Seacoast Citizens Radio Club, West Atlantic City, N.J. Officers: Russ Stokes, KCC1719, president; Tom Gallo, KCC3013, vice president; Warren Fox, 3Q0059, second vice president; Dot Stokes, KCC1852, treasurer; and Jean Truman, KCC2378, secretary. The group publishes Seacoaster’s News, has an editor and three reporters. Meetings are held monthly at the West Atlantic Volunteer Fire Company quarters, West Atlantic.

● Colorado County Citizens Band Radio Club, Cat Spring, Texas. Officers: Nolan L. Renz, KED0038, president; Buster Mooney, KED0228, vice president; Franklin Reese, KEE2150, secretary/treasurer; plus three net control officers and five directors. Meetings are on the second Wednesday of each month.

● Marshall County CB Radio Club, Guntersville, Ala. Officers: L. C. Mitchell, 6Q3852, president; Johnny Dunn, KDB5040, vice president. There are also three board members and an emergency team coordinated through police and other civic groups by the president.

● Citizens Emergency Radio Patrol, North Tonawanda, N. Y. Officers: John McKnight, 2Q4712, president; Vernon Batt, KIC5311, secretary; Ronald Beu, KID3474, treasurer; and Wayne Shoen, KIC5821, sergeant at arms. This emergency group works closely with the Frontier Fire Company, holds practice emergencies, and expects to put two or three skin-diving teams plus marine units in action by next summer.

● Civil Defense Citizens Band Radio Club, Concordia, Kan. Officers: Derald Deal, president; Kenneth Bullegh, vice president; Wm. Rae Heffner, secretary; and Dallas Hockett, scribe. They publish a call book covering a 50-mile radius of Concordia.

● South Georgia C Bees, Brunswick, Ga. Officers: Matt Whorton, KDE1598, president; Harold Hood, KDD9269, vice president; Gene McDaniels, KKM3038, secretary; Ann Whorton, KDE1598, treasurer; Jimmy Jones, KDB7328, REACT commander. There are three board members, and The CB Monitor is put out by editor Ronald Weston, KHD5750, and three assistants.

That wraps it up—for the year! I'll CB'ing you in '65!

—Matt, KHC2060

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December, 1964
The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used. Reports should be sent to P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the eighth of each month; be sure to include your WPE Monitor Registration and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to all contributors.

Angola—R. Angola, Luanda, is on 4885 kc. and is heard in Eastern areas from 1645 with instrumenals. A combination of c.w. QRM and HJIP (Dominican Republic) on 4884 kc. make Luanda difficult to receive.

Basutoland—The Lesotho Broadcasting Corporation, Maseru, will broadcast on the short waves before the end of 1964, according to overseas sources. However, the official name will not be used at first since Basutoland will not become Lesotho until 1966.

Bolivia—A new station is R. 21 de Diciembre, Kathvi, 5120 kc., reportedly operating from a mine near Lallagua. Programs consist mostly of Latin American and Bolivian music with few anmnts from 2045 to 2202/close.

Another new Bolivian station is R. Nueva America, La Paz, 4795 kc. Noted broadcasting in Spanish, it has been heard from 2247 to 2302/close with many ads. According to some sources, reports go to Casilia 2431, La Paz.

Brazil—A rarely heard station is PSL, Agencia Nacional, Rio de Janeiro, on 7935 kc. It has been noted around 1730-1800 with operatic music but accompanied by very heavy RTTY QRM.

A new station is R. Educadora Rural, Campo Grande, 3295 kc. Noted after another Brazilian (in Uberlandia) signed off, it features Brazilian vocals and commercials until 2300/close.

R. Marajoara, Belen, 15,245 kc. has extended its schedule and is now heard well afternoons with s/off at 1600.

Chile—Station CES97, R. Presidente Balmaceda, on the new frequency of 5978 kc., has been noted from 2230 to 0005 s/off. There is a full ID in Spanish at 0000, during which reports are requested. There may be an anmnt in Eng. at this time some days.

Cyprus—If you need this country, try for the Cyprus Telecommunications Authority, 10,-

P A K S

CIRCLE NO. 24 ON READER SERVICE PAGE

102 POPULAR ELECTRONICS
Ecuador—Station HCEH3, R. El Progreso, Loja, listed for 4775 kc. but actually on 4700 kc., has been noted from 2145 with lengthy periods of local music to 2330/close. The only ID noted was at 2242.

El Salvador—Evidently reactivated, YSS, San Salvador, has been found on 6010 kc. at 2250-2328 with music and Spanish but accompanied by considerable QRM.

England—The British Broadcasting Corp. is carrying out experimental xmsns on single sidetones, relaying the General Overseas Service, at 2200-0000 on 9317 kc., at 0100-0300 and 0415-0445 on 15,913 kc., and at 0830-1245 and 1300-1715 on 12,182 kc.

A special Australian xmsn was noted on 15,105 kc. at 1200 with a cricket match and at 1415 with Eng. lessons in French to Europe.

Fiji—Present short-wave operations of R. Fiji are in Eng. at 1300-1600 and 2200-0530 on 3230 kc. and at 1630-2300 on 4758 kc., and in native language during the same time periods on 3284 and 5785 kc.

Germany (West)—Deutsche Welle, Cologne, has been found on 11,785 kc. with Eng. to Africa at 1515-1548; it goes into French at 1550.

Gibraltar—This is another difficult country to log. Look for MLU, a station of the British Royal Air Force, on 4615 kc. It’s a c.w. station which has been noted around 0030 with a reasonably slow running marker. Reports go to: Chief Operator, Radiotelegraph Station MLU, British Royal Air Force, Gibraltar. A companion station, MLU2, operates on 11,855 kc., but this one has not yet been logged.

Guinea—Conakry on 9670 kc. is heard at 1715-1730 with continuous African music and anmts in French.

Honduras—Station HRST, R. 1º de Mayo, Tela, can be noted on 4790 kc. with Latin American pop tunes and commercials from about 2125 to 2158/close, but don’t confuse it with R. Atalaya, Guayaquil, Ecuador, on 4789 kc.

Station HVR1, R. Luz, Olanchita, Yoro, 4890 kc. operates at 0700-2200 with 1000 watts. Not likely to be heard in most of N.A. is their 1230-1300 daily Eng. feature, “Norteamerica y su Musica.”

India—All India Radio has Eng. on 15,225 kc. at 0830-1000 (news at 0831, commentary at 0840). Reports go to Box 500, New Delhi. Also

December, 1964 103
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logged recently were Eng. xmsns to East Asia and China at 0500-0600 on 9520, 11,770, 15,105, and 17,855 kc.; at the same time to Australia and New Zealand on 11,710 and 15,165 kc.; and to the British Isles and Europe at 1445-1545 on 6130 kc. (replacing 5995 kc.) and on 9915 kc.

Iran—R. Iran, Teheran, is noted on 15,205 kc. at 1330 in Arabic, at 1500 in French, and at 1430 and 1530 in Eng., dual to 11,730 kc. This is the station being widely reported behind R. Nederland's Sunday program on 11,-730 kc. There is an Eng. newscast at 1530.

Israel—The 1515-1545 Eng. xmsn from The Voice of Israel is noted at good level on 9009 and 9620 kc.

Korea (South)—Seoul has Eng. at 2200-2230 and 0230-0300 on 11.925 kc., and at 0530-0600 on 9640 kc. in the General Service, and at 0900-0930 on 11.925 kc. to S. E. Asia. French to Europe is aired at 0200-0230 and to S. E. Asia at 0930-1000 on 11.925 kc. Spanish to L.A. can be heard at 2230-2300 on 11.925 kc.

Kuwait—Kuwait was noted recently as late as 1600 with Arabic chanting and talks on 4867.5 kc. This station has Eng. at 1300-1400 (news at 1315) on the above outlet in parallel with 9520 kc.

Leeward Islands—R. Montserrat, Box 51, Plymouth, 885 kc., has been noted around 1800-1900. Their schedule reads: daily at

DX COUNTRY AWARD RULES

Are you eligible to apply for a 25, 50, 75, 100, or 150 Countries Verified Award? Here is a brief resume of the rules and regulations.

(1) You must be a registered WPE Short-Wave Monitor and show your call on your application.

(2) You must submit a list of stations for which you have received verifications, one for each country heard. You must also supply the following information in tabular form: (a) country heard; (b) call-sign or name of station heard; (c) frequency; (d) date the station was heard; (e) date of verification. All of the above information should be copied from the station's verification. Do not list any verifications you cannot supply for authentication on demand. Do not send any verifications at this time. Should any verifications need to be sent in for checking, we will notify you and give you instructions on how to send them.

(3) A fee of 50 cents (U.S. coin) must accompany the application to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible. Applicants in countries other than the U.S. may send the equivalent of 60 cents (U.S.) in coins of their own country if they wish.

(4) Apply for the highest DX award for which you are eligible. If, at a later date, you are eligible for a higher award, then apply for that award.

(5) Send your application, verification list, and fee to: Hank Bennett, Short-Wave Editor, P. O. Box 333, Cherry Hill, N. J. 08034. Do not include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the awards until you have a Short-Wave Monitor Certificate in your possession). Reports, news items, or questions should be mailed in a separate envelope.
**DX States Awards Presented**

To be eligible for one of the DX States Awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in 20, 30, 40, or 50 different states in the U. S. The following DX'ers have qualified for and received awards in the categories indicated.

**Fifty States Verified**
Ron Kusmack (VE4PE4U), Winnipeg, Man., Canada
John Toikkanen (WPE8FFD), Conneaut, Ohio
Jack Winther (WPE6BJD), Moraga, Calif.
Walter Smart (WPE8EKW), Pittsfield, Ill.
Paul Larsen (WPE502YE), Tinley Park, Ill.
Michael Mandruck (WPE2GZF), Rochester, N. Y.
James Pierce (WPE9EYQ), Mt. Vernon, Ill.
David Algeo (WPE8E2Z), Dayton, Ohio
Joseph McDaniel, Jr. (WPE3XY), Hagerstown, Md.

**Forty States Verified**
Edward Semrad (WPE9GTP), Milwaukee, Wis.
Michael Fletcher (WPE4DPS), Waco, Texas
Robert Berg (WPE5ANO), Fort Worth, Texas
R. Maybaum (WPE6GAU), San Francisco, Calif.
George Hemingway (WPE1DYG), Taftville, Conn.
Craig Larson (WPE9GJE), Indianapolis, Ind.
Ray Schubnel (WPE1AGS), North Adams, Mass.

**Thirty States Verified**
Edward Craven (WPE1FUA), Hartford, Conn.
David Kaplan (WPE1F7J), Hartford, Conn.
Gene McAvoym (WPE3FSR), Lutherville, Md.
Jesse Ring (WPE4GLX), Narrows, Va.
Joseph Sudol (WPE2JHP), Garfield, N. J.
John Day (WPE9AXQ), Kinnmund, Ill.

**Twenty States Verified**
Ronald Shopinski (WPE3DKA), Mt. Carmel, Pa.
Jack Pleska (WPE3EUN), Simpson, Pa.
Mike Rhodes (WPE8GAY), Celina, Ohio
James Jordan (WPE5CYL), Laurel, Miss.
Mal Gogol (WPE2LQD), Huntington Station, N. Y.
Mike Fisher (WPE3FOD), Pottsville, Pa.
Henry Brown, Jr. (WPE1EXZ), Falmouth, Mass.
David Kaplan (WPE1F1J), Hartford, Conn.
William Steckiel (WPE3FPX), Pottsville, Pa.
George Hall (WPE2KOR), Saddle Brook, N. J.
Philip Drago (WPE6FAV), Santa Monica, Calif.
Michael Hofferberg (WPE2KMX), Bronx, N. Y.
Conrad Durocher (WPE1ASP), N. Smithfield, R. I.
Alan Zajac (WPE4HMY), Hampton, Va.
Billy Akin (WPE4EUW), Columbia, Tenn.
Ray Hartman (WPE9GON), New Berlin, Wis.
Elliott Block (WPE8HGD), Cincinnati, Ohio
Tim Kerfoot (VE3PE1TH), Toronto, Ont., Canada
Nick Oliviero (WPE1FMD), New Britain, Conn.

Steven Russell (WPE3E2WZ), Bethesda, Md.
Edwin Bolto, Jr. (WPE2KWO), Wayne, N. J.
Mertin Bakke (WPE9DJC), Westby, Wis.
Edward Hudgens (WPE6FE), Gardena, Calif.
Timothy Pawlak (WPE8BHZ), Bay City, Mich.
David Evans (WPE8CGX), Pataskala, Ohio
James Peshock (WPE5DOD), Richardson, Texas
Stephen Dionne (WPE2LOU), Binghamton, N. Y.
Dick Schler (WPE4HIO), Chattanooga, Tenn.
Richard Shaw (WPE2KIT), N. Bergen, N. J.
Don Van Wienen (WPE8HBN), Allendale, Mich.
Kenneth Feldman (WPE6DUX), Los Angeles, Calif.
Tom Rupe (WPE9DJK), Park Ridge, Ill.
Jim Russell (WPE9GYH), Moenith, Ill.
Peter Hartquist (WPE6FNY), Fairfield, Calif.
Bob Thrower (VE7E7W), Vancouver, B. C., Canada
Sonny Lea (WPE4GCP), Rocky Mount, N. C.
Vincent Yucas (WPE1FJA), S. Boston, Mass.
Neal Yermish (WPE3FMH), Philadelphia, Pa.
Jim Skatoff (WPC0CHB), St. Louis, Mo.
Joel Resnick (WPE2LMZ), New York, N. Y.
Arthur Bonito (WPE2DZE), Secaucus, N. J.
Michael Sevigny (WPE1FTG), Biddeford, Maine
Stephen Berlinski (WPE1FTF), Bridgeport, Conn.
Robert Read (WPE4HPB), Atlanta, Ga.
Thumper Person (WPE2LY), Chester, N. J.
Peter Bartlett (WPE1FSK), Marshall Hills, Mass.
Robert Ramlow (WPE6FQQ), West Allis, Wis.
C. R. Schwesig (VE2E1CM), Verdon, Que., Canada
Brian Dexter (WPE2IEF), Hastings-On-Hudson, N. Y.
Douglas Byron (WPE2LOR), Poughkeepsie, N. Y.
Joe Beals III (WPE1FRF), Marshfield, Mass.
Glen Wright (WPE9EQ), Findlay, Ill.
Michael Cripps (WPE3DAT), Lake Forest, Conn.
Charles Wohlers (WPE2IRQ), Mountain Lakes, N. J.
Bob Wallenhorst (WPE84HFM), St. Bernard, Ohio
Warren Leach (WPE8HOK), St. Clair Shores, Mich.
George Virtue (WPE6FKE), Waterford, Calif.
David Husom (WPE0CQ), Richfield, Minn.
Andrew Durosky, Jr. (WPE2KWW), Richmond Hill, N. Y.
Rick Hoebbe (WPE6EJB), Sunnyside, Calif.
Arthur Harris (WPE2MS), Hollis, N. Y.
Mozambique—Station CR7RA, R. Pax. Beira, opens at 2300 weekdays on 3060 kc. and has been noted to 2345 or later with pop tunes and all-Portuguese annons.

Netherlands Antilles—Reports are pouring in on PJB, Trans-World Radio, Bonaire, with excellent reception being noted on the West Coast for the 800-kc. outlet. The daily schedule for this frequency, as given by the station, is as follows: Portuguese at 0330-0430, Spanish at 0430-0530, Eng. at 0530-0730, Dutch at 1715-1730 (Fridays only), Spanish at 1800-1815, (Thursdays only), and Eng. at 2030-2200. The schedule for Sundays reads the same except that Eng. is given at 0530-1700 and Spanish at 1700-1815. However, the schedule as released by R. Nederland lists "The Happy Station Program" on Eng. on Sundays at 1910-2030; has anyone heard it yet? Station PJB has been testing on 5855 and 9705 kc. 800-kc. at 1900-0130 in Eng. and Spanish. Reports are requested and return postage is not required. A late report indicates that 11,855 kc. may be another test channel, for it was noted at 0900-1000.

Peru—A new station is R. Jaen, Jaen, Provincia de Cajamarca, logged at 2145 on 5005 kc. The ID is La Voz de la Frontera.

Portugal—The Voice of the West, Lisbon, has a DX program on the second and fourth Sundays of each month at 2115 and 2315 on 6025 and 6185 kc.

Portuguese Guinea—Bissau is back on 5017 kc. and was noted at 1600 with Portuguese music and both male and female announcers.

Uganda—R. Uganda, Kampala, is weak at 1600 on 5026 kc. with a woman giving final annots in Eng.; s/off is at 1604.

U.S.A.—Keith Glover of R. Australia reports that the U.S. intends to establish a communications station in the Indian Ocean. The U.S. has evidently conferred with British officials on the plan. The station will be built on an island and its purpose will be to help facilitate traffic in that part of the world.

U.S.S.R.—A new type of jamming has been noted, consisting of Russian-language programs with frequency modulation. This is apparently being used on some jammed channels in addition to the usual type of jamming.

**SHORT-WAVE ABBREVIATIONS**

annmt—Announcement
c.w.—Morse code
Eng.—English
ID—Identification
kc.—Kilocycles
k.w.—Kilowatts
kr.—Radio
QRM—Station interference
QSL—Verification
RTTY—Radioteletype
s/off—Sign-off

N.A.—North America
QSL—Verfication
Reykjavik—Engineering Department advises that the relay station in the Maldives is not yet in operation. Quite apart from the technical requirements and the building of such a relay base extension, some time must elapse for various political arrangements to be completed."

**ABBREVIATIONS**

anmt—Announcement
c.w.—Morse code
cr.—Radio
ID—Identification
IT—Interval signal
c.kc.—Kilocycles
k.w.—Kilowatts
QSL Cards For You?
The SWL QSL Bureau is currently holding QSL cards for the following WPE Monitors. If your WPE registration is listed here, send a stamped, self-addressed envelope to Mr. LeRoy Waite, 39 Hannum St., Ballston Spa, N.Y. 12020, and your card(s) will be forwarded to you.

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WPE1EKE  WPE21QK  WPE5BZD
WPE1ESB  WPE21VS  WPE5CHE
WPE1FDW  WPE21XG  WPE5CUC
WPE1FGM  WPE21NI  WPE5DAX
WPE2CFM  WPE3DNC  WPE6CJ
WPE2CON  WPE3DOV  WPE6DQD
WPE2DMN  WPE3DVE  WPE6DRR
WPE2FG  WPE3DYL  WPE6FCN
WPE2GQD  WPE3EFF
WPE2HK  WPE3ESC  WPE7BLZ
WPE2HXV  WPE3FKR  WPE9FCQ
WPE21AR  WPE3FO
WPE21AV  WPE4FCS  DL1PE1AP
WPE21JB  WPE4FL  DM1PE1AE
WPE21KU  WPE4FPL  TA3PE1J

Vatican City—Vatican Radio, 15,290 kc., is good at 1000-1010 with world-wide religious news; after an IS hymn, played on a celesta, Polish was heard. This xman was dual to 7250, 9645, and 11,740 kc. The latter three channels were also heard well at 1940-2005 with religious news in English.

Vietnam (North)—The Voice of Vietnam cannot be reached by mail as the Universal Postal Union will not deliver incoming mail to Hanoi. (In similar instances in the past, particularly in connection with mail service to Iron Curtain countries, reports addressed to the station in care of Radio Moscow have usually reached their destination—Ed.).

Yemen—A Maryland reporter writes: “In the local newspaper, I read that Yemen, Arabia, and other countries have signed a radio pact, thus adding more assurance to my earlier report that Yemen was, in fact, setting up a station.” Meanwhile, information gathered at the Yemen pavilion at the New York World’s Fair reveals that R. Sana, 5510 kc., is now up to 70 kw. (it was 25 kw.) and is scheduled to operate at 2200-0100, 0600-1000, and 1100-1700.

Clandestine—Some time back we stated that a listed address for Radio Libertad, 2113 Ocean View Drive, Miami Beach, Fla., was fictitious since that location turned out to be a section of open beach. However, a correction now indicates that the proper address is Box 2113, Ocean View Branch, Miami Beach, Fla. Reports may also be sent to Box 5550, Caracas, Venezuela. The station is now being noted afternoons on 15,050 kc., and on 7308 kc. at 0100 and 2020, but these frequencies may vary.

Kiss Me Honey has been logged on 9555, 11,700, and 11,850 kc. at 0800. The afternoon xman, usually ending around 1345, is often noted behind Peyk-e Iran until that station signs off, then is in the clear. For those who have not logged Kiss Me Honey, the station makes no announcements and the recording from which the station derives its nickname

December, 1964

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ONLY $79.95

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CIRCLE NO. 40 ON READER SERVICE PAGE

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All certificates are filled in and lettered before mailing; they are mailed flat and unfolded. If you want to register and receive your WPE identification sign, fill in the application blank below before January 15, 1965. Mail with 25 cents in coin to: Monitor, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y., 10016. Canadians should use their own currency. All other applicants not in the U. S. A. should use five International Postal Reply Coupons. Allow 4-6 weeks for processing.

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<td>Street, City and Zone</td>
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<td>State and Zip</td>
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<td>Receivers in use</td>
<td>Make Model</td>
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<td>Make Model</td>
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<td>Age Occupation</td>
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<tr>
<td>Ham/CB call-letter assignment(s)</td>
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<tr>
<td>I listen mostly to SW Broadcast Hams CB BCB VHF VLF</td>
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<tr>
<td>I use the following antennas</td>
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<tr>
<td>I have QSL cards and countries verified.</td>
<td>Check if subscriber to P.E.</td>
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<tr>
<td>Signature Date</td>
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*(Good only until January 15, 1965)*

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**Pre-tuned/pre-packaged IF strip**

Model 8902 pre-tuned 455 KC IF strip provides excellent gain (55 db) and selectivity (6 db bandwidth: 3 KC). No alignment is required. Included among the 21 components on the PC board are a mechanical filter, 2 transistor amplifiers and a diode detector capable of driving earphones. Overall dimensions: $\frac{3}{4}'' \times \frac{3}{4}'' \times 1\frac{1}{2}''$.

Model 8901 input IF transformer adapts the IF strip for use with a converter in capacity detectors, AM and CB receivers. Both units are included for $5.75 net.

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is played in a manner that would indicate it to be a continuous tape.

Radiofonikos Stathmos I Foni Til Alithias (Voice of the Truth), a quasi-clandestine Greek station, has been noted in Europe on 8071 kc. at 1255. It is believed to be operating in Eastern Europe, probably in Leipzig.

Voice of the Turkish Cyprus Fighters is listed by some groups as being in operation at 0300-0445, 0800-1040, and 1430-1630 on "41, 44, and 48 meters" in Turkish. No exact frequencies are given but one is thought to be 6700 kc.

International Waters—R. Albatross, a converted minesweeper, is to start operations for 13 hours daily from the Wash beachhead to East Anglia. No frequency was listed.

R. Noordzee, a new pirate station beamed to the Dutch from a platform in the North Sea, operates on 1400 kc. and is currently scheduled at 0400-0600 and 1100-1500. This station reportedly will open a TV outlet with an ID of Television North Sea.
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**December, 1964**

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# The Wonderful World of Lids

(Continued from page 70)

the rig is working," Pheobus said hurriedly as he twisted dials, threw meters, and stepped on the accelerator.

"Whiskey baker two yellow banana peel, this is kay two brown spotted zebra. What say old man?"

"How do you know he's an old man?" I asked. "And is brown spotted banana peel a code name?" Pheobus just grimaced and looked pained as he listened to his microphone, waiting for a reply.

"Sorry brown spotted zebra," the voice came back. "I can barely read you—you're way down in the mud . . ."

Before I could ask him what this "mud" business was about, Pheobus went into action. "Cue are X there, I'm running in my bare feet. I'm switching over to the linear."

Pheobus' feet were not bare, but I thought it would be better not to remind him, for he was in a frenzy. Lights came on, dials began to spin, and the air smelled like ozone.

"How do you read me now, old man?" Pheobus asked the cyclotron.

"Sorry brown spotted zebra," said the voice. "Your sigz are three by four. Sorry I can't stick around as I have a sked coming up with Yankee Victor three papa whiskey, and he'll be looking for me. Seventy-three. Kay two brown spotted zebra, whiskey baker two yellow banana peel is cue are zed."

"Three by four!" Pheobus raged. "He must be using a crystal set. Why that lid . . . I ought to . . ."

WHEN I left, Pheobus Sharney was seated morosely before his monster, staring out into space and occasionally mumbling something that sounded like "lid." I have pondered this term and the many others used during this strange, revealing session. Dictionaries do not seem to carry them.

I can only conclude that radio hams live in a world of their own, and have invented a special language to baffle casual intruders. To use their strange word of approval, I call it "The Wonderful World of Lids."
FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, components. Poly Paks. P.O. Box 942, Lynnfield, Mass.


CB WPE QSL Cards, Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

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TRANSISTORIZED Products Importers catalog, $1.00, Intercontinental, CPO 1717, Tokyo, Japan.


CB WPE QSL Cards, Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

TV CAMERAS, transmitters, converters, etc. Lowest factory prices. Catalog 10¢. Vanguard, 190-48 99th Ave., Hollis, N.Y. 11423.

WEBBER Labs. Transistorized converter kit $5.00. Two models using car radio 30-50Mc or 100-200Mc, one Mc spread. Easily constructed. Webber, 40 Morris, Lynn, Mass.

SIMPLEX transistor system described February Popular Electronics. Complete kit quality components, $15.00 Postpaid. Electromart, 1616 South 81st St., Milwaukee, Wisconsin 53214.


INVESTIGATORS, free brochure, latest sub miniature electronic surveillance equipment. Ace Electronics, 11500-L NW 7th Ave., Miami 50, Fla.

RECEIVE telephone calls in your car. 30 mile range. No FCC approval necessary. Easily built for few dollars. Attaches to car radio antenna. Plans $2.00. Deeco, Box 7263-AD, Houston 25, Texas.

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December, 1964

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ per extra word. All copy subject to publisher's approval. Closing Date: 5th of the 2nd preceding month (for example, March issue closes January 5th). Send order and remittance to: Martin Lincoln, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.


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RADIO-TV Tubes, free list. Surplus Electronic Parts, 2162 So. Broadway, Wichita 11, Kansas.

ANSA Fone Schematic $2.00, Jerry Reeves. 1815 4th Street, Seabrook, N.J. 08303.

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FREE catalog: Wholesale Electronic parts and equipment. Western Components, Box 2581, El Cajon, Calif. 110VAC 60cy from car generator. Powers lights, refriger- erator, transmitter, receiver etc. Simple, easy to convert. Plans. $2.00. Tedco, P.O. Box 12098, Houston, Texas 77017.


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ELECTRONICS

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EQUIPMENT


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If you know what it takes to build a fine speaker system, you will truly appreciate KLH's new Model Seventeen. Here is a speaker that delivers a quality of performance we believed unattainable at a price we considered impossible just a few years ago. At $69.95*, the Seventeen brings together all of the know-how, all of the advances in speaker design which KLH has pioneered in the past several years.

Model Seventeen is an 8 ohm, full-range, two-way, acoustic suspension loudspeaker system. It has a 1 3/4" direct radiator tweeter with elastomeric suspension and a 10", long-exursion woofer. The enclosure is handsome oiled walnut — 11 1/4"W x 23 3/4"H x 8 1/2"D. The Seventeen is field serviceable. The grille cloth can be changed in a snap. The LCR crossover network is designed as an integral part of the system and permits an increase or decrease of 2.5 db in the high frequency level without acoustical 'shelving'. The Seventeen has, by far, the lowest harmonic distortion in the bass of any speaker in its price range.

But no description of the Seventeen, no matter how detailed, can tell you how it sounds. You've got to hear it. Only then will you be able to understand what an unusual achievement the Seventeen is, in high performance at low cost. The Seventeen is at your dealer's now. Listen to it. We think you'll agree it's the breakthrough speaker of the year.

*Suggested retail; slightly higher on the west coast.
The Most Sweeping Change in Speaker System Design... Starts with the New E-V FOUR!

Until now, there have been just two ways to determine the absolute quality of a speaker system: the scientific method, and the artistic approach. But each, by itself, has not proved good enough.

The scientist, with the help of impersonal equipment, charts and graphs, has strived to obtain the finest possible objective results. If the figures were right, then it had to sound right, and anyone disagreeing was dismissed as "not objective". But often, two speakers measured substantially the same, yet sounded quite different.

On the other hand, the artistic school of loudspeaker design has depended on the judgement of a handful of experts whose "golden ears" were the final yardstick of perfection. If you didn't agree with the experts, your ear was "uneducated" and not discriminating. But too often the measured response of the expert's system fell woefully short of reasonable performance—proof that even trained listeners can delude themselves when listening to loudspeakers.

Now, with the introduction of the E-V FOUR, Electro-Voice has pioneered a blend of the best features of both measurement methods to lift compact speaker performance to a new level of quality. It wasn't easy. The use of both techniques required extensive facilities, something E-V enjoys in abundance.

For instance, E-V has one of the industry's largest, most completely-equipped laboratories for the study of acoustical performance. Actually, the E-V engineering staff alone is larger than the entire personnel complement of many other speaker firms. In the E-V lab, measurement of speaker performance can be made with uncommon precision. And the interpretation of this data is in the hands of skilled engineers whose full time is devoted to electro-acoustics.

But beyond the development of advanced scientific concepts, E-V embraces the idea that a thorough study of the subjective response to reproduced sound is essential. E-V speakers must fully meet both engineering and artistic criteria for sound quality. Where we differ from earlier efforts is in greatly increasing the sample of expert listeners who judge the engineering efforts.

To this end, experts in music and sound from coast to coast were invited to judge and criticize the E-V FOUR exhaustively before its design was frozen. Adjustments in response were made on the spot—in the field—to determine the exact characteristics that define superb performance. It was not enough to say that a unit needed "more bass". What kind of bass? How much? At what frequencies? These are some of the more obvious questions that were completely settled by immediate adjustment and direct comparison.

The new E-V FOUR is the final result of this intensive inquiry into the character of reproduced sound. According to wide-spread critical comments, the E-V FOUR sound is of unusually high calibre. And careful laboratory testing reveals that there are no illusions—the measurements confirm the critics' high opinion of this new system.

Of course, it is one thing to design an outstanding prototype—and something else to produce an acoustic suspension system in quantity at a fair price. It is here that extensive production facilities, combined with creative engineering approaches, guarantee the performance of each E-V FOUR. And these same facilities ensure reasonable value. In fact, the E-V FOUR sells for but $151.87 with oiled walnut or mahogany finish and just $136.25 in unfinished birch. Yet, in judging its sound qualities, it was successfully compared with speaker systems costing as much as $200.00.

We urge you to make your own analysis of E-V FOUR compact speaker performance. Visit your E-V high fidelity showroom and compare, carefully, this new system.

We feel certain that you will agree with the engineers and the critics that the new E-V FOUR offers a truly full measure of high fidelity satisfaction.

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