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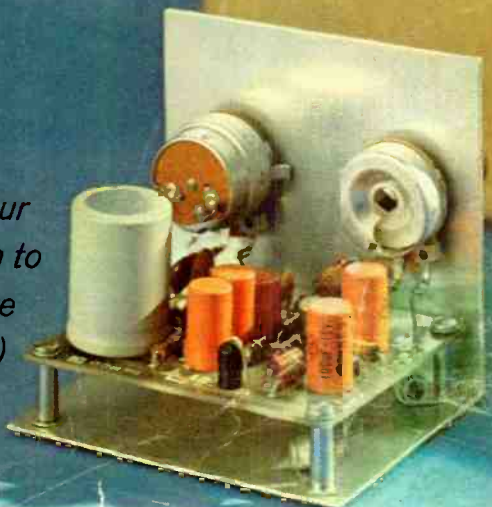

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"I am a Senior Engineering Aide at Litton Systems, in charge of checkout of magnetic recording devices for our computers. Without the help of NRI I would probably still be working in a factory at a lower standard of living."

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"NRI training enabled me to land a very good job as Electronic Technician with the Post Office Dept. I also have a very profitable spare-time business fixing Radios and TV."

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VOLUME 25 **SEPTEMBER, 1966** NUMBER 3

SPECIAL TV FEATURES

ELECTRONIC CONSTRUCTION PROJECTS

COMMUNICATIONS

ELECTRONIC FEATURES AND NEW DEVELOPMENTS

DEPARTMENTS

Horn honks, warbles, and shrieks **55**

Color TV's first forty years **45**

POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

This month's cover photo by Bruce Pendleton

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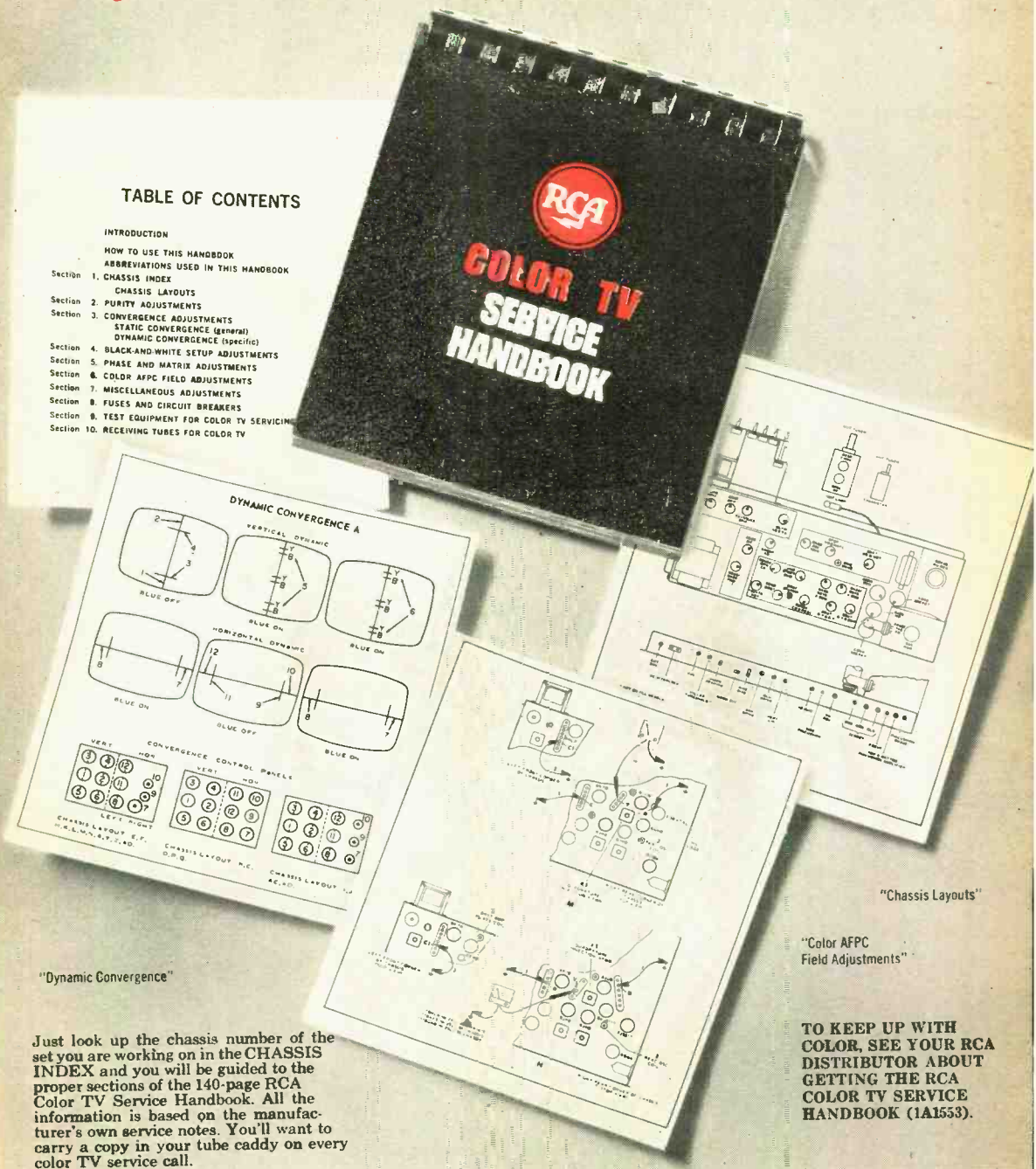

Just look up the chassis number of the set you are working on in the CHASSIS INDEX and you will be guided to the proper sections of the 140-page RCA Color TV Service Handbook. All the information is based on the manufacturer's own service notes. You'll want to carry a copy in your tube caddy on every color TV service call.

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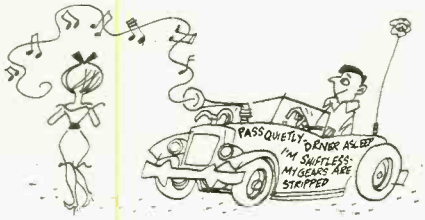
TRANSISTORIZED "HORN?"

Some day a smart designer will come up with a transistorized "Horn?" for installation on those smart sports cars. It will use, maybe, several prerecorded signals on four or five small endless tapes and a pickup head for each tape. The drivers will then be able to make any of the following sounds simply by pressing different buttons: (A) a "Bronx Cheer" for the slow drivers; (B) the "Roar of



a Lion" for other sports car drivers; (C) the "Whinny of a Horse" for friends; and (D) the "Meow of a Puddy Cat" for the girls.

D. C. YEAGER
Miami, Fla.

D.C., how about a sound to promote the safety and sanity of drivers?

LIGHT-TO-SOUND TRANSLATOR

As a beginner in electronics, I felt that the "Light-to-Sound Translator" (June, 1966) would be easy to build—and it was. As a Scout, I can use it for sending and receiving Morse code. The gadget is very light and simple to operate. Its compactness enables it to be taken anywhere, and it is the marvel of my schoolmates. But a friend and I are having a dispute about it. He says that if I hook a mike up to the batteries and the light source, and substitute a speaker for the sounder in the receiver, I can project my voice through light waves. Is this true?

LINWOOD FRANTUM
Millbury, Mass.

If you hook up a momentary-on d.p.d.t. switch to the Translator, and hook up a code practice oscillator to one pole and the blinker light to the other pole, you can monitor your own c.w. transmissions.

LLOYD HANSON
Fort Collins, Colo.

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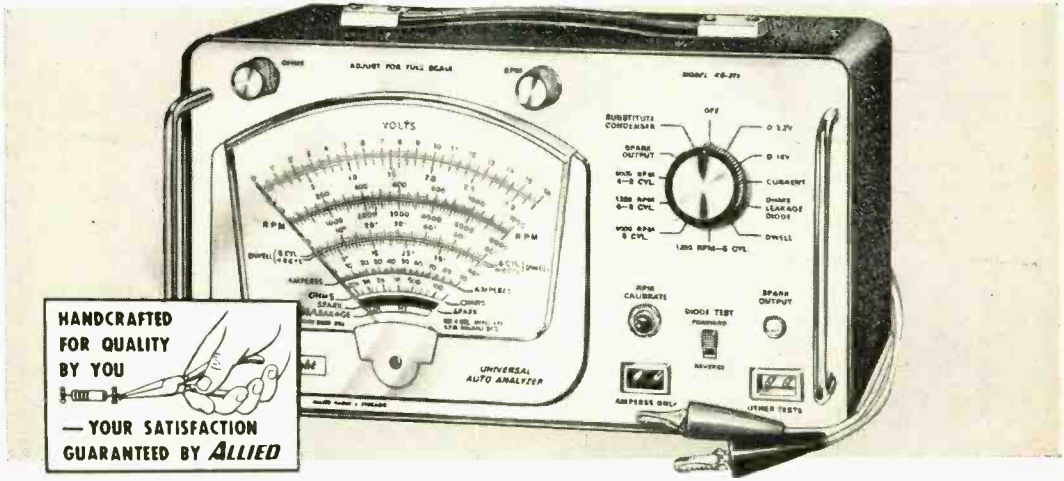

From an article in April 1965
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CIRCLE NO. 35 ON READER SERVICE PAGE

LETTERS (*Continued from page 6*)

project since many modifications can be made. If the unit is operated indoors, a light shield should be used to minimize hum pick-up from a.c. lighting. The audio to modulate the light bulb is taken from the detector in a transistor radio.

LLOYD GORDON
Toronto, Ont., Canada

L.F., try substituting a mike for the transistor radio recommended by L.G. And L.H., your idea is a good one, too.

CORRECTION IN WATTS

We appreciate your coverage of our new FM unit, the MRT-50, in the June issue, page 70, in the table on VHF/FM radiotelephones. However, the MRT-50 is rated at 50 watts, not 12 as stated. It has 12 channels, and this is probably where the confusion arose. We would appreciate your correction of the mistake. Incidentally, we now have a firm price of $650 for the unit.

EDWARD MAUTNER
Pearce-Simpson, Inc.
Miami, Fla.

TIP ON A STICKY TIP

I emphatically disagree with Mr. William S. Gohl's "Tip" entitled "End-of-Tape Signals Tell You When To Stop" (*Tips & Techniques*, June, 1966). It is a mistake to use Scotch tape anywhere on magnetic recording tape at any time. Scotch tape "bleeds" and "runs" and "oozes"—and if Mr. Gohl continues to stick pieces of Scotch tape at the beginning or end of his magnetic tape, he will shortly wind up with some badly smeared erase, recording,

and playback heads. And he will find oxide building up on his heads to the point where he can only get a whisper out of his recorder at full volume. I've seen it happen. Any good quality splicing tape is the only kind of adhesive that should be used on magnetic tape.

DAVID A. CROWLEY, SR.
Elizabeth, N. J.

MR. THURAS' MAGIC BOX

I have just completed construction of the speaker enclosure described in "Mr. Thuras' Magic Box," by David Weems (April, 1965). The speaker I installed is a Lafayette SK-255 and I am very pleased with the resulting "clean" sound. I use the speaker as an extension speaker in our patio, connected to our 10-year-old Magnavox Model 274M, with 20-watt mono amplifier chassis AMP-132. The

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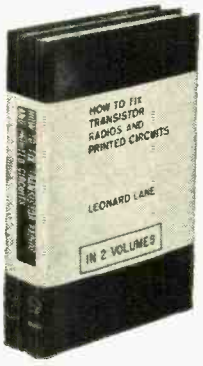

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LETTERS (*Continued from page 8*)

Magnavox set is in a cabinet with two 12" coaxial speakers. I have replaced the original record player with one taken from a Webcor "Musicale" Model 1655, in which I installed a Shure Dynetic Cartridge M3D stereo, wired for mono reproduction. I am a rank amateur in electronics, but I have been successful in making these adjustments and connections. I'm glad I undertook the building and assembly of "Mr. Thuras' Magic Box."

WILLIAM G. O'BARR
South Laguna, Calif.

ELUSIVE TV GHOSTS

I have ghost troubles on my color TV, and suggestions and tips from technicians and friends, plus what I have read in books, have not helped. The curious thing is that for many months my color TV set worked fine with twin lead and a 10-year-old conical antenna. Then the ghosts came. I installed a coloraxial system, as suggested by a leading manufacturer, with a new flat-type antenna having V-type elements. The ghosts were still there. I installed another antenna. Same

thing. I even tried a brand-new 1966 color TV to be sure the trouble was not in the set. I rotated the antenna in both directions, and even changed its location on top of the roof—it's a good 25 feet above the house. Nothing good has happened. Do you have any suggestions?

FRANK CIRILLO
Stamford, Conn.

Frank, chances are that your ghosts will mysteriously disappear within a few months, and will come again next spring. It sounds as though the leaves on the trees in your neighborhood are your ghost "carriers."

MICROSCOPIC EYEBALLS

I'll buy most of the answers to the "Meter Reading Quiz" on page 71 of June P.E., but Mr. Balin must have microscopic eyeballs if he can read 102 volts on scale #7.

JAMES C. WOOD, W9RMI
Cerro Gordo, Ill.

Don't know about Mr. Balin's eyeballs, but this is a case where the printer's ink "bled" too much. —30—

See page 12 for "Out of Tune"

Where the action is you'll find the hot new . . .

Hallicrafters CB-20 *"Reacter"*—$99.95!

Yours today—the ruggedest, cleanest, most powerful basic CB transceiver that ever rode the range!

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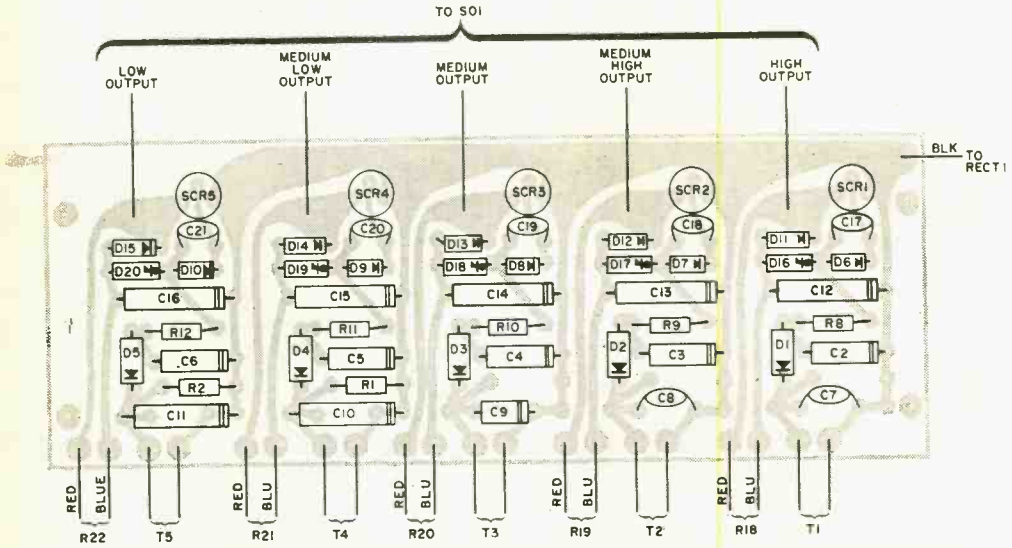
CIRCLE NO. 13 ON READER SERVICE PAGE

OUT OF TUNE

Musette Color Organ (*July*, 1966, *page* 60). The leads coming from transformers *T1* through *T5*, and those coming from resistors *R18* through *R22* should be interchanged. The correct wiring to the circuit board is shown below. Also note that the positions of resistors *R1* and *R2* were reversed in the original circuit board diagram; they should be wired in as shown. The above changes do not affect the printed circuit board layout, or the schematic, which are correct as presented in the article.

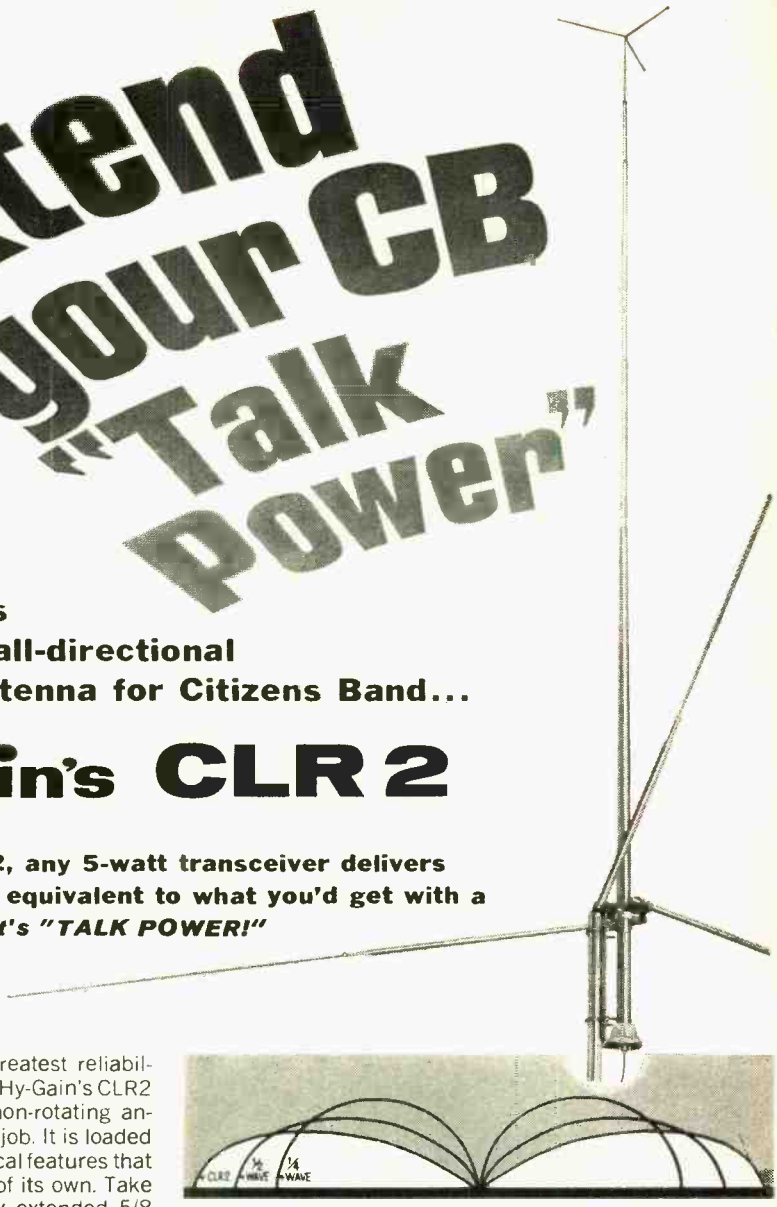


Extend your CB "Talk Power"

with the world's most powerful all-directional base station antenna for Citizens Band...

hy-gain's CLR 2

With a Hy-Gain CLR2, any 5-watt transceiver delivers all-directional power equivalent to what you'd get with a 12.55 watt rig. *That's "TALK POWER!"*



For maximum range and greatest reliability in your communications, Hy-Gain's CLR2 is the one all-directional, non-rotating antenna that is built to do the job. It is loaded with electrical and mechanical features that clearly put it in a class all of its own. Take for example the electrically extended 5/8 wavelength vertical radiator. In test after test conducted by every authoritative source in the electronics field, a 5/8 wavelength radiator has conclusively proven to deliver a stronger signal over a greater area than either a 1/4 wavelength or 1/2 wavelength radiator. The chart graphically shows how power wasted in the atmosphere by 1/4 wavelength and 1/2 wavelength radiators is concentrated into a lower, more extended arc close to the horizon by a 5/8 wavelength radiator thus providing a stronger signal over a greater area.

What else does the CLR2 have that makes it deliver maximum "Talk Power"? It has the original static-removing "Top Hat" that drastically cuts receiver noise...a moisture-proof matcher that insures total electrical reliability...a unique electrical system that puts the entire antenna at DC ground for maximum static removal and lightning protection... rugged, heavy duty, all-weather construction rated to withstand winds up to 100 mph. For maximum "Talk Power"—greatest readability—you'll want a CLR2...a bargain in power at **$29.95** Net.

Available from your Hy-Gain Dealer or Distributor

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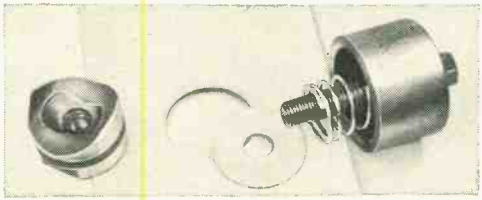
CIRCLE NO. 14 ON READER SERVICE PAGE

PARTS METHODS IDEAS GADGETS DEVICES TIPS & TECHNIQUES

SPRING EJECTOR PUMPS OUT PUNCHED SLUGS

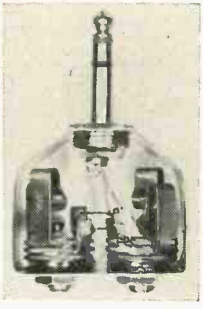
Still finding it tough to eject the slug from that old chassis punch? You can lick this

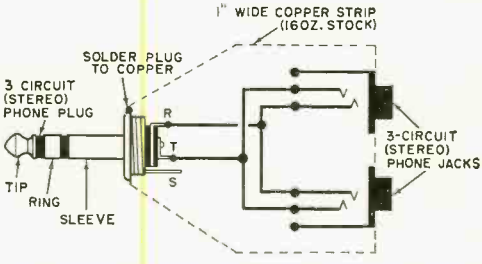


problem by inserting a stiff spring in the die to serve as an automatic ejector. It never fails. —*Robert Barbieri*

TWO STEREO HEADSETS FROM ONE STEREO JACK

The cone-shaped adapter in the photo below is of the home-brew variety through which two audiophiles can simultaneously plug in their headsets to a single stereo jack. The adapter is made from a 1"-wide copper strip (16-ounce or heavier stock) bent as shown, with the two overlapping ends soldered together. Make the adapter frame as small as possible with just enough clearance for the jacks to avoid shorting against the frame when the plugs





are inserted. Then drill and ream out openings for the jacks. To insure a good ground, solder the master plug directly to the copper frame. And it's a good idea to use lockwash-

(*Continued on page 20*)

POPULAR ELECTRONICS
READER SERVICE PAGE

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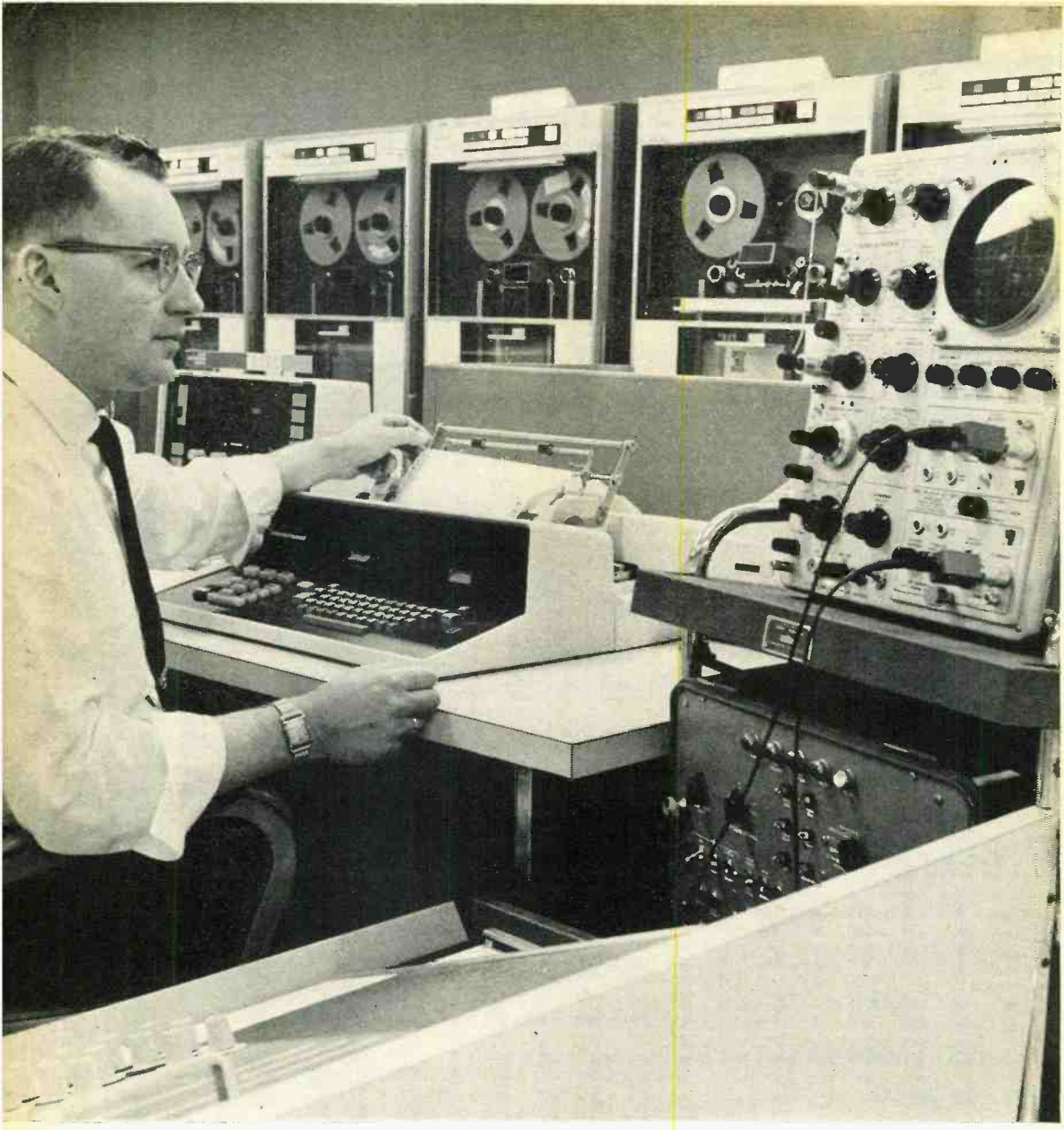

Why Fred got a better job...

I laughed when Fred Williams, my old high school buddy and fellow worker, told me he was taking a Cleveland Institute Home Study course in electronics. But when our boss made him Senior Electronic Technician, it made me stop and think. Sure I'm glad Fred got the break . . . but why him . . . and not me? What's he got that I don't. There was only one answer . . . his Cleveland Institute Diploma and his First Class FCC License!

After congratulating Fred on his promotion. I asked him what gives. "I'm going to turn $15 into $15,000," he said. "My tuition at Cleveland Institute was only $15 a month. But, my new job pays me $15 *a week* more . . . that's $780 more a year! In twenty years . . . even if I don't get another penny increase . . . I will have earned $15,600 more! It's that simple. I have a plan . . . and it works!"

What a return on his investment! Fred should have been elected most likely to succeed . . . he's on the right track. So am I *now*. I sent for my three *free* books a couple of months ago, and I'm well on my way to Fred's level. How about you? Will you be ready like Fred was when opportunity knocks? Take my advice and carefully read the important information on the opposite page. Then check your area of most interest on the postage-free reply card and drop it in the mail *today*. Find out how you can move up in electronics too.

How You Can Succeed In Electronics

. . . Select Your Future From Five Career Programs

The "right" course for your career

Cleveland Institute offers not one, but five different and up-to-date Electronics Home Study Programs. Look them over. Pick the one that is "right" for you. Then mark your selection on the reply card and send it to us. In a few days you will have complete details . . . without obligation.

1. Electronics Technology

A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

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If you want a 1st Class FCC ticket *quickly*, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

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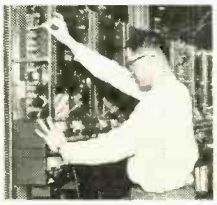

Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

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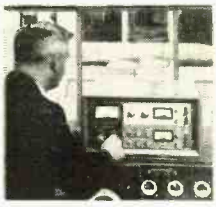

This exciting program includes many important subjects such as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.

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In addition to providing you with comprehensive training in the area indicated, programs 1, 2, 3, and 4 will prepare you for a Commercial FCC License. In fact, we're so certain of their effectiveness, we make this *exclusive* offer:

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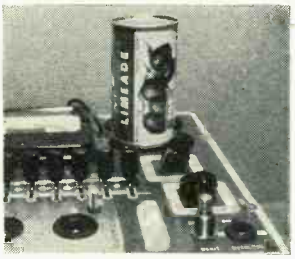
TIPS

(*Continued from page 14*)

ers between the jacks and frame to keep the jacks from turning and shorting out the wires. The diagram shows the simplicity of the internal wiring. If desired, a cover can be placed on both sides of the frame to conceal the wiring. —*Art Trauffer*

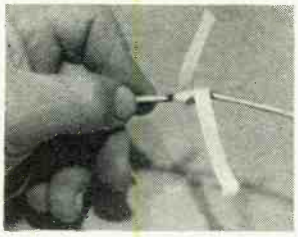
TIN CAN OVEN KEEPS TUBE TESTER HONEST

You can improve the reliability of your tube tester with a tin can oven that simulates the living and working conditions of a vacuum tube. Line the inside of the can—beer, frozen juice, etc.—with asbestos and, after inserting the tube in the tester, place the can over the tube. Allow a few minutes for the tube to warm up before testing. —*H. R. Rosenblatt*



OLD TRICK KEEPS TAPE FROM UNWINDING

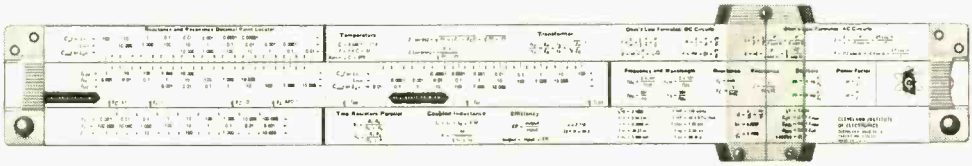
Here's how to make electrical tape stick to small round surfaces without unwinding: cut off a short length from the roll and wrap two turns tightly around the area being covered. Tear the piece that remains lengthwise down the middle and interlace the split ends until the surface is covered. Bet the tape won't slip while you are putting it on or ever afterwards.—*Glen F. Stillwell*



SELF-STICK FELT PROTECTORS CUSHION DEFLOCKED TURNTABLES

A worn and rough turntable is bad news to a record. Rather than glue on a new felt cover, or pull out the flocking kit, you can pick up a package of small, circular felt pads at your hardware store and stick them on the turntable as shown. Use as many pads as you want, in a circular arrangement. They hold the record away from the turntable, act as a cushion, and reduce dust pickup considerably. —*Carl Durant*

IN ELECTRONICS AND ELECTRICITY THIS AMAZING NEW SLIDE RULE SEPARATES THE MEN FROM THE BOYS!



LOOK WHAT YOU GET...

YOU GET... a patented*, high-quality, all-metal 10" electronics slide rule. "Your computer in a case". Has special scales for solving sticky reactance and resonance problems . . . an exclusive "fast-finder" decimal point locater . . . widely-used electronics formulas and conversion factors. PLUS . . . all the standard scales you need for non-electronic computations such as multiplication, division, square roots, logs, etc.

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YOU GET... a sturdy, handsome carrying case. It's made of genuine top-grain leather, doubly reinforced at the "wear-spots", features heavy duty liner for extra slide rule protection, has a removable belt loop for convenient carrying. "Quick-Flip" cover makes it easy to get your rule in and out of the case. Stamps you as a real "pro" in electronics.

A $50.00 VALUE FOR LESS THAN $25.00!

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NOW . . . take full advantage of what you know about electronics and electricity . . . solve complex problems in seconds while others plod along the old-fashioned "pad and pencil" way!

READ WHY OTHERS CALL THIS REMARKABLE NEW SLIDE RULE PACKAGE TODAY'S BIGGEST BARGAIN IN ELECTRONICS.

The Editor of Popular Electronics, Mr. Oliver P. Ferrell says:
"Why didn't someone think of this before. The convenience of having all relevant formulas imprinted right on the slide rule saved me time the very first day!"

A student, Mr. Jack Stegleman says:
"Excellent, I couldn't say more for it. I have another higher-priced rule but like the CIE rule much better because it's a lot easier to use."

The Head of the Electrical Technology Dept., New York City Community College, Mr. Joseph J. DeFrance says:
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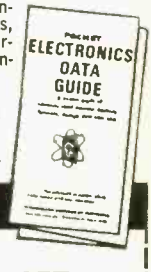
ANYONE **WHO SENDS IN THIS COUPON WILL RECEIVE, ABSOLUTELY FREE, A HANDY POCKET ELECTRONICS DATA GUIDE.**

It's a useful, pocket-sized electronics "encyclopedia" . . . jam-full of valuable facts, formulas and other helpful information. Carry it with you . . . when it comes to electronics, you'll be the "man-with-the-answer"!



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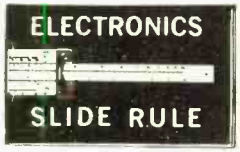

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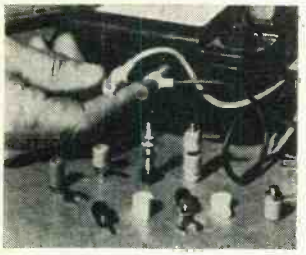
CIRCLE NO. 7 ON READER SERVICE PAGE

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 on page 15.

SNAP-ON TEST LEAD TERMINALS

Troubleshooting can be speeded up with "Tes-Con-Ects," a new line of test lead terminals announced by *Waldom Electronics*. The various terminals snap on and off instantly, making it unnecessary to have many different pairs of test leads on hand. Consisting of alligator clips, spade tongue, phono and banana jacks, etc., the terminals are designed to match any equipment under test. They are available individually as well as in kit form, and leads are also available in lengths from 24 to 72 inches, with color-coding, if desired.



Circle No. 75 on Reader Service Page 15

"LISTEN-IN" CONVERTER

You can listen in on any frequency from 25 to 175 MHz if you have an ordinary AM radio and a "Listen-In." A pocket-sized converter introduced by *Metrotek Electronics*, "Listen-In" operates in a piggyback fashion with any AM radio—including pocket-sized transistor radios. Two models are available—a single-crystal unit and a 2-crystal unit—both powered by two 1½-volt penlight batteries. The circuitry is on a printed board and is solid state.

Circle No. 76 on Reader Service Page 15

PIANO PICKUP

The *Ampeg* PM-1 Piano Pickup is a microphone suitable for use with both upright and grand pianos. Its unique design, which employs a special acoustical cup, is said to produce a mellowing effect which is far different from the harshness identified with most amplified pianos. Volume can be adjusted by turning a control on the pickup.

Circle No. 77 on Reader Service Page 15

SOLID-STATE ENGINE ANALYZER

Own your own car or boat? You can tune up its engine electronically just as the professionals do—with the all-solid-state universal self-powered engine analyzer announced by *EICO Electronic Instrument Co., Inc.* The Model 888 can be used on all 6- or 12-volt, 4-, 6-, or 8-cylinder engines, with negative or positive grounds. It tests the complete electrical /ignition system including storage battery, generator, alternator, voltage regulator, alternator diodes, starter, starter solenoid, distributor, points, condenser, ignition coil, spark plugs, dwell angle, carburetor, fuses, bulbs, switches, accessories, and all electrical wiring. The comprehensive "how to" manual also lists idle speeds and dwell angles. Model 888 is available either as a kit or factory-wired.

Circle No. 78 on Reader Service Page 15

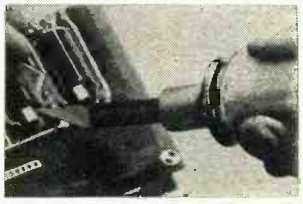
"8-PLUS" TAPE REEL

According to the *Telex Corporation*, the new Magnecord "8-Plus" reel provides 50% more tape storage capacity than a standard 7-inch reel. The hi-fi or stereo connoisseur can record up to 10 hours of programming on one reel, and a full 2½-hour opera can be recorded without having to reverse the tape. Four complete operas, or up to 200 average-length musical selections, can be stored on a single reel.

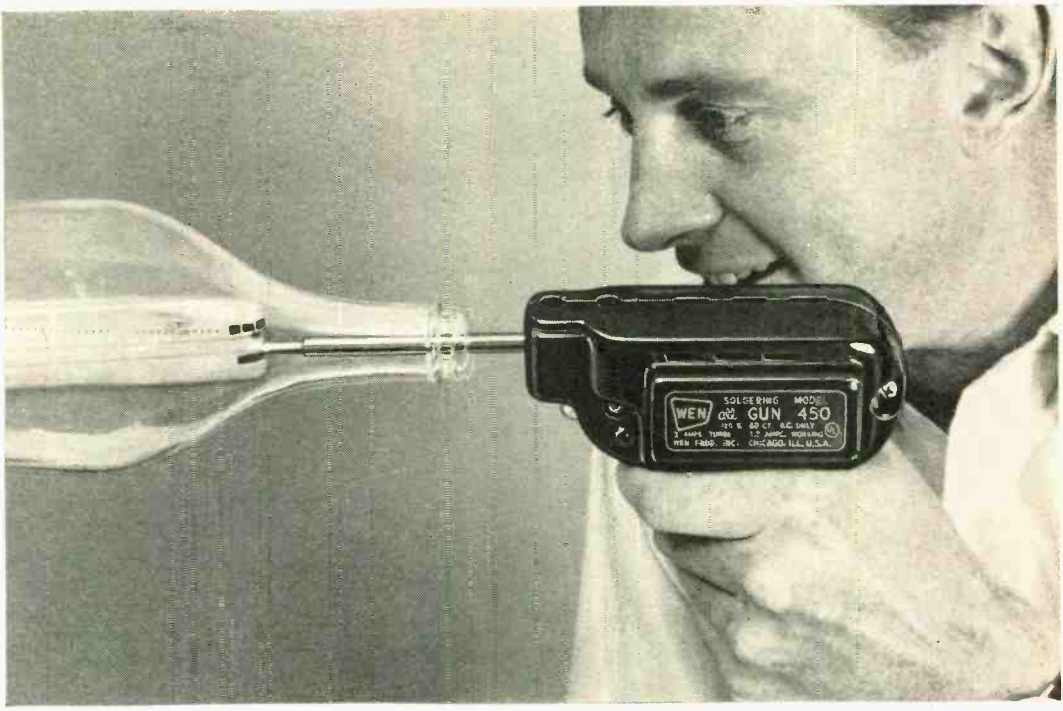
Circle No. 79 on Reader Service Page 15

"HOT-KNIFE"

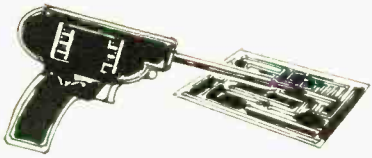
Without pressure, *Ungar Electric Tools'* "HOT-KNIFE" (#4025) will cut through the low-temperature epoxy coatings used to encapsulate components on printed circuit boards. Consisting of a 47½-watt heating unit with a collet closure and a razor-type blade, it fits into Ungar's red (#776) soldering handle or the Clean Room (#777) soldering handle. The HOT-KNIFE delivers approximately 500° F to the cutting blade. When used on a syn-



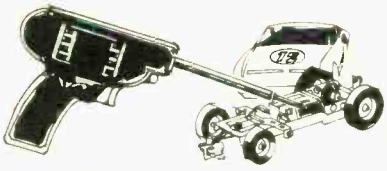
HERE'S PROOF!



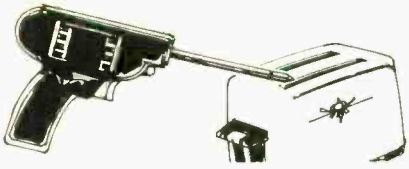
You can reach soldering points with a Wen gun you can't touch with any other!



Reach inside delicate printed circuits!



Reach inside tiny models!



Reach inside household appliances!

The "slim-line" single-post on WEN guns is 45% more compact than those bulky old-fashioned double-posts! It's tailor-made for hard-to-reach jobs! For all its compactness, it's a real fire-ball! For example: WEN's heavy-duty tip generates up to 450 watts of heat power; 125 more than the next hottest gun! And, all WEN tips have a built-in brain that *automatically* controls the flow of heat! Makes every WEN gun "goof-proof!" See WEN's complete line of "automatic" soldering guns; prices start at $4.95. The hottest thing in soldering!

WEN "HOT ROD" GUN KIT
Model 222 gun. Two tips, two accessory items, solder, case.
$11.95 (suggested list price)

JUST SAY **WEN**

For free brochure write Dept. 49.
WEN PRODUCTS, INC.
5810 Northwest Highway, Chicago, Ill. 60631

CIRCLE NO. 34 ON READER SERVICE PAGE

PRODUCTS (*Continued from page 22*)

thetic material, such as dacron or nylon, it not only cuts but also seals the material to prevent raveling and fraying.

Circle No. 80 on Reader Service Page 15

AUTOMATIC-TUNING TABLE RADIO

A first! The 1967 Panasonic RE-1125 solid-state AM table radio features the world's first electronic automatic tuning, resulting from the use of a newly developed "hyper-abrupt" junction-type variable capacitor called a "capistor." This component makes possible the instant dialing of any wanted station by the flick of a finger atop a "touch'n tune" lever. Distributed by the *Matsushita Electric Corp. of America*, the RE-1125 also has an illuminated frequency indicator and a two-position day and night switch for station screening.

Circle No. 81 on Reader Service Page 15

PORTABLE VOM

Triplett Electrical Instrument Company has introduced a portable volt-ohm-milliammeter, Model 630-APLK, with a transtorized switching circuit that guards against accidental burnouts, provides comprehensive overload protection, and virtually eliminates bent pointers, burned-out resistors, shunts and coils, and changes in accuracy due to overheating. Featuring a sensitivity of 20,000 ohms per volt d.c. and 5000 ohms per volt a.c., the VOM has an accuracy of ± 1½% d.c. and ± 3% a.c. when in a horizontal position. The unit is usable with frequencies through 500 kHz. A single, easy-to-read selector switch minimizes chances of error when changing ranges, and a mirror-backed scale insures accuracy by eliminating parallax.

Circle No. 82 on Reader Service Page 15

FM STEREO KIT

Having interference problems? An FM stereo kit made by the *Finney Company* will convert an old-fashioned 300-ohm twin-lead hookup to the shielded protection of 75-ohm coaxial cable. It can be installed in a few minutes, using ordinary hand tools, and will eliminate all outside and inside line pickup interference that normally occurs with FM stereo sets equipped for 300-ohm operation. The kit (Model 7512B) includes high-performance indoor and outdoor matching transformers.

Circle No. 83 on Reader Service Page 15

UNDERWATER SPEAKER

For the pool-owning music lover who has almost everything—here's one thing more. The UL-3 is a specially designed speaker by *Pioneer Electronics U.S.A. Corporation* that projects a true high-fidelity sound while entirely submerged. Having a dynamic range of 50 to 20,000 hertz, it is completely operational to a depth of 16.5 feet and, according to the manufacturer, maintains superior sound quality in a water temperature range of from 14° F to 140° F.

Circle No. 84 on Reader Service Page 15

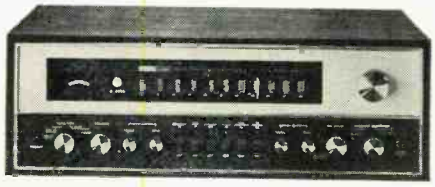
STEREO HEADPHONES

Stereo headphones incorporating two ¾" speakers and cushion ear-pieces are available with a five-year warranty from the Piezoelectric Division of *Clevite Corporation*. Frequency response is 20 to 18,000 hertz, and impedance matches 4-, 8-, or 16-ohm amplifier outputs. Normal listening level is attained with 1-mW input power per phone; distortion is less than 1%.

Circle No. 85 on Reader Service Page 15

100-WATT FM STEREO RECEIVER

Harman-Kardon, subsidiary of The Jerrold Corporation, is producing a 100-watt solid-state FM stereo receiver, the "Stratophonic" SR-900B. At a full 100 watts, its frequency bandwidth is claimed to be from 5 to 100,000 hertz. Germanium diffused-junction output transistors are credited for this extraordinary power bandwidth and frequency response; the cool operation of these transistors virtually eliminates output failures from sudden overloads. In addition, the SR-900B features an easy-to-read D'Arsonval tuning meter and a positive-action automatic FM stereo indicator light. An oiled walnut cabinet is optional.



Circle No. 86 on Reader Service Page 15

NOW FIELD EFFECT TRANSISTOR and INTEGRATED CIRCUIT PROJECTS

IN 3 HEP SOLID-STATE PROJECT BOOKS FROM MOTOROLA

Motorola's HEP program provides you with the latest in quality semiconductors and offers proven projects incorporating these new devices. These project books, prepared for beginner and expert, contain easy-to-follow text and illustrations that make construction as easy as "electronics by the numbers." These books open new vistas for using semiconductors in test equipment, computers, musical instruments and fun circuits.

The first Integrated Circuit Project Book for hobbyist and experimenters contains eight chapters, 96 pages, including a basic introduction to integrated circuits. Build your own completely portable square wave generator featuring a 10 nanosecond rise time, and frequency response from 6 Hz to 60 kHz in four ranges. For fun you can build an I/C 4-octave organ with separate voicing controls. Other projects include a glidetone, binary computer, oscillator, electronic string guitar etc. Price **$1.00**

Ten chapters, including a basic description on semiconductor fundamentals. Projects include a regulated power supply, intercom, motor speed control, 6-meter converter, minifi amplifier, signal generator and other circuits. Price **$.50**

Another HEP first—a project book full of circuits utilizing the field effect transistor (FET). 96 pages. Projects include a high impedance DC Voltmeter (22 mega-ohms) with a scale of accuracy of ±2% that requires no rezeroing when changing ranges; a four-input audio-mixer with a flat frequency response of 20 Hz to over 100 kHz, as well as such projects as a timer, crystal calibrator, vibrato preamp etc. Price **$1.00**

On sale at all Motorola HEP franchised outlets, the books are also available by sending the coupon below, with the appropriate amount, plus 10 cents for handling to HEP, Box 955, Phoenix, Arizona 85001.

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City_____

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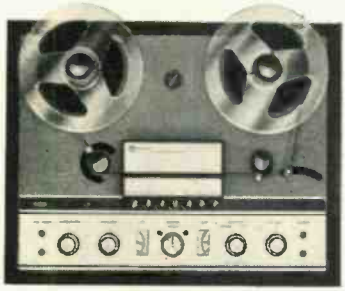
NEW Heathkit® /Magnecord® 1020 4-Track Stereo Recorder Kit



Kit AD-16
$399.50
(less cabinet)

Save $170 by doing the easy assembly yourself! Features solid-state circuitry; 4-track stereo or mono playback and record at 7½ & 3¾ ips; sound-on-sound, sound-with-sound and echo capabilities; 3 separate motors; solenoid operation; die-cast top-plate, flywheel and capstan shaft housing; all push-button controls; automatic shut-off; plus a host of other professional features. 45 lbs. Optional walnut base $19.95, adapter ring $4.75

NEW 4-Speed Transistor Portable Phonograph Kit!

Worth at least 50% More!
Assembles in 1 to 2 hours ... just wire one small circuit board, mount the 4" x 6" speaker and plug in the preassembled changer. Features automatic mono play of all 4 speeds; dual Sapphire styli for LP's or 78's; 45 rpm adaptor; olive and beige polyethylene over sturdy, preassembled cabinet. Compact size and light weight for suitcase portability. Operates on 117 v. AC. 20 lbs.

Kit GD-16
$39.95

All-Transistor 30-Watt FM /FM Stereo Receiver Kit

Kit AR-14 **$99.95**
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Features 31 transistors, 10 diodes for transparent transistor sound; 20 watts RMS, 30 watts IHF music power @ ±1 db, 15-50,000 Hz; wideband FM/FM stereo tuner, two preamplifiers and two power amplifiers; compact 3⅞" H x 15¼" W x 12" D. size. Assembles in around 20 hours. Mounts in a wall, or optional Heath cabinets (walnut $9.95, beige metal $3.95) 16 lbs.

Deluxe 10 Band Transistor AM /FM /Shortwave Portable Radio Kit

10 bands tune longwave, broadcast, FM and 2-22.5 MHz shortwave. Features 16 transistors, 6 diodes, 44 factory-built and aligned RF circuits; separate AM and FM tuners; two built-in antennas; 4" x 6" speaker; battery-saver switch; earphone and built-in jack. Operates anywhere on 7 flashlight batteries, or on 117 v. AC with optional charger/converter GRA-43-1 @ $6.95. Assembles in 10 hours. 17 lbs.

Kit GR-43
$159.95

In The New FREE Heathkit® Catalog

NEW Deluxe SB-301 Amateur Band Receiver Kit

Kit SB-301

$260.00

(less speaker)

Complete coverage of 80 thru 10 meters with all crystals furnished, plus 15 to 15.5 MHz coverage for WWV; full RTTY reception capability; built-in switch-selected ANL; front-panel switching for control of 6 and 2 meter plug-in converters; crystal-controlled front-end for same rate tuning on all bands; 1 kHz dial calibrations — 100 kHz per dial revolution; plus the same styling and features of the famous Heathkit SB-300 Receiver. 23 lbs.

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Kit SB-610

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Operates with transmitters 160 thru 6 meters, 15 watts thru 1 KW, and with receiver IF's through 6 MHz; displays envelope, AF & RF trapezoid patterns; function switch position for RTTY; full mu-metal shielded CR tube; two-tone audio test oscillator with balance and output level controls; full capability with Heath SB-series equipment; manual contains discussion for use with CB units. 14 lbs.

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CIRCLE NO. 38 ON READER SERVICE PAGE

ELECTRONICS LIBRARY

SECRETS OF ELECTRONIC ESPIONAGE

by John M. Carroll

Don't be deluded into thinking that this is a book on "bugging"—the title is unfortunately true, but simultaneously misleading. The first 200 pages of John Carroll's latest book (his third since giving up magazine editing) comprise a fascinating record of radio communications and radar in World Wars I and II, the Korean War, and the ever-present Cold War. This portion of the history of electronics has received too little attention, and Carroll's book is a very readable factual account of the "now it can be told" type. The last part of the book actually is on bugging, but by the time you get there the words on personal espionage will seem pale compared to those on the wartime happenings.

Published by E. P. Dutton & Co., Inc., 201 Park Ave. South, New York, N.Y. 10003. Hard cover. 224 pages. $3.95.

BASIC ELECTRICITY

by Gilbert L. Rainey

The keynote of this workbook is to encourage laboratory skills at the senior high school and junior college levels. The author outlines scores of experiments in resistance, capacitance and inductance using readily available equipment.

Published by Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017. Soft cover. 180 pages. $3.95.

SEMICONDUCTOR CIRCUITS: Theory, Design and Experiment

by J. R. Abrahams and G. J. Pridham

A major aim of this book is to give the student of electronic engineering confidence in his ability to design and modify circuits involving transistors and related semiconductor devices. Both of the authors, now Senior Lecturers at the Enfield College of Technology, have been concerned with the design of transistor circuits from the days of the early point-contact devices. In Part I, the physical theory of semiconductors is discussed briefly. Part II includes a number of complete circuit designs, and deals with aspects that the authors feel have been neglected in previous textbooks on semiconductors. Some 20 demonstrations or experiments are given in Part III.

Published by Pergamon Press Inc., 44-01 21st St., Long Island City, New York 11101. Soft cover. 310 pages. $4.95. —30—

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CIRCLE NO. 3 ON READER SERVICE PAGE

NEW LITERATURE

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15.

An up-to-date coil catalog and replacement directory is now available from *J. W. Miller Company.* Consisting of 168 pages, Catalog 166 lists more than 2500 new items. Specifications and prices for the full line of coils and components are included, and a cross-reference section—containing over 30,000 individual entries—gives exact replacements for all recognized TV sets, radios, and car radios.

Circle No. 87 on Reader Service Page 15

All sorts of permanent alnico and ceramic magnets, in rod and bar forms, are described in a 4-page brochure put out by the *Maryland Magnet Co.,* plus horseshoe, channel, lifting and holding magnets.

Circle No. 88 on Reader Service Page 15

The complete line of standard and special *Greenlee* chassis punches for radio, TV, and electrical work is pictured and described in a new 8-page catalog. Standard round, square, "key," "D," and double "D" punches are covered in detail, and a variety of "specials" are presented.

Circle No. 89 on Reader Service Page 15

Acoustic Research, Inc., has available a 12-page booklet on its line of acoustic suspension loudspeakers and turntables. Featured in the booklet are many favorable press comments on the various pieces of equipment by well-known magazine reviewers.

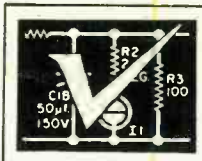
Circle No. 90 on Reader Service Page 15

Some 250 products are illustrated and described in the 48-page, 2-color, pocket-size 1966 Short Form Catalog published by *EICO Electronic Instrument Co., Inc.* Included are test instruments, amateur radio equipment, 2-way CB radios, and stereo hi-fi components —in both kit and factory-assembled form.

Circle No. 91 on Reader Service Page 15

Datak's recently expanded line of over 2000 alphabet sheets and electronic marking sets is fully covered in its 32-page 1966 catalog. Also provided is information on Project-A-Type translucent colored letters and sheets, architectural symbols, drafting sheets, and Instantex, an unusual new art medium.

Circle No. 92 on Reader Service Page 15



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 P.E. readers. Here's how it works: Check 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 postcard to Operation Assist,* POPULAR ELECTRONICS, *One Park Avenue, New York, N.Y. 10016. Give maker's name, model number, year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Because we get so many inquiries, none of them can be acknowledged.* POPULAR ELECTRONICS *reserves the right to publish only those items not available from normal sources.*

Olympic RT-11A/Apn-12 receiver; tunes 160 to 230 MHz. Operating manual needed. (John Cahill, 31 S. Home Ave., Park Ridge, Ill. 60068)

TCS-6 transmitter, made by Hazeltine; tunes 1.5 to 12 MHz; has 7 tubes. Schematic and operating manual needed. ("Woody," W9RMI, RR #1, Cerro Gordo, Ill. 61818)

Hallicrafters SX-42 receiver. **Nucleonic** RDN uranium finder. Schematics needed. **Midwest** receiver; tunes 5 to 2000 meters; has 18 tubes. Schematic and power transformer needed. (Glenn Little, 2305 Camellia Ct., Savannah, Ga. 31404)

Jefferson-Travis Model 351 marine transceiver. Schematic and operating manual needed. (Bruce T. Bracker, 141 Cayman Dr., Lake Worth, Fla. 33460)

Motorola 61T21 receiver. circa 1940; tunes 550 kHz to 12 MHz; has 6 tubes. Schematic needed. (John Milbocker, Johannesburg, Mich. 49751)

GE E-155 "Sentry Box" receiver; tunes 140 kHz to 70.0 MHz on 5 bands. Schematic needed. (Ben Stillwell, 1188 Sunrise Ln., Prineville, Ore. 97754)

Supreme AAA-1 "Diagnometer," circa 1932. Schematic, source for parts, and information on updating unit needed. (E. R. Pyle, 49 Village Way, Malvern, Pa.)

Masco MA35RC sound system. ser. 30608; has 8 tubes and 3 transformers. Schematic needed. (Vaughn N. Kimball, Box 229, N. Uxbridge, Mass. 01538)

Branston Kit No. 199. All available information wanted. (George Kemp, 153-02 79 Ave., Flushing, N.Y. 11367)

Heathkit W4-AM amplifier. Balancing information needed. (Julio Varas, 51-44 Goldsmith St., Elmhurst, N.Y.)

Grundig-Majestic 8050 "Eagle Eye" AM/FM console, circa 1948. Operating manual and source for "Baton" remote control and "Mystic Maestro" needed. **Metro Electric** "Metrodyne" single-dial receiver, circa 1923; has 7 tubes. Conversion data needed. (H. G. Humphrey, 5200 Prairie Rd., Junction City, Ore. 97448)

ARC-3 receiver. surplus. Operating manual needed. (Ed W. Guthrie, 1986 Laramie St., Memphis, Tenn. 38106)

Teletest DM456 "Dynamatis" tube tester, ser. 1918. Operating manual needed. (Louis Lerrin, 2575 S.W. 24 Ave., Miami, Fla. 33133)

Hints and Kinks, Volume 4, needed. (A. J. Johnson, Box 507, Aptos, Calif. 95003)

RCA "Mark VIII" stereo amplifier; has 6 tubes. Schematic and operating manual needed. (Ismael Díaz-Colón, 119 St. Marks Ave., Apt. 5, Brooklyn, N.Y.

(*Continued on page* 38)

NEW! H.E.L.P.

FOR SALESMEN, HOUSEWIVES, VACATIONERS, ETC.

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☐ EMERGENCY ☐ CONVENIENCE

2-Way Radio Communication . . .

5¾" x 4⅜" x 1½" FITS IN GLOVE COMPARTMENT

CITI-FONE II is designed for use with your car radio and modification or dismounting of the radio is not required. The standard car antenna (with matching accessory) can be used.

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9 transistors—2 diodes
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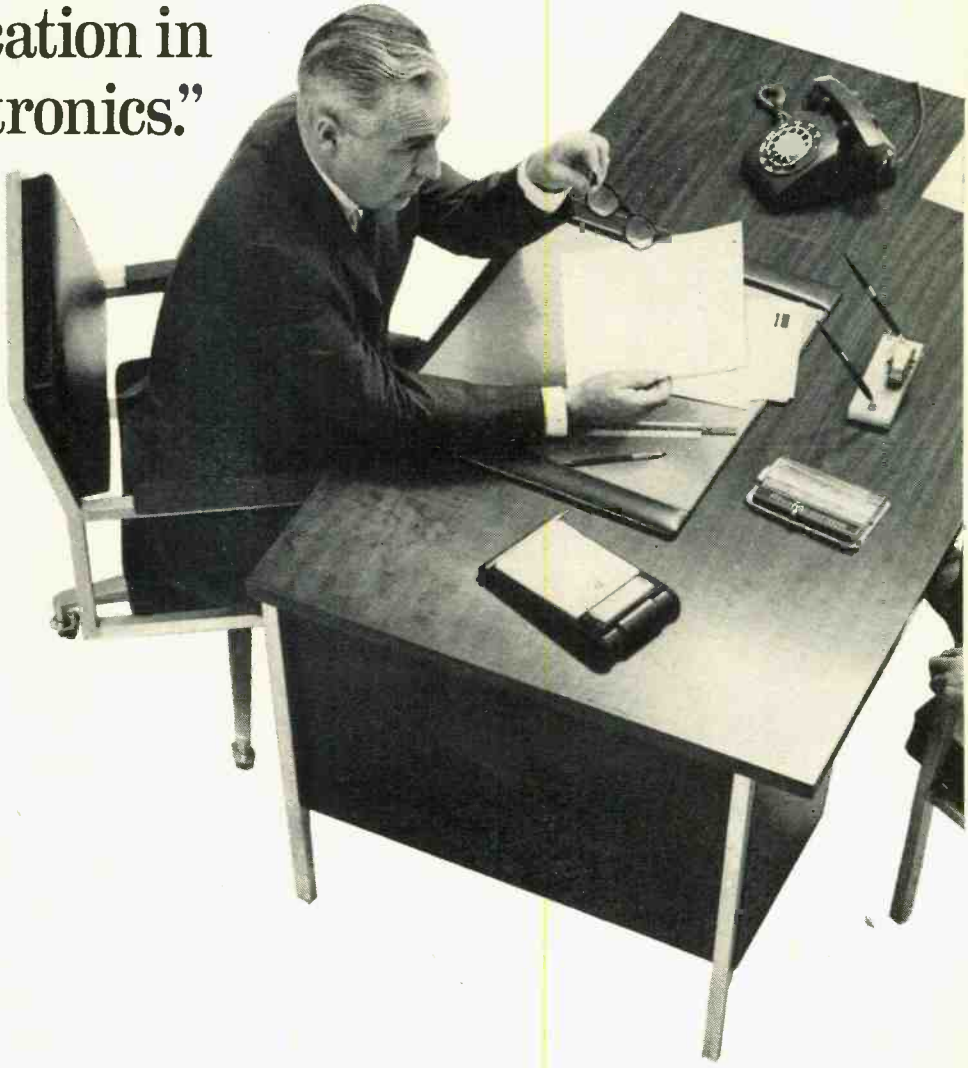
Oak Park, Michigan 48237

CIRCLE NO. 21 ON READER SERVICE PAGE

"He's a good worker. I'd promote him right now if he had more education in electronics."



Could they be talking about you?

You'll miss a lot of opportunities if you try to get along in the electronics industry without an advanced education. Many doors will be closed to you, and no amount of hard work will open them.

But you can build a rewarding career if you supplement your experience with specialized knowledge of one of the key areas of electronics. As a specialist, you will enjoy security, excellent pay, and the kind of future you want for yourself and your family.

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☐ Space Electronics ☐ Nuclear Engineering Technology
☐ **NEW! Industrial Electronics for Automation**
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ASSIST

(*Continued from page 32*)

Zenith S-14549 receiver, circa 1950; tunes AM and FM; has 7 tubes. Schematic needed. (Steve Cohn, 52 Dick Dr., Worcester, Mass. 01609)

Hickok OBQ-1 VTVM, circa 1944; has 4 tubes. Schematic needed. (Jay Whitehurst, Box 825, Conroe, Tex. 77301)

RT53B/TRC-7 transceiver, made by Espey, ser. 982. Operating manual or crystal data needed. (R. D. Holen, 10031 Lyndale, Minneapolis, Minn. 55420)

RME HF-30X receiver, circa 1939; tunes 28 to 60 MHz on 2 bands. Schematic and parts list needed. (David Houser, 107 N. Siebold, Ossian, Ind.)

Abbott TR-4 transceiver; has 4 tubes. Schematic and/or address of company needed. (Bob Peters, 208 Princeton Ave., Staten Island, N.Y. 10306)

1C5-GT tube needed or source for same. (David Cordone, 224 E. Mohave Rd., Tucson, Ariz. 85705)

GE Model 805 TV set, circa 1945; has 19 tubes and picture tube. Schematic and operating manual needed. (Michael Keith, 680 Keith Ln., West Islip, L.I., N.Y.)

3EP1 cathode-ray tube needed or source for same. (David Hamilton, River Rd., Rt. 1, Paw Paw, Mich. 49079)

Tobe condenser analyzer, circa 1934. Schematic needed. (L. S. Marston, 205 Baublits Dr., S.E., Warrington, Fla.)

Zenith "Royal 500" receiver; has 7 transistors. **Realtone** "Sound Design" receiver; tunes AM and FM; has 10 transistors, 1 thermistor and 3 diodes. Schematics needed and knob for Realtone receiver. (Dave Beck, 4th ESB-SSC-USAAPS, Fort Bliss, Tex. 79916)

Philco 37-670 receiver, circa 1938; tunes kHz to 18 MHz on 5 bands; has 11 tubes. Schematic needed and source for capacitor SG H07. (Nelson Carvalho, Nelson Ave. & Delsea Dr., Franklinville, N.J. 08322)

RCA MI-4288-L amplifier, ser. 5419; has 4 tubes. Schematic and source for power and output transformers needed. (Alan G. Thompson, 315 S. West St., Angola, Ind. 46703)

Edison R4 receiver, circa 1930. Schematic needed. (Wallace S. Ryno, 1907 "D" Ave., National City, Calif. 92050)

Philco "Predicta" TV set, circa 1956. Source for plastic safety screen and SF21A picture tube needed. (Thomas McHenry, 508 2nd St., N.W., Independence, Iowa 50644)

Magnolia TC-27 transceiver, ser. 2271, Class D. Schematic needed. (R. M. Smith, 3534 1st Ave., N.E., Cedar Rapids, Iowa 52402)

RBA-5 receiver, made by Federal Electric, circa 1946; tunes 150 to 600 kHz. Schematic and operating manual needed. (Thomas L. Greenwood, 2609 La Grande St., Huntsville, Ala. 35801)

John Meck T 60-1 transmitter. **Sonar** VFX-680 75-meter transmitter. Schematics needed. (Earl Robinson, 3656 Highwood Dr. S.E., Washington, D.C. 20020)

Heathkit DX-40 transmitter, circa 1955; has 6 tubes. **Hallicrafters** S-20-R "Sky Champion," circa 1945; tunes 550 kHz to 45 MHz; has 9 tubes. **Sylvania** Model 151 oscilloscope, circa 1950. Schematics needed. **Sears-Roebuck** receiver; tunes 3 bands; has 6 tubes. Instruction leaflet needed. (J. Scott Rupert, 521 N. 7 St., Apollo, Pa. 15613)

RCA 155A C-R oscilloscope; has 5 tubes. Operating manual needed. (M. Schweizer, 1853 28 Ave., San Francisco, Calif. 94122)

Montola R654-PM receiver; tunes BC; has 5 tubes. **National** SW-5 "Thrillbox" receiver; has 5 tubes. **National** WTX-30 transmitter, circa 1939; 80-10 meters, 60 watts. Schematics needed. (Richard Mote, 13703 River Forest, Corpus Christi, Tex. 78410)

Simpson AN/PSM-4A multimeter. Operating manual needed. (Jerry De Simone, 994 Karol Way, Apt. C., San Leandro, Calif.)

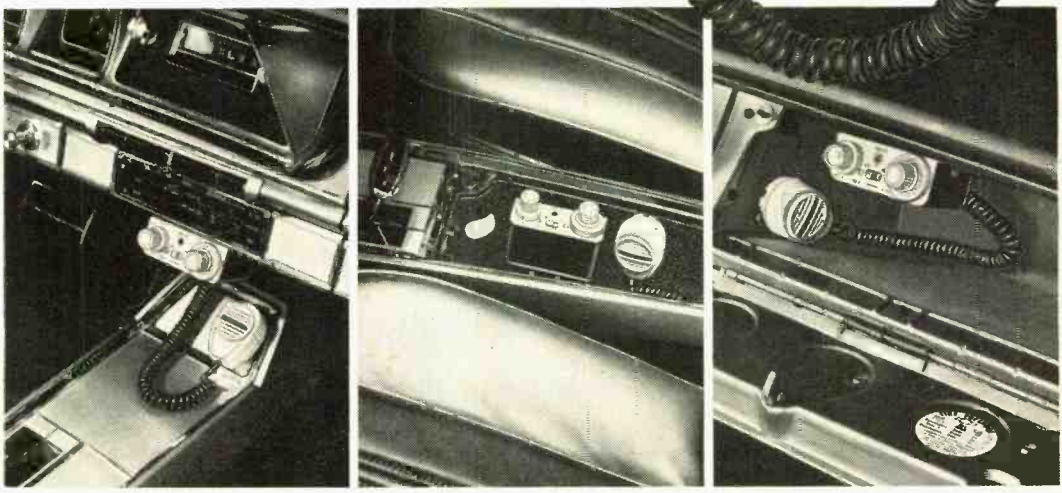
Detrola auto radio, circa 1932; has 5 tubes. (Leroy Gross, 150 W. Alachua, Cocoa Beach, Fla. 32931)

Stromberg-Carlson 1035PL radio/phonograph combination, ser. 33842; tunes AM, FM and s.w. Schematic, alignment data, and parts list needed. (R. H. Wilson, 8 Del Rey Ct., Vallejo, Calif. 94590)

3AP1 cathode-ray tube basing diagram and data needed. (Bob Palmer, 9612 Raytown Rd., Kansas City, Mo. 64134)

-30-

the International MO-23 citizens radio transceiver hides...



under the dash ..... in the console ..... in the glove compartment

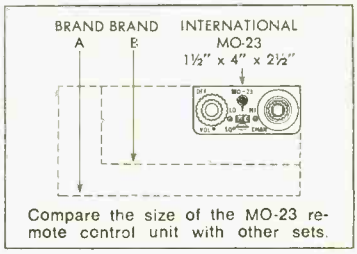
The MO-23 remote control unit is so small it will rest on the palm of your hand (1½" H x 4" W x 2½" D). You can install the MO-23 under the car dash . . . in the glove or console compartment. Compare this versatile mobile two-way radio with other makes. See for yourself how little space this unit really requires. Technically speaking, the MO-23 combines the best advantages of tubes and silicon transistors.

CHECK THESE FEATURES:

- 23 Crystal Controlled Channels
- Miniature Solid State Remote Control
- Illuminated Channel Selector
- Transmit/Receive Trunk Unit
- Transistor Power Supply

Ask your dealer to show you the International MO-23. We think it's a great new transceiver. You will too!

WATCH FOR INTERNATIONAL "FLYING SHOWROOM '66".
WELCOME ABOARD!



Compare the size of the MO-23 remote control unit with other sets.

FCC Citizens Radio license required. All use must conform with Part 95, FCC Rules and Regulations.

INTERNATIONAL
CRYSTAL MFG. CO., INC.
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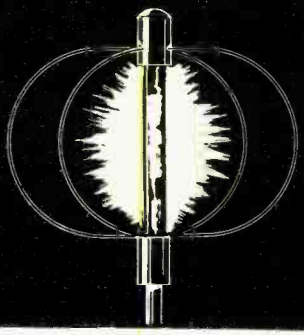
CIRCLE NO. 15 ON READER SERVICE PAGE

A bunch of us were sitting around trying to come up with a really big new idea in citizens band base station antennas, when suddenly . . . a light went on!



Meet the Speakin' Beacon —totally new idea in CB base antennas from the idea people!

Model M-148 CO-AX OMNI ANTENNA WITH VISUAL RF OUTPUT INDICATOR!

- Neon light works on RF energy — no separate electrical connection!
- Stati-light ball dissipates static electricity, minimizes noise.
- Beautiful, brawny polished aluminum construction—built to withstand 90 MPH winds!
- Efficient co-axial design. No horizontal radials needed — easily installs anywhere you can mount a vertical pipe!
- Exceptionally low angle of radiation — maximum talk power down where you want it!
- Gamma matched — very low VSWR!
- Built-in lightning protector!

Lights up when you transmit! Here's a tremendously effective and rugged base antenna for all the range and performance you need, built to the highest quality standards in the industry—but with a sensational new feature never before available on a communications antenna.

Up topside, built right into the famous field-proven A/S "STATI-LIGHT BALL," there's a permanent-circuit neon light. Push to transmit—it *lights up*, triggered instantaneously by the keying of your microphone, visibly verifies your RF power output! Also helps to guide mobiles visually to your 10-20.

CB net price: $29.95

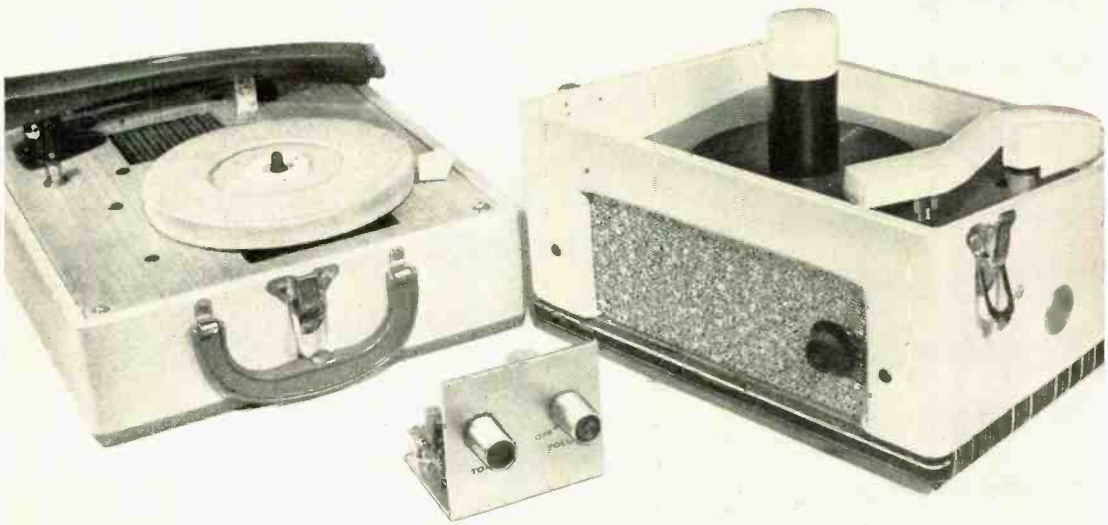
the antenna specialists co.
division of Anzac Industries, Inc.
12435 Euclid Ave., Cleveland, Ohio 44106

"Stripes of Quality" TM

CIRCLE NO. 4 ON READER SERVICE PAGE

COVER STORY

UPDATE TO SOLID STATE



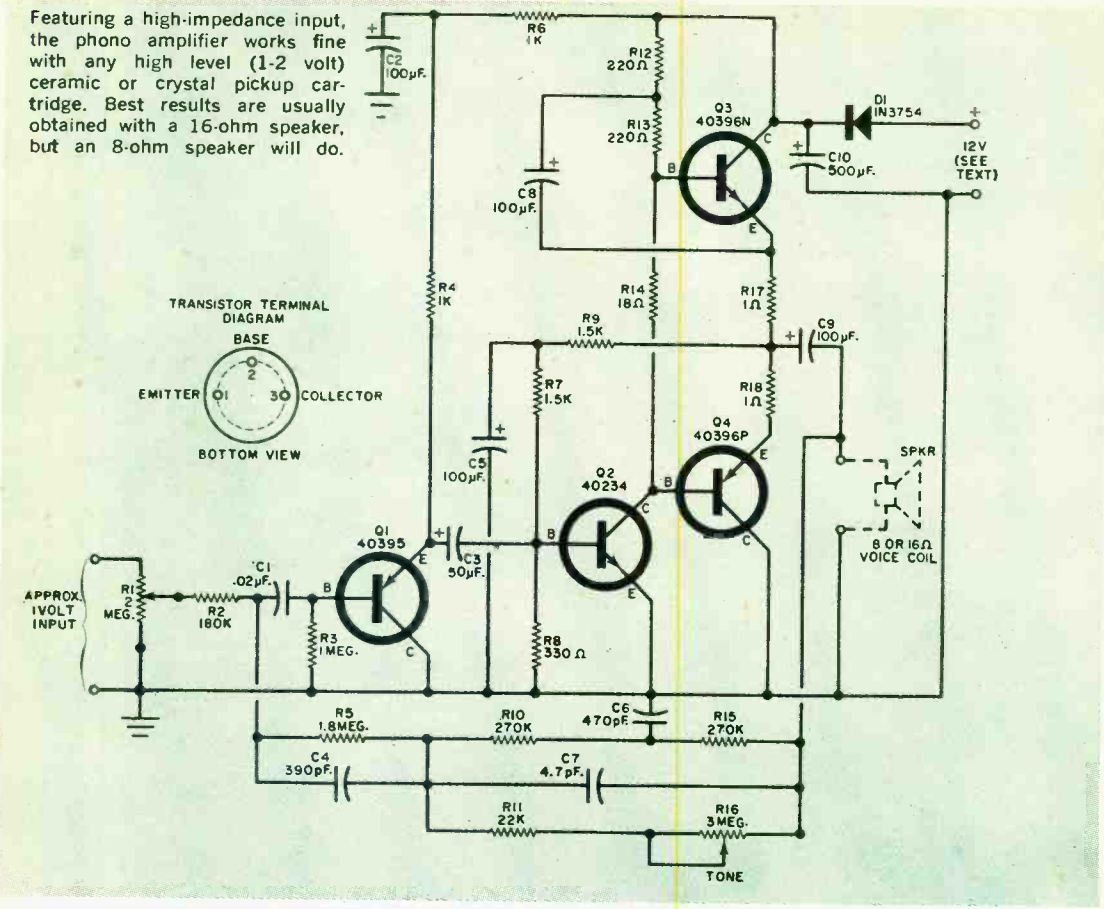
LOW-COST, INSTANT-PLAY TRANSISTORIZED PHONOGRAPH AMPLIFIER IS IDEAL REPLACEMENT FOR OLDER TUBE TYPES

UNLIKE the proverbial "tempest in a teapot," this solid-state phonograph amplifier really kicks up a storm. Featuring push-pull output amplification for more power, less distortion, and truer fidelity, the unit has been designed to satisfy the need for an inexpensive, easy-to-build phonograph amplifier that will operate satisfactorily with most high-level, low-cost ceramic or crystal cartridges.

Whether you'd like to update that old discarded record player or assemble a new one around the solid-state amplifier design, this four-transistor unit is sure to please all but the most discriminating listener.

By LOUIS E. GARNER, JR.

Featuring a high-impedance input, the phono amplifier works fine with any high level (1-2 volt) ceramic or crystal pickup cartridge. Best results are usually obtained with a 16-ohm speaker, but an 8-ohm speaker will do.



How It Works. The amplifier input from a phono cartridge is applied to the base of emitter follower *Q1* (as shown in the schematic diagram, above) through volume control *R1*, limiter resistor *R2*, and coupling capacitor *C1*. With *Q1* serving as an impedance-matching device, this transistor provides a high input impedance to the source and a low output impedance to driver *Q2*.

Transistor *Q1*'s output, developed across *R4*, is applied to the base of *Q2* through *C3*. Bias for this stage is provided through *R3*. The output of *Q2* is then direct-coupled to push-pull amplifiers *Q3* and *Q4*. The *R7-R8* divider combination, together with *R9* and *C5*, provide a compensated base bias for *Q2*.

A common output from the push-pull amplifiers is developed across emitter resistors *R17* and *R18* and coupled through *C9* to the speaker voice coil. Resistors *R12*, *R13*, and *R14*, together with *C8*, provide the base bias voltage for *Q3* and *Q4*.

A special type of feedback equalization network in the tone control circuit provides low-frequency roll-off compensation whenever the volume control is turned up fully. The network components consist of *C4*, *R5*, *R10*, *C6*, *R15*, *C7*, *R11* and *R17*. Potentiometer *R16* is the tone control. The main advantage of this equalization arrangement is that it improves tonal quality without introducing excessive losses. The amplifier can be powered directly by a 12-volt battery. However, since the attached record changer will usually be a.c.-operated, it will be advantageous to employ either a 12-volt filament transformer, or make a direct connection to the 12-volt auxiliary winding on the phonograph motor.

Diode *D1* and capacitor *C10* provide a

PARTS LIST

C1—0.02-μF, 50-volt disc ceramic capacitor
C2, C5, C8, C9—100-μF, 15-volt electrolytic capacitor
C3—50-μF, 15-volt electrolytic capacitor
C4—390-pF disc or tubular ceramic capacitor
C6—470-pF disc or tubular ceramic capacitor
C7—4.7-pF disc or tubular ceramic capacitor
C10—500-μF, 25-volt electrolytic capacitor
D1—50-volt PIV diode (RCA 1N3754 or equivalent)
Q1—RCA 40395 transistor
Q2—RCA 40234 transistor
Q3—RCA 40396N transistor (see text)
Q4—RCA 40396P transistor (see text)
R1—2-megohm potentiometer, audio taper (with s.p.s.t. switch S1)
R2—180,000-ohm resistor
R3—1-megohm resistor
R4, R6—1000-ohm resistor
R5—1.8-megohm resistor
R7, R9—1500-ohm resistor
R8—330-ohm resistor
R10, R15—270,000-ohm resistor
R11—22,000-ohm resistor
R12, R13—220-ohm resistor
R14—18-ohm resistor
R16—3-megohm potentiometer, audio taper
R17, R18—1-ohm resistor

All resistors ½ watt

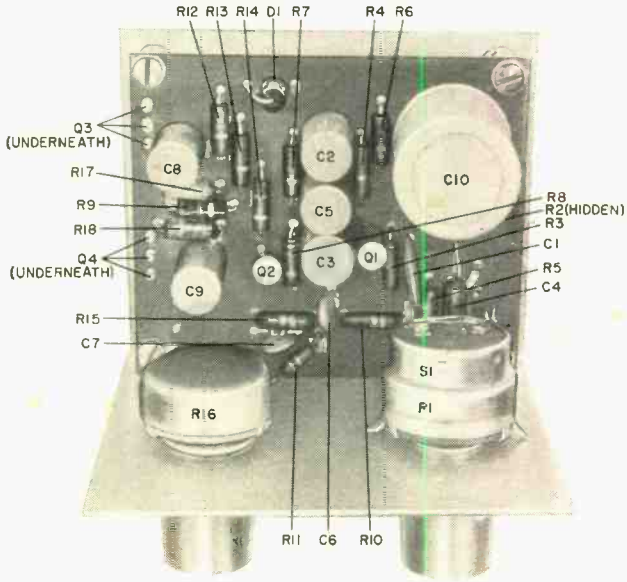
S1—S.p.s.t. switch (on R1)
1—3¼" x 2¾" x 3" (approx.) L-shaped aluminum chassis/panel
2—Heat sink clips (RCA SA2100)
Misc.—Knobs (2); ½"-long standoff spacers (4); screws, nuts, lock washers, solder, etc.

NOTE: A complete kit of parts, including an etched circuit board, is available from DEMCO, 219 W. Rhapsody, San Antonio, Texas 78216, for $9.50 postpaid

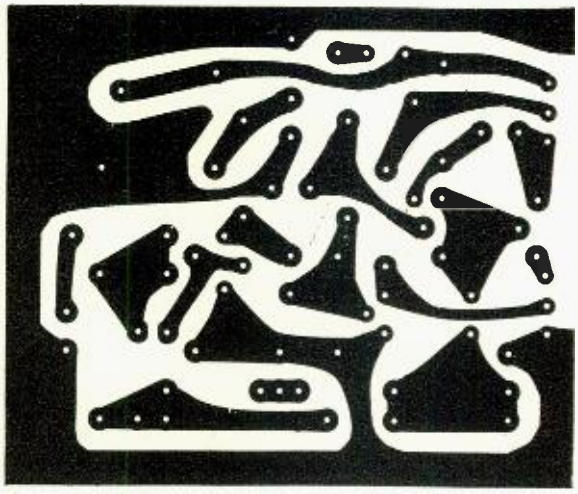
rectified d.c. output to operate the unit. For battery-powered motors, or when you want to use a battery supply for the amplifier, *D1* serves to protect the circuit from an accidental battery polarity reversal.

Construction. The amplifier can be assembled on the 3¼" x 2¾" x 3" L-shaped aluminum chassis, or on any other convenient-sized chassis. If you are doing a conversion job, investigate the possibility of using the existing chassis; in most cases, it will be quite adequate. You may even be able to use your old volume and tone controls—if these are of the proper resistance. But bear in mind that a metal chassis must be used to provide adequate heat-sinking for output transistors *Q3* and *Q4*. These transistors (RCA 40396N and 40396P) are matched pairs, and must be purchased as such.

It is far more convenient to mount the components on a printed circuit board or simply on a perforated phenolic board than to wire them directly to the chassis. The size board required will be determined essentially by available spacing, but a 3" x 3" board is usually suitable. If you prefer to use a printed circuit board, or want to work from a kit, these are available from DEMCO (see Parts List).



Except for Q3 and Q4, which are mounted underneath the circuit board, all components are visible.

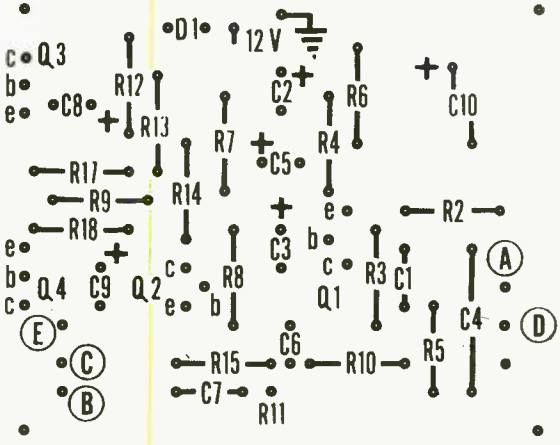


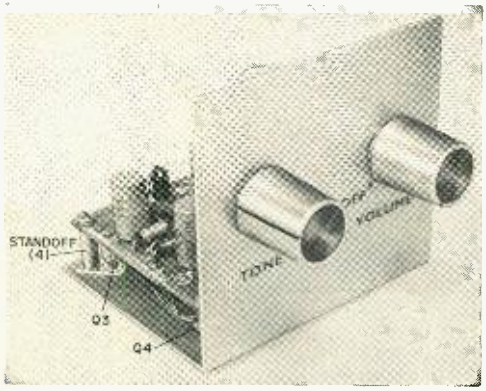
Actual size photos show foil side (left) and component side (below) of printed circuit board that can be used instead of point-to-point wiring. A packaged kit is also available (see Parts List).

It is recommended that the builder employ point-to-point wiring on the phenolic circuit board because of the simplicity of the circuit. Besides, you will get a greater feeling of accomplishment when the job is completed.

Transistors *Q3* and *Q4* are mounted directly on the chassis in any convenient location. The other transistors, *Q1* and *Q2*, can be mounted on the circuit board. As shown in the illustrations, both the volume and tone controls are panel-mounted.

The circuit board is mounted on spacers as shown, although this arrangement can be varied to suit any preferred installation. Connect the external wires from the pickup cartridge to the ungrounded side of the volume control, and connect the ground shield to a good chassis ground. (Cartridges such as the Sonotone 2TA-S and Astatic 70-TS, 74-TS or 76-TSB can be used.) Connect the loudspeaker voice coil to the "C" and "E" terminals (see schematic).





Transistors Q3 and Q4 can be inserted in small plastic cable clamps and installed underneath the standoffs used to support the printed circuit board.

If an auxiliary motor winding or a filament transformer is used as a power source, connect one lead of the 12.6-volt winding to diode *D1*'s anode, and the other lead to ground. If a battery is being used instead, connect the positive lead through a s.p.s.t. switch installed on the volume control (*R1*) to the anode terminal of *D1*. In this case, motor power is controlled by a separate switch.

After double-checking your work, apply power—and enjoy good listening.—30—

WHY DID IT TAKE 38 YEARS TO BRING COLOR TV INTO THE AMERICAN HOME?

THE COLORFUL HISTORY OF COLOR TV

By DANIEL M. COSTIGAN

FORCED by circumstances to lurk "just around the corner" for nearly four decades, color television broadcasting is now triumphing over a hapless past. By the end of 1966, about 10,000,000 homes will have color TV receivers. In fact, there are stories being told that in some cities color TV receivers are selling faster than they can be uncrated.

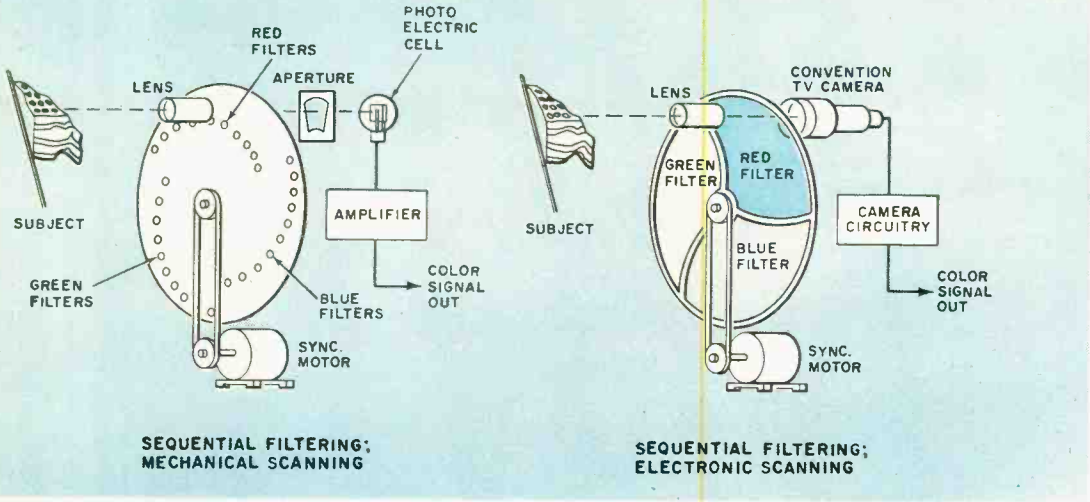
It has taken a lot longer for the color TV breakthrough to occur than most readers probably realize. The path that color TV had to follow in those four decades was far from smooth. In fact, it is a credit to the many men who persevered in the field as well as to the technology that color TV has become a real entertainment medium.

The First Decade. Talking movies and radio were novelties when the Scottish inventor John Logie Baird made England the site of the first color TV demonstration. Two-and-one-half years before the color demonstration in July 1928, Baird had startled the world with his black and white television transmission. Both systems used mechanical scanning, the difference being in the sequential color filtering on the scanning disc in the color transmission. By today's standards, the original Baird apparatus was crude and cumbersome, but all those that viewed the pictures saw distinguishable colors, properly disposed.

Here, in the United States, in June 1929, color TV was demonstrated by Dr. H. E. Ives of the Bell Telephone Laboratories. Doctor Ives had been working on a "visual telephone" and, using a device similar to Baird's, evolved a bulky array of gas discharge tubes and whirling discs. The essential difference between the Baird and Ives systems was that Ives conceived simultaneous transmission of separate colors within a restricted frequency passband—the idea basic to the system of color TV that would become an industry standard many years later.

Of course, there were other experimenters working with TV and even a few working with color TV, but all employed unwieldy apparatus and achieved inadequate results.

The Second Decade. For some strange reason, color TV lay dormant from about 1929 to 1940, when it was stirred to life again by a young Hungarian engineer,



Both of the above illustrations show color field-sequential scanning (other techniques are dot and line). The photoelectric cell "sees" one element at a time as each line of one complete color field is scanned. The color TV camera tube in the electronic scanning system "sees" one complete field at a time, but scanning process within tube results in much the same color signal output as with the mechanical scanner.

Peter C. Goldmark. Working for the Columbia Broadcasting System, Goldmark modified a method proposed for color movies—spinning color wheels in front of the camera and projector lens. The wheels could be synchronized so that a rapid succession of pictures—one for each of the primary colors—could be integrated by the eye of the viewer to form a full color reconstruction of the original scene. This system became known as the "field sequential" system and was the center of heated controversy in the post World War II boom years.

The first CBS color TV broadcasts were transmitted over W2XAB from atop the Chrysler Building in New York City. Visitors to New York can still see the original TV antennas mounted on the four faces of the building.

It was evident that the CBS color TV transmissions suffered from the limitations imposed by the black and white TV scanning standards. With only a 343-line resolution and 120-field rate, there was severe flickering of the brilliant color-saturated images. But, before efforts could be made to solve this difficulty, color TV work was suspended as the United States entered World War II.

At the close of the war, color TV was being considered as a powerful adjunct to black and white TV. On December 9, 1946, with the majority of Americans having yet to see *any* TV, an FCC hearing was convened in Washington, D.C., to decide the future of color TV.

Heartened by successful colorcasts, CBS had petitioned the FCC for the immediate commencement of commercial color broadcasting. To overcome the flickering problem, CBS had moved into the UHF broadcasting band and changed its transmission system to 144 fields and 525 lines. The results were impressive, but practically the entire electronics industry questioned the shift to UHF broadcasting.

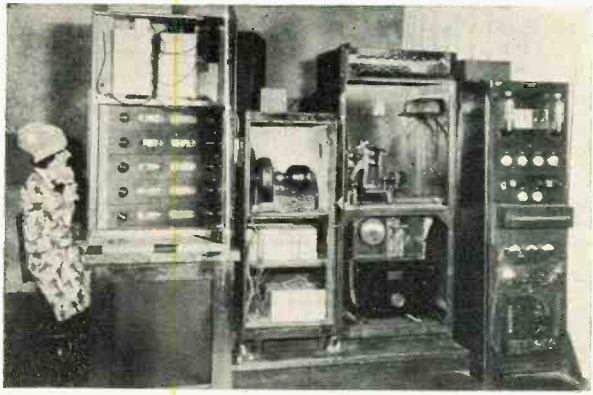
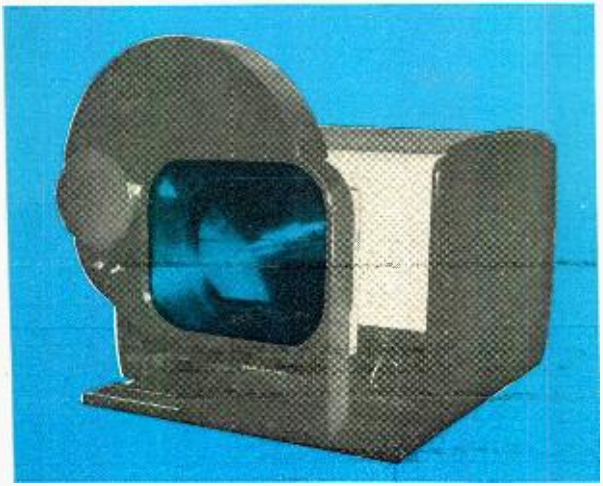


Photo from Bell Telephone Laboratories shows a woman being televised back in 1929, wearing a party hat. Color scanning equipment then consisted of a disc, gelatin filters, and multiple photocells.



For a while it looked like color TV would be relegated to an incompatible electromechanical system with a whirling disc as an integral part of the set. But the fact remains that commercial color TV signals were actually transmitted and received more than 15 years ago with this type of equipment. Shown here is a CBS system mounted on an RCA set.

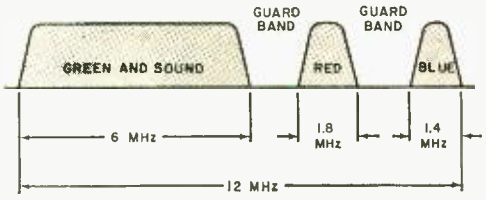
Meanwhile, RCA was not standing by on the sidelines letting CBS steal all the thunder. RCA now entered the FCC hearing with a proposal for an all-electronic color TV transmission method that did away with the whirling disc. This was good news to many, but the RCA system amounted to a complete and separate TV system for each of the three primary colors—the cost of this TV set would be twice that of the CBS receiver. Understandably, the FCC rejected both the CBS and RCA proposed color TV systems. The Commission then initiated a quest for an acceptable color system that would work in the VHF broadcasting band and within the 6-MHz channels.

Color TV was going to be a battleground, not so much between the rival systems, but between the advocate of color TV (CBS) and those who insisted that the immediate emphasis of the TV industry should be on black and white. Although General Electric had experimented with mechanical color systems, and Philco and Hazeltine were working on different color TV systems, no company besides CBS thought color TV was ready to market.

The Third Decade. By 1949, the color TV protagonists were ready for another "go" before the FCC. In renewing its original petition, CBS offered the same system of whirling discs, but modified to permit operation within the 6-MHz channel width of black and white TV. As an expedient, CBS had reduced the number of lines from 525 to 405, but through a technique called "crispening" had improved the color TV picture; and over a closed circuit, the quality was considered excellent.

A brand-new all-electronic system was proposed by RCA. The revised RCA system—called "dot-sequential"—would broadcast the picture a color at a time, but instead of a whole field being transmitted before a color change (as in the CBS system), the color cycle occurred several times within a scan line.

Significantly, the RCA color signals were received as black and white pictures on black and white TV receivers. The system was "compatible"—the key word in the months to come.



Early color TV signals occupied more than the 6-MHz bandwidth of black and white channels. With the cooperation of the TV industry, the NTSC succeeded in specifying a compatible color TV signal standard also confined to the 6-MHz band width.

While the RCA dot-sequential principle was sound, the electronics were complex and critical of adjustment. Demonstrations were marred by "color crawl," a form of signal interference between the main TV carrier and the color carrier, plus poor registration from the superimposed images of the three picture tubes.

A "line sequential" system offered by Color Television, Inc. was equally as complex as RCA's, and also suffered from image registration woes.

Having listened to more than 50 witnesses and sifted through 10,000 pages of testimony, the FCC on October 10, 1950, voted to adopt CBS's field-sequen-

(*Continued on page* 90)

WILL CATV REVOLUTIONIZE YOUR TV VIEWING HABITS?

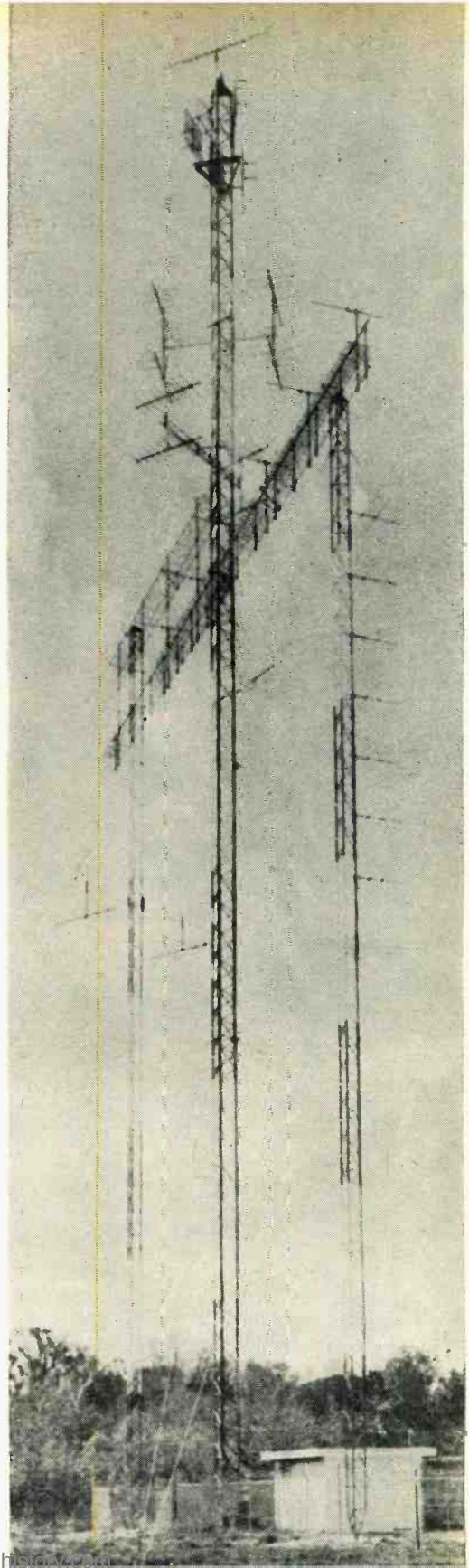
MORE CHANNELS AND BETTER SIGNALS ARE PROMISED AS THIS FAST-GROWING INDUSTRY ASSUMES PUBLIC UTILITY PROPORTIONS

by **LON CANTOR**

ABOUT 16 years ago, back in the hills of Pennsylvania, a new industry was born. Community antenna TV (CATV) first saw the light of day in the fall of 1950. At that time, television had already become an important way of life for most Americans. Dealers were happily selling TV sets, antenna installations, and service contracts. But, not everywhere. A number of isolated communities were blocked from television reception by high mountains and other circumstances. Further, the FCC had imposed a freeze on new TV channels.

Bob Tarlton, a dealer in Lansford, Pa., was unhappy about the situation. Like dozens of other Pennsylvania towns, Lansford was cut off from the TV world by mountains. Tarlton decided to do something about it. He went to Jerrold Electronics with the idea of mounting an antenna high on a hill outside of town and piping the signals from Philadelphia into Lansford.

Jerrold engineers started to design amplifiers and other devices to make



such a system possible, and before long, the country's first commercially successful CATV system was a reality. The cost of erecting the antenna and cable system was defrayed by a high installation fee, plus a monthly subscription fee. A school holiday was declared in Lansford the day the system was turned on.

Before long, the idea was being copied all over Pennsylvania, and it soon spread to other states. Today, there are approximately 1700 CATV systems operating in 48 of the 50 states (all but Rhode Island and Alaska). The map on page 52 shows the number of systems by state. These systems serve approximately 1.7 million homes, including about 5 million people, or 3% of the viewing audience.

The world's largest CATV system is in Vancouver, Canada, serving 26,000 homes. In the United States, Williamsport, Pa., has the largest system, with 21,000 subscribers.

Costs and Channels. In the early days of CATV, installation rates were very high—sometimes in excess of $150. This was because the CATV operators were afraid they would be put out of business when the channel freeze was lifted and a town would get local programming. Soon, however, they began to realize that the public was willing to pay for reception of outside programming even when local programming was available. Assured that their businesses were permanent, they lowered installation rates.

Today, hookup to a CATV system in some areas costs less than $25, and subscribers are offered a free trial period. More important, once the operators were assured of the public's appetite for more programming via CATV, they began moving into larger and larger communities. From totally isolated communities, CATV moved into towns having one or more local channels. This was possible because CATV offered an increase in the number of channels available.

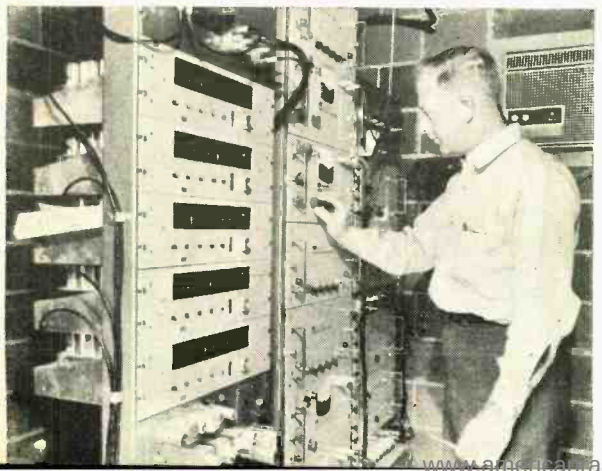
The earliest CATV system carried only three TV channels, but technology has managed to keep pace with demand. Engineers developed 5-channel systems, then 7-channel systems, and 9-channel systems. Today's CATV systems are capable of carrying up to 12 TV channels, plus 40 FM stations. Thus, viewers in small towns like Williamsport, Pa., can get more and better television reception than people in New York City.

It is only during the past year or so that CATV has really begun to burgeon. New systems are presently being added at the rate of about 40 per month, with the pace increasing rapidly. And system size is growing, too. In 1963, the median system had only 850 subscribers. Now, the median is well over 1200.

Seventy-five percent of all CATV systems are owned by local independent operators, but there are also some giant multiple system companies. H & B American is the largest CATV system operator, followed by Teleprompter Corporation, RKO General Television, Cox Broadcasting and a number of others. Among the prominent equipment manufacturers are Jerrold Electronics, SKL, Entron, AMECO, Viking, and Blonder-Tongue.

Growing Pains. Like most rapidly growing industries, CATV has raised a storm of controversy. It has been opposed by a number of special interest groups including theater owners, TV technicians, and broadcasters, and some distributors and dealers fear that they will be put out of business. While it is true that TV dealers lose some antenna business, they more than make up for it by increased TV set sales and repair service.

Robert Schlosser of Pontiac, Ill., described the impact of CATV on his busi-



At left is the CATV tower and antenna installation at Ormond Beach, Fla. Small building houses head-end equipment, including FM and TV receivers, amplifiers, and power supplies. The various signals are carefully regulated to prevent interference, and to provide good reception.

ness in this way, "More people signed up for the service than we had expected. Some who are signing now, were much opposed to it earlier.

"For a number of years, police radio interference was a very difficult problem for a large part of the city. It was especially bad on the three UHF stations that were desired. Almost any set in our stock is now free of this interference in any location using the cable.

"Color TV and remote control sets are now selling. Very few color sets were in use before the cable came. Fading and interference could not be overcome even with expensive antenna installations.

"Our biggest surprise was the increase in repair service. With steady signals and program variety, people became more critical of their reception. We have had many complete overhauls, including new picture tubes."

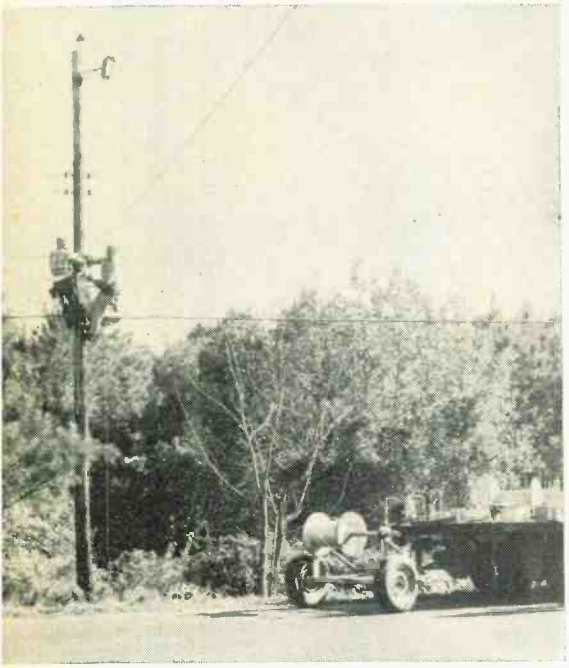
Actually, CATV operators need the good will of local dealers and technicians in order to prosper. In Lafayette, Ind., for example, local dealers and technicians were responsible for 1500 of 6500 subscriptions which were sold before the system went into operation in February of last year.

Most CATV operators refuse to lease, sell or service TV sets. And, in many systems, the rule is that employees of the cable company are not permitted to remove the back of a subscriber's TV set even on their own time, such action being grounds for dismissal.

Some industry experts estimate that 90% of all TV homes get very poor color TV reception. Cable systems, especially in areas like New York City, can overcome this problem. A good cable system can deliver perfect color pictures to its subscribers on several channels. Thus, color TV should help CATV, and CATV should spur sales of color receivers.

Broadcasters On The Fence. Broadcasters have taken a rather ambivalent stand on CATV. As a group, the National Association of Broadcasters (NAB) see CATV as a threat. They claim that community systems will drive weak stations off the air and keep new channels —especially UHF channels—from starting operations. Individually, many broadcasters support CATV. According

Final step in cable run is installation of drop line to the subscriber's home (below). In most areas, the CATV cable must be placed at least 40 inches below electric lines and 12 inches above the telephone lines.



Cable can be run underground or on poles. Space on existing poles is rented for about $2.50 per pole, annually, plus insurance. Experienced crew can string up to 14 miles a day.

to Dr. Martin Seiden, an economist hired by the FCC to study CATV, nearly one-quarter of all television station licensees are actually in the CATV business themselves.

The broadcasters first raised the "economic injury" issue in 1959, when there were only about 800 CATV systems. Although the number of CATV systems has more than doubled since then, the broadcasting industry has also been enjoying a tremendous boom. As of a recent accounting, 111 new commercial channels, and 65 new educational channels have come on the air since 1959. Of these new stations, 33 commenced operations in areas served by CATV.

Dr. Seiden's report to the FCC stated that 86 stations in the U.S. reported declining revenue during 1963. More than three-fourths of these had no CATV systems operating even in the fringes of their signal areas. Dr. Seiden concluded, that "CATV penetration has not been a direct cause of declining revenue."

Public Service Elements. A new cable TV system has a profound effect on the community it serves. For example, Mayor R. K. Ellings of Winona, Minn., wrote: "Our local cable system started with eight channels of service, added a ninth, added the background music service, then the weather service, later added a tenth television channel and, most recently, five channels of Minneapolis FM radio—without ever changing the initial rates . . . We promote it (CATV service) in our industrial brochures . . . if it weren't a good service, people wouldn't buy it."

In addition to entertainment channels, CATV systems can supply any or all of the following services:

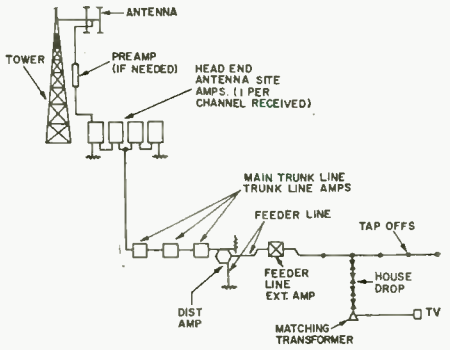
(1) A local Time-Weather-Music channel.

(2) Free cable service to libraries, schools, hospitals, police stations, etc.

(3) A direct line to the U.S. Weather Bureau. This feature enables an advisor at the weather bureau to pick up a "hot line" phone to report emergency weather information. The "hot line" overrides the audio on all channels carried by the cable. When a storm is due, people get instructions and information fast.

(4) A local channel for the use of fund drives, charitable institutions, municipal officials, etc.

HOW A CATV SYSTEM WORKS



A tower is erected on a favored antenna site. Antennas for each channel to be received are mounted on the tower. The antenna signals are amplified by a preamplifier (if necessary) and then sent to the head-end of the system. The head-end, which is usually enclosed in a concrete "shack," amplifies and processes all of the signals. It eliminates interference and carefully balances and regulates all signals.

The output of the head-end then goes into trunk-line amplifiers. For reliability, most CATV systems use solid-state amplifiers. Spacing between amplifiers must be carefully calculated. Since cable attenuates some channels more than others, slope controls are necessary. Also, thermatic equalizers are used to compensate for changes in cable slope with changes in outside temperature. Finally, automatic gain-control units are used every third amplifier to keep the signal strength constant. Too much signal overloads the amplifier, causing "windshield wiper effect"—a dark vertical shadow moving back and forth across the TV screen. Too little signal can cause "snow."

Once the signal is brought into town by the trunk-line, it is split into feeder-lines by distribution amplifiers. Long feeder-lines require line extension amplifiers. Feeder-lines are sent all over town. Subscribers' homes are connected to the feeder-lines through tap-offs—devices which send a tiny amount of the signal into the feeder-line to a subscriber's TV set, yet provide high isolation between the set and the feeder-line.

The entire CATV system uses coaxial cable, which cannot be connected directly to an ordinary TV set. Therefore, a matching transformer is mounted on the back of each subscriber TV set. If the home has two or more TV sets, a splitting device is used inside the house. Special splitting devices are available for connecting FM receivers to the line from the tap-off.

Just in case you would like to buy a CATV system, costs range from $150,000 to $5,000,000, depending upon the number of channels and the size of the community. Average system costs more than $300,000.

More than 1600 CATV systems are now in operation. All states except Alaska and Rhode Island have service. Pennsylvania, with 279 systems, heads the list; California is next with 134 systems.

One of the most impressive non-entertainment uses of CATV is as an aid to educational TV. Some 169 communities across the nation get educational TV programming by cable. All told, CATV systems serve about 156,000 students in 435 educational institutions including public schools, parochial schools, and colleges. In most cases, operators provide their services free to schools.

Future of CATV. CATV could eventually provide every person in the country with a variety of excellent TV reception. Already, systems are using microwave to bring in channels hundreds of miles away. Soon, it will be possible to bring in TV reception from other countries. One of these days a TV viewer in New York should be able to tune in on a live BBC broadcast from London featuring a group performing Shakespeare. Or an American soldier stationed in Japan might watch a live presentation of the "Miss America" contest.

CATV systems presently exchange programs between Canada, New York State, Ohio and Michigan. The French-speaking residents of Berlin, N.H., now enjoy French-language programming from Montreal via cable. Similarly, Spanish-language programs from Mexico are taken by cable to the Spanish-speaking minorities in southern California.

Although your TV dial has space for only 12 VHF channels (2 through 13), CATV can make it possible for you to receive as many as 20 or 40 channels. All you would need to tune them in, if the channels were on the cable, would be an inexpensive converter on the back of your TV set.

All of this indicates that CATV may well be the answer to the desire for more varied programming everywhere. The CATV operator with 40 channels at his disposal is not like a TV broadcaster with only one.

When there are many more channels available at any one time, it is possible to present highly specialized programs, even programs of interest to a limited number of people, on some channels, and the general interest programs on the other channels, to retain the entire audience. The broadcaster who can deliver only one program at a time usually strives to capture as many people as possible by presenting a middle-of-the-road program of broad general interest.

CATV—Present. CATV is presently fighting for its place in the total communications picture. In February, 1966, the FCC issued regulations covering nearly all CATV systems and freezing CATV's movement into the top 100 met-

(*Continued on page* 102)

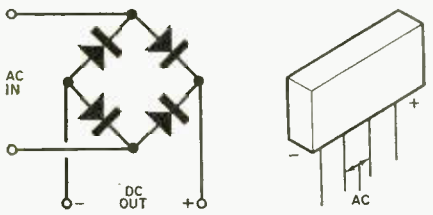
BUILD A
HANDFUL OF POWER

TINY MODULAR RECTIFIER CIRCUITS SIMPLIFY CONSTRUCTION OF A.C.-OPERATED D.C. POWER SUPPLIES

By EDWARD M. LONG

A NEW generation of pre-packaged full-wave bridge rectifiers for a.c.-operated low-voltage d.c. power supplies has recently appeared on the horizon. Made of matched diffused-junction silicon rectifiers encased in epoxy, these units can be used with any filament transformer to provide a "handful" of d.c. power for operating transistorized circuits, low-voltage d.c.-operated equipment, or for test purposes.

These prepackaged rectifiers are currently being produced by a number of firms, and are being marketed through electronic parts distributors. The Mallory FW-50 unit, rated at 1.5 amperes, 50 PIV, was selected for illustrative purposes. It can be used with either a 12-volt or 24-volt miniaturized filament transformer.



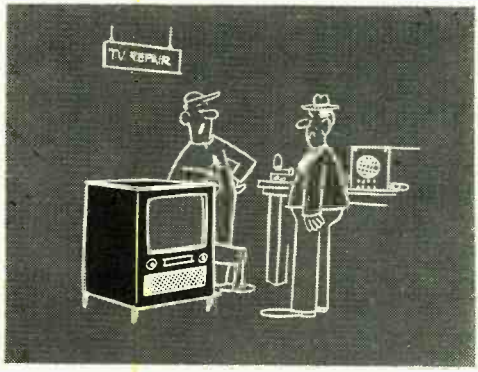
Hardly bigger than a thumbnail, the new prepackaged bridge rectifiers offer numerous advantages to the circuit designer as well as to the experimenter.

The power supply in the photo shows the rectifier module mounted on the transformer (Olson Electronics T-290) and connected through a terminal strip. Both the rectifier and the terminal strip are fastened on the transformer with epoxy. The extra lugs on the terminal strip can be used for mounting a filter circuit, if one is desired.

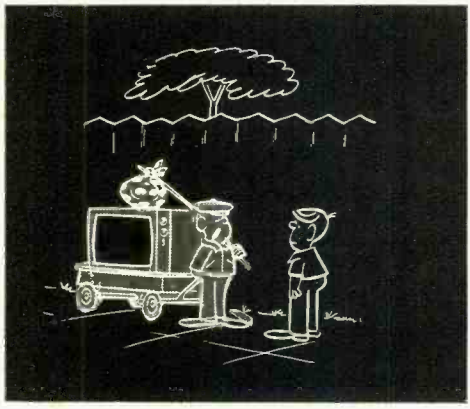
As shown in the diagram, the a.c. input leads are connected to the center legs while the d.c. output leads are connected to the outer legs. If it is desired to improve the d.c. regulation of the power supply, a bleeder resistor can be connected across the d.c. output terminals. The value of the bleeder will depend on the load requirements. -30-

THE CRT SLAVES

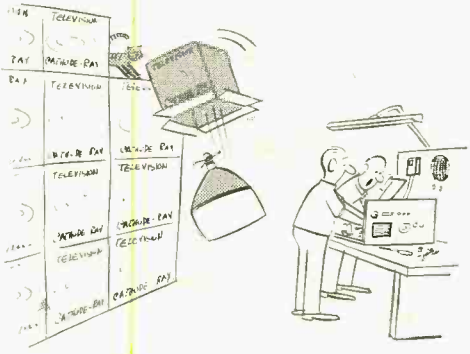
By AL JOHNS



"First, I'll give you the good news! Your cabinet's in excellent shape."

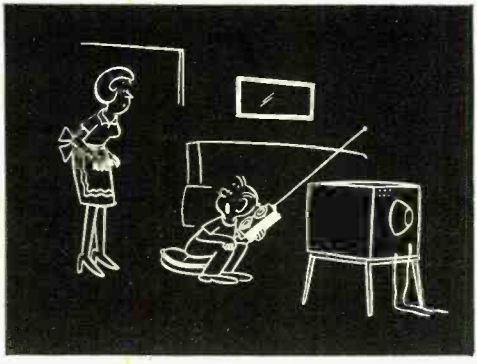


"So long, Freddie... I'm running away from home."



"Hold that perfectly still— this is the delicate operation."

"What's in the survival kit?"



"Jimmy's set isn't working."

BUILD THE LITTLE HONKER

By LYMAN E. GREENLEE

ON YOUR BOAT or on the road . . . on your farm or in your plant—or wherever you may roam—the "Little Honker," with its distinctive reverberant sound, will serve as an emergency siren, a foghorn or a come-'n'-get-it-horn. Small in size but big in performance, the unit incorporates a 12-volt-operated transistorized circuit that delivers an output of 15 watts to any attached horn or external speaker system.

The versatile Honker circuit provides two manually selectable tones in addition to a siren-like sound to add urgency to your call or alarm. The basic unit is equipped with an 8-ohm speaker that serves as a monitor but which can be used as a low-power signaling device.

How It Works. The circuit (Fig. 1) consists essentially of a low-frequency oscillator, *Q1*, which also doubles as a power amplifier. The oscillator frequency—and thus the pitch of the horn—is determined essentially by the value of base resistors *R3* and *R4* and capacitor *C1*. Thus, when *S2* is pressed to remove the shunt across *R3*, the oscillator frequency is lowered because of a timing change. With switch *S3* closed, flasher lamp *I1* intermittently shunts the *R3-R4* combination, producing a siren-like effect. Resistor *R1* provides operating bias for *Q1*.

HONK HONK

AN AMAZING, LOW-COST, HIGH-POWER, TRANSISTORIZED SIREN—PERFECT FOR HOLIDAY CAMPING, PLEASURE BOATING, OR WINTER SPORTS

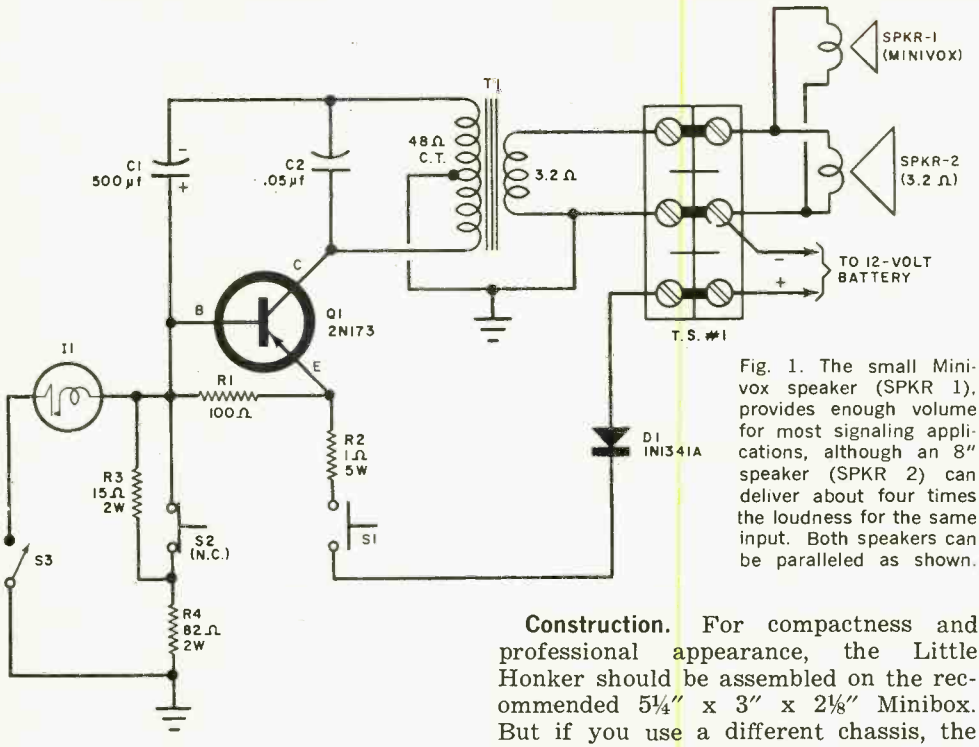


Fig. 1. The small Minivox speaker (SPKR 1), provides enough volume for most signaling applications, although an 8" speaker (SPKR 2) can deliver about four times the loudness for the same input. Both speakers can be paralleled as shown.

The horn blows when *S1* is depressed to apply battery power. Diode *D1,* in series with the battery, protects *Q1* should the battery polarity be accidentally reversed while the battery is being connected. Output transformer *T1* is an impedance-matching device but also provides a feedback path to sustain oscillation.

Construction. For compactness and professional appearance, the Little Honker should be assembled on the recommended 5¼" x 3" x 2⅛" Minibox. But if you use a different chassis, the unit will work just as well.

First, lay out and drill all the mounting holes called for in the dimensional drawing (Fig. 2). Also, drill four ⅛" holes in the bottom cover to support the ⅜"-diameter rubber feet. Each hole should be spaced about ½" away from its nearest corner.

Next, assemble the parts illustrated in Fig. 3 on the 2½" x 3" piece of per-

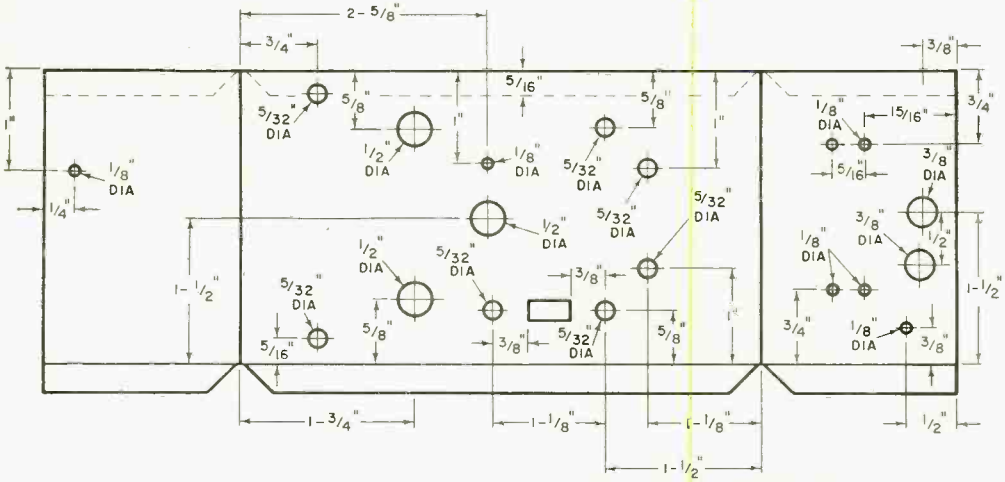


Fig. 2. This plan view of the Minibox enclosure shows the layout and gives the dimensions of all of the mounting holes. If a different-size enclosure is preferred, this layout can still serve as a useful guide.

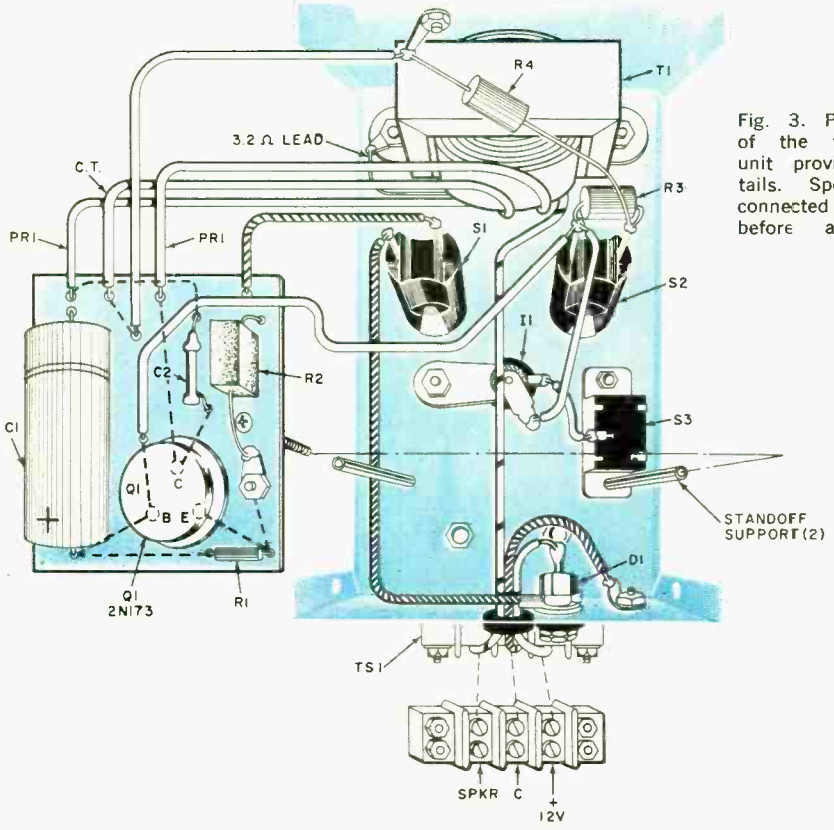
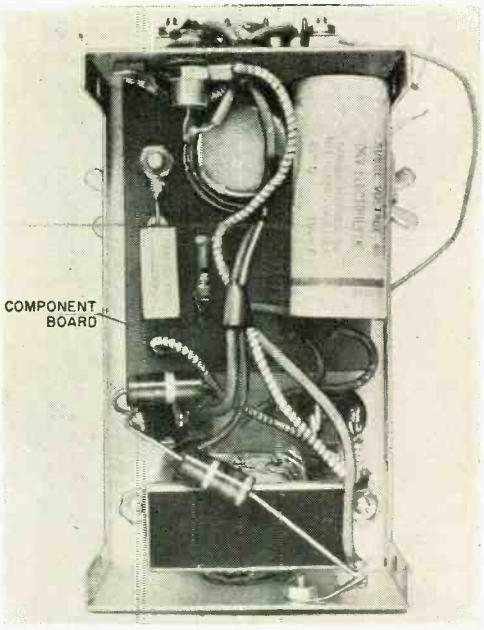


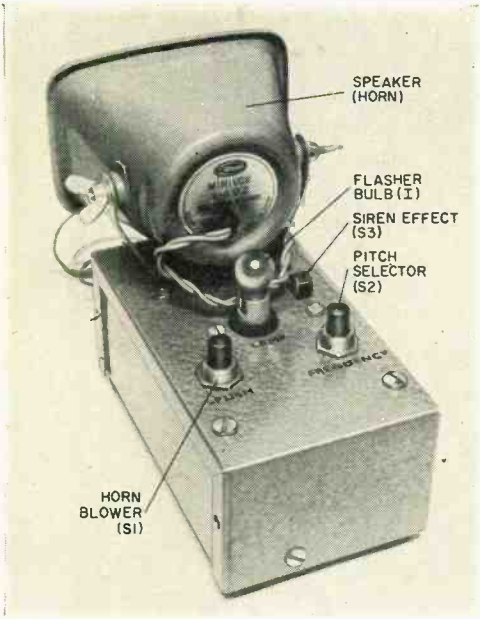
Fig. 3. Pictorial diagram of the fully assembled unit provides wiring details. Speaker must be connected to terminal strip before applying power.

PARTS LIST

C1—500-μF, 25-volt electrolytic capacitor
C2—0.05-μF, 600-volt ceramic capacitor
D1—1N341A diode, 6 amperes, 50 PIV, with mounting kit
I1—Flasher lamp (General Electric 257, available from auto supply stores)
Q1—2N173 transistor
R1—100-ohm, ½-watt resistor
R2—1-ohm, 5-watt wirewound resistor
R3—15-ohm, 2-watt carbon resistor
R4—82-ohm, 2-watt carbon resistor
S1—Normally open push-button switch
S2—Normally closed push-button switch
S3—S.p.s.t. slide switch
SPKR 1—3-watt, 8-ohm speaker (Minivox S-602, Olson Electronics, Akron, Ohio)
SPKR 2—3.2-ohm speaker
T1—Output transformer: primary, 48 ohms center tap; secondary, 3.2 ohms (Lafayette AR-503 or equivalent)
TS1—3-pin terminal strip (Cinch-Jones 3-540)
1—5¼" x 3" x 2⅛" Minibox (Bud CU-2106A)
2—⅝"-long brass rivets for circuit board standoffs (use ¼" No. 6 screws inside)
Misc.—Bayonet socket for flasher lamp; ⅜"-o.d. rubber feet (4); ½"-o.d. rubber grommet; #6 solder lugs (3)



Underchassis view shows component board mounted on ⅝"-long rivets used as standoff supports.



Full view of the Little Honker shows the operating switches, flasher and speaker mounted on Minibox.

forated phenolic board. The transistor has a ⅜" mounting stud with a nut and washer that secures it to the circuit board. When the board has been assembled, lay it aside for the time being, and get back to the Minibox.

Using two *8-32* x ⅜" screws, mount the transformer under the chassis. Install a #6 solder lug under one of the mounting screws as shown. Install the switches, diode (observe polarity, and do not overheat when soldering), and flasher lamp socket. Then install the terminal strip on the outside of the case.

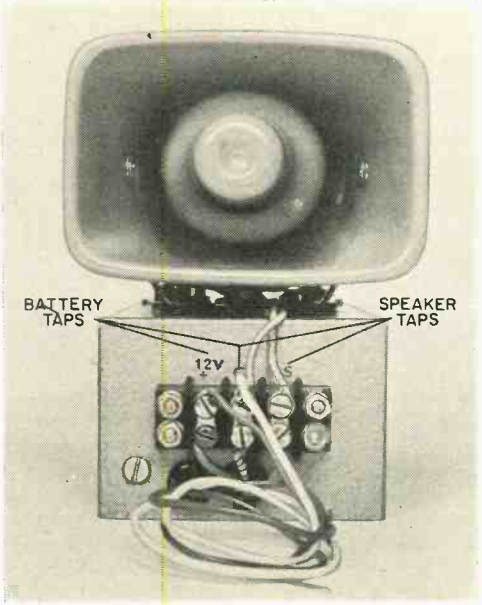
Mount and secure the Minivox speaker bracket on the case. Connect and solder the two leads going from *I1* to *S2* and from *I1* to *S3* before mounting the component board under the chassis. As shown in Fig. 3, the board is mounted on the two ⅝"-long standoff spacers, and is secured with *6-32* x 1"-long screws, nuts, and lock washers.

Install *R3* and *R4* and complete the remaining wiring connections. Check all wiring against the pictorial (Fig. 3) and schematic (Fig. 1) to make sure your work is complete.

Insert the GE 3257 flasher bulb in its socket, mount *SPKR 1* in its support, and connect the voice coil wires of this speaker to the *SPKR* and the common (C) terminals on the terminal strip. For maximum loudness, you can connect a large speaker in parallel with the monitor speaker. If you choose the proper series/parallel combination, several speakers within the unit's power rating can be used. Remember that for maximum efficiency, the combined speaker impedance should be in the 3- to 4-ohm range.

Installation and Operation. Connect a 12-volt d.c. power source between the "12V" and "C" terminals on the terminal strip. Your car battery, a lantern battery, or filtered a.c.-operated power supply will be quite suitable. Small transistor batteries can also be used although these may be quickly dissipated because of their low ampere/hour rating.

The Honker will sound whenever you press *S1*, the *on-off* switch. When the slide switch (*S3*) is flipped on, the flasher lamp is routed in the circuit, and a siren effect will be produced just as soon as the bulb warms up. Switch *S2* produces two different tones, depending on its setting. The Honker is virtually maintenance-free, and should give you many seasons of reliable service. —30—

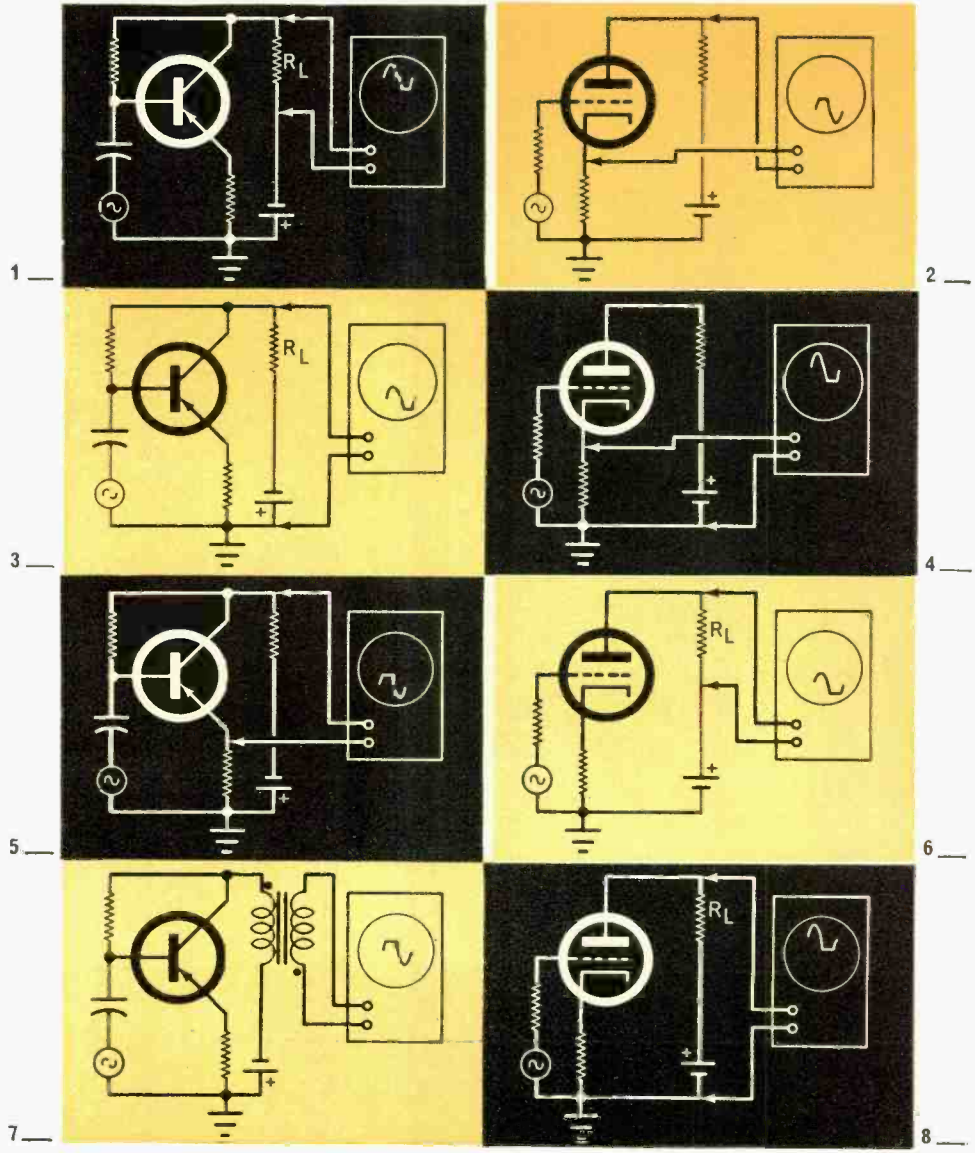


Battery and speaker connections are made, respectively, to the "12V" and "S" taps on the terminal board. The "C" lug is grounded to the chassis.

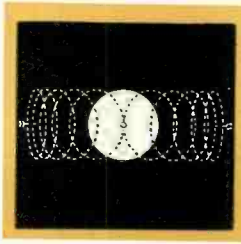
CUTOFF/SATURATION QUIZ

By ROBERT P. BALIN

The pattern displayed on an oscilloscope can, if properly interpreted, tell you a great deal about the circuit operation. For example, it can tell you if an amplifier stage is distortion-free, or whether it is operating with too much or too little bias. Flattening or clipping of the positive or negative peak of an input sine wave is the most obvious indication. Other indications include the position of the waveform above or below the zero volt or base line in a d.c. oscilloscope function. In the illustrations below (1-8), a d.c. scope is shown connected to various points in both tube and transistor circuits. From the displayed waveform, a skilled technician should be able to determine whether an amplifier is operating in its cutoff (C) or its saturation (S) region. HINTS: Remember that as a tube (or transistor) approaches saturation, its plate (or collector) voltage decreases; conversely, this voltage increases as the tube (or transistor) approaches cutoff. Note polarity of scope hookup. The encircled input sine wave is the symbol for generator and does not indicate signal phase.

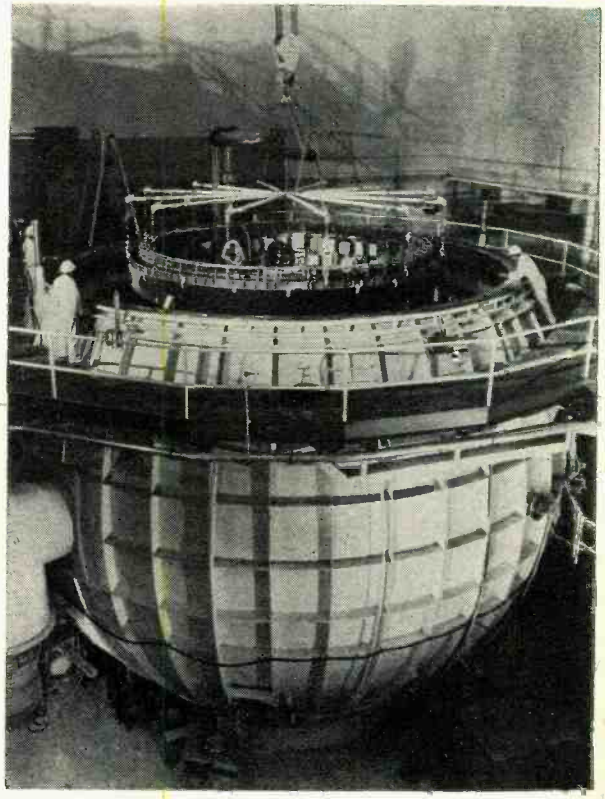


(*Answers on page* 101)



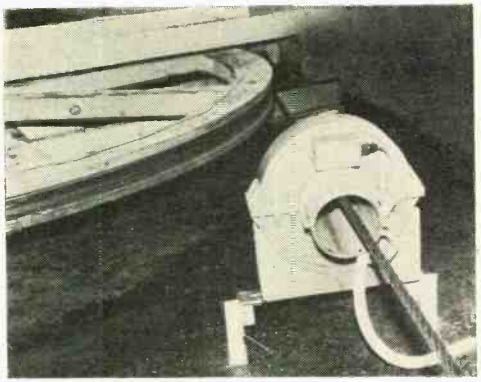
ZERO-BEATING THE NEWS

TALK ABOUT TRAFFIC—The ultrasonic traffic detectors shown below are destined for New York City's automated traffic control center. Developed by Sperry Rand, the radar-like devices use subaudible sound waves to detect the presence or motion of any type of vehicle. Mounted above or to the side of a thoroughfare, each can cover one, two, or three traffic lanes.



INFINITE IMPEDANCE—Perma-Nuclear battery by General Radioisotope Processing Corp. produces the same current (5×10^{-13} amperes) into a dead short as into a high-resistance load.

SIMULATED "ASTRONAUT"—An electronic acoustical testing dummy that "talks" and "listens" has been developed by CBS Laboratories for NASA's Manned Spacecraft Center. Representing every contour of the average astronaut's head to within 0.1", it will be used to evaluate personal communications systems such as space helmets, earphones, and microphones.



COMMUNICATION BY CABLE—Coded signals and telephone conversations are transmitted to moving cars directly over hauling cables of cable-car systems by new ITT communication system utilizing magnetic waves. Shown above is transformer coil of Dachstein aerial cableway (Vienna) launching a magnetic wave.

TESTING FOR MOON FLIGHT—Instrument unit for NASA's Saturn/Apollo launch vehicles is lowered into space simulation chamber (left) at Douglas Aircraft's Space Systems Center to undergo environmental testing in conditions typical of those which will be encountered during flights to the moon.

TWO-POUND RADAR—"Blind" firing of man-held weapons in jungle environments is now possible with a 2-pound radar developed by Radio Corporation of America. Only slightly larger than a pie box, the device can locate moving objects smaller than men and distinguish between such targets as walking and running men and animals, and between jeeps, trucks, and tanks. Sounds generated by the radar are created by Doppler effect—frequency change of radar's 9-gigahertz signal is converted to sound frequencies so operator can determine type of target.

THE WAR ON SKATING

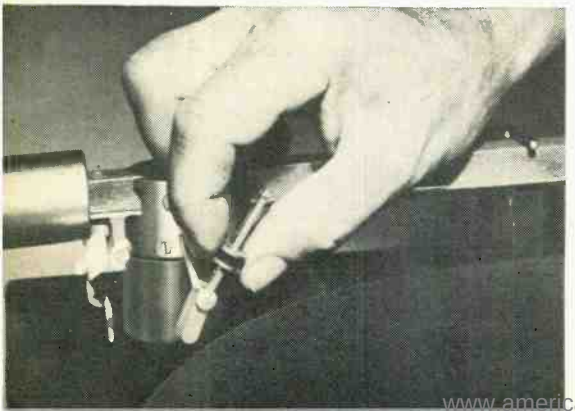
IMPROVEMENTS IN TONE ARMS HAVE REVEALED A NEW FORCE TO PLAGUE HI-FI ENTHUSIASTS —BUT IS IT SO IMPORTANT?

By HANS FANTEL

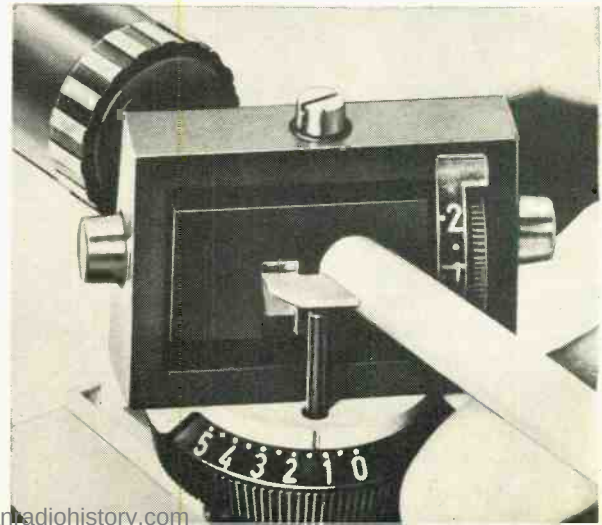
LOOK AT some new-model hi-fi tone arms and you'll find them studded with odd little gismos: dials; pointers; mysterious setscrews; and midget counterweights zooming up and down on strings and pulleys like pigmy elevators. With all this extra hardware, some tone arms look like a cross between the moon "Surveyor" satellite and a Polynesian outrigger.

All of these odd pieces of hardware are weapons in the new war on skating. When hi-fi fans talk about skating—and most of them do these days—it has nothing to do with ice or the roller rink. It happens on a record. The term "skating" refers to a sneaky force that makes the tone arm skid inward on a record even if the turntable is perfectly level. Without "anti-skating" countermeasures and if the arm is properly balanced, the skating force won't make the arm skitter all over the disc, but the stylus *will* push

Garrard's Lab series of automatic turntables incorporates an adjustable counterweight to provide anti-skating bias. Skating—as shown in the illustration above—is the tendency of a tone arm to "pull" toward the center of a disc. If the record has no grooves to hold the stylus, the arm will skate.



The user sets both of the dials on the Dual 1019 auto/professional turntable to identical readings. The dial at the right sets stylus pressure and the dial in the center sets anti-skating compensation.



steadily on the inner wall of the record groove, trying to push toward the center. The result is lopsided groove tracking.

If you now have a good, low-friction tone arm, you can demonstrate the skating effect by a simple experiment. All you need is a smooth, grooveless record —a lacquered recording blank used for disc recording is ideal for the purpose. Start the skating test by leveling the turntable with a spirit level, then lower your tone arm and stylus on the spinning grooveless disc. With the turntable level and no grooves to guide the arm, you'd expect the arm to stay right where you put it or be flung out off the record. But an invisible force seems to grab the arm, and it "skates" toward the center.

Just what accounts for this uncanny skating force that seems to defy the laws of equilibrium? The answer is shown in the drawing on page 69. But the big question remains: What happens when you're playing a regular recording? What does the skating force do to the music?

Where the Squabbling Starts. Even expert opinions clash head-on. "It's at least as serious as any other factor known to introduce record playback distortion," insists Julian Gorski, President of United Audio Products, U.S. representatives for Dual automatic turntables. Acting on this conviction, Dual engineers equipped their top-rated Model 1019 record player with an anti-skate mechanism in the tone arm.

They could have saved themselves the trouble, thinks Edgar A. Villchur, who heads Acoustic Research, Inc. Taking the opposite view, Villchur is convinced that skating makes no difference in the sound you hear. The only drawback of skating, he claims, is that it makes it necessary to increase the tracking force by about 10 to 15 percent.

"The question then becomes," says Villchur, "whether the inclusion of an anti-skating device is worth it." His own answer is clear. He didn't bother to put any anti-skate mechanism on the arm of the highly regarded Acoustic Research "AR" record player.

With the experts at odds, the average audio fan must weigh the facts for himself. He must sift the evidence, find out what happens and why.

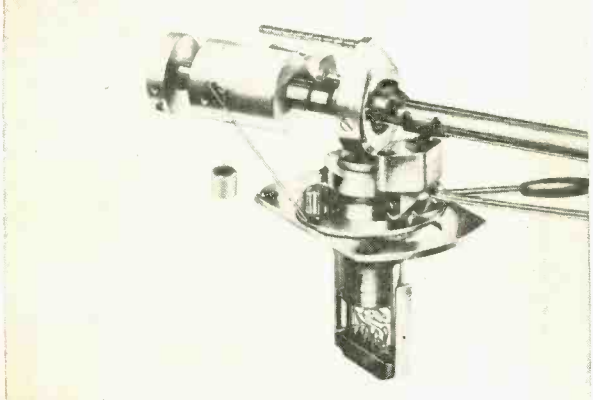
What Happens. Picture the stylus riding the groove of a stereo disc. Ideally, it should contact both sides of the groove with equal pressure so that both stereo channels are precisely traced. Yet the skating force shoves the stylus up against the inner groove wall. The result is triple trouble:

(1) The extra push on the inner wall adds extra wear to that side—also the inner stylus surface wears out sooner.

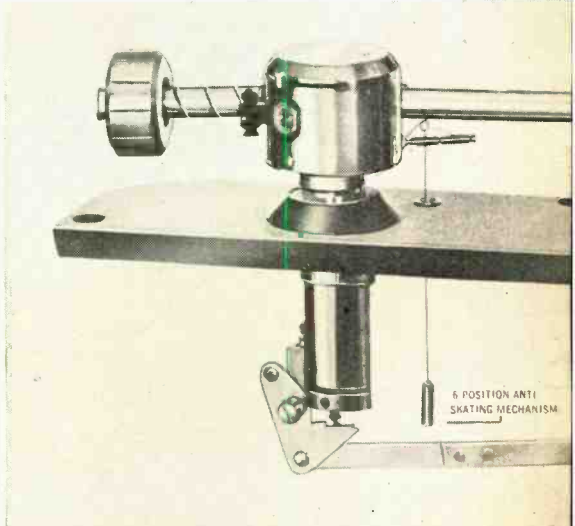
(2) Pushed away from the other groove wall, the stylus no longer makes permanent contact with all groove wiggles, and for small fractions of a second, rattles loosely in the groove. This inability to follow the exact musical waveform results in distortion.

(3) With one-sided pressure constantly acting on the stylus, it gets pushed off-center. Riding on a bias may put a

This British-designed tone arm introduced a new dimension in record playback. Among the many unique features of the Shure/SME tone arm is the anti-skating bias adjuster, which is a weight that varies its pull as tone arm travels across the record.



A dangling weight is also used in the Thorens Model TP14 professional tone arm to counteract skating.



slight permanent kink in the stylus suspension and eventually unbalance the stereo effect by limiting the free stylus swing on one side.

The Fighters. One group of designers has come up with a variety of odd gismos—some working by weight, some by springs—to counteract the skating force. The idea is to apply an equal and opposite force to the tone arm to cancel out the skating force.

The trouble is that the skating force doesn't stay constant. It varies as the arm swings across the record. Also, it depends on the amount of stylus pressure, stylus diameter, and even on the type of record material. Anything altering the friction between stylus and record also alters the skating force. It took a lot of ingenuity to design anti-skate mechanisms to take account of all these variables, and in the latest crop of tone arms, you find various solutions to the problem.

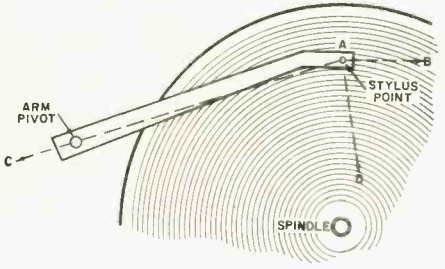
Among professional-type tone arms, the ADC "Pritchard" model, the Shure-SME 3009, and the new Thorens TP-14 sport peculiar-looking antiskate devices: tiny counterweights riding up and down on strings and pulleys as the tone arm moves across the disc. Among record changers, Garrard's Lab 80 has a calibrated sliding weight on a flip-type lever. And about the neatest and easiest-to-adjust anti-skate mechanism is built into the Dual 1019. You just set a dial to a figure corresponding to the tracking force required for your cartridge. A non-fatigue precision spring-and-lever arrangement takes care of the rest. Miracord recently adopted a similar arrangement for its Model 50-H changer. In each case, the instruction book tells exactly how to adjust these new devices.

WHY TONE ARM SKATES

The skating force stems from the strange geometry of tone arm tracking. If the stylus traveled in a straight radial line toward the center of the disc, the whole problem wouldn't come up at all. All forces would then be balanced and symmetrical. No side-thrust would develop.

But the stylus doesn't travel straight. It swings in an arc around the tone arm pivot. What's more, the cartridge rides crooked, offset by an angle on the arm. This offset angle is calculated to assure more accurate tracking—to keep the cartridge nearly tangent to the record groove at all points of the play. But at the same time, it makes the geometry nonsymmetrical. Therefore, the friction force on the stylus becomes nonsymmetrical also. As shown in the diagram below, side-thrust develops against the inner groove wall. That's the origin of the skating force.

As shown, record friction pulls the stylus in direction A-B. The reactive force of the arm pulls back in direction A-C. The result of the angle between these two lines is side-thrust D—the skating force. It's like tying a rope to a tree, then running it around a person, and pulling at the loose end. The rope will try to straighten out, pushing the person sideways. In tone arms, it's the stylus that gets pushed.



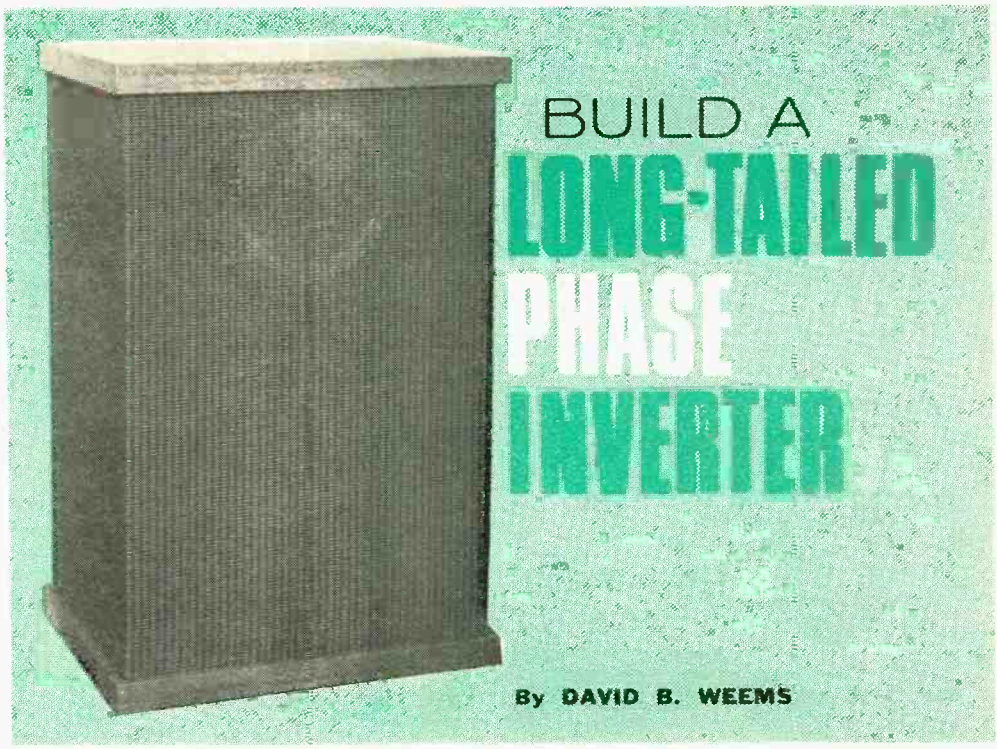
Con & Pro. All this ado is about nothing much, claims the opposition group of audio engineers. They have done some fancy figuring to prove that the sideways thrust of the skating force is only about one-tenth the downward stylus pressure. Since today's top cartridges ride at pressures of 2 grams or less, that leaves just about 0.2 gram skating thrust. Too little to bother about, they say.

Those are fighting words to hard-bitten hi-fi'ers who insist that the whole idea of high fidelity is the pursuit of perfection. No flaw, no matter how slight, can be ignored.

The anti-skaters argue that the better your cartridge, the more sensitive it is to skating distortion. The higher the stylus compliance, the more easily the stylus bends sideways under skating stress. And the better the bearings in your tone arm—with less friction drag to bind it—the more readily it skates.

"In the early days of stereo, when arms and cartridges were fairly stiff-jointed," says Gorski, "you could afford to ignore skating. But the best of today's equipment is so sensitive that even

(*Continued on page* 98)



BUILD A LONG-TAILED PHASE INVERTER

By DAVID B. WEEMS

NEW LABYRINTH-TYPE SPEAKER ENCLOSURE DESIGN ANSWERS OLD QUESTIONS WITHOUT RAISING NEW ONES

IF THERE'S one thing most audio experts seem to agree on, it's that the battle over the relative merits—or demerits—of different speaker enclosure designs rages on unabated.

Advocates of the labyrinth-type enclosure have long attested to its superior reproduction qualities at the lower limits of the speaker's frequency range. They also claim better transient response and less obvious effects of any mismatch.

Proponents of the bass reflex type enclosure counter by noting that one can easily correct a mismatch in a bass reflex cabinet without resorting to major surgery. They will even admit to superior low-frequency response in horns or pipes while claiming that the latter tend to impede reproduction in the midrange.

Many authorities have downgraded the bass reflex enclosure by stating flatly that if critics call the labyrinth a resonant pipe, then the bass reflex is nothing more than a resonant box.

But even the most fanatic partisan will admit, privately, that not even his own pet speaker system is perfect. That being the case, any new speaker or enclosure design always evokes a great deal of interest—and suspicion.

A New Design. From England comes a new speaker enclosure design which has been dubbed an *acoustical transmission line* by its designer, A. R. Bailey, of the Bradford Institute of Technology. At first glance, it looks somewhat like a labyrinth enclosure, except that the length of the pipe—eight feet—suggests a departure from labyrinth design.

An unusual feature is that the cabinet is filled with long-fiber wool, in contrast to the common practice of just lining the wall surfaces of an enclosure. In all

probability, Bailey got his name for the enclosure from a theory for electrical transmission lines, which states that if a line of finite length is terminated in a resistance equal to the characteristic impedance of the line, disturbances along the line are not reflected back to the source, and such a line will behave as though it were of infinite length. The fiber wool acts as the terminating resistance in an acoustical transmission line.

But the more you look at Bailey's enclosure, the more it looks like a modified labyrinth. Recall that labyrinths provide maximum damping at one-quarter wavelength while maximum sound output is obtained at one-half wavelength. The 8′ length specified by Bailey corresponds to a quarter-wavelength at 35 Hz—just about the resonant frequency specified for the woofer.

In reality, Bailey's contribution seems to be mainly the long-fiber wool which damps resonant frequencies and produces an ultra-low-pass filter that eliminates midrange interference. Also, with this design, speaker mismatch is difficult to detect.

Bailey's speaker enclosure design employs an oval-shaped British speaker that is not generally available. It has, therefore, been modified slightly by the author to accommodate an American-made low-resonance 12″ speaker—the Allied Radio KN-888HC. Also, since long-fiber wool is not generally available, kapok has been substituted.

The enclosure presented here performs well in the 50 to 60 Hz range and has excellent transient response. But this doesn't mean that everybody will like it; after all, not everybody likes lobster, either.

Incidentally, this version of Bailey's enclosure is called the *long-tailed phase inverter* simply because it has an extra-long curled tube which reverses the phase of the low-frequency rear wave coming from the speaker to reinforce—rather than cancel—the sound coming from the front of the cone.

Construction. An important design feature of any speaker enclosure is its rigidity. And although labyrinths are not subject to unduly high pressures, every precaution must be taken during construction to insure the utmost in rigidity.

BILL OF MATERIALS

2—4′ x 7′ sheets of ¾″ plywood
1—10′ length of ¾″ x ¾″ clear pine (for cleats)
1—5′ length of 1½″ x ¾″ clear pine (for cleats)
1—Box of #8 x 1¼″ flathead wood screws
24—#8 x 2″ flathead wood screws (for sides)
4—¼″ x 2″ bolts (for mounting speaker)
3—Pounds of loose kapok
Misc.—Grille cloth, wood trim, nails, glue, cheesecloth, wool or cotton batting, clamps

This means that screws should be closely spaced and in tight, and that all joints should be glued in place.

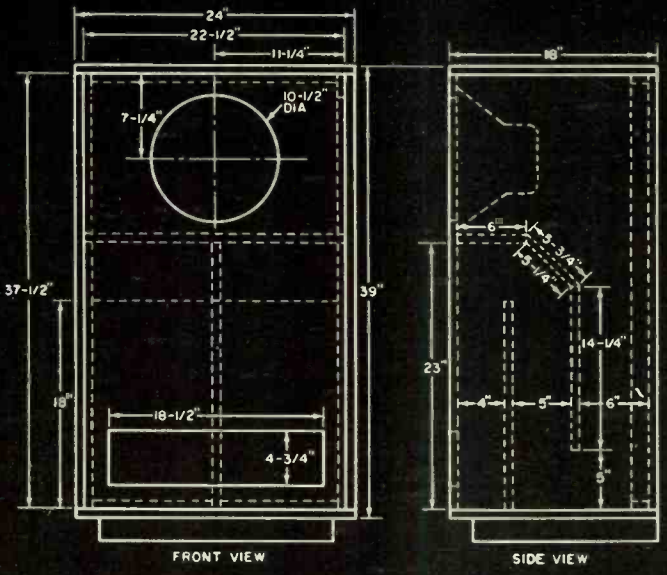
Your first task, of course, will be to cut the plywood and pine cleats to the sizes specified in the Table Of Dimensions. One important rule of thumb is to *measure twice, cut once.* Also, a note of caution: when cutting out the 18″ slot in panel *K*, be careful to make the slot just wide enough to accommodate panel *J* snugly.

Overall dimensions for the enclosure, including measurements for panel mounting, are given in Fig. 1. Additional construction details appear in Fig. 2. Note that panel *H* is first cut at 45° so that one side has a width of 5¾″ while the other is only 5¼″ wide. Then the longer side is trimmed down so that the thickness of the tapered edge is ¾″.

After sanding down all the panels, and before assembly, draw a guide line through the middle of panels *G*, *H*, *I*, and

Table of Dimensions

IDENTIFICATION	SIZE	QUANTITY
	¾″ Plywood	
A, B	22½″ x 37½″	2
C, D	18″ x 37½″	2
E, F	18″ x 24″	2
G	22½″ x 14½″	1
H	22½″ x 6¼″	1
I	22½″ x 6″	1
J	22½″ x 18″	1
K	9¾″ x 23″	1
	¾″ Clear Pine	
Front (lower)	¾″ x 23″	2
Front (bottom)	¾″ x 10″	2
Front (top)	¾″ x 22½″	1
Sides (upper)	¾″ x 13½″	2
Sides (lower) & diagonal brace for back	1½″ x 36″	3
Rear (top & bottom)	1½″ x 22½″	2



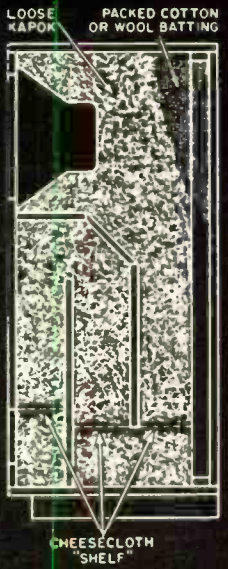
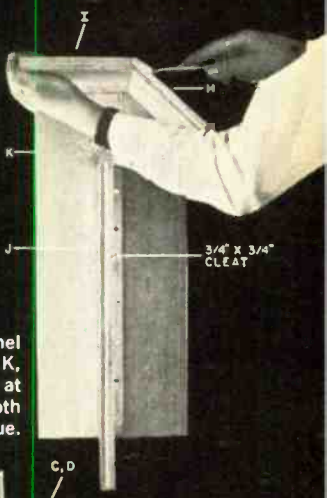


Fig. 1. Overall dimensions are provided in front view drawing of phase inverter enclosure (above). Location and mounting dimensions of interior panels are shown in the side view. At upper right, finished cabinet is packed with kapok, while interior surfaces are lined with a thin layer of cotton or wool batting.



After fitting panel J tightly into K, secure the cleat at the joint with both screws and glue.

Fig. 2. The slot in panel K (below) must be cut to close tolerances to insure a tight fit during assembly. Panel H is first cut at a 45° angle and then the points are cut off.

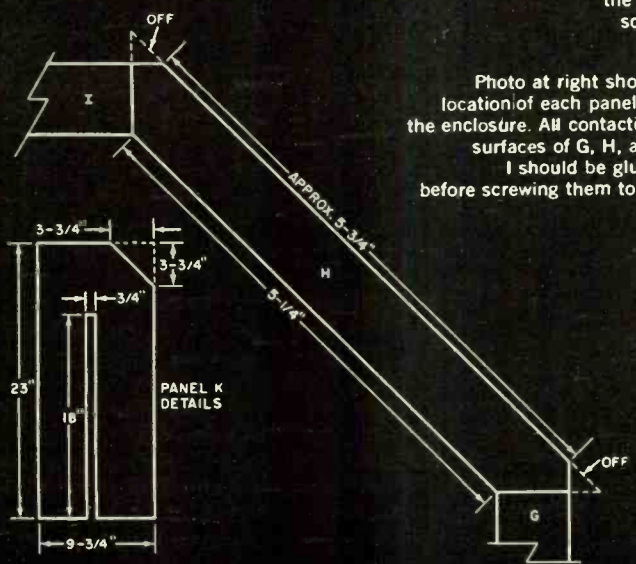
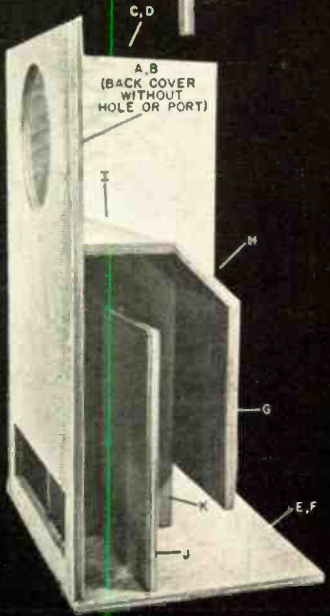
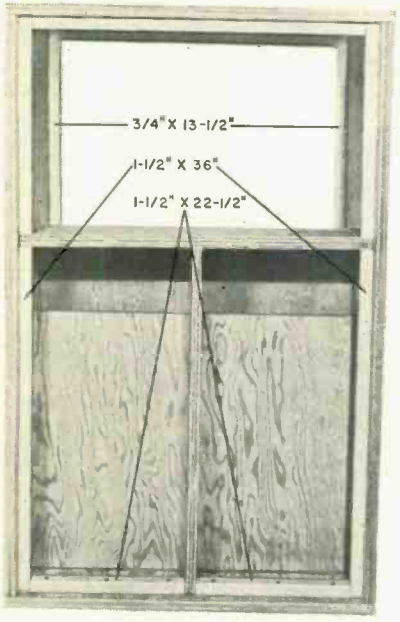
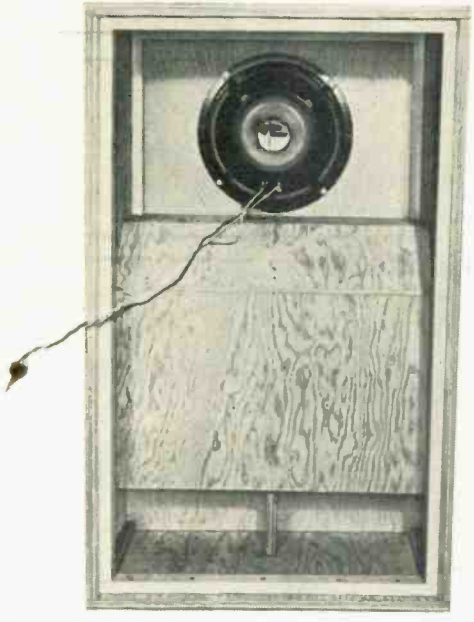


Photo at right shows location of each panel in the enclosure. All contacting surfaces of G, H, and I should be glued before screwing them to K.





After cutting and fitting the cleats, apply a little glue to the contacting surfaces, and nail them in place temporarily with small nails. Then secure them permanently with #8 x 1¼" flathead screws.



Rear view with back cover removed shows modified labyrinth appearance of phase inverter enclosure prior to packing of cabinet with kapok. The speaker shown is Allied Radio's KN-888HC, which replaces the British speaker used in the original design.

J where they will be attached to panel *K*. After panel *J* has been pushed into position, attach a ¾" x ¾" x 18" cleat to panels *J* and *K* (see photo) using glue and screws.

All contacting surfaces of panels *G*, *H*, and *I* should be liberally glued and then screwed to panel *K*. Screws should go diagonally through *H* into *I* and *G* (see Fig. 2).

Next, you can mount the previously assembled panels on the bottom piece, *E*, after which you add the sides, *C*, and *D*, and the top, *F*. Incidentally, you will find it a lot easier to add cleats to these parts before assembly. Note from the illustrations that the partitions are recessed ¾" in from the front and sides of the baseboard in order to accommodate the front and side panels.

Apply glue to the edges of the partitions and then nail the front and side panels to the partitions. Then add a few 2"-long screws to give extra strength to the joints.

This is a good time to pack the middle section of the labyrinth with kapok. (Long-fiber wool is preferred, of course, if you can get it.) However, because kapok tends to settle, you should tack a single layer of cheesecloth from the bottom of panel *G* to the back of panel *J* (see Fig. 1).

After half-filling the partitions, make a pillow of loose kapok wrapped in cheesecloth and drape it over the top of *J* to fill the upper middle section as well as the front tube. Now you can attach the front panel using both glue and screws to secure it in place. Turn the cabinet upside down and finish filling the front tube with kapok right up to the level of the port. Tack another cheesecloth partition across from the top edge of the port to the front of panel *J*. Then fill the area behind the port with kapok.

Finishing Touches. Paint the side and front of the labyrinth with flat black paint and allow it to dry thoroughly before adding the grille cloth. It is advisable to cover the port with a piece of open-weave black cloth.

Because grille cloth is available only in 36" widths, and since the height of the cabinet is 39 inches—not including feet—it is necessary to use trim that

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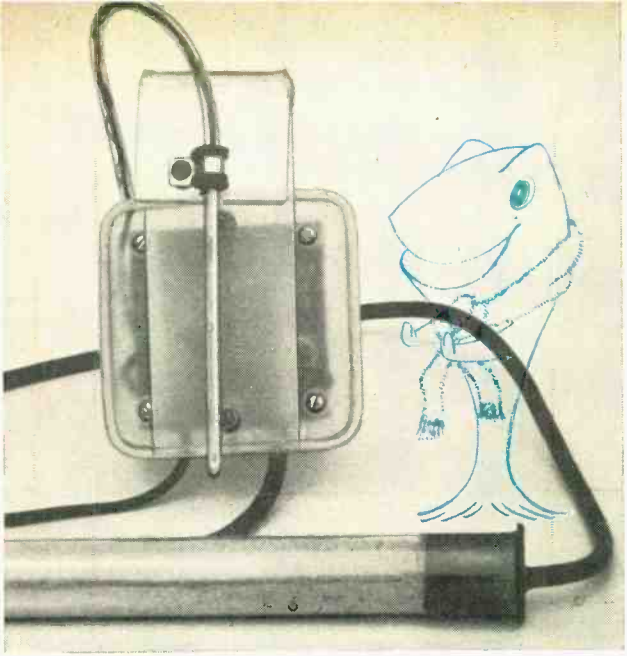


NEW!

STATIC-FREE THERMISTORIZED AQUARIUM HEATER

NO MORE RADIO INTERFERENCE FROM YOUR AQUARIUM HEATER . . . THERMISTOR-CONTROLLED SOLID-STATE DESIGN EMPLOYS NOISELESS SCR SWITCHING

By A. E. DONKIN, W2EMF

WHETHER YOU'RE an amateur ichthyologist or just a fellow with a few tropical fish, you'll want to build this transistorized thermistor-controlled aquarium heater, and get rid of that annoying radio interference that your present bimetallic thermostat produces. What's more, you'll be able to maintain precise temperature control to within ± 0.5-degree of setting.

When equipped with a standard 75-watt submersible heater, the unit will operate satisfactorily in small tanks—up to 20 gallons—and maintain the desired tank temperature within a differential of up to 10° F above or below ambient. For larger aquariums, or where greater temperature differentials exist, a larger heater can be employed or a full-wave rectifier substituted for the single rectifying diode used.

How It Works. As shown in Fig. 1, *Q1* functions as part of the sensing circuit while *Q2* acts as a triggering device to turn on *SCR1*. Thermistor *TH1* and *R1* form a voltage divider that provides a variable base bias for *Q1*. Potentiometer *R3* in *Q1*'s emitter establishes the operating range of the transistor, and thus serves as the temperature control adjustment.

In operation, if the tank temperature is below normal, the relatively large voltage drop across *TH1*—due to its high resistance at low temperatures—places a high reverse base bias on *Q1*, cutting off the transistor.

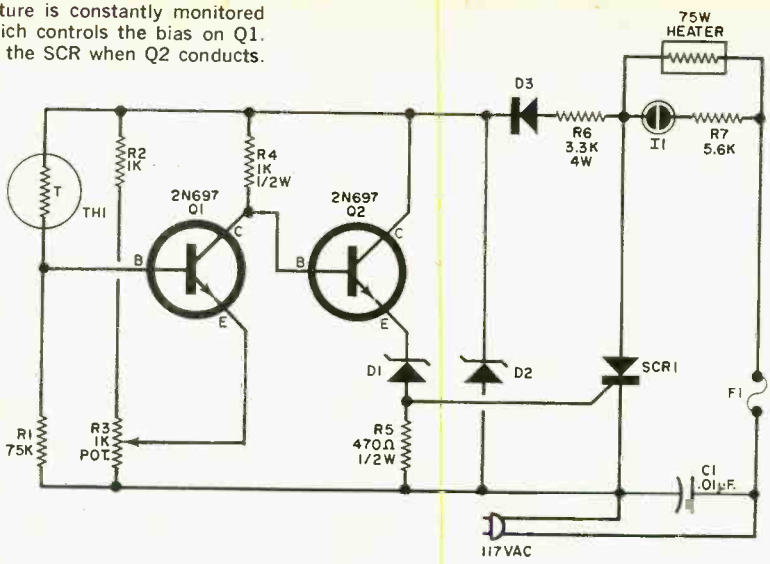
With *Q1* at cutoff, the forward bias developed across *R4* drives *Q2* in a high state of conduction and the zener or avalanche breakdown voltage of *D1* is exceeded. Thus, the emitter voltage across *R5* is applied to the gate of *SCR1* to turn on the device which energizes the heater in its anode circuit.

As the water temperature increases, causing the thermistor resistance to go down, *Q1* becomes forward-biased and conducts. The output at the collector overcomes *Q2*'s forward base bias, and this transistor is driven into cutoff. This turns off *SCR1* and the heater is de-energized.

Diode *D2* is a voltage regulator that maintains the d.c. at the cathode of rectifier *D3* at a constant 18-volt level. Neon lamp *I1*, in series with *R7*, is a test device used during initial adjustment of the unit.

Construction. To assure maximum operating safety, the thermostat's electronic circuitry is housed in a plastic freezer container rather than in a metallic box. Begin construction by preparing the aluminum panel shown in Fig. 2. It is made from a 1½" x 2⅝" by ⅛"-thick aluminum plate laid out and drilled to the dimensions given, and

Fig. 1. Water temperature is constantly monitored by thermistor TH1, which controls the bias on Q1. Heater is turned on by the SCR when Q2 conducts.



then made into an L-shaped bracket. Not shown are two small holes that must be drilled to mount the bracket.

Secure the bracket to the circuit board (see Fig. 3) using two *6-32* x ¾" screws inserted from the bracket side of the board through two ⅜"-o.d. x ½"-long standoffs and nuts. Do not install the remaining two standoffs at this time.

Mount the fuse holder where shown, then install and wire up the remaining parts. In the model shown here resistor *R6* consists of three 10,000-ohm, 2-watt resistors in parallel. This combination was used for no other reason than the fact that they were readily available. However, it is more convenient to use a single 3300-ohm, 4-watt resistor instead.

Also, if desired, *Q1* and *Q2* may be wired directly into the circuit, eliminating the transistor sockets. Be sure to use a low-wattage iron when soldering transistors and diodes, and avoid overheating these devices. And be sure to observe diode polarities.

When installing the SCR mounting kit, apply a little silicon grease between the aluminum panel and the mica washer to improve heat conduction. The thermistor must be mounted in a glass tube and the wires run through a small plastic air hose that you can get from an aquarium supply store. To seal the thermistor glass tube at one end, use a Bernz-O-Matic type torch to heat the tube until it is red-hot, and then draw

PARTS LIST

C1—0.01-μF, 150-volt ceramic disc capacitor
D1—Z4XL6.2 silicon zener diode (GE)
D2—Z4XL18 silicon zener diode (GE)
D3—1N3755 silicon diode (RCA)
F1—3-ampere fuse (and fuse holder)
I1—NE-2 neon lamp
Q1, Q2—2N697 transistor
R1—75,000-ohm, ½-watt resistor
R2, R4—1000-ohm, ½-watt resistor
R3—1000-ohm, ½-watt miniature molded composition potentiometer
R5—470-ohm, ½-watt resistor
R6—3300-ohm, 4-watt resistor
R7—56,000-ohm, ½-watt resistor
SCR1—2N3228 silicon-controlled rectifier
TH1—Thermistor (Veco 51A1 from Newark Electronics, or Fenwal Electronics EMC4 from Allied Radio)
1—75-watt submersible aquarium heater
1—3¼" x 3¼" x 2⅜" plastic freezer container with cover
1—2" x 7" piece of ¼"-thick plexiglass
1—2¾" x 2¾" perforated phenolic board
1—1½" x 2⅜" piece of 1/16"-thick aluminum plate
6—⅛"-i.d. x ½"-long standoffs
Misc.—6-32 x 1"-long screws with four flat washers and nuts (2); small plastic clamps (3); 6-32 x ¾"-long screws with nuts (4)

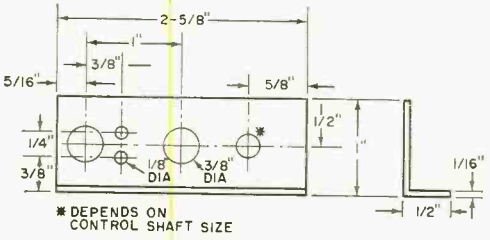


Fig. 2. Mounting bracket is made from 1/16"-thick aluminum plate cut to dimensions given. It acts as a heat sink for SCR1 and as a support for R3.

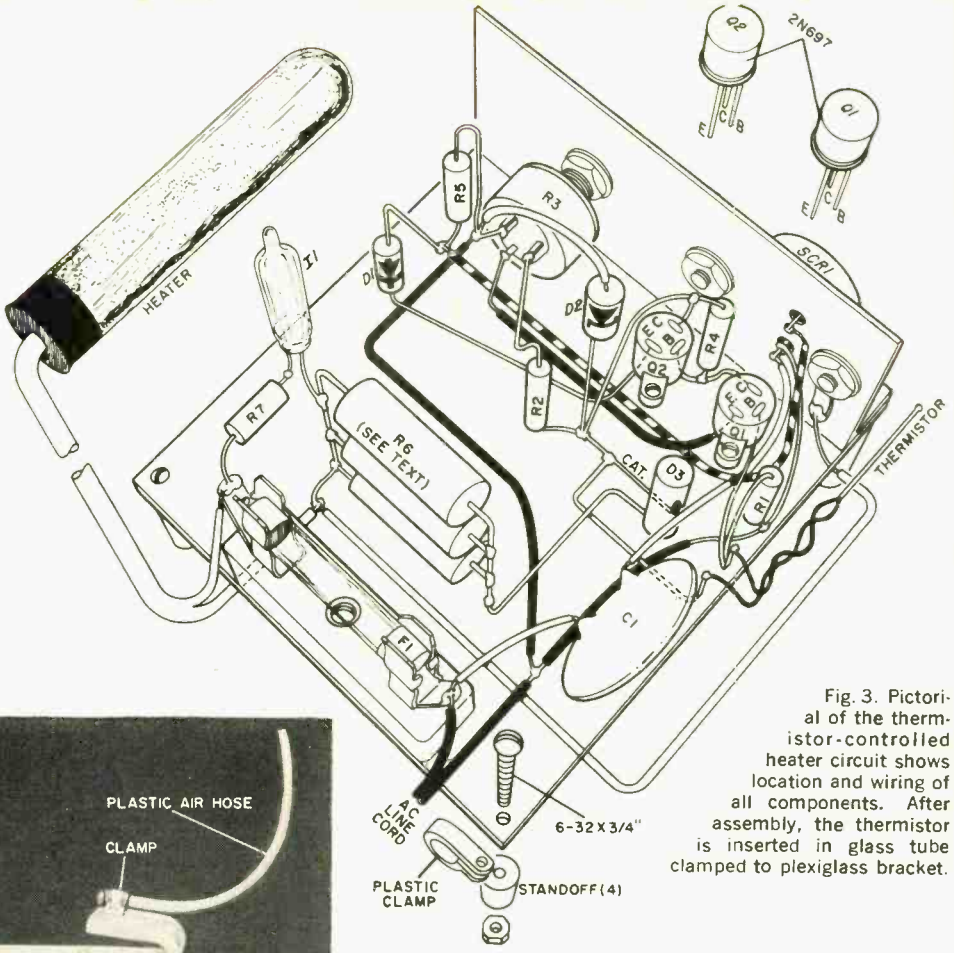


Fig. 3. Pictorial of the thermistor-controlled heater circuit shows location and wiring of all components. After assembly, the thermistor is inserted in glass tube clamped to plexiglass bracket.

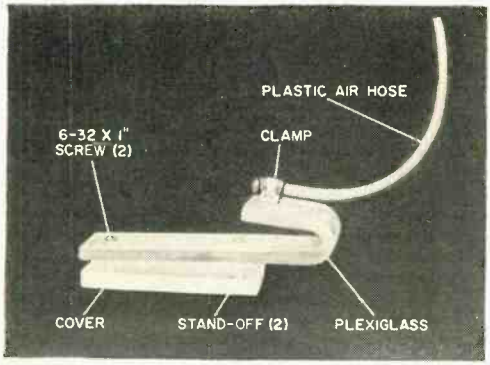


Fig. 4. Mount formed plexiglass on plastic container cover using standoff supports and screws indicated. Use a flat washer on either side of the cover to prevent premature rupture of the plastic. Thermistor glass tube shield is secured under clamp.

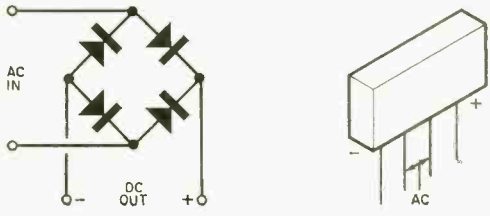


Fig. 5. Terminal connections for optional full-wave rectifier module can be used in place of D1 (see Fig. 1) in order to increase the heater output.

out the glass so that it seals itself. If you want to round off the sealed end of the tube, simply heat the end some more.

Testing. After carefully checking out your wiring, give the circuit a dry run—outside of the aquarium. Plug in the unit and adjust temperature control potentiometer *R3* until the neon light comes on, indicating that the heater is working.

Now place the thermistor glass tube in the palm of your hand and squeeze the tube gently to apply a little heat. If the light goes out, the indication is that all is working well. If the light stays on, try readjusting *R3* slightly until it goes out.

Caution: Do not operate the heater out of water for any extended period of

(*Continued on page* 94)

SOLID STATE

By LOU GARNER, Semiconductor Editor

HOLY HOWLING chatter chopper," exclaimed the teen-ager whose telephone conversation—normally a three-hour affair—had just been interrupted by a continuous tone signal after a mere ten minutes of gossip. The culprit—or "parent's friend," depending on your viewpoint—was not some fiendish device concocted by an arch criminal, but a small transistorized circuit dubbed a *Call Limiter* by its manufacturer, Pulse Communications, Inc. (100 S. Early St., Alexandria, Va.)

First introduced at the 1966 Armed Forces Communications and Electronics Association Convention in Washington, D.C., last June, the *Call Limiter* is a solid-state timer/switch circuit that first switches a brief warning tone into the telephone conversation after a preselected period of time, and later switches to a continuous tone that cuts off further communication.

The young lady's lengthy telephone call has just been interrupted by the "Call Limiter" (above), a device designed to limit long telephone conversations.

Designed for use by telephone companies, the device will be available, one day, to individual subscribers on a monthly fee basis. Currently, however, it is being used primarily in long-distance private tie-line systems.

Basically, the *Call Limiter* is an electronic package embodying miniaturized solid-state components in printed card circuitry. One such card, which measures 4″ x 6″, is installed for each phone circuit; up to 20 cards can be mounted in a standard rack. Operating power is furnished by the 24- or 48-volt battery used by most telephone systems.

In operation, the device automatically switches on a one- to three-second warning tone after a time period of from five to ten minutes of telephone conversation. If the call is not terminated within one to three minutes after the warning, the unit switches on a continuous tone which prevents further conversation.

A second version of the *Call Limiter* switches on a periodic "reminder" tone rather than a continuous tone signal. In both versions, the timing intervals are preselected by the individual telephone subscriber, but the tone, once started, continues until a disconnect takes place. The unit "resets" in less than a half-second after a line disconnect.

Reader's Circuit. *Put that pencil down, Mister*! No use writing to complain that Fig. 1 is wrong, for even though it may seem a bit unusual to the newcomer to the art, there's nothing wrong with connecting *Q1*'s base to ground as shown. The circuit, submitted by reader J. Rodney Clark (1586 Liveoak Dr., Port Credit, Ontario, Canada) represents a practical application of what was, at one time, the most popular of the three basic transistor circuit arrangements—the *common-base configuration*.

Seldom encountered in present-day de-

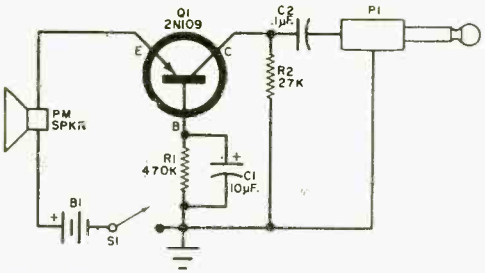


Fig. 1. Moderate-to-high gain common-base transistor amplifier, submitted by reader J. Rodney Clark, features low-input and high-output impedances.

signs, which use the common-emitter hookup almost exclusively, the common-base circuit features low-input and high-output impedances. This makes it ideal for matching a low-impedance source to a high-impedance load. Furthermore, the circuit is quite stable, and provides moderate-to-high gain. Reader Clark has taken advantage of these characteristics and designed a high-output dynamic microphone.

The audio signal developed by the permanent magnet loudspeaker, used as a microphone, is applied to *Q1*'s base-emitter circuit. Base bias is furnished by the drop across *R1*, bypassed by *C1*. The amplified output signal developed across collector load *R2* is coupled to an audio amplifier or other external load through d.c. blocking capacitor *C2*. Operating power is furnished by *B1*, controlled by s.p.s.t. switch *S1*.

The speaker can have a 4- or 8-ohm voice coil; cone size is not critical. While larger speakers can provide higher output than smaller ones, a miniature speaker is usually preferred for this application. Resistors *R1* and *R2* are half-watters. Capacitor *C1* is a 10-volt electrolytic, and *C2* is a small ceramic or paper type capacitor. Transistor *Q1* is a general-purpose *pnp* audio type such as the CK722 or 2N109. An *npn* type can be used instead, but *B1* and *C1* polarities must be reversed in that case. The battery is any 9-volt unit. Switch *S1* can be either a NO push-button type (for push-to-talk operation) or a slide, toggle or rotary switch.

The circuit can be assembled on a perforated phenolic board, on an etched circuit board, or on a small metal chassis, as preferred. Observe the usual precaution of *not* overheating the transistor when soldering the leads. To provide shielding and minimize hum pickup, the microphone should be housed in a metal case such as a Minibox.

The completed microphone/preamplifier should have a signal output level comparable to that of sensitive carbon microphones, and thus can be used in similar applications such as with a CB or ham radiotelephone rig, in a p.a. or paging system, or as a general-purpose unit for lab and workshop tests.

Manufacturer's Circuit. If you've examined the newer imported transistor receivers, you may have found that some of them have no i.f. transformers. After a double-take, you may have scratched your head, shrugged your shoulders, and decided that you were looking at an old-fashioned TRF set in modern regalia rather than at an up-to-date superhet. And the chances were equally good that you were wrong, for you had probably encountered the very latest in i.f. amplifier circuit design—a transformerless i.f. amplifier strip using frequency-selective electromechanical ceramic filters.

Although these ceramic filters—dubbed "transfilters"—are also being manufactured in the United States by at least one manu-

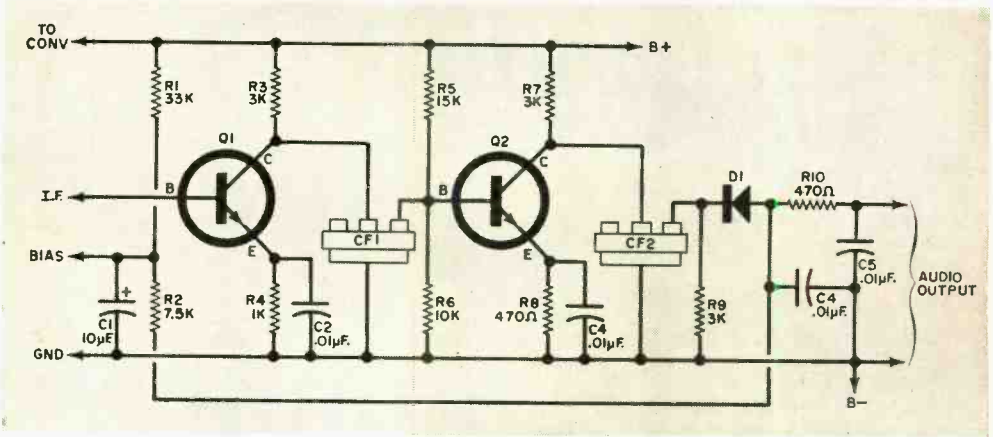


Fig. 2. Typical transformerless i.f. amplifier strip employing frequency-selective electromechanical filters shows Q1 and Q2 in common emitter configuration, and conventional diode D1 as second detector.

facturer (Clevite Electronic Components, Bedford, Ohio), they are not widely available as individual components. However, more and more distributors are starting to carry these items in stock. Smaller in size than conventional i.f. transformers, they require no alignment, yet feature low loss and good selectivity. Transfilters are also inexpensive (about $1.50 apiece), and can be used in relatively simple circuits.

A typical i.f. amplifier strip using transfilters (Fig. 2.) is presented by the Murata Mfg. Co., Ltd. (Kyoto, Japan) in its catalog No. 660-E. It is similar to the circuits used in many imported receivers, and can be used as a guide when assembling home-built sets. The circuit features a two-stage i.f. amplifier with *Q1* and *Q2* in the common-emitter configuration and a conventional diode (*D1*) as a second detector. An a.g.c. bias voltage is produced by the filtering action of *C1* and *R2*, and limited by the *R1-R2* voltage divider.

The i.f. signal from the converter is applied to *Q1*'s base-emitter circuit. The amplified output at the collector is coupled through ceramic filter *CF1*, to second i.f. amplifier *Q2*. Base bias for this stage is provided by voltage divider *R5-R6* and varied by emitter resistor *R8*, bypassed by *C3*. The output of *Q2* is coupled through a second ceramic filter, *CF2*, to diode detector *D1*. Resistor *R9* serves as the diode load and *R10*, in conjunction with bypass capacitors *C4* and *C5*, functions as the audio filter.

Except for ceramic filters *CF1* and *CF2*, which are Murata SF-455B units, the circuit is a conventional i.f. amplifier/detector using standard parts. Only a converter and audio output stage must be added to complete the receiver.

New Developments. Commercial laser applications have moved a giant step towards reality with General Electric's recent introduction of a low-cost solid-state laser diode, type H1D1. Selling for less than a hundred dollars, the H1D1 is a gallium arsenide unit capable of producing 300 nanosecond infrared light pulses with a peak power of 5 watts and peak current of 100 amperes at room temperature. Typical potential commercial applications include use in communications links, instrumentation, night surveillance, intrusion alarms and optical range finders.

Electronic "aspirin?" Not quite, but scientists at Western Reserve University Medical Center have developed an electronic pain killer that can be implanted in the body. Essentially a thin metal plate implanted at a point in the spinal cord where pain impulses can be blocked, it is powered by a transistorized stimulator which, in turn, receives its power from an external pocket-sized radio transmitter.

The IIT Research Institute demonstrated a completely transistorized home tape recorder for color TV at a recent NAB convention. Using a standard 7-inch reel of ¼-inch tape, the recorder could be used with a suitable TV camera (also being developed) to take "home movies" in color and to play them back immediately through your TV set.

London police officers—Bobbies—are now equipped with pocket-sized two-way FM transceivers, permitting instant communication with their headquarters. Each set has a lapel microphone which is worn inside the police uniform, and a tiny earpiece which resembles a hearing aid earphone. Transistorized, the sets are manufactured by the Cossor Communications Company, a subsidiary of the Raytheon Company. Confidential message to London lawbreakers: *take it easy*!

Transistips. Are you lazy? Don't feel insulted, for laziness can be a virtue rather than a shame. Quite often it's the lazy man who comes up with an idea for a great invention. The lazy man would rather work with his mind than with his hands, and in an effort to avoid work, often develops new inventions which make life easier and more rewarding.

But, true laziness has no virtue if it means just sitting on our hands—a log or stone is just as bad. The virtue comes from being able to accomplish a maximum of work with a minimum of effort. And this type of laziness can pay off in the electronics industry.

Do you organize your projects? A hard worker does not. But the lazy man realizes that he'll work less—and accomplish more—if he makes sure he has all the parts needed for his project before he starts, that all his tools are in order, and that he has ample space to work in.

Do you design your own circuits? Most of us do from time to time. For there's a real joy in being creative. But the hard worker starts "from scratch," spending many a sweating hour over the slide rule or breadboard. The lazy man first checks circuit handbooks, magazine articles, and other sources for a proven circuit he can "borrow" and adapt to his needs. And, he often does a better job in much less time.

Do you install "used" parts in your projects. You bet you do! That is, unless you have a private mint. The hard worker takes his parts directly from the junk bin and wires them in place. The lazy man, on the

(*Continued on page* 102)

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

CERTIFICATE CHASING

SOONER OR LATER most amateurs get the urge to work "all" of something. The goal might be a Worked All States (WAS) certificate, a Worked All Continents (WAC) certificate, or a Worked All Counties in _____ (you name the state) certificate. Going a step further, whatever the amateur activity involved, the odds are that you can find a certificate for doing it among the over-700 certificates and awards offered by various amateur clubs, societies, and magazines throughout the world.

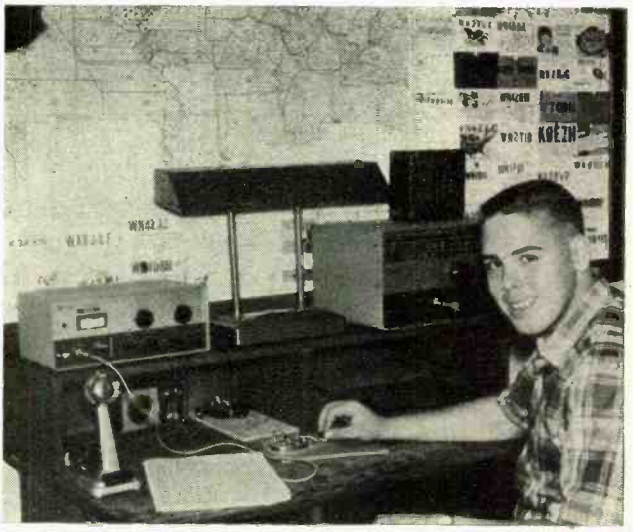
If you are not interested in certificates, the whole thing may sound like kid stuff to you, but thousands of amateurs get their greatest pleasure in amateur radio from collecting certificates.

Certificate Nets. Many certificate chasers congregate daily in nets on several different amateur bands. The most active groups meet on 7223 kHz, 14,330 kHz, and 14,340 kHz at 1800 GMT, daily, and often stay in operation all afternoon and into the evening. On 75-meter phone, there are nets on 3980 kHz at 2000 GMT (Illinois); on 3948 kHz at 0430 GMT (Missouri); and on 3943 kHz at 0100 GMT (East Coast). Three CW frequencies used are 3575, 7030, and 14,075 kHz, the latter two being most active after 1800 GMT, and the former after dark locally. Still other certificate nets are sometimes active on the 21-, 28-, and 50-MHz amateur bands.

The fact that these nets meet daily for hours at a time is indicative of their popularity. One of their claimed advantages is that, with many certificate chasers clustered together, it is easier to locate stations required for certain awards than it is to ferret them out individually. But some critics complain that the main activity on these nets is waiting for a chance to call the desired stations while they fade out or leave the air. Others complain about whip-cracking and bickering by net control stations. These complaints cause some operators to avoid the nets.

Working All States. One of the most sought-after amateur certificates is the

AMATEUR STATION OF THE MONTH



Operating as a Novice, Robert Duncan, WN4AJR, of Decatur, Ga., has worked 80 and 40 meters for a total of 47 states, including Alaska and Hawaii, and nine countries on four continents. He is expecting his General ticket momentarily. Bob's equipment includes a Knight-Kit T-60 transmitter and a R-55A receiver used in conjunction with an 80-meter dipole and a 40-meter Hy-Gain 18-V vertical antenna. He is very proud of his 20-wpm code certificate. Bob will receive a free one-year subscription to POPULAR ELECTRONICS for submitting the winning September photo in our Amateur Station of the Month contest. If you would like to enter the contest, send us a clear picture of your station with you at the controls, accompanied by some details on your ham career and on the equipment you use. Mail your entry to: Amateur Radio Contest, c/o Herb S. Brier, Amateur Radio Editor, P. O. Box 678, Gary, Ind. 46401.

Shan Jackson, WN6RBL, in Long Beach, Calif., transmits on 7191 kHz with a Globe Chief feeding a Hy-Gain 14-AVQ antenna. His receiver is a Lafayette HA-230. Shan has 50 of 98 contacts confirmed.

ARRL's WAS (Worked All States) certificate. Earning it is difficult enough to challenge the skill of any amateur operating on the frequencies below 50 MHz; yet it is not so difficult as to prevent an amateur with average equipment from earning it.

On the other hand, you can make earning WAS as difficult as you wish. For example, you can try doing it within a year in the Novice bands with a power under 75 watts. Several Novices do it every year. Or try to WAS on 50 MHz; if you succeed, you will not be the first one to do so, but the field is not overcrowded.

Whatever bands you use, the first step in earning a WAS certificate is to listen and listen some more for stations in missing states. When you find one, call it every time its operator calls CQ or signs off after another contact. If you don't make any contacts the first day, keep a record of the new states heard, and look for these stations around the same times and frequencies on subsequent days, because most amateurs have pretty regular operating habits.

After working a new state, the surest way to obtain the QSL card is to airmail your own card immediately. Enclose it in an envelope with a stamped return envelope. You will probably get a return of about 90% on cards sent in this manner, compared to a return of about 60% on cards mailed with simply a four-cent stamp affixed. If you want to wait for the other operator to QSL first, you had better plan on working ten or more stations in each of the rarer states to be reasonably sure of receiving a QSL card.

When you are ready to apply for your WAS certificate, carefully check your cards against a list of the 50 U. S. states (the ARRL reports that many applications are accompanied by missing or duplicate cards), and double-check each card for accuracy and completeness, because each one will be carefully inspected by the ARRL before the certificate is issued.

Finally, mail the cards and your application—with sufficient postage for their return—to the American Radio Relay League, Inc., 225 Main St., Newington, Conn. 06111. It usually takes about 10 days for the certificate to arrive.

Can you find the "Three Witches" on the air? See text for details on this just-for-fun certificate.

"Three Witches Award." A just-for-fun certificate is the "Three Witches Award." To obtain it, the applicant must work Roberta, K9IVG; Yolanda, WA9CCP; and Pauline, WA9CNV; and exchange QSL cards with them. He must then find the "Three Witches" on the air at the same time and work them again before he will be awarded an attractive certificate showing the three witches on their brooms.

Information on other operating awards can be found in the *Radio Amateur's Handbook* and in other amateur publications.

News From Here and There. In the March, 1966, issue of *Bandspread* published by the Cedar Valley Amateur Radio Club, Cedar Rapids, Iowa, Ben, W1NXJ, described an ultrasimple modification of the Hallicrafters HA-1 electronic keyer for use with a standard telegraph key. It consists of mounting a 2-terminal jack which matches the plug on the key cord at a convenient spot on the HA-1 chassis and connecting the jack between pin #2 (control grid) of tube V4A, which is half of a 12AU7, and the keyer chassis. Plugging the key into the jack permits keying the transmitter via the HA-1 keying relay while monitoring one's sending on the HA-1 code monitor. The modification does not affect the normal keyer operation.

The *Indiana Amateur TV and UHF Club Newsletter,* put out by the NAFI Radio Club, Naval Avionics Facility, 21st and Arlington, Indianapolis, Ind., reports that on April 17 six different amateur TV stations in the Indianapolis area were in contact with each other both by picture and voice

(*Continued on page* 107)

JUST WHEN I FORGOT

MY (SOLDERING) GUN!

Sequel I

IF YOU JUDGE the success of a contest by number of entries received, the "No Gun" contest (POPULAR ELECTRONICS, July, 1966, page 38) is a resounding one. Hundreds of letters and postcards have poured in with nonsensical remarks about electronics. Choosing winners has been a difficult task; and with so many good stories to tell, we have decided to continue the contest for a few months more. Listed below are the winners of soldering guns for this month.

This month's "classic" was submitted by Larry Brown, who claims that, while checking electronics repair work by repairmen fresh out of military schools, he heard on several occasions, *"Hey! I found what's wrong with this set—the fuse is shorted!"*

Stories about TV installation and servicing constituted about half of the "No Gun" contest entries. Although many were duplications, and some as old as TV itself, a few of the better stories bear repeating—especially the "old saw" about the newly installed TV receiver whose owner complained that the TV picture was better in the store. To which the TV installer/repairman replied (as he rolled the picture with the vertical hold control), *"Lady, stop me when you see the best picture."*

Another TV installer explained away 300-ohm twin lead running to the antenna by informing a customer that *one wire was for sound and the other for the picture.* Color TV has added new woes to the proponents of 300-ohm twin lead, and to dramatize the price differential between coax and twin lead, one bright store clerk stated, *". . . with 300-ohm lead, the colors in your color TV won't run when it rains."*

And then there's the story of the old-timer who, when paying his monthly TV cable fee (CATV), loftily informed one of the engineers, *"My first radio set was a 6-tube Neutrodyne—we didn't have electrons in those days."*

THIS MONTH SOLDERING GUNS GO TO:

Thomas E. Bishop, Sr.	Harvey L. Coontz
Fred Perlman	Luther Hoffman
Maxwel Sklar	John Tucciarone, Jr.
Fred Ziegler	C. A. Sampson
John Doepke	Larry Brown

The best place to overhear colorful, but inane, comments on electronics is at a radio parts store. Some of the questions asked, and many of the answers given, are priceless gems. One salesman reported that he had given up truthful answers to questions about battery life in transistor radios and now, with a straight face, he solemnly states that *the batteries will last 2 months, 4 days, and 7 hours.* A satisfying answer to most people.

At Harvey Radio in New York City a woman customer reportedly asked the clerk for a *"six by five" radio tube* (to which the clerk probably replied "inches or feet?"). But not all "funny" remarks are made by customers —one clerk in a Newark, N.J., store, when asked for a 2-watt, 750-ohm resistor, returned to the counter with two 1-watt, 750-ohm resistors, saying that *the two resistors needed only to be put in parallel to make up the wattage rating.*

Hams and CB'ers were overheard making scores of implausible remarks. In number of entries, hams and CB'ers came out about equal, though the CB'ers were many times as "funny." Probably the funniest remark made by a CB'er was in a Waterloo, Iowa, electronics supply house. The CB'er was returning a 60′ length of RG-8/U 52-ohm coax cable. In addressing the clerk, the CB'er complained, *"I measured the value of this cable with my VOM and it's nowhere near 50 ohms. It's an open circuit. I want some 52-ohm cable that works."*

Over-the-air remarks by "knowledgeable" CB'ers are frequently ridiculous, not so much because of what is said, but because the advice given is simply guesswork. Examples? One CB'er to another on increasing power: *". . . take out that 6AQ5 and stick in a 12AQ5. It has twice the power."* Or, *". . . those sideband rigs are great. Man, that PEP means 'Plenty of Extra Power.'"*

We are still looking for wild, implausible, or inane remarks about anything electronic. Each entry we print earns the writer a soldering gun kit.

Send your entries to the "Gun Contest," POPULAR ELECTRONICS, One Park Ave., New York, N.Y. 10016. No entries will be returned or acknowledged. In cases of duplication, the entry with the earliest postmark is the winner. —30—

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

FOR THE MONTH OF SEPTEMBER

Prepared by ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

COUNTRY	CITY	TIME—EST	TIME—GMT	FREQUENCIES (MHz)
		MORNING BROADCASTS		
AUSTRALIA	Melbourne	7:15-8:15 a.m.	1215-1315	9.58
CANADA	Montreal	7:15-8:15 a.m.	1215-1315	5.97, 15.32
DENMARK	Copenhagen	7:30-8 a.m.	1230-1300	15.165
FINLAND	Helsinki	7:15-7:45 a.m.	1215-1245	15.185 (Tues., Sat.)
GREAT BRITAIN	London	9:30-11:30 a.m.	1430-1630	15.35, 17.81
SWEDEN	Stockholm	9-9:30 a.m.	1400-1430	15.42
		EVENING BROADCASTS		
ALBANIA	Tirana	7-7:30 p.m.	0000-0030	7.265
BULGARIA	Sofia	7-8 p.m.	0000-0100	9.70
CHINA	Peking	8-10 p.m.	0100-0300	11.945, 15.06, 17.68
CUBA	Havana	8-11 p.m.	0100-0400	6.17
CZECHOSLOVAKIA	Prague	8-9 p.m.	0100-0200	5.93, 7.115, 7.345
ECUADOR	Quito (HCJB)	9-11:30 p.m.	0200-0430	9.745, 11.915, 15.115
EGYPT	Cairo	8:30-10 p.m.	0130-0300	9.595
GERMANY	Berlin	8-9 p.m.	0100-0200	6.16, 9.73
	Cologne	8:30-9:50 p.m.	0130-0250	6.075, 9.64
GREAT BRITAIN	London	4:15-10:30 p.m.	2115-0330	7.13, 9.51, 11.78
HUNGARY	Budapest	8:30-9:30 p.m.	0130-0230	6.235, 9.833
ITALY	Rome	8-8:20 p.m.	0100-0120	9.63, 11.81
JAPAN	Tokyo	6:45-7:45 p.m.	2345-0045	15.135, 17.825
LEBANON	Beirut	9:30-10 p.m.	0230-0300	9.575
NETHERLANDS	Hilversum	8:30-9:30 p.m.	0130-0230	9.59 (Bonaire relay)
PORTUGAL	Lisbon	9-9:45 p.m.	0200-0245	6.025, 6.185
ROMANIA	Bucharest	8:30-9:30 p.m.	0130-0230	6.15, 9.57
SOUTH AFRICA	Johannesburg	7:30-8:30 p.m.	0030-0130	9.525, 11.90
SPAIN	Madrid	8-9:30 p.m.	0100-0230	6.13, 9.76
SWEDEN	Stockholm	8:15-9:45 p.m.	0115-0245	9.705
SWITZERLAND	Berne	8:15-9:15 p.m.	0115-0215	6.12, 9.535
U.S.S.R.	Kiev	7:30-8 p.m. (Mon. & Thurs.)	0030-0100 (Tues. & Fri.)	9.665, 9.685
	Moscow	5-5:30 p.m. & hourly to 12-1 a.m.	2200-2230 & hourly to 0500-0600	7.15, 9.665, 9.685
VATICAN	Vatican	7:50-8:10 p.m.	0050-0110	5.985, 7.25, 9.645

TO WESTERN NORTH AMERICA

COUNTRY	CITY	TIME—PST	TIME—GMT	FREQUENCIES (MHz)
ARGENTINA	Buenos Aires	10-11 p.m. (Mon.-Fri.)	0600-0700 (Tues.-Sat.)	9.69
AUSTRALIA	Melbourne	5-7 p.m.	0100-0300	15.22, 17.84
BULGARIA	Sofia	8-8:30 p.m.	0400-0430	9.70
CHINA	Peking	7-9 p.m.	0300-0500	9.457, 11.82, 15.095
	Taipei	6:50-7:50 p.m.	0250-0350	11.86, 15.345
CZECHOSLOVAKIA	Prague	7:30-8:30 p.m.	0300-0430	5.93, 7.115, 7.345
GERMANY	Berlin	7:45-8:15 p.m.	0345-0415	6.16, 9.73
	Cologne	9-9:40 p.m.	0500-0540	6.145, 9.735
HUNGARY	Budapest	7-8 p.m.	0300-0400	6.235, 9.833
JAPAN	Tokyo	6-7 p.m.	0200-0300	15.135, 17.825
KOREA	Seoul	7-7:30 p.m.	0300-0330	15.125
PORTUGAL	Lisbon	8-8:45 p.m.	0400-0445	6.025, 6.185
SOUTH AFRICA	Johannesburg	6:30-7:30 p.m.	0230-0330	9.525, 11.90
SWEDEN	Stockholm	7:15-7:45 p.m.	0315-0345	9.705
SWITZERLAND	Berne	8:15-9:15 p.m.	0415-0515	6.12, 9.535
U.S.S.R.	Moscow	7-10:30 p.m.	0300-0730	9.735, 11.755, 11.85

SHORT-WAVE LISTENING

By **HANK BENNETT,** W2PNA/WPE2FT
Short-Wave Editor

INTERNATIONAL DX PROGRAMS

THE FOLLOWING LIST notes by country SWL DX'ing programs which should be of particular interest to the readers of POPULAR ELECTRONICS:

AUSTRALIA—*R. Australia*; "Australian DX'ers Calling"; Saturdays at 1900 and 2200, Sundays at 0500 and 0715.

BULGARIA—*R. Sofia*; Fridays at 1930 and 2130, Saturdays at 0000 and 0400.

CANADA—"Radio Canada Shortwave Club"; Saturdays at 1235, 1835, 2130, 2320, and Sundays at 0750.

CZECHOSLOVAKIA — *R. Prague*; "Around The World"; alternate Fridays at 0100 and 0330.

DENMARK—*Voice of Denmark*; Tuesdays at 1920 and 2035, Wednesdays at 0220 and 1250, Thursdays at 0950 and 1520.

ECUADOR—HCJB; "DX Party Line"; first and third Monday of month at 0230, first and third Wednesday at 0930.

FINLAND—Finnish Broadcasting Co.; Fridays at 1600, 2100, Saturdays at 1215.

GERMANY—*Deutsche Welle*; second Monday of month at 0915, 1520, 1830, 1945, and second Tuesday at 0100, 0230, 0415, 0530.

HAITI—4VEH; "DX Corner"; Fridays at 1215.

HOLLAND—*R. Nederland*; Thursdays at 0742, 1442, 1942, 2042, 2142, and Fridays at 0142.

HUNGARY—*R. Budapest*; Tuesdays at 1930, Sundays at 2200 and 2330, Mondays and Wednesdays at 0030 and 0300.

JAPAN—*R. Japan*; "DX News"; fourth Saturday of month at 1015-1545 ,1755, 1925, and fourth Sunday at 0045, 0815, 1300, and 1545.

KOREA (SOUTH)—KBS; last Thursday of month at 0315, 0515, 0645, 1045, 1545, and 2115.

NEW ZEALAND—*R. New Zealand*; "Arthur Cushen's DX World"; first Wednesday of month at 0640 and 1030, following Sunday at 0100.

POLAND—*Polskie Radio*; second Friday of month at 1830, following Monday at 2130.

PORTUGAL—"Radio Portugal DX Club"; second Friday of month at 1400, 1830, 2030, 2330, and second Saturday at 0215, 0315, 0400, 0745, 0830.

RUMANIA—*R. Bucharest*; Wednesdays and Fridays at 0130, 0300, 1930, and 2230.

SWEDEN—*R. Sweden*; "Sweden Calling DX'ers" (last part of Eng. xmsn); Tues-

(*Continued on page* 109)

Doug Hammock, Jr., who SWL's from Morehouse, Mo., is more familiarly known as WPEØEOF. His receiver is a Knight-Kit "Star Roamer." To date, Doug has 42 countries verified out of a total of 72 logged.

Garnet Frank, WPE2MWM, Potsdam, N.Y., has four receivers. For primary service he uses a Hallicrafters SX-122 and SX-110; for FM tuning, a Magnavox FM-13; and for camping, a Zenith Royal 3000-1.

U.F.O.'s OR "KUGELBLITZ"?

KNOWN NATURAL FORCES USED TO EXPLAIN BALL LIGHTNING

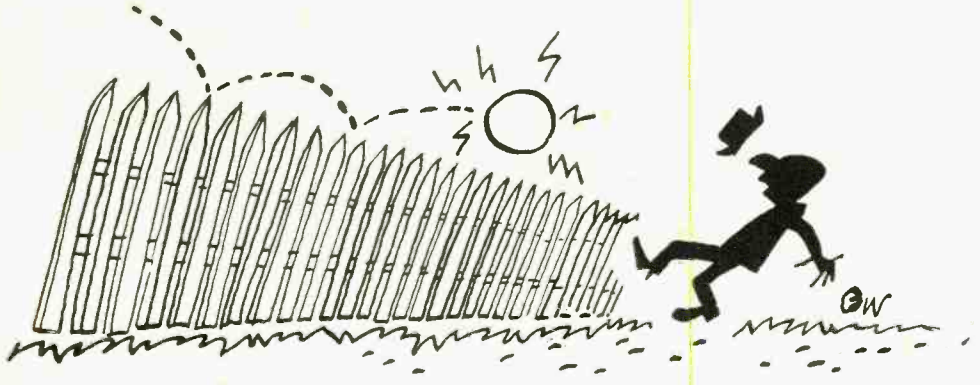
PEOPLE SAY they have seen ball lightning (or "kugelblitz") dancing along fences, drifting through open doors and windows, perching on telephone wires, floating inside high-flying airplanes, and dropping down stovepipes and chimneys. It is reported to have slipped from a room by way of a keyhole; drifted inside an iron stove and blown it to bits; fallen into a four-gallon cask of water and brought it to a steady boil. Is there really such a phenomenon as ball lightning? Two scientists at Westinghouse Research Laboratories say that there is!

Aided by an electronic computer, Drs. M. A. Uman and C. W. Helstrom have shown mathematically that known natural forces will explain ball lightning, and they have drawn a model that predicts many of its strange properties which amazed eye witnesses have described on and off for years.

Although lightning strokes apparently give it birth, ball lightning is not at all like the short, brilliant, jagged flashes familiar to all of us. It usually appears as a round, moving blob of light about the size of an orange or small grapefruit. It can be white, or almost any color of the rainbow. It drifts through the air or hovers near the ground for periods of a few seconds to several minutes. Then it collapses and disappears, sometimes quietly, sometimes with a bang.

Drs. Uman and Helstrom describe ball lightning as a luminous, high-temperature region of air having high electrical conductivity. The heating occurs when direct currents of electricity funnel through a particular region between storm clouds and the ground, making the air in that region hot enough to glow. According to the theory, ball lightning of a 5000-degree centigrade central temperature and 20-centimeter (8") diameter should appear to the human eye to be about as bright as a 1000-watt light bulb!

When the cloud-to-ground currents are symmetrical about the ball and flow symmetrically through it, the ball will hang stationary in space. Any change in these symmetrical forces will cause the ball to move. It will disappear quietly when the electric currents through it gradually fade away. But it will collapse or blow up with a bang whenever the current is rapidly shut off or increased. —30—



ON THE CITIZENS BAND

By **MATT P. SPINELLO,** KHC2060, CB Editor

THERE ARE approximately two dozen U.S. Citizens Band newspapers published each month that are well worth the effort put into them. Subscribers, club members, and electronic publications have received these CB papers regularly ever since they were first shakingly put together. And well-organized CB clubs have grown to realize that their individual publications draw attention from other communications enthusiasts, and more important, reflect on the association's record of activities and assists.

CANADIAN CB'ER TAKES A STAND

On the unfortunate side of the picture, too many CB'ers have found themselves with lengthy unfulfilled subscriptions—no more issues received, and no refunds! The reasons are numerous. In most cases the club publication has been assigned to an energetic few (sometimes only *one*) who must write, edit, and print the club's news. In addition, they have to gather the news, solicit advertisers, and handle subscriptions and correspondence. In the long run, lack of interest by the majority—despite pleas from the publication staff for help—usually smashes the press.

Harold Merton, XM-44-042 (see photo above), a highly active CB'er in Canada since that country first established the General Radio Service, ran into a little different publishing problem. He did something about it, and today is publishing probably one of the finest, most informative non-profit CB/GRS bi-monthlies available in either country.

When a national electronics publication in Canada dropped the GRS column Harold was writing, as well as the ham and SWL column, Harold decided it was time Canadian CB'ers had a publication of their own that would keep them posted on General Radio Service news and information from coast to coast. His idea was generated into what Canadian CB'ers now know as *SCOPE* (Serving Canadian Operators of Personal-radio Equipment).

The Canadian government gave the green light to the GRS service in April, 1962, and Harold was the 42nd CB'er in the country to be issued a license. Since then his photographic efforts and editorial comments have appeared in three American publications and two Canadian ones, including material in this column. He has also published two annual directories for the South Western General Radio Association and is currently compiling a national directory to be published next year.

There isn't a bad CB newspaper to come out of Canada (the few that are available are well-planned, well-written), but *SCOPE*, in its second issue, came out—in a word—clean! The distribution of the issue was 5000, a pretty envious record after only a second try, considering that Canada's licensed CB users only number near 10,000.

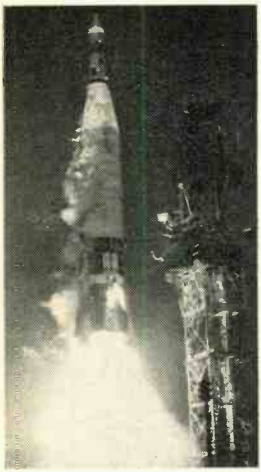
SCOPE is sent free of charge to GRS members through requests from GRS clubs, equipment dealers, and individuals interested in passing out quantities. The printing costs are to be defrayed by advertising revenue and a GRS/CB identifier program re-

(*Continued on page* 103)

Harold Merton's photographic ability (he is currently president of the Western Ontario Branch of the Professional Photographers of Canada), plus his ten years of experience with the London/Ontario Daily News, would seem to thoroughly qualify him to put out SCOPE—Canada's newest CB scoop-sheet.

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.



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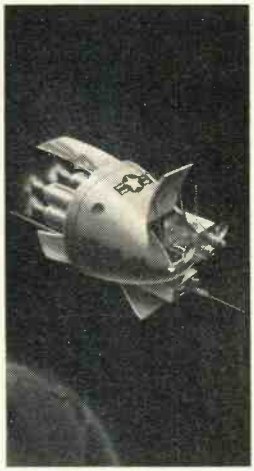

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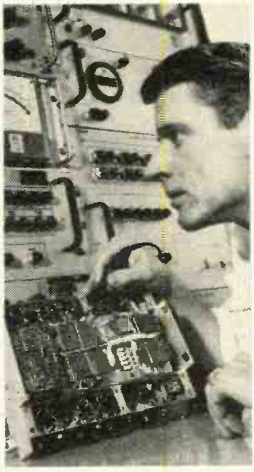

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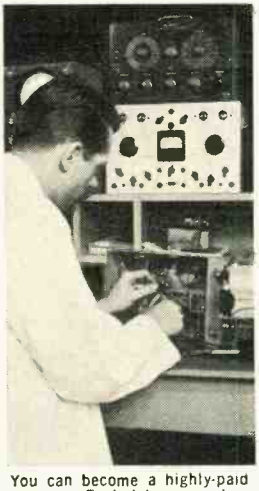

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HISTORY OF COLOR TV

(*Continued from page 47*)

tial system as the national standard for color TV. At the time, the decision was the best that could be made.

The outcry that went up from the TV industry was loud and pitiful. Advocates for all-electronic systems predicted the return of TV to the electromechanical mold from whence it came. And, there remained the question of compatibility —the CBS color system would require modification of all black and white TV receivers to permit even monochrome reception of colorcasts. Undaunted by the clamor, CBS began limited color TV broadcasting, and on June 25, 1951, launched commercial color TV.*

Just when it looked as though color had finally gotten its cue to step out from the wings, the Korean War began dominating the headlines. No sooner had the first trickle of color sets and converters reached the market than a government order was issued restricting the use of certain materials vital to TV manufacturing. It was 1941 all over again, and commercial color TV was back on the shelf.

Meanwhile, RCA had continued to refine and simplify the dot-sequential system with which it had failed to impress the FCC at the 1949-50 hearings. At the same time, the National Televison System Committee (NTSC), representing a cross-section of the TV industry, had been preparing a set of detailed specifications for a standard color TV system that would be acceptable to all broadcasters and manufacturers. The RCA-developed system influenced, to a large extent, the NTSC proposals that were taking shape.

As time passed, and the number of black and white receivers in use continued to grow, it became more and more evident that the FCC's 1950 decision to adopt an *incompatible* color system had been a bit hasty. Consequently, in December, 1953, following an exhaustive series of field trials, the decision was reversed in accordance with a stipulation that had been made at the time of rendering, and the industry-supported NTSC proposals were adopted as the new national standard. CBS was among the industry participants who approved the actions.

Using the NTSC system, simultaneous transmission of all three primary colors was achieved without need for wider broadcasting channels. Instead of colors being sampled in a rigid sequence, they are broken down, as they appear, into three basic components: luminance (or brightness), saturation (or vividness) and hue (or tint). In transmission, the luminance variations amplitude-modulate the main carrier (as in a monochrome system), while variations in saturation and hue modulate a "chrominance" subcarrier. Saturation and hue are kept separate by combining ampli-

SPECIAL DEFINITIONS

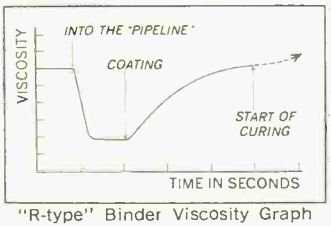
Line Resolution	Measure of the narrowest line width which can be transmitted or received.
Field Rate	Number of fields per second. Standard rate is 60 per second (30 odd line fields interlaced with 30 even line fields—odd and even fields are sequentially scanned and transmitted).
Brightness	How bright or dim the dominant color appears to the eye. It is not the same as saturation, which has to do with the amount of white light simultaneously present.
Saturation	Purity of color, freedom from mixture of white or grey. Deep red has little or no white light and is fully saturated. Pink is diluted red and has low red saturation.
Chrominance	Collective term referring to color, hue, saturation, etc.
Hue	Dominant wavelength which distinguishes a color such as red, yellow, etc. Deep red and pink are of the same hue, but differ in saturation.
Luminance	Brightness of a given unit of picture area irrespective of colors. It produces a conventional black and white picture.

**The writer recalls having fashioned his own color wheel and cardboard and colored cellophane. By adjusting the sweep controls, the CBS transmission could be broken into four separate small pictures. Any one of these could be selected for viewing through the crude motor-driven filter.*

Some plain talk from Kodak about tape:

The binder that ties things together... and how to sound in the pink

"La sauce, c'est tout,"—the sauce is everything, say the French. An oversimplification perhaps. Still, as far as sound recording tape goes, the sauce—our "R-type" binder—counts for a lot. First off, there must be a mutual affinity between binder and oxide. It must be a good oxide mixer, while still Keeping individual oxide particles at arm's length, you might say. Of course, fast drying, superior chemical stability, and a dozen other mechanical and chemical properties are a must. One very interesting point involves the "R-type" binder's viscosity characteristics . . .



"R-type" Binder Viscosity Graph

A Sticky Problem. Familiar with no-drip house paints? They're thick in the can . . . thin when you apply them (for low effort) . . . yet thicken again as soon as applied, so they won't drip. Somewhat the same thing has to happen when one applies the binder-oxide mix to the tape backing. It's got to go on smoothly—low viscosity . . . then it's got to stay put—high viscosity. To thicken the plot, once the coating is on, the tape is passed through a very strong magnetic field to physically align the oxide particles—low viscosity again. Once aligned, the particles have got to stay locked in "at attention!"—high viscosity. That's asking a lot of a binder. And ours delivers.

It's Loaded. Our "R-type" binder not only gives you a more disciplined, smoother, more efficient oxide layer . . . but it allows us to incorporate a high oxide density in the magnetic dispersion. High output is the "proof" of this density. That's why KODAK tapes give you from 1 to 3 db extra output compared to equivalent competitive tapes.

Pink Noise Testing . . . or how hi-fi is your room? Room acoustics certainly color the sound you hear . . . may even produce effects you have ascribed to electronics. Take test tapes, for example. They frequently make use of pure tones, even pure sine waves that easily go through your amplifier yet give a most confusing impression to your sound-level meter or ears. The culprit? Standing waves caused by hard parallel surfaces—like walls, floor and ceiling—which reflect the sound back and forth. At the point of reinforcement, the sound is loud; at the null point, it's low. What to do? Persian wall-hangings, bearskin rugs and soft rounded forms—if you're lucky enough—help keep standing waves down. But to develop the very best in KODAK Sound Recording Tapes, our engineers turn to "pink noise" testing.

Why Pink? Unlike pure tones that make for easy instrumentation, musical sounds are complex—very similar to narrow bands of "white noise." But a white noise generator produces a mixture of all possible tones with equal energy-per-unit frequency. By breaking this white noise down into one-third octave bands of equal energy, we can study portions of the sound spectrum separately, yet have sound waves that are sufficiently complex so standing waves no longer confuse the issue. We call this type of white noise "pink". We're working on a practical sim-

plification that will let you do something of this sort for your own checkout. But meanwhile, relax to the music of KODAK Tape, secure in the knowledge that it is even "Pink Noise Tested!"

KODAK Tapes—on DUROL Base and polyester base—are available at most electronic, camera, and department stores. To get the most out of your tape system, send for free, 24-page "Plain Talk" booklet which covers the major aspects of tape performance. Write: Dept. 940, Eastman Kodak Company, Rochester, N. Y. 14650.

EASTMAN KODAK COMPANY, Rochester, N. Y.

CIRCLE NO. 8 ON READER SERVICE PAGE

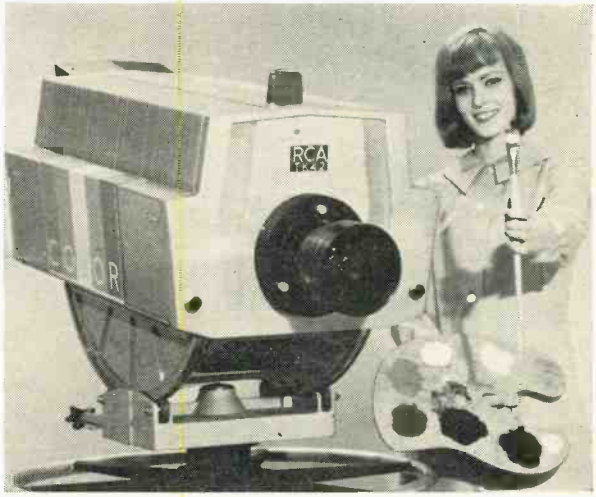
tude- and phase-modulation of the common subcarrier.

Along with the NTSC system came the tricolor picture tube, which eliminated the need for separate picture tubes and an optical system in the receiver. A prototype of this tube had been demonstrated by RCA at the 1950 FCC hearing.

In 1954, NBC and CBS joined in putting the NTSC system on the air commercially, and RCA marketed its first commercial color set in March of that year. By the year's end, NBC had broadcast a total of 68 color hours as against 46 for CBS. The figure tripled for NBC the following year and has continued to increase gradually through subsequent seasons. However, CBS began to lag in its color scheduling, and by 1960 had ceased broadcasting color entirely except for an occasional special program.

Meanwhile, the rosy prophecies of spectacular sales of color receivers were not materializing. Apparently, TV set owners were skeptical of color and had adopted a "wait and see" attitude. They were not about to scrap their present sets and spend $600 to $1000, or more, for the dubious privilege of being able to watch a handful of shows in colors that were often smeary and unnatural.

By early 1956, a cumulative total of only 50,000 color TV receivers had been sold—less than 15% of the figure that



Latest in studio color cameras from RCA costs over $70,000, is fully transistorized, and has 4 camera tubes—1 for each primary color, 1 for luminance.

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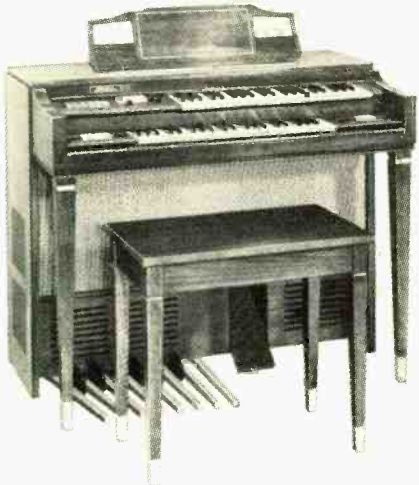

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CIRCLE NO. 39 ON READER SERVICE PAGE

had been forecast two years earlier! Magnavox, Motorola, General Electric, Emerson, and two or three other manufacturers entered the market with color receivers of their own, but bowed out as soon as it became apparent that color TV was not selling.

The Turning Point. Technological progress went on, nonetheless, and RCA, having already sunk close to $100 million into color TV, persevered. In 1960 a supersensitive camera tube was introduced to overcome the 80% light loss through the camera's color filters. This broadened the range of subjects that could be televised in color. Meanwhile, improvements continued to be made in the tricolor (shadow-mask) picture tube.

The turning point came late in 1961. Color receiver sales were up and other manufacturers were again tempted to enter the market. By early 1962, RCA had been joined by Zenith and ten other manufacturers in producing color TV receivers, and the average price was down to $600. As the number of sets in use approached the million mark and annual sales continued to mount at an ever-increasing rate, advertisers began eyeing color with renewed interest. By the year's end, the ABC network had begun broadcasting color, and twelve more manufacturers had entered the receiver market.

On the surface, the upturn appeared to have little immediate impact. Annual sales of monochrome sets continued to grow and, in 1964, reached the first new high in nine years. But, at the same time, the demand for color sets had already begun to exceed the supply, and there were mounting backlogs of orders for cameras and other color TV broadcast equipment.

If, by the fall of 1965, any doubt remained that color TV had finally arrived, it was quickly dispelled by the return of the pioneer—CBS—with half of its prime time programs being offered in compatible color.

As this story goes to press, there are more than nine million color sets in use in American homes, half of which were purchased only within the past year. There's still a long way to go before color TV sets will have entirely replaced the 70 million monochrome sets now in use throughout the country. But the way things look at the moment, by 1968—color's 40th anniversary—black and white TV should be well on its way to becoming a relic of a bygone era. —30—

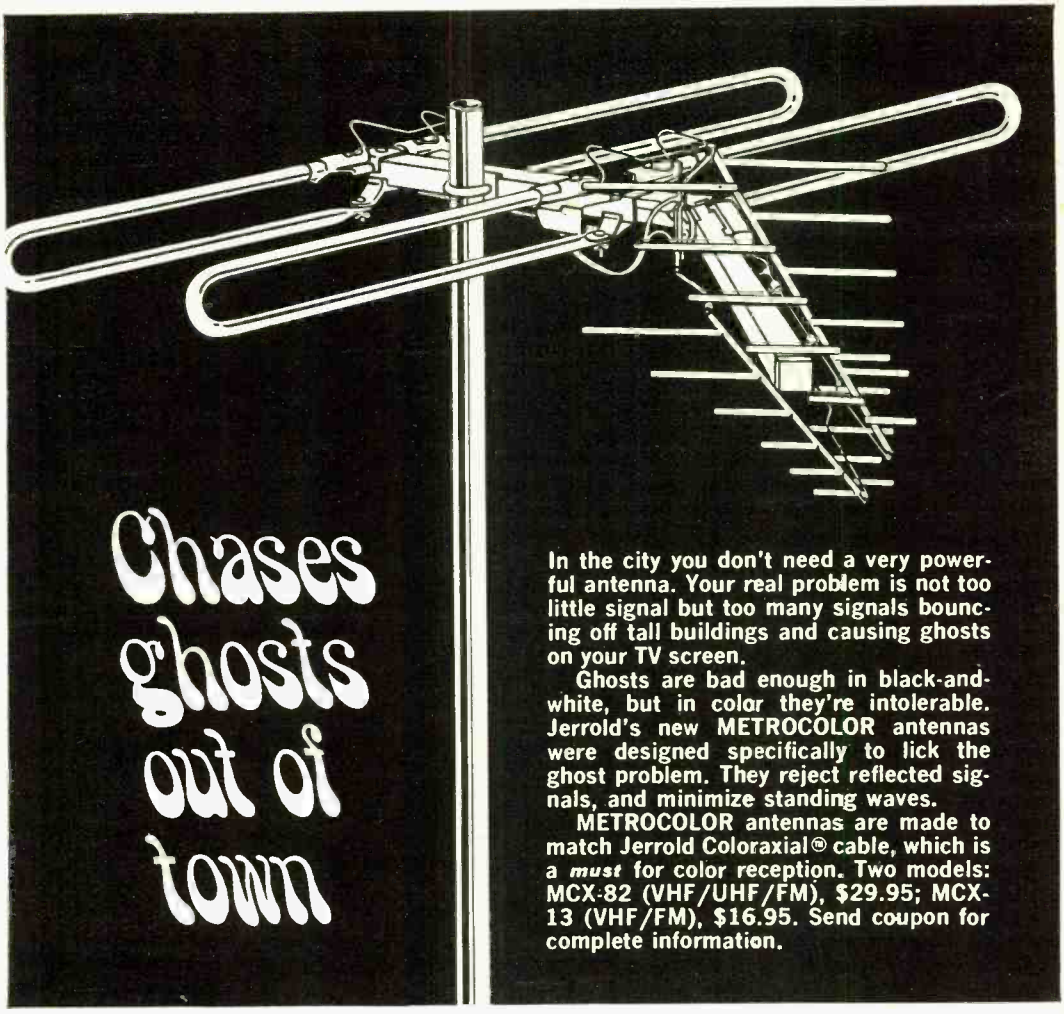
AQUARIUM HEATER

(*Continued from page 75*)

time since this can cause the heater to overheat and probably damage the glass tube.

Final Assembly. You are now ready to install the circuit in the plastic container. First, align the ¼"-thick piece of plexiglass on the plastic cover as shown in Fig. 4. Measure out the locations for two mounting holes and then drill holes with a ⅛" bit. Drill a third hole at the opposite end where the thermistor will be mounted.

To form the plexiglass, place the end



Chases ghosts out of town

In the city you don't need a very powerful antenna. Your real problem is not too little signal but too many signals bouncing off tall buildings and causing ghosts on your TV screen.

Ghosts are bad enough in black-and-white, but in color they're intolerable. Jerrold's new **METROCOLOR** antennas were designed specifically to lick the ghost problem. They reject reflected signals, and minimize standing waves.

METROCOLOR antennas are made to match Jerrold Coloraxial® cable, which is a ***must*** for color reception. Two models: MCX-82 (VHF/UHF/FM), $29.95; MCX-13 (VHF/FM), $16.95. Send coupon for complete information.

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CIRCLE NO. 16 ON READER SERVICE PAGE

with the two holes in a vise. Then heat the other end with a torch until it becomes soft enough to bend. Using heavy long-nose or gas pliers, bend the heated end into a hook with an opening large enough to fit over the fish tank wall.

When the plexiglass cools off, screw it onto the plastic cover using two spacers and *6-32* x 1″-long screws. Use flat washers over both sides of the cover to prevent it from tearing prematurely.

Now mount the remaining two standoffs on the circuit board using *6-32* x ¾″ screws and #6 nuts. Be sure to place a plastic cable clamp around the heater cable and another one around the line cord before securing the clamps in place between the circuit board and the standoffs as shown in Fig. 3.

Run the thermistor through the short piece of air hose, slip the glass case over it, and then secure the entire assembly on the plexiglass with the remaining clamp. The thermistor should be adjusted so that, when mounted on the fish tank, it sticks down as far in the water as possible, without water being allowed to seep through the top opening of the glass.

The entire installation must be watertight for water is a very good conductor of electricity, and unless every precaution is taken to separate this lethal combination, your entire project could wind up being a disaster.

Installation. If your circuit passes the "squeeze test," you are ready to install it in your aquarium. Just in case you haven't used one of these thermostats before, here are a couple of hints:

(1) Hang the thermostat on the outside of the fish tank, and allow the heater to rest at the bottom of the tank. Keep the thermistor well down in the water to avoid faulty operation that could cause the tank to overheat.

(2) Be sure to use a circulating pump. Even in a small tank, there may be temperature differences of five degrees or more between the top and bottom of the tank.

The heat required to maintain the desired water temperature depends, essentially, on the difference between the water temperature and the room temperature. Since the SCR is a half-wave device, it supplies current to the heater for only half of the *on* cycle. Thus, a 75-watt heater consumes only about 37½ watts. If your heater never turns off (allow a couple of days for stabilization), you need more heat.

The easiest solution to this problem is to add another heater in parallel with the first. Another solution is to full-wave rectify the line voltage to provide power to the heater during the complete cycle of operation. A fully assembled bridge rectifier, such as the Motorola MDA-952-4, or equivalent, can be wired up as shown in Fig. 5.

Under normal operating conditions, your new thermostat should provide your tropical fish with true living comfort for years to come. Your reward is to sit back and let your little pets enjoy all the *transistorized* heat they need. -30-

LONG-TAILED PHASE INVERTER

(*Continued from page 72*)

extends at least 1¾″ from the top and bottom edges to cover the grille cloth. But be sure to complete your finishing work on the trim before you mount the speaker, so that dust particles will not get into the speaker.

Also, cover all interior surfaces of the speaker enclosure above panel *H* with a 1″-2″ layer of cotton or wool batting. Pack the tube behind *G* with loose kapok pillows. Then make a tightly packed pillow of wool batting and attach it to the inside of the cabinet, behind the speaker.

If you find it necessary to alter some of the dimensions given in order to accommodate a different speaker, or for effects, you can do so under controlled conditions; but in no case should the cross-sectional area of the tubes be made smaller. In fact, a subtle improvement may be achieved by adding about three inches to the depth of the enclosure and by making each tube about an inch deeper. For this modification, the port should be enlarged to 18½″ x 6″.

If you have carefully followed the instructions, and have installed a reasonably good low-frequency speaker, your *long-tailed phase inverter* will provide good listening. -30-

WAR ON SKATING

(*Continued from page* 68)

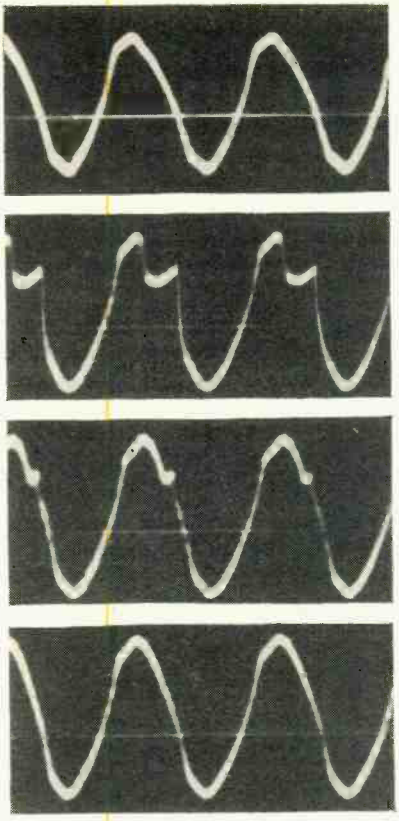
slight unbalances must be corrected."

Other experts bear him out. "We've found that skating compensation helps tracking in some of the new cartridge models with an elliptical stylus," reports Len Chase of New York City's Electronic Workshop. "Skating problems are more severe with that stylus shape." The reason, most likely, is that the thin ridge of the elliptical stylus digs deeper into the record material, so the added friction increases the skating force.

The Evidence. Julian Hirsch, well-known audio engineer, reported in *HiFi/Stereo Review* (May, 1966, page 33) that the effects of anti-skating devices can be observed on test equipment. Using the *HiFi/Stereo Review* test record, a high compliance cartridge, and a tone arm with an adjustable anti-skating feature, Hirsch fed the stereo cartridge output to a high gain oscilloscope (see illustrations at right). Sure enough, without skating compensation, the scope clearly showed distortion in one channel, apparently the result of haphazard tracking along the outer groove wall. As soon as the anti-skate dial was adjusted to the proper setting, the distortion disappeared on the scope.

But can you really hear the difference? On high-level test tones, the ear confirmed what the eye saw on the scope screen. As the waveform on the scope smoothed out after proper anti-skate adjustment, the sound of the affected stereo channel cleared up also. However, this happened only: (a) if the cartridge was tracking at its minimum recommended pressure; (b) if the test tone was recorded at an extremely loud level, making tracking conditions far more critical than normally encountered in musical material.

Oddly enough, these results prove that both sides in the current skating squabble have a legitimate point. The evidence on the scope left no doubt that anti-skating devices provide better tracking, just as claimed by Gorski and like-minded engineers. Yet the evidence also bears out the opposition claim that the improvement is slight and occurs only in very loud passages, only at minimum tracking force, and only with high-compliance cartridges.



In the Hirsch-Houck tests on skating distortion, the two uppermost oscilloscope pictures show the response along the inner (top photo) and outer (second photo) walls. Distortion is visible in the outer wall trace since the stylus is losing contact with the groove. The two remaining photos show the addition of anti-skating force to counteract the generation of distortion. In the third photo, some distortion is visible, and in the bottom photo, we can see optimized anti-skating compensation.

So what conclusions can be drawn? It stands to reason that the average listener with only a casual interest in fidelity just isn't going to bother about anti-skating. In any case, chances are that his equipment is too crude to show up such subtleties. But there's another type of listener—the man who takes pride in a first-rate rig, who cares about the fine points in audio design and likes to keep up with technical advances. He'll root out harm in the arm and tolerate no stylus skate. —30—

punchy galore

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CIRCLE NO. 41 ON READER SERVICE PAGE

TV COLOR-BAR GENERATORS

COMING UP!

MOST TV SETS in the homes of experimenter/hobbyists that are in need of servicing or other adjustments will have their innards exposed long before a serviceman is called, and that goes for color TV sets, too. The apparent complexity of a color TV set will serve as a bar to an electronically minded person only for a very short time.

With color TV firmly entrenched on the American scene, color bar generators are coming into their own, and they will soon share the spotlight with the other types of test equipment now in general use. It is practically impossible to converge a color picture tube without a dot or line display, and that is only one of the many functions of this particular type of test equipment.

We don't predict that there will be two color bar generators "in every pot," but we do think there is one in your very near future, perhaps as soon as next month, when we will present a comprehensive, up-to-the-minute roundup of available equipment.

Which one will you go for? What features will you seek out? Will it be a kit, or a factory-wired job. How much money will you have to spend?

There are many features, and quite a few test equipment manufacturers are working feverishly to have enough equipment on hand to satisfy the demand. Among them are Allied, Amphenol, B & K, EICO, Heath, Hickok, Jackson, Lectrotech, Mercury, Precision, RCA, Seco, and Sencore.

There are NTSC signal and rainbow generators; tube and transistor types; battery- and line-operated versions; units with and without gun killers; and units with many different types of test patterns. Some have audio and video signals as well as r.f. signals.

Don't miss this "must" reading in the October issue, especially if you want to be sure that your color TV set is in good working order. A "How It Works" section will be included in the article. —30—

QUIZ ANSWERS

(*Quiz appears on page 59*)

1 CUTOFF. Initially, because the collector side of load R_L is positive with respect to the other side of the resistor, the waveform appears above the base line. As the transistor approaches cutoff, the drop across R_L is reduced. This causes the display to move down toward the center of the screen. At cutoff, the current ceases and the drop across R_L is at a minimum, producing a flattening of the sine wave peak near the base line.

2 SATURATION. Although the voltage at the plate is positive with respect to the cathode, the scope "sees" a negative voltage since its leads are reversed. Thus, the trace appears below the base line. As the tube approaches saturation, the plate-to-cathode voltage decreases, and the display moves up toward the base line. During saturation, the plate-to-cathode voltage remains constant, and the waveform flattens out at the top to reflect this condition.

3 CUTOFF. The voltage at the collector is equal to the battery voltage minus the drop across R_L. With the collector negative with respect to ground, the displayed waveform is below the base line. At cutoff, the drop across R_L is at minimum and the collector becomes even more negative, and causes the peak farther away from the base line to flatten out.

4 CUTOFF. Since the signal at the cathode is positive with respect to ground, the displayed waveform appears above the base line. As the tube approaches cutoff, the cathode current decreases—and the cathode becomes less positive, allowing the beam to move down to the scope's base line. At cutoff, current ceases and the drop across the cathode resistor is zero; and the waveform flattens out at the base line.

5 SATURATION. In this arrangement, the collector is negative with respect to the emitter, and the waveform is displayed below the base line. As the transistor approaches saturation, the collector voltage becomes less negative, and the display approaches the base line. At saturation, the collector voltage is at its minimum value and can decrease no further. Thus, a leveling off occurs at the base line.

6 SATURATION. The voltage across R_L is such that the plate end of the resistor is always negative or zero with respect to the battery end; thus, the signal appears below the base line. As the tube approaches saturation, the drop across R_L increases and the trace moves farther away from the base line. At saturation, the drop across R_L remains constant, resulting in a flattening out of the waveform at the level farthest away from the base line.

7 CUTOFF. Except for the transformer coupling to the scope, this circuit is the same as the one discussed in problem 1. The use of a transformer modifies the waveform by (1) reversing the polarity of the voltage across the secondary, and (2) removing the d.c. component from the signal, causing the display to be essentially centered on the screen.

8 SATURATION. The plate voltage with respect to ground is, of course, equal to the battery voltage, less the drop across R_L. Being positive, the plate voltage causes the display to appear above the base line. As the tube approaches saturation, the plate voltage becomes less positive because of an increase in the drop across R_L, and the trace moves down toward the base line. At saturation the plate voltage remains constant at its lowest level, and the signal peak near the base line is clipped.

CATV

(*Continued from page* 52)

ropolitan markets. At the same time, the FCC gave CATV a relatively free hand in other markets. The FCC's right to assume jurisdiction over CATV was confirmed by the House Commerce Committee in June.

Also in June, a Federal court decision declared that CATV was liable for payments to copyright holders on any programs they transport to subscribers. The ruling was handed down by U.S. District Judge William Herlands in a suit brought by United Artists against Fornightly Corporation, a West Virginia CATV operator.

But the fight is far from over. Subscribers who have enjoyed the benefits of CATV are not likely to hold still for any curtailment of service. And people in present non-CATV areas are finding it hard to understand why they must get along with only a few channels while other areas enjoy great television diversity.

According to a bill introduced in Congress by Representative Oren Harris, the purpose of government control of the airwaves is to provide "a national television policy stressing viewer access to the greatest practicable diversity of local, network, educational and other television programs." When the dust of the battle has settled, CATV is sure to play a big part in meeting this objective. In years to come, CATV may indeed revolutionize viewing habits. —30—

SOLID STATE

(*Continued from page* 78)

other hand, checks used components first, for it's a lot easier to locate a defective part this way than to troubleshoot a finished circuit. And who wants to work that hard?

Do you prepare clip-lead parts in advance? Not unless you're lazy. For I know a very lazy man who has a stock of assorted capacitors equipped with alligator clips, and a few pots similarly equipped with short leads and alligator clips. If he's in doubt about a bias resistor value, for instance, he simply clips a pot in place, ad-

justs it for optimum results, then measures the resistance setting with an ohmmeter, and installs the nearest fixed value resistor in its place. On the other hand, if you prefer to work, just solder and unsolder a hatful of fixed resistors until you find the proper value.

Do you double-check your wiring before applying power? The lazy man does. After all, why go to the extra work of rewiring a circuit to replace a blown transistor or burnt out resistor or two caused by a wiring error?

Until next month, then, relax, have fun . . . but do things the lazy man's way.

—*Lou*

ON THE CITIZENS BAND

(*Continued from page* 85)

cently instituted. To date the unpaid staff of the journal includes Harold as publisher, a brother, Ray Merton, XM-44-1948, circulation manager; and Mrs. Betty McGuffin, XM-44-1979, identifier coordinator.

General layout, art work, and printing of the new Canadian publication are excellent. Editorial and news content are equally good, not merely several thousand loosely chosen words simply designed to fill several pages. The Department of Transport (Canada's FCC) column is chock full of the latest regulatory information; club news is informative and complete, usually accompanied by Merton photography.

The Department of Transport appears to be looking favorably upon *SCOPE*. In a letter to Harold, DOT Director F. G. Nixon said in part, ". . . We would appreciate being favoured with a copy of future editions

FREE CB USER'S GUIDE

The "User's Guide to Citizens Band 2-Way Radio" published by Amphenol is a 20-page "handbook" full of useful information for the would-be CB'er. Material covered includes the safety, control, and convenience features of CB equipment in general, how to select the type of unit most suitable for a specific purpose, information on antenna installation, a glossary of CB radio terms, and the Amphenol line of equipment. The Amphenol people have offered to supply reasonable quantities of the booklet to clubs for use in public relations projects, demonstrations, etc., provided that a club's presiding officer makes the request on club stationery. Write to Melvin A. Snyder, Amphenol Distributor Division, Amphenol Corporation, 2875 S. 25th Ave., Broadview, Illinois 60153, for single or multiple copies.

of *SCOPE* and take this opportunity to wish you success in your venture." Ditto!

Club Chatter. Maumee Valley CB Radio Club, Fort Wayne, Indiana, has changed the date of its CB Radio Roundup to September 25. The event will be held, as scheduled, at the Memorial Coliseum from 10 a.m. to 5 p.m. For more information, contact MVCBRC president Jack Dold, KHA9478, P. O. Box 1031, Fort Wayne, Indiana.

The Cereal City Citizens Radio Club, Inc., Battle Creek, Mich., published its first newspaper, the *CB Chatter Box*, in December, 1962. After the second issue hit the mail, the editor resigned, and club president Don Cortright, KPM0665, took over the job. Now, after 41 monthly issues, during which time there were no tardy, omitted or abbreviated papers, Don has resigned his post due to business commitments.

1966 OTCB CLUB ROSTER

The following clubs are represented on the OTCB Club Roster for the first time. Active CB clubs not yet registered with this column are urged to fill us in on their operation, giving us the club history, membership totals, public service assists that have been made, and a listing of current officers. Include a good, clear photograph if you can shake your publicity chairman loose, and we'll show the rest of the CB world what your operation really looks like. Send all material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016.

San Pablo, California—*Circuit Breakers of the Bay Area.* Membership: 49. Current officers: James Saltkill, KFD4399, president; John Hairgrove, KLA7069, vice president; Ruby Miranda, KNA1941-2, secretary; Martha Seymour, KFD4165-2, treasurer; John Louis, KFC0005, sergeant at arms. Club publishes monthly newspaper edited by Al Brogan, KNA4201.

Stockton, California—*The Stockton CB'ers.* Membership: 79. Officers: Carl McHenry, KFD6217, president; Dean Barker, KFD4313, vice president; Jim Cox, KLA3648, secretary; Jim Sperry, KFD2307, treasurer; and board members Bill Fortine, KNA3350; Sparkey Smith, KNA1900; Bob Morris, KFD2761; and Otto Rathjen, KNA0500.

Flint, Michigan—*Michigan Wolverine Radio Club.* Group has associate chapters in Livingston and Frankfort, with two to be added soon. All chapters are equipped with emergency units trained in civil defense and Red Cross emergency rescue and treatment work. Club publishes MWRC News Monthly, well-prepared and informative. State chairman is Larry Sneden, KNM6617.

Montreal, Quebec, Canada—*Greater Montreal REACT Teams, Reg'd.* Brothers Jack and S. Reeves Coleman, XM-52-4155, took it upon themselves to organize a REACT control for the entire city of Montreal after a trip to the U.S. a year ago; a stateside REACT control unit sent the Canadians home well versed and highly impressed with the REACT program. Team members are made up of club members from the Montreal Bilingual Radio Club, XM Mont-Royal Club, the XM'ers, Beaver Radio Association, and other GRS clubs in the area. Group has been involved with fire fighting work and with the St. Johns Ambulance center. They also inaugurated the idea for a CB blood bank through the Canadian Red Cross which they hope will spread throughout Canada and the United States.

I'll CB'ing you,

—Matt, KHC2060

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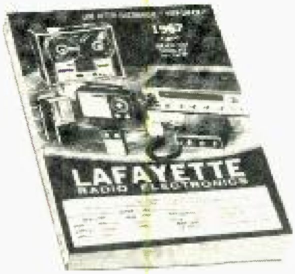

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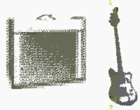

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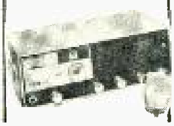

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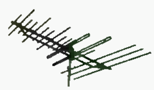

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AMATEUR RADIO

(*Continued from page 80*)

—video on 432 MHz and audio on 147.3 MHz. Club members are now planning to set up an amateur TV relay network between Louisville, Ky., and Chicago, Ill., following in the footsteps of British amateur TV'ers who regularly relay their pictures over as many as five stations.

On Sunday, August 28, the Southern Counties Amateur Radio Association of Southern New Jersey will hold its annual outing at Egg Harbor Lake, Egg Harbor City, N.J., starting at 9 a.m. This family-type affair will include pie eating contests and potato sack races for the youngsters, and lockers and showers will be available along with protected lake bathing. And, of course, there will be transmitter hunts, door prizes, and the classic swap shop. The SCARA station, K2BR, will be on at 3.85, 50.55 and 147 MHz to provide talk-ins to the campsite. Admission is $1 per person, or $1.50 for the family.

NEWS AND VIEWS

Robert Beaudoin, WN1FCN, 104 Cleveland St., Manchester, N. H., needs contacts and QSL's from Hawaii and Alaska for his Novice WAS. He doesn't pass up the DX while looking for the KH6's and KL7's, however; he has 18 countries in his log. Bob uses a Johnson "Ranger" transmitter, a National NC-155 receiver, and three antennas—a 3-element, 15-meter beam, a 40-meter dipole, and an end-fed wire on 80 meters . . . **Kim Stuber, WB4CQJ,** 200 N. W. 40 Ct., Pompano Beach, Fla., did not "get on the ball" fast enough when he was WN4WWJ; consequently, his Novice license expired before he earned his General ticket. As WB4CQJ, Kim manipulates a Heathkit DX-100 transmitter, a National NC-183D receiver, and three antennas on 80, 40, 20, and 15 meters. He'll sked you if you need Florida or Broward County . . . **Walt Kornienko, WN2WID,** 129 Culver St., Somerset, N. J., uses a secret weapon in the form of a 40-meter, inverted-V antenna in his attic to make contacts. His electron generator is a homebrew 15-watt transmitter, and the receiver is a Hammarlund HQ-150. In two weeks Walt has made 16 contacts in six states.

Al Noone, WN6SAZ, 1189 S. Muirfield Rd., Los Angeles, Calif., certainly didn't take long to find the secret of getting out. In 10 weeks, he has worked 49 states (Vermont is the hold-out), with 48 confirmed. On the DX front, his total is 32 countries worked in all continents; 19 of the countries in five continents have QSL'ed. With a record like that, you would naturally expect something pretty special in the way of equipment at WN6SAZ. Well, his transmitter is a Heathkit DX-60 running 75 watts, and it feeds a Hy-Gain 18-AVQ vertical roof-mounted with separate radials for 15, 40, and 80 meters. A Hy-Gain, 3-element, 15-meter beam is in the works now . . . **Dan Rutter, WN8SQA,** 1541 Cornell Dr., S.E., Grand Rapids, Mich., receives with a Heathkit HR-10 and transmits on a Heathkit DX-40. A 40-meter dipole, 40' high, acts as the go-between in both transactions. Dan's logbook shows 35 states and 9 countries worked, and he is a member of the QRP Club.

David Proper, WB2PMP, 139 Thompson Ave., Oceanside, N. Y., works AM, CW, and SSB on all bands between 80 and 2 meters. A Hallicrafters SX-117 receiver and HT-44 transmitter cover the amateur bands up to 30 MHz, and Hallicrafters HA-6 and HA-2 transverters extend the coverage to the 50- and 144-MHz bands. Dave uses a 6-and-2 meter beam about 25′ high on the higher frequencies and dipoles on the other bands. Although the dipoles are only 15′ high, Dave has worked 48 states, New Zealand, and other Pacific DX on 40 meters, his favorite DX band . . . **Lloyd Wright, VE3CFR,** 30 Rosel Crescent, London, Ontario, Canada, spends most of his waking hours on the air. Professionally, he is Commercial Director for CFPL-FM and CFPL-TV; on the amateur bands, he is the Ontario Phone Net Manager, Emergency Coordinator, and Official Bulletin Station; and he likes to chase certificates on CW. Among his three walls full of certificates are WAS, WAVE, Worked All Bermuda, and DXCC. An E. F. Johnson "Valiant" runs 200 watts on AM, and a Johnson "Invader" drives a Hammond 500 to 1000 watts on SSB. Lloyd has been an amateur for eight years and an SWL for "39."

Jim Rushing, WN5NTE, 602 San Patricio, Taft, Texas, has a 40-meter dipole antenna only 10′ high. But with it he has worked 35 states and 5 countries—with the help of a Johnson "Ranger" running 75 watts and a Drake 1-A receiver. As you may have guessed, Jim spends most of his time on 15 and 40 meters, although he does get on 80 meters at times . . . **Lee Barrett, WN2UKO,** 17 Crescent Dr., Potsdam, N.Y., proved that you can make lots of contacts with a simple receiver by working 18 states and six countries using a Knight-Kit "Star Roamer" receiver. He transmitted on a Heathkit DX-60A via an all-band "trap" dipole or a 15-meter dipole. We speak in the past tense about Lee's Novice career, because *his* license also expired before he took the General exam, but his General license and new call letters are on the way.

The first step toward seeing *your* "News and Views" in these pages is to write that letter to us. Include a good sharp picture, and your station will be considered for selection as the Amateur Station of the Month. Thank you for sending us your club paper. The address is: Herb S. Brier. Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ

"It's from Bill. The finance company repossessed his sideband rig."

SHORT-WAVE LISTENING

(*Continued from page 83*)

days at 1100, 1230, 1400, 1445, 1615, 1945, 2200, and 2330, and Wednesdays at 0145 and 0315.

SWITZERLAND—"Swiss Shortwave Service Merry-Go-Round"; Saturdays at 0730, 0919, 1215, 1400, 1515, 1615, and Sundays at 0215, 0519.

U.S.A.—WNYW; "DX'ing Worldwide"; Saturdays at 1330 and 2130.

Station WNYW. Did you notice something strange about that last item listed above? *Radio New York Worldwide* has changed its call-sign. For nearly 30 years the station has been known as WRUL. Before that, when it was first formed, it had the experimental call of W1XAL. Now, in keeping with the name of the station, the new call-sign is WNYW.

From WNYW comes word that the Russians are developing a mini-radio transmitter which will keep tabs on tourists in that country. The small radio units are to be attached "inconspicuously" to the travelers' cars during customs inspection. The signals from the "thing" can then be picked up by a network of police patrol stations which can check if a car deviates from its prescribed course.

CURRENT STATION REPORTS

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 Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the fifth of each month; be sure to include your WPE identification, and the make and model number of your receiver. We regret that we are unable to use all the reports received each month, due to space limitations, but we are grateful to everyone who contributes to this column.

Austria—A regular short-wave service of the *Austrian Radio* was recently inaugurated with this schedule: 6000 kHz at 0430-2300; 6155 kHz at 0500-1100, 1700-2200, and 2300-0430; 7245 kHz at 0600-1300 and 1700-2000; 9525 kHz at 0000-0500 and 1300-1700; 9610 kHz at 1700-1900 (Sundays only); 9770 kHz at 2300-0400; 11,785 kHz at 1100-1700; 11.895 kHz at 1100-1300; 11.900 kHz at 1100-1400 (Saturdays only); 15.210 kHz at 1700-1900; 15.410 kHz at 0600-0900; 17.750 kHz at 1500-1700; 17.755 kHz at 0900-1100; 17,800 kHz at 1300-1500 and 17.855 kHz at 0500-0900. Report forms and schedules are available and reports are requested. Send them to *Austrian Radio*, Short-Wave Service, P. O. Box 700, A-1041, Vienna, Austria.

Bechuanaland—The BBC Central African Relay Station, Francistown, is operating at 0915-2045 on 7295 kHz as well as on 602 and 926 kHz (medium waves). Another report also lists it as being on 4845 kHz.

Bolivia—*R. Pio XII* has been noted on 5960 kHz

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corporation
Eng.—English
ID—Identification
IS—Interval signal
kHz—Kilohertz
kW—Kilowatts
N.A.—North America
QRM—Station interference
R.—Radio
RTTY—Radioteletype
s/off—Sign-off
s/on—Sign-on
xmsn—Transmission

around 0200. There is some question as to its location, which was given as Siglo Viente when monitored.

Brazil—Station ZYK41, *Radiodifusora de Petrolina,* Petrolina, has been heard in Portuguese on 5025 kHz to 0300/close. One of the rarer Brazilians, at least in West Coast areas, is ZYR58, *R. Difusao de Sao Paulo,* 6165 kHz; noted with a soccer game at 0030, it suffered QRM from XEWW, Mexico City, and at 0100 from Havana. *R. Excelsior,* Sao Paulo, is now active on 15,265 kHz in dual to 9585 kHz. *R. Nove de Julho,* Sao Paulo, is active on 17,705 kHz and in the clear generally from 0030 to 0100 s/off with German songs.

Canada—West Coast monitors might try to log the First Narrows Signal Station, VAS, West Vancouver, B.C., Canada. Look for it on 1650 kHz (port operations), 2182 kHz (calling and distress), and 2366 kHz (intership). The station is equipped to transmit and receive on 1630, 2318 and 2638 kHz, and verification is by letter. (Your Short-Wave Editor recalls that years ago "VAS" was assigned to a medium-wave outlet at Glace Bay, N. S.)

Canary Islands—*R. Nacional Espana,* Tenerife, is good from 0200 to 0307 s/off on 11,800 kHz, with all-Spanish language but with some U. S. records.

China—A presumably new outlet of the *R. Peking* Home Service was noted with s/on at 1025 on 9755 kHz, music by a cappella and orchestra, then Chinese talk and music to 1100 when the familiar "Peking pips" were sounded. This is dual to 11,290 and 11,330 kHz.

Another station, possibly *Inner Mongolia A,* is heard on 6974 kHz at 1400 with Peking's IS, an ID in unknown language, and the Peking opening march. The programming does not resemble Peking's Home Service.

Colombia—Seldom-heard HJNE, *R. Sol,* Cali. 6140 kHz, shows up well at times around 0525 with a complete ID and typical programming. Station HJLW, *R. Ecos del Combeima,* Ibaque, has been heard on 4785 kHz, under severe RTTY QRM from 0300, with mostly Latin American music and commercials; s/off is at 0400.

Congo (East)—As of July 1, Leopoldville has been renamed Kinshasa; Stanleyville is now Kisangani, and Elisabethville is now Lubumbushi.

Cuba—At press time, the Eng. schedule from Havana reads: to northern Europe at 2010-2140 on 15,155 kHz; to South America at 2050-2150 on 15,300 and 15,340 kHz; to Africa at 1800-1900 on 17,735 kHz; and to N. A. at 0100-0600 on 9525 kHz and at 0330-0600 on 6135 kHz.

Egypt—English is broadcast from Cairo as follows: to Middle East and northern Africa on 7075 kHz at 0630-0700; to Europe on 9475 kHz at 2245-2315 and on 11,915 kHz at 2145-2315; to South America on 11.710 kHz at 0130-0230; to western Africa on 15.135 kHz at 2045-2215; to South Asia on 17.690 kHz at 1300-1430; and to eastern Africa on 17.690 kHz at 1930-2015.

Ethiopia—Test xmsns were noted recently from Addis Ababa on 15.400 kHz from 0500 to 0530 s/off with a missionary program in an African language, and on 11,890 kHz at 0430-0500 in Eng. and asking for reports. Another new frequency is 15,370 kHz; it was noted in use to the Persian Gulf area in Arabic with close at 0425.

Formosa—*The Voice of Free China,* Taipei, announces that Eng. is broadcast at 0250-0350 on BED7, 7130 kHz; BED69, 11,825 kHz; BED45,

11,860 kHz; BED60, 15,125 kHz; BED49, 15,345 kHz; BED39, 17,720 kHz; and BED95, 17,780 kHz. Reports indicate best reception on 17,720 and 15,345 kHz.

Germany (East)—*R. Berlin International* has Eng. to N. A. at 0100-0130 and 0230-0300 (East Coast) on 9730 and 11,890 kHz, and at 0345-0415 and 0445-0515 (West Coast) on 11,875 and 11,920 kHz.

Italy—A new schedule from Rome lists Eng. as follows: to N.A. at 0100-0120 on 11,800 and 15,385 kHz, to Egypt at 2020-2040 on 7235, 9710, and 11,810 kHz, and at the same time to Malta on 5990, 7275, and 9710 kHz; to Great Britain at 2115-2135 on 9575 and 11,905 kHz; to the Middle East at 1200-1230 on 9575 and 11,905 kHz, and to Japan at 2205-2225 on 11,905 and 15,310 kHz. Other xmsns were heard on 11,710 kHz at 0200 in Arabic, on 11,865 kHz at 0300 (new frequency) and on 21,560 kHz at 1705 in Italian.

Japan—*R. Japan* is beamed to eastern N.A. at 2345-0045 on 15,135 and 17,825 kHz, with DX news on Saturdays at 0030. News in Eng. is given on 9560 kHz at 1810 and during the 1955-2015 xmsn on 15,195 kHz.

Lebanon—Beirut's program to N.A. is at 0130-0400 with Eng. at 0230-0300 on 11,760 kHz. Spanish was noted being broadcast to South America at 0030 on 15,235 kHz.

Netherlands—*R. Nederland* has a special Eng. xmsn for CJRC, Toronto, and WUOM, Ann Arbor (Mich.) at 2030-2050 on 15,425 and 11,950 kHz on Tuesdays and Fridays. The West Indies beam at 2305-2345 is now on 15,320 kHz (replacing 11,920 kHz) and 9715 kHz. The Spanish "Happy Station Program" is on the same channel Sundays at 2200.

New Zealand—Daily Eng. xmsns from Wellington go to the Pacific Islands at 0600-0845 on 9540 and 6080 kHz, with Home Service at 1700-1945 on 9540 and 6080 kHz and at 2000-0545 on 11,780 kHz; to Australia at 0900-1145 on 9540 and 6080 kHz, with Home Service at 2000-2230 on 9540 kHz and at 2230-0545 on 15,110 kHz; to members of the New Zealand scientific party in the Ross Sea area of Antarctica on Sundays only at 0215-0245 on 9540 kHz and at 0815-0845 on 6080 kHz.

Nigeria—The *Voice of Nigeria* is being heard on 9690 and 15,255 kHz with an Eng. newscast at 2200. This station also operates at 1300-1700 on 15,255, 11,915, 9690, and 7275 kHz (and until 1600 on 4990 kHz).

Pakistan—*R. Pakistan*, Karachi, is heard with its Home Service on 4690, 6242, 7042, and 15,095 kHz; Eng. news is at 1500-1515, and s/off at 1545.

This is the listening post of Morris Goldman, in Chicago, Ill. Otherwise known as WPE9FTZ, Morris is an enthusiastic TV DX'er. His primary SWL receiver is a Hammarlund HQ-110; for broadcast monitoring, he uses a Philco table model. His SWL record to date: 27 countries logged, 23 verified.

The 17,705-kHz channel, dual with 15,202 kHz (both new), is good with Eng. at 0030-0115 (news at 0045) beamed to Southeast Asia.

Peru—Station OAX2S, *R. Jaen,* is now on 5004 kHz, and is heard around 0300 with typical Peruvian music and few anmts; WWV, Washington, and an RTTY station offer heavy QRM. Station OBZ4I, *R. Prelatura Nullius de Yauyos,* Canate, is good at times around 0345 with Spanish music and talk on 3320 kHz.

Senegal—Look for Dakar on 11,895 kHz (its old frequency of years ago) at 2200-2300 with pop music, anmts in French and the "talking drums," and on 7160 kHz at 0730 with "Chaine Nationale."

South Africa—A schedule from Johannesburg shows *Radio RSA, The Voice of South Africa,* to be on the air from Monday to Saturday on this schedule: 0415-0427 to Kenya, Uganda and Tanzania on 7270 and 9525 kHz; and 0500-0512 to Rhodesia, Zambia and Malawi on 5980 and 7270 kHz. Daily xmsns: 1000-1455 to all of Africa on 7270, 9525, 11,900, and 15,220 kHz; 1600-1655 to Rhodesia, Zambia, and Malawi on 5980 and 7270 kHz; and 1700-1755 to Kenya, Uganda, and Tanzania, 2100-2155 to Nigeria and Ghana, and 2200-2255 to United Kingdom and Europe, all on 7270 and 9525 kHz. A service to the U. S. and Canada, with four xmsns daily, will begin "in the future" as well as broadcasts to Europe in French, German, Portuguese, Spanish and Dutch, and at a still later date to the Far East, Southeast Asia, Australasia, and Latin America.

Switzerland—Berne's newest Eng. schedule reads: to Australia and New Zealand at 0700-0830 and 0415-0545 on 11,775 and 9595 kHz and at 0115-0245 on 11,775 kHz; to Africa at 0845-1015 on 17,830, 15,430, and 15.305 kHz; to United Kingdom and Ireland at 1145-1315 on 11,865 and 9665 kHz and at 1845-2015 on 9665 and 7110 kHz; to Asia, India, Pakistan, China, Japan, and Southeast Asia at 1330-1500 on 17,830, 15.395. 15,305, and 11.855 kHz; to the Middle East at 1515-1645 on 17,830, 15,305, 15,255, and 11,880 kHz; and to N.A. at 0115-0245

SHORT-WAVE CONTRIBUTORS

Roger Camire *(WPE1GEK)*, Manchester, N. H.
Stan Mayo *(WPE1GMF)*, Portland, Maine
Eric Lebowitz *(WPE2JJY)*, Jackson Heights, N. Y.
Kenneth Coyne *(WPE2LSI)*, Long Beach, N. Y.
Robert Kaplan *(WPE2MJR)*, Bronx, N. Y.
Alan Raylesberg *(WPE2MKW)*, Bayside, N. Y.
Albert Sauerbier *(WPE2NDA)*, Washington, N. J.
Roger Greene *(WPE2NFC)*, Bronx, N. Y.
J. R. McAleer *(WPE2OEJ)*, Whitestone, N. Y.
Steve Slusar *(WPE2OFC)*, Hicksville, N. Y.
Peter Macinta *(WPE2ORB)*, Kearny, N. J.
Ed Kowalski *(WPE3AK)*, Philadelphia, Pa.
Norman Griffin *(WPE3GUM)*, Croydon, Pa.
John Wilson *(WPE3NB)*, Wilmington, Del.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Kenneth Alyta, Jr. *(WPE4FXB)*, Charlotte, N. C.
Bob Conder *(WPE4HQT)*, Winston-Salem, N. C.
Steve Scott *(WPE4JBG)*, Palm Harbor, Fla.
Del Hirst *(WPE5CFU)*, Snyder, Texas
Stewart Mac Kenzie *(WPE6AAA)*, Huntington Beach, Calif.
Shaler Hanisch *(WPE6BPN)*, Pasadena, Calif.
Trev Clegg *(WPE6FAF)*, Fresno. Calif.
Laurence Hansford *(WPE6FKA)*, Auburn, Calif.
Jack Alexander, Jr. *(WPE6FQU)*, Anaheim, Calif.
Bob Noll *(WPE9HXS)*, Sandwich, Ill.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAE)*. Pueblo, Colo.
Dave Carlson *(WPEØEOB)*. St. Louis, Mo.
Hector Borreos *(KP4PE1G)*, Bayamon, P. R.
Jack Perolo *(PV2PE1C)*, Milwaukee, Wis.
Daniel Thomas *(VE3PE2IR)*, Burlington, Ont., Canada
Trevor Burke *(VE7PE1AW)*, Victoria, B. C., Canada
Mike Thompson *(VE7PE1BE)*, Vancouver, B. C., Canada
David Alpert, Morton Grove, Ill.
Bob Hill, Washington. D. C.
Bill McDaniel. Markham, Ill.
Kenneth Watson. Thornhill, Ont., Canada
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

ALL radio listeners interested in furthering the hobby of SWL'ing—regardless of whether you DX on the BCB, VHF, TV, SW, or FM bands—are eligible to apply for a POPULAR ELECTRONICS "Certificate of Registration." You must have verified (have QSL cards from) a minimum of five radio stations, of which one was outside the borders of the United States. There is no age limit, or special equipment qualification; the only requirement is that the applicant have a sincere interest in radio communications.

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. Mail with 50 cents in coin (or stamps) to: MONITOR, P.O. Box 333, Cherry Hill, N.J. 08034. (Personal checks will not be acceptable). Canadians should use their own currency, and other applicants not in the U.S.A. should use 10 International Postal Reply Coupons. Allow 4-6 weeks for processing.

(Please Print) (Do not fill out)

Name . . . . . .

Street, City and Zone . . . . . .

State and Zip . . . . . .

Receivers in use Make . . . . . Model . . . . . .

Make . . . . . Model . . . . . .

Age Occupation . . . . . .

Ham/CB call -letter assignment(s) . . . . . .

I listen mostly to SW Broadcast Hams CB BCB VHF VLF . . . . . .

I use the following antennas . . . . . .

I have QSL cards and countries verified. Check if subscriber to P.E. . . . . .

Signature Date . . . . . .

on 11.715, 9535 and 6120 kHz and at 0415-0545 on 11,715 and 9535 kHz.

Vatican City—*Vaticano Radio* is noted on 11,770 kHz at 0027 with bell IS, ID at 0030, and a call to Latin America in Spanish. The station uses Spanish to 0044 close, then opens again at 0050 in English.

Venezuela—*Escuelas Radiofonicas*, San Fernando, is now on 2440 kHz (replacing 2430 kHz) and on 4910 kHz (6110 kHz) at 0100 with ID and typical Venezuelan music.

Zambia—Call-signs and frequencies for Zambia's International Telephone Service are as follows: 9JV9, 7765 kHz; 9JA20, 10,107 kHz; 9JA4, 10,280 kHz; 9JA21, 12.120 kHz; 9JA5, 13,390 kHz; 9JA6, 13,828 kHz; 9JA7, 15,760 kHz; 9JA8, 18,845 kHz; 9JA9, 19,987 kHz; and 9JA22, 20,120 kHz. Reports should go to Republic of Zambia G.P.O., Telecommunications Division, G.P.O. Headquarters, P. O. Box 1660, Ndola, Zambia. A correct report will bring a letter signed by the Postmaster General of Zambia.

DX COUNTRIES AWARDS PRESENTED

To be eligible for one of the DX Countries Awards designed for WPE Monitor Certificate holders, you must have verified stations in 25, 50, 75, 100, or 150 different countries. The following DX'ers recently received their awards.

ONE HUNDRED AND FIFTY COUNTRIES VERIFIED

Richard Markell (WPE6DXC), Los Angeles, Calif.
James Young (WPE6ENA), Wrightwood, Calif.
Edward Fellows (WPE7BLN), Seattle, Wash.

ONE HUNDRED COUNTRIES VERIFIED

Serge Neumann (WPE6AKA), Santa Monica, Calif.
Jack Winther (WPE6BJD), Moraga, Calif.

SEVENTY-FIVE COUNTRIES VERIFIED

David Lund (WPEØAUO), Sioux City, Iowa
George Hemingway (WPE1DYC), Taftville, Conn.
David Skinner (WPE2GHO), Belleville, N. J.
Martin Schneider (WPE2SV), Watertown, N. Y.

FIFTY COUNTRIES VERIFIED

Jack Page, Jr. (WPE5DXH), Pontotoc, Miss.
Dan Henderson (WPE4GW), Silver Spring, Md.
Alan Petersen (WPEØEHF), Hampton, Iowa
Robert Kaplan (WPE2MJR), New York, N. Y.
Bernard Greene (WPE2MNJ), Brooklyn, N. Y.
Bob Gordon (WPE3FWH), Clairton, Pa.
Michael Busse (SV1PE1E), Athens, Greece
C. N. Coombe (WPE2MOB), Trenton, N. J.
Ira Schultz (WPE2NGG), White Plains, N. Y.
John Greenfield (WPE2LVF), APO, New York, N. Y.
Roger Camire (WPE1GEK), Manchester, N. H.
Paul Slater (WPE1FRT), Medford, Mass.
John Sgrulletta (WPE2MXF), Bedford Hills, N. Y.
William Via (WPE3FHB), Baltimore, Md.

TWENTY-FIVE COUNTRIES VERIFIED

Frank Fowler, Jr. (WPE2NUO), APO, New York, N. Y.
William Woodfield (WPE4HGT), Norfolk, Va.
Mike Finigan (WPE4ISQ), Monroe, N. C.
David Miller (WPE3GMH), Pittsburgh, Pa.
Henry O'Meara (WPE2OCG), Brockport, N. Y.
Gerald Larocque (WPE1GED), Greenfield, Mass.
Don Summerhill (WPE5EJJ), El Dorado, Ark.
Richard Cooper (WPE1GHI), Wayland, Mass.
Walter Pratt, (WPE1FHE), Shrewsbury, Mass.
John Swenson (WPE4ITV), Annandale, Va.
David Lalor (WPE5EIQ), Corpus Christi, Texas
Martin Brennert (WPE2FXP), Jersey City, N. J.
Gary Wilburn, Jr. (WPE8IFT), Cincinnati, Ohio
Richard Kindt (WPE3GKQ), Cleona, Pa.
Gary Kieffer (WPE5DZD), Tecumseh, Okla.
Warren Peabody (WPE1GGI), Marblehead, Mass.
Victor Lipinski (WPE4HTV), Alexandria, Va.
David Gamble (VE3PE1WB), Sudbury, Ont., Canada
Werner Breitkopf (VE2PE1JA), Montreal, Que., Canada
Brent Holcomb (WPE4HLH), Clinton, S. C.
Arthur Krass (WPE2NEX), Richmond Hill, N. Y.
Lothar Koenig (WPE2NTB), Brooklyn, N. Y.
Ronnie Tamagni (WPE2NUK), Vineland, N. J.
David Hallidy (WPE2MUA), Camillus, N. Y.
Brent Stackhouse (WPE8IBS), Bronson, Mich.
Stephen Budensiek (WPE8ISI), Salem, Ohio
Thomas Park (VE1PE9T), New Glasgow, N. S., Canada
Bill Marple (WPE6FVU), Los Angeles, Calif.
Edward Pyatt (WPE4IGG), Conway, S. C.
Robert Beaudoin (WPE1GGC), Manchester, N. H.
W. E. Moyer (WPE8ILJ), Dayton, Ohio
Douglas Smith (WPE4IFN), APO, New York, N. Y.
Gary Welch (WPE1GFJ), Atkinson, N. H.
John Megas (WPE1GJL), Ellsworth, Maine
Tom Frost (G2PE6A), Goodmayes, England
Allan Gardner (WPE2NBV), Carlstadt, N. J.
Bruce Nazarian (WPE8IAH), Detroit, Mich.
Tim Vorel (WPE9FIB), Westchester, Ill.
Mark Hosmer (WPE9HPM), Carmel, Ind.
Leonard Shobar (DL4PE1BC), Landstuhl, West Germany
Tom Taggart (WPE8IHL), Lakewood, Ohio
H. A. Strothers (WPE4INW), Arlington, Va.
John Kuc (WPE1GFM), Indian Orchard, Mass.
Charles Angell (WPE3TP), Collegeville, Pa.
Robert N. Mayer (WPE9HQG), Winnetka, Ill.
Ronald Engelbrecht (WPEØEOZ), Jefferson City, Mo.
Gus Spreitzer (WPE8HRY), Cleveland, Ohio
Gary Schwartz (WPE6GGG), Rossmoor, Calif.
George Zeller (WPE8HLX), Salem, Ohio
D. Kent (VE3PE2GG), Rexdale, Ont., Canada
Robert Johnston (VE3PE1SX), Oshawa, Ont., Canada
Charles Yeager (WPE1FGM), Fairfield, Conn.
Alan Rich (WPE1GMR), Northboro, Mass.
John Kroll (WPE8IFO), Flint, Mich.
Art Glover (WPE7CGL), Port Angeles, Wash.
Perry Davis (WPE2MQS), Jamaica, N. Y.
C. Rasin (WPE2ORL), Bloomfield, N. J.
George Sprout (WPE3GMW), Reading, Pa.
Harry Dence (WPE4IKY), Cynthiana, Ky.
Russell Feran (WPE5CXT), New Orleans, La.
Steve Barley (WPE4IEL), Bassett, Va.
Ronald Miller (WPE9HCG), Peoria, Ill.
Wayne Harrell (WPE5EKB), El Dorado, Ark.
Thomas Olshark (WPE3GJT), Luzerne, Pa.
Merrill Meyer (WPE2NEC), New York, N. Y.
Edward Suffern (WPE4IUZ), Jacksonville, N. C.
Walter Miscichowski (WPE2BEH), Buffalo, N. Y.
Glen Jenkins (WPE4IVJ), Camp Lejeune, N. C.
Steve Kennedy (WPE4IAX), Sarasota, Fla.
Robert Astmann (WPE2LWS), Kenmore, N. Y.
Charles Bailey (WPE4IXM), Athens, Ga.
Howard Beaton (WPE2OGX), Port Chester, N. Y.
Roger Collinge (WPE2NPN), Milford, N. J.
Bob Huber (WPE3GUN), Wilmington, Del.
Harold Don Allen (VE2PEIJM), Arvida, Que., Canada
Joe Prine (WPE4HRU), Lakeland, Fla.
Jorcam Dester (WPE2MBK), Madison, N. J.
Bruce De Vlieger (WPE2IVS), Newark Valley, N. Y.
Coy Overton (WPE4DO), Durham, N. C.
Bruce Kesselman (WPE2OGO), Woodbridge, N. J.

DX AWARDS PROGRAM RULES

Here's an easy way to get a copy of the rules and regulations for each of the three phases of the DX Awards Program to date (Countries, States, and Provinces). Just supply a postage stamp or return envelope, and your Short-Wave Editor will send you a leaflet containing the rules for all three phases—plus a copy of the official Countries List for DX Awards. The stamp or envelope, with your request, should go to: DX AWARD RULES, P. O. Box 333, Cherry Hill, N. J. 08034.

Clandestine. *R. Euzkadi* was caught on the new frequency of 15,080 kHz at strong level from 2030 to 2110 s/off. This station has dropped 11,260 kHz but still operates parallel to 13,245 kHz. S/off is with an anthem, then the Euzkadi IS twice.

R. Libertad's frequencies, as announced, are 15,050, 11,865, 9325, 7308, 6240, and 1400 kHz. Actual monitoring finds the station on 9290, 7300, 1406, and the other announced channels. S/on is at 0000.

International Waters—Here are a few brief notes on the many stations in the waters around England. *R. Caroline South* is now back on "Mi Amigo" with 25 kW on 1187 kHz at 0500-2300. *R. Caroline North* relays *Caroline South* (same times) from vessel "Cheetah II," the ship once used by Swedish pirate *Radio Syd*. *R. Britain & R. England*, are broadcasting, both with 55 kW.; the former has pop music, the latter has light music (no frequencies listed). *R. City* is on 1033 kHz with 20 kW at 0600-1800 but has been noted as late as 0000. *R. Scotland*, up from 1241 kHz to 1260 kHz, operates 24 hours daily; plans are afoot to raise power from 20 to 50 kW. *R. Essex* can be heard on 1351 kHz; reports should go to T. P. Bates, Westcliffe-On-Sea, Essex, England. *R. Dynavision Calling* was noted at 1430-1530 on 1280 kHz—it may be a new station testing. *R. 270* is probably back in operation now after repairs to broken mast. *R. Channel*, anchored off Bexhill, Sussex, England, will begin "very soon." *R. Tower*, 1266 kHz, is scheduled to operate at 0600-1800. —30—

PIGTAILS

A radio-wave signal generator the size of a *grain of rice*! Hard to believe, isn't it? But a unit has been developed by the U. S. Army in which the essential material—gallium arsenide—is a speck invisible to the naked eye. Experiments have shown the device to be highly efficient, to have unusual frequency stability, and to be easy to tune. It operates over wide frequency ranges in the microwave and millimeter portions of the spectrum.

The origin of the human hearing mechanism has been traced back 350 million years by Willem A. van Bergeijk of Bell Telephone Laboratories—some 50 million years earlier than previously determined. His findings indicate that a middle ear, or air-filled "spiracular pouch," existed then in some members of a family of prehistoric fish called Rhipidistia, ancestors of the amphibians. According to Dr. van Bergeijk's theory, these fish should have been able to hear sounds not only through water but through the air as well.

POPULAR ELECTRONICS
SEPTEMBER 1966
ADVERTISERS INDEX

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. 90¢ per word (including name and address). Minimum order $9.00. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.

READER RATE: For individuals with a personal item to buy or sell. 55¢ per word (including name and address). No Minimum! Payment must accompany copy.

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¢ extra per word. All copy subject to publisher's approval. Closing Date: 1st of the 2nd preceding month (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P.O. Box 942, Lynnfield, Mass.

MESHNA'S TRANSISTORIZED CONVERTER KIT $5.00. Two models converts car radio to receive 30-50 mc or 100-200 mc (one mc tuning). Meshna, Lynn, Mass. 01904.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Radios, Parts, Picture Catalog 25¢. **Meshna,** Nahant, Mass. 09108.

"SPECIAL! WPE-SWL-CB-QSL cards, 3 colors, **$2.50** per 100—Free Samples, Garth, Jutland, New Jersey."

CANADIANS—GIANT Surplus Bargain Packed Catalogs. **Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio.** Rush $1.00 (Refunded). **ETCO,** Dept. Z., Box 741, Montreal, **CANADA.**

WEBBER LAB'S Police—Fire Transistorized Converter kit 30-50mc. & 100-200mc. (1 mc. spread) $5.00 each. 26-200mc. on broadcast band using any type radio, crystal controlled $23.00 wired pp. tunable—crystal controlled $11.00 kit. 72 Cottage Street, Lynn, Mass.

JAPAN & Hong Kong Electronics Directory. Products, components, supplies. 50 firms—just $1.00. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

CANADIANS, TRANSISTORS AND PARTS. Free catalogue contains reference data on 300 transistors. J. & J. Electronics, Dept. PE, Box 1437, Winnipeg, Manitoba.

TRANSISTORS—Miniature Electronic Parts. Send for free Catalog. Electronic Control Design Company, P. O. Box 1432K. Plainfield, N.J.

INVESTIGATORS, FREE BROCHURE, LATEST SUBMINIATURE ELECTRONIC SURVEILLANCE EQUIPMENT, ACE ELECTRONICS, 11500-L NW 7TH AVE., MIAMI, FLA. 33168.

TELEPHONE VOICE SWITCH: (LS-500). ACTUATES AUTOMATICALLY AND UNATTENDED ANY TAPE OR WIRE RECORDER. PICTORIAL INSTALLATION INSTRUCTIONS INCLUDED. $23.75. POST PAID USA, WJS ELECTRONICS. 737 NORTH SEWARD, HOLLYWOOD, CALIF. 90038.

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BUG DETECTOR: WILL DETECT AND LOCATE SURREPTITIOUS TRANSMITTING DEVICES IN CONFERENCE ROOMS, HOME AND OFFICES, ETC. WRITE FOR DETAILS. WJS ELECTRONICS, 737 NORTH SEWARD, HOLLYWOOD, CALIF. 90038.

CB-WPE-QSL CARDS. Same High Quality, Beautiful, Glossy multi-color cards. New **LOW PRICES. 26 SAMPLES,** 25¢. Dick, W8VXK, 19QA0625, Gladwin, Mich. 48624.

DIAGRAMS—SENT AIRMAIL—TELEVISION $3.00. **RADIO 1919-1965** $2.00. **GIVE MODEL. DIAGRAMS, BOX 55, WILLIAMSPORT, PA. 17704.**

ELECTRONIC "CRACKAJACKS," relays, transistors, photocells, etc. Guaranteed prizes. $1.00 ppd. **DART ELECTRONICS,** Box 214, Jericho, N.Y.

WE SELL CONSTRUCTION PLANS. Telephone Equipment: $40 Answering Machine, $15 Bell System Type Speaker Phone, $10 Legal Telephone Connector, Telephone Extension in your car, $25 Automatic Dialer, Central Dial System. Phonevision. Television Equipment: $50 Camera. $30 3DTV Converter, $35 All Electronic Color Converter, Video Recorder. Hobbyist: $50 Ultrasonic Dishwasher, Transistorized Teletype and Morse Code Copier, $75 Electron Microscope, Electronic Tranquilizer, Private Eye Tail Transmitter, Police Radar Detector plus Legal Jammer. Plans $4.95 each. Telephone Engineering Course $39.50. **SUPER HOBBY CATALOG** 25¢. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood, Calif. 90046.

TRANSISTOR TV CAMERA KIT NOW AVAILABLE! 17 transistor circuit, printed circuit construction, self-contained sync generator and power supply, **RF** and **VIDEO** outputs, large **EASY-TO-FOLLOW** instructions. **EXCELLENT PERFORMANCE. COMPLETE KIT ONLY** $149.50 less vidicon tube. Be the first in your neighborhood to experience the fun of televising your friends and relatives on the living room TV. Many other tube and transistor **STARTER KITS** also available—$18.95 up. Rush 10¢ for **IMMEDIATE DELIVERY** of our **NEW** information-packed 1966 **TV CATALOG.** Don't buy any other TV camera until you've seen our **UNBELIEVABLE PRICES! ATV RESEARCH,** Box 396P, South Sioux City, Nebr. 68776.

R.F. CONVERTERS. World's largest selection. Also CCTV cameras, transmitters, etc. Lowest factory prices. Catalog 10¢. Vanguard 196-23 Jamaica Ave., Hollis, N.Y. 11423.

INVESTIGATORS—DETECTIVES—INDUSTRIAL SECURITY OFFICERS: New 1966 line of Electronic Surveillance Devices. Incorporating most advanced subminiature design. Greater range; lower battery drain; unique sophisticated circuitry; extremely durable. **HIGH QUALITY PROFESSIONAL EQUIPMENT AT ROCK BOTTOM PRICES.** Foolproof wireless units are extremely **SIMPLE TO USE!** You **DO NOT** have to be an engineer to get **PROFESSIONAL** results with **THIS** equipment. **TROL** 1966 models ready **NOW!** Take advantage of Special Introductory Offer. Don't delay! For **FREE** details write **TROL ELECTRONICS-PE,** 31 West 8th Street, New York, N.Y.

RECTIFIERS, transistors, other components. Catalog free. Electronic Components Co., Box 2902C, Baton Rouge, La.

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

RADIO – T.V. Tubes—33¢ each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

007 ELECTRONIC devices. Straight from James Bond's **GOLDFINGER** and **THUNDERBALL.** Reasonable prices. Free catalog. Baker Electronics, R.R. 3, Greencastle, Indiana 46135.

ORIENTAL Electronics Directory. 200 Japanese—Hong Kong Manufacturing Exporters. All products. $2. Dee, Box 211, Beverly Hills, Calif. 90213.

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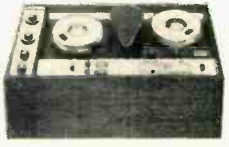

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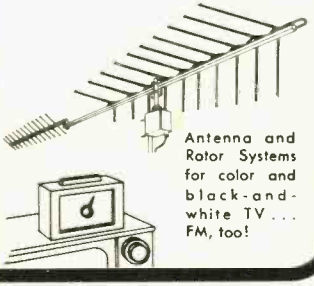

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