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APRIL 1958

35 CENTS

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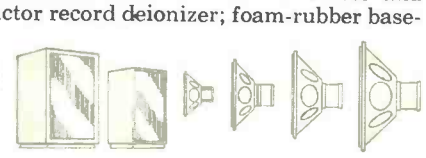

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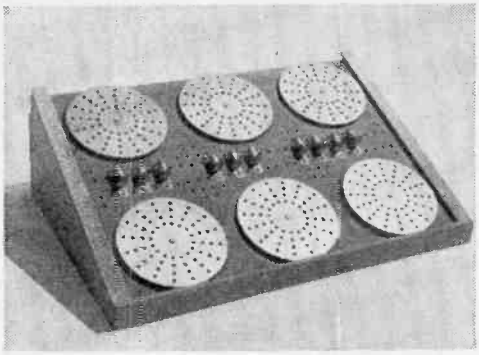

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POPULAR ELECTRONICS

VOLUME 8 NUMBER 4

APRIL 1958

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Stereo unit on cover courtesy of Electro-Voice, Inc.

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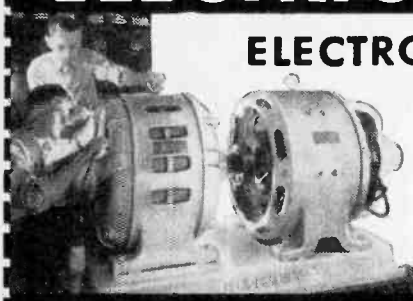

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How to . . . make a "Half-Pack" transistor radio . . . put a public address system to work . . . make disc records . . . substitute capacitors . . . these are only a few of the other articles that will be in the May issue.

IN THIS MONTH'S
RADIO & TV NEWS
(APRIL)

The Complete TV Remote Control
Audio Operated Switch
Simple Transistor Keyer Unit
"Mobile-Dip"—a Portable Grid-Dip Meter
The Weakest Link—First or Last?

By JOHN T. FRYE

Little Drops of Water

IT HAD BEEN the warmest spring day so far, and now in the late afternoon the mercury was still standing in the high seventies as Carl skipped down the outside steps leading to the basement laboratory of his friend, Jerry. Carl stopped short in the open doorway and looked in amazement at his pal seated on the worn leather couch.

Jerry, taken by surprise, was a study in frozen animation. Clutched in his hand was a short metal rod with a silvery disc about an inch and a half in diameter fastened at its edge to the rod. A wire went from the handle to a small box resting on his knees, and another wire from this box was wrapped around the index finger of his left hand. Jerry's protruding tongue was pressed firmly against the metal disc; and with his slightly bulging eyes, he looked for all the world like a chubby gargoyle.

"Yank in your revolting-looking tongue and tell me what's going on here," Carl demanded. "What's that you're licking?"

"Why I supposed anyone would recognize an electronic popsicle," Jerry replied.

"Electronic popsicle!"

"Sure. You know how you get a taste sensation when wires from a cell are touched to the tongue. Well, this afternoon I got to thinking about it and wondering if different polarity produced different taste; s-o-o-o, I decided to find out. There's just a flashlight cell with a reversing switch in this little box so I can give my popsicle a positive or a negative flavor at will."

"Could you tell any difference?"

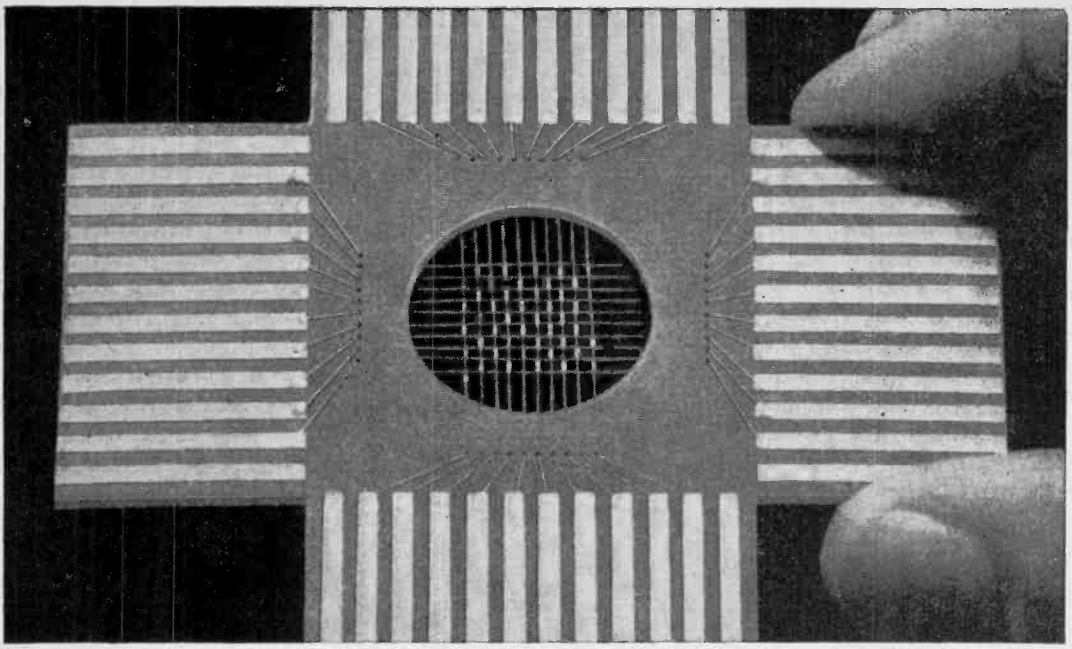
"Before I had time to find out, a certain big ox came barging in."

"Okay, okay; but lay aside that electric pacifier of yours and come on over and look at the automatic window-closer I've spent all day rigging up."

JERRY followed his friend across the back lots and up the stairs to Carl's room. As they stood in front of the open window, Carl said slowly: "I don't know if I can explain how this thing works. It's pretty complicated."

"Try me; I'm very bright," said Jerry.

"Okay. See that little rectangular thing



Model (simplified) illustrates basic structure of magnetic "Twistor" memory—magnetic and copper wires interwoven as in a window screen. Twisted condition of the magnetic wire shifts preferred direction of magnetization from a longitudinal to a helical path. One inch of twisted wire, thinner than a hair, can store as much information as ten ferrite rings. "Twistor" was invented at Bell Laboratories by Andrew Bobeck, M.S. in E.E. from Purdue University.

New twist in memory devices

An ingenious new kind of magnetic memory has been developed by Bell Laboratories scientists for the storage of digital information. Known as the "Twistor," it consists basically of copper wires that have been interwoven with magnetic wires to form a grid.

"Twistor" gets its name from a characteristic of wire made of magnetic material. Torsion applied to such a wire shifts the preferred direction of magnetization from a longitudinal to a helical path. This helical magnetization has been applied to produce a magnetic storage device of unprecedented capacity for its size.

In a magnetic memory, information is stored by magnetizing a storage element. In conventional memories the storage elements consist of rings of ferrite. In the "Twistor," they consist of tiny segments of hair-thin magnetic wire. At each intersection of the grid, one such segment is capable of storing a binary digit.

The "Twistor" is simple and economical to fabricate, and its minute energy requirements are easily supplied by transistor circuits. Bell Laboratories engineers see important uses for it in future telephone systems which demand the compact storage of much information, as well as in digital computers for civilian and military applications.

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Carl & Jerry (*Continued from page 8*)

out there on the edge of the garage roof? It's a moisture-sensing unit. Actually it's just a sheet of tin foil glued to a piece of insulation with a very narrow zigzag strip cut out of the foil so that the sheet is separated into two pieces. Binding posts make connection with each half of the foil. That shielded, rubber-covered wire leads from the sensing unit up to this little gadget here, and this flashlight battery maintains a small potential across the two pieces of the foil. Am I getting through to you so far?"

"I read you loud and clear. Carry on."

"If a drop of rain water falls so that it bridges the tiny gap between the sections of the foil, the battery drives a small current through the conducting water. The current is amplified by the little transistor and causes this sensitive single-pole double-throw relay to pull down and close the bottom set of contacts. That applies current to the small reversing motor which, in turn, drives this speed-reducing gear train that turns this shaft made of a piece of broom-handle. Sash cord is wrapped around the broom-handle and works over the little pulleys fastened to the top of the window frame so that when the motor runs one way it pulls the window down. When it turns in the other direction it pulls the window up."

"But does it work?"

"Does it ever! Just let me show you."

AS HE SAID THIS, Carl picked up a glass of water from the dresser and made an

. . . Jerry's protruding tongue was pressed firmly against the metal disc; and with his slightly bulging eyes, he looked like a chubby gargoyle . . .

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Carl & Jerry (*Continued from page* 10)

expert toss of the contents so that some of the water splashed on the sensing unit. Instantly there was a loud whirring noise, and the window slammed shut with a bang.

"What stops the motor after the window is down?" Jerry exclaimed.

"See this switch here on the casing? It's operated by the two little nails driven in the top and bottom of the sash. Notice that when the window comes clear down a nail flips the switch one way. That cuts the current off the pull-down winding of the motor and connects the pull-up winding so that current will go to it when the transistor-operated relay releases and the top contacts close. When the window is opened wide, the switch is flipped back by the other nail so that current is cut off the pull-up winding and everything is ready for the current to go to the window-closing winding when the relay armature is pulled down again. So the window will close when it starts to rain, and when the rain—"

As though on cue, there was a repetition of the whirring noise, and the window shot to the wide-open position.

"The water has dried off the sensing unit," Carl explained.

"Carl, that *is* a slick contraption," Jerry applauded, "and I'm going to fix up one for my room, too. Right now, though, I've got to eat supper. How's about taking in that show at the 'State' tonight?"

"Fine. I was going to suggest that myself. See you about seven."

"Okay, and I'm going to take along my water pistol and give that nasty-tempered little dog at the corner of Spear and Ninth Street a surprise when he runs out and tries to bite us. Unless someone breaks him of that habit, he's really going to harm some kid one of these days. Water won't hurt him, but I know he hates it."

But the boys were doomed to disappointment. The little terrier did not show up to snarl at their ankles, even though they went around the block three times in the hope of tempting him out. Like most dedicated teachers, they were very eager to impart a needed lesson!

THE SHOW was a double feature; so it was quite late when it was over. Being none too eager for their parents to know the lateness of the hour, they walked very softly on the grass between their two houses, staying in the deep shadows. Just as they were preparing to part and steal quietly in their respective back doors, Jerry clutched Carl's arm and pointed at a ladder

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Carl & Jerry (*Continued from page* 12)

leading up to Carl's wide-open window.

"Holy cow! Someone's been burgling the house!" Carl gasped.

"Yeah, but the question is: is he still in there or has he gone?" Jerry whispered. "Let's go in my house and call the police."

Before they could turn away, they heard a slight noise at the window, and in the faint illumination of the alley light they could make out a dim form swinging a leg over the window sill.

"He's going to get away," Carl groaned.

The shadowy figure got both feet on the ladder and then turned around and leaned back inside the room to pick up something from the floor. At that instant Jerry pulled his water pistol from his pocket.

"Are you nuts?" Carl hissed. "Put that thing away. You can't fool anyone with it."

Without replying, Jerry pulled the trigger; and a silvery spray arched through the air and fell on the roof of Carl's garage. Instantly there was a whirring sound from the top of the ladder and then a loud grunt. The window had come squarely down across the small of the burglar's back and pinned him to the sill. The whirring continued as the motor kept grinding away with the sash cord undoubtedly slipping on the broom-handle.

In a flash Carl darted forward and pulled the ladder from beneath the wildly waving feet. At the same time Jerry bolted into his house to call the police. When he got back outside, the burglar's feet were still kicking futilely at the siding, and Carl had gone inside to alert his family to the situation. A squad car jerked to a halt in front of the house and two policemen piled out of it. One accompanied Jerry and Carl up to the latter's room while the other took up a position beneath the window.

IT WAS A STRANGE sight that flashed on when Carl snapped the light switch in his bedroom. Half in and half out of the window was a rat-faced man whose arms were flailing the empty air like the flippers of a turtle lying on its back. On the floor in front of him rested a pillow-case bulging with his loot.

"Get me out of here," he pleaded. "This thing is cutting me in two."

Gingerly Carl edged around until he could work the limit switch and then raise the armature of the relay manually so that the window released its victim. The policeman hauled him into the room by the collar and snapped a pair of handcuffs on his wrists.

"You boys have a real prize here," the officer remarked. "This is none other than Ghost Gargan, one of the slipperiest second-

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Carl & Jerry (*Continued from page* 14)

story men ever to grace a prison cell. How on earth did you ever trap him?"

Quickly the boys explained the operation of the automatic window. The other officer had come up by this time, and when they had heard the whole story, the two policemen laughed and slapped each other on the back until tears came into their eyes.

"Oh, wait until we tell this!" one of them gasped. "The great Ghost Gargan taken by a couple of kids with a water pistol!"

"So, okay, you wise guys," Ghost snarled; "but just remember it don't make you badge-toters look too good either. *You* couldn't catch me. And I've got news for you: kids are smarter now than they used to be. Take these punks for instance. You'd think they would be going around letting air out of tires, tin-canning dogs, breaking windows, and doing other things like that. But are they? Oh, no! Not these two! They're fooling around with this electronic jazz, keeping a man from making a living."

"Never underestimate the power of H_2O," Carl said smugly as the officers started toward the door with Gargan between them. "Remember that little rhyme about:

'Little drops of water,
little grains of sand
Make the mighty ocean
and the mighty land.'"

"Come on; let's go to jail," Gargan groaned. "I've had all I can take." —30—

. . . Half in and half out of the window was a rat-faced man whose arms were flailing the empty air . . .

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POP'tronics BOOKSHELF

"COMMERCIAL RADIO OPERATOR'S LICENSE GUIDE—Elements 1 and 2" by Martin Schwartz. Published by American Electronics Co., 1203 Bryant Ave., New York 59, N. Y. 48 pages. Soft cover. 75 cents.

This is the first of a series covering the elements of the FCC Commercial Radio Operator's License Examinations. In addition to giving a complete answer for each one of the FCC study questions, the book also contains sample FCC practice examinations using multiple-choice type questions.

Recommended: To all "boning up" for Elements 1 and 2 of the Commercial License exams.

"1958 TEST EQUIPMENT ANNUAL" edited and published by Howard W. Sams & Co., Inc., Indianapolis 5, Ind. 116 pages. Soft cover. $1.00.

Published annually by the Sams Company, this latest edition is a gold mine of information for those contemplating the purchase of new or replacement test equipment. You'll find specifications listed for over 350 different items, ranging from a 49¢ probe connector to a $725 tube tester. Test equipment available in kit form *only* has not been included, however. In addition to the product listings, there are sections devoted to general use of test equipment and special articles on troubleshooting, alignment and maintenance.

Recommended: to the electronic beginner wishing to compare specs' and to the serious serviceman who wants to know what's available to the trade.

"PRINCIPLES OF ELECTRICAL MEASUREMENTS" by H. Buckingham and E. M. Price. Published by Philosophical Library Inc., 15 East 40th St., New York, N. Y. 600 pages. Hard cover. $15.00.

Problems of electrical measurement are becoming the concern of industrial and mechanical engineers. As automation gains headway, it is more and more necessary for the industrial engineer to understand the electronic principles and techniques his machines "use" to accept and convey

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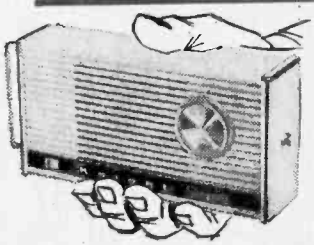

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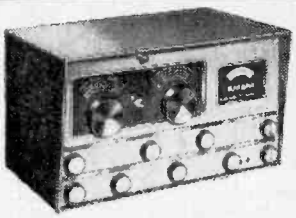
- Sweep Generator
- R/C Substitution Boxes
- Voltage Calibrator



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Bookshelf (*Continued from page* 18)

information. This volume includes discussions and examples of the application of oscilloscopes, bridges and a number of less familiar instruments.

Recommended: to those interested in the application of laboratory measurement techniques to the industrial domain.

"TV TUBE SUBSTITUTION AND TROUBLE CHASER CHART" compiled by H. G. Cisin, Amagansett, N. Y. Chart, 35 cents.

This chart performs three functions. As a picture guide, it shows at a glance 22 common picture faults due to tube trouble. As a TV tube trouble chaser, it shows which tubes to test; and it also indicates tube substitutions where exact types are not available. Over 256 different types of tubes are listed.

Recommended: to all P.E. readers, who may obtain a copy at the special price of 10 cents by writing directly to H. G. Cisin. Say you saw it in POPULAR ELECTRONICS.

Free Literature Roundup

You'll find information on the new polymerized and tri-polymer cones used in the Hartley 217 full-range speaker and the Hartley-Luth "Holton" speaker system in new illustrated folders published by Hartley Products Co., 521 E. 162nd St., New York 51, N. Y. Details and illustrations of this company's complete line of cabinets, including some new designs, are included.

University Loudspeakers' complete line of high-fidelity speaker systems and factory-assembled enclosures is covered in a new brochure. Styling features of each cabinet are presented and the acoustic design is discussed. Technical specifications of the speaker components are also given. Write to University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y., for your copy.

Photos, schematic diagrams and detailed descriptive data on the Viking amateur equipment and accessory line are presented in Catalog #957 (28 pages) available from E. F. Johnson Co., Waseca, Minnesota.

A new catalog describing the Karlson Ultra-Fidelity line of loudspeaker enclosures has recently been issued by Karlson Associates, Inc., 1610 Neck Rd., Brooklyn 29, N. Y. Models ranging in price from the $26.70 bookshelf-type unfinished model to the $249 console for 18" speakers are illustrated. All cabinets feature newly patented Karlson acoustic transducer. —30—

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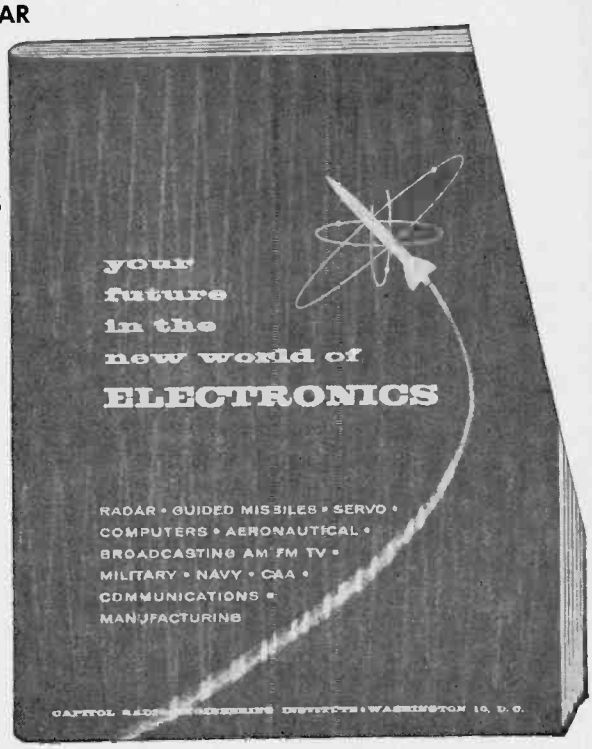

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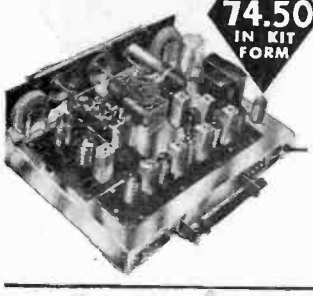

KT-500 74.50 IN KIT FORM

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 18 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500.....Net **74.50**

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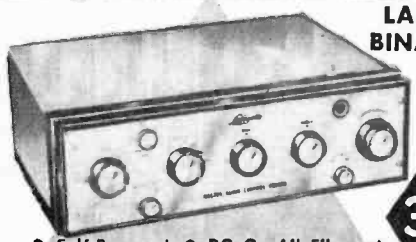

KT-300 39.50 IN KIT FORM

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KT-300—Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. .....Net **39.50**

LT-30—Same as above completely wired and tested with cage and instruction manual. .....Net **59.50**

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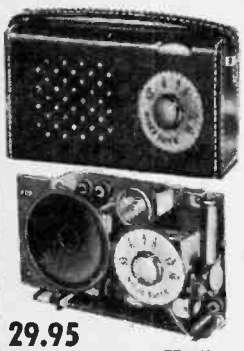

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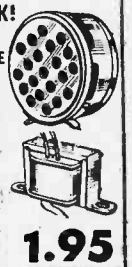

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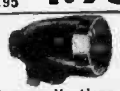

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LETTERS FROM OUR READERS

Fast Worker

■ I have just completed calibration of the lean pocket neon voltmeters (January '58). I finished the construction within a week after getting the magazine. Both are housed in 3 x 2 x 1" plastic boxes which I painted with a spray can. I plan to build the whole series.

DUDLEY GLASS III
Beverly Hills, Calif.

Audience for WWV

■ I read "Can You Spare the Time" by Myron Joseph in the February issue of POPULAR ELECTRONICS and thought it was a fine article. I use both WWV and WWVH in my work.

M SGT. ALLEN M. RAYMOND
USAF

■ Since I first saw an issue of POP'tronics, I've become addicted to it. I was especially glad to see on page 49 of the February '58 issue Myron Joseph's article entitled "Can You Spare the Time?" I recently assembled a three-tube broadcast and short-wave receiver. A few days before I got the February issue, I picked up WWV on both 10 and 15 mc., but didn't know what it was about. When I saw "Can You Spare the Time," I learned what WWV was doing and found it very interesting.

JOHN DUNN
Forest Hills, L. I., N. Y.

Mr. Joseph says thanks.

Some Changes Made

■ By adapting a few minor changes to Bradford Van Ness' instructions in "Tune on the Nose," (January '58 POPULAR ELECTRONICS), I attached a tuning meter to my Heathkit FM-3 tuner (he describes the FM-3A). The results are excellent. The addition of this tuning meter is the best thing that ever happened to Heath's reliable tuner. My compliments to Van Ness.

M. M. MASON
Grosse Pointe, Mich.

Turntable Belt Wanted

■ Can you or any of your readers tell me where I can obtain a ⅛"-diameter fabric or plastic endless belt approximately 34" long (total length)? This is for a turntable I built. I am now using a spliced belt which is about gone.

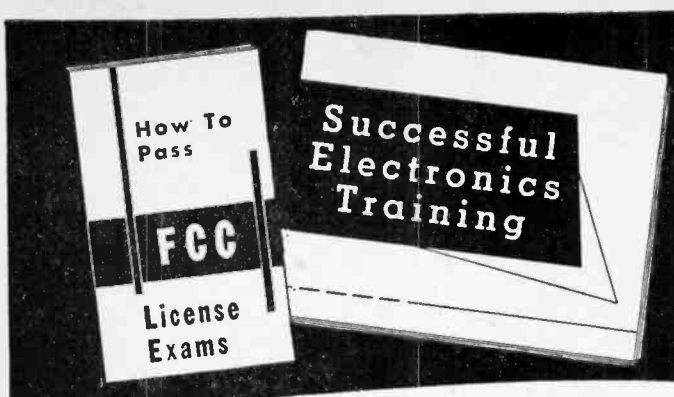
WALTER RAY
Shreveport, La.

Try Components Corp., Denville, N. J.

The Demi-Quad's Good

■ I would like to tell you how much I enjoy your very fine magazine and your excellent articles, such as "DX with a D-Q" in January '58, page 65.

I built the Demi-Quad antenna for a little over $5 (boy, that junk box comes in handy). I made only one change in it; I used 300-ohm twin-lead



Want To Double Your Pay

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Get your FCC Commercial License . . . —or your money back

FIND OUT what the FCC license means

Your FCC license is recognized by employers as proof of your technical ability.

FIND OUT how the FCC license helps you get a better job or increase your pay on your present job

When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. He was helping wire and install an interoffice phone system. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.
James S. Glen, Jr.
2920 Knob Hill Rd., Tacoma, Wash.

"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."
Boyd Daugherty, 105 Goodwin Ct., Apt. C, Falls Church, Va.

MAIL COUPON TODAY
You'll Be Glad You Did

FIND OUT how to get your FCC license in a minimum of time

	License	Time
John H. Johnson, Boise City, Okla.	1st Class	20 weeks
Prentice Harrison, Lewes, Delaware	1st Class	27 weeks
Herbert W. Clay, Phoenix, Ariz.	2nd Class	22 weeks
Thomas J. Bingham, Finley, N. Dak.	2nd Class	9 weeks

FIND OUT how we guarantee your FCC license

The Master Course in Electronics will provide you with the mental tools of the electronics technician and prepare you for a First Class FCC License (Commercial) with a radar endorsement. When you successfully complete the Master Course, if you fail to pass the FCC examination, you will receive a full refund of all tuition payments.

FIND OUT how employers make job offers like this to our graduates every month

WEST COAST MANUFACTURER: "We are currently in need of men with electronics training or experience in radar maintenance. We would appreciate your referral of interested persons to us."

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Desk PE-37 4900 Euclid Bldg. Cleveland 3, Ohio

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- ☐ Military
- ☐ Broadcasting
- ☐ Radio-TV Servicing
- ☐ Home Experimenting
- ☐ Manufacturing
- ☐ Telephone Company
- ☐ Amateur Radio
- ☐ Other

In what kind of work are you now engaged? _____

In what branch of Electronics are you interested? _____

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

Desk PE-37

Letters

(*Continued from page 24*)

in place of the coax because my receiver (Hallicrafters S-38) takes only 300-ohm line.

With the antenna pointing in an east-west direction, I have logged over half of the states, eight of the call areas (I need W1 and W2 land), and quite a bit of choice DX. In two years of SWL'ing I have never run across a better single-band antenna.

JOHN DALEY
30 River Road
Pittsfield, N. H.

■ Thanks for the "Demi-Quad" antenna in your January issue. It was just what I needed. I built it and it works like a charm. Up until now I've been using two 50′ straight-wire antennas.

I have rigged the "D-Q" to turn by two lengths of heavy twine running into my bedroom window. Since I'm a SWL (W1), I did not use a balun transformer.

BOB NICKELSON, JR.
New Bedford, Mass.

Club News

■ I have often wondered if anyone would be interested in forming a DX club for AM radio. I enjoyed your article on TV DX'ing (January, 1958) and that is what gave me the idea of maybe starting a DX club for AM.

Using a Heathkit tuner, during the past few months I have logged 106 stations coming from the U.S., Canada, Bermuda and Mexico. So far, about one-half of the stations have verified my reports, either with letters or DX cards. The DX cards look like the ones hams send out.

I would appreciate hearing from anyone interested in starting such a club.

JIM ERNST
563 Park Ave.
Scotch Plains, N. J.

Anybody interested? Write Jim if you are.

Which Microphone?

■ In your February 1958 issue, you had an article entitled "Wireless Mike for Short Distances." The microphone specified in the parts list was a PA-27. Wasn't the smaller MS-108 shown?

MICHAEL HOFFMAN, KN8DYY
Cincinnati, Ohio

Yes, Mike, you're right. Lafayette's MS-108 is a much better fit.

You Can Help

■ Every week we have a one-hour tape-recorded program for all patients with tuberculosis here at the San. It's made up of doctors' talks, news and music. We wondered if some of your readers would send us tapes, up to approximately 15 minutes in length, on any subjects which would be of interest to 250 people from all walks of life. These could include hobbies, sports, occupations, interests, etc.

Our entire program is recorded at 3¾ ips, so

Letters

(*Continued from page 26*)

this speed would be preferable. Anyone who sends us tapes that he wants to have returned should enclose a letter with the tapes. If the tapes do not have to be returned, we will be happy to forward them on to other groups or institutions requesting them, anywhere in the world.

Here's a project for all tape recorder fans that will be very much appreciated by a great number of persons who are not healthy enough to enjoy the things you can hear, see and do in every-day life.

ROBERT C. SHELLSKA
Baker San
Calgary, Alta., Canada

Can any of our readers spare some prerecorded tapes? It's for a worthy cause.

Tape Correspondence

■ I am writing to you in the hope that you may be able to assist me in contacting some one interested in tape recording. I thought it possible that you might know of some club I could write to with a view to corresponding with recorded tapes. I have two recording units, a Ferrograph Model 2A/N, and a Motek "Elizabethan," both of which employ standard twin track systems at 7½ and 3¾ ips. By trade I am an electrician, and my hobbies are tape recording, music, radio experimenting and servicing.

I would also like to say how much I enjoy your magazine, especially the construction articles, which are so easy to follow. My only regret is that a lot of the parts described are not available here. To my mind POPULAR ELECTRONICS is the best of its kind available in this country.

NEIL A. KERR
Kihi Kihi, Te Awamutu
New Zealand

Again, anybody interested?

Help Needed

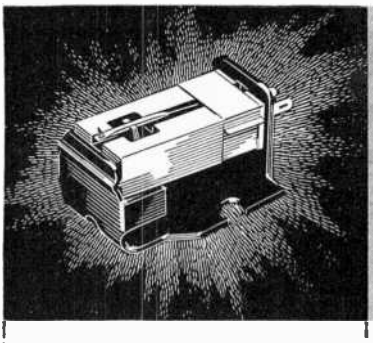
■ I have a tetrode transistor which I have tried in many circuits, such as the one in P.E., May 1957, p. 90. I tested the fourth electrode with an ohmmeter, using the base, emitter, and collector separately as the other electrode. It registered nothing. Can any of you "Votees" help me out?

STANLEY LIVINGSTON
71 Lakeland Ave.
Patchogue, N. Y.

You didn't give any information on the make and type of tetrode transistor that you have, Stanley. Perhaps some reader has had some experience in this respect and can assist you. —30—

PLEASE!

POP'tronics receives nearly 1000 letters a month from readers. Many request plans for special construction projects, analysis of service problems or opinions of commercial equipment. We wish it were possible to comply with individual personal attention but we do not sell plans, analysis or advice.



NOTICE!
DON'T BUY A NEW

high fidelity phonograph cartridge until you've read this vital stereo report . . .

SPECIFICATIONS

RESPONSE: 20-16000 cps. ±2.5 db to RIAA
ELEMENTS: Ceramic
OUTPUT: (Westrex 1A) .5 volt rms.
COMPLIANCE: 2. x 10^{-6} CM/dyne
TRACKING FORCE: 6 grams
WEIGHT 2.4 grams
STYLUS: .7 mil
MOUNT EIA (RETMA). Standard ½" and 7/16" centers
CHANNEL ISOLATION: 20 db

THE MISSING LINK to popular-priced stereophonic sound reproduction has been found: It's the new Electro-Voice TOTALLY COMPATIBLE Stereo Cartridge . . . plays the new stereo discs superbly . . LP's too . . . even better than existing cartridges.

By breaking the stereo cartridge cost bottleneck, Electro-Voice has made popular-priced quality stereo a reality E-V's ceramic stereo cartridge (Model 21D with .7 mil diamond stylus) sells for only $19.50 (Audiophile net) and is available now at your audio dealer or from your serviceman.

Here are some of the answers to your questions concerning stereo:

Q How does the COMPATIBLE E-V Stereo Cartridge differ from CONVENTIONAL cartridges?

A It has the ability to play both the new type stereophonic discs and conventional records. Inherent in its design is an improved monaural performance. *Exclusive* design for rumble suppression of 15 db or better will permit the use of Electro-Voice's Stereo Cartridge *with any type of changer or transcription player!*

Q Are stereo discs compatible with conventional cartridges?

A Most cartridges damage the stereo record. DO NOT BUY STEREO DISCS UNTIL YOU HAVE AN E-V STEREO CARTRIDGE. You may then play monaural or stereo discs monaurally. Add a second speaker and amplifier, and you have stereophonic sound.

Q What about modification problems?

A Using an Electro-Voice Stereo Cartridge, which is constructed so that its output is already corrected to the RIAA curve, you will not require the equalization of the *second* amplifier. Inserting the cartridge is simple. It will fit virtually any standard tone or transcription arm. The addition of a second amplifier and speaker is not complicated.

Q What about record availability?

A Recordings by major record manufacturers will be available in mid-1958.

Q What effect will stereo cartridges and records have on your present equipment?

A Only your cartridge will be obsolete. All other components are compatible with stereo.

Q What if you don't have a HI-FI system now . . . should you wait?

A *No.* Proceed as before—with one exception: you should insist on a stereo cartridge initially. When you are ready for stereo, merely add a *second* speaker and amplifier.

Q How do you go about getting your Electro-Voice Stereo Cartridge?

A Visit your dealer. If you don't know the name of your nearest dealer, please write Electro-Voice. Ask for E-V Stereo Model 21 D with .7 mil diamond stylus or E-V Stereo Model 26 DST Turnover with .7 mil diamond Stereo tip and 3 mil sapphire tip for monaural 78 rpm records ($22.50).

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STEREO

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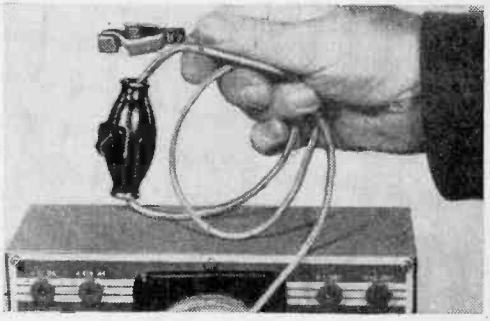
TIPS and TECHNIQUES

TEST LEAD SWITCH

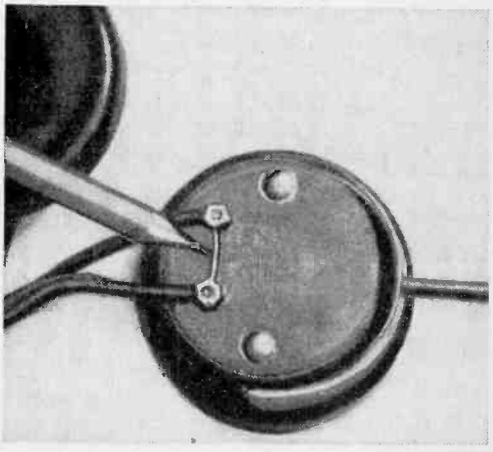
A snap switch in series with one or more of your test leads permits temporary disconnection of an instrument without actually removing the test clip. This is often



desirable in checking for intermittent defects or when tests must be momentarily interrupted. —*H. L.*

SAVE BURNED-OUT EARPHONES

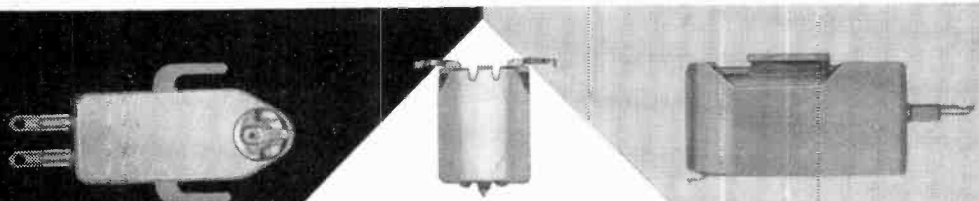
Chances are that only one phone of a pair is burned out, and you can still use the other one. The burned-out phone can serve to keep outside noises out of one ear while you listen to the good phone with the other ear. Since both phone units are



connected in series, you can determine which is burned out by connecting a wire jumper across the terminals of one unit at

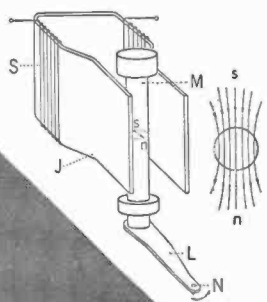
NORELCO® *presents*

the world's **second finest*** pickup cartridge



a new MAGNETO-DYNAMIC design by Philips of the Netherlands

*The world's **finest** pickup cartridge is carefully guarded at the great Philips audio research center in Eindhoven, the Netherlands. It is the laboratory prototype of the new NORELCO "Magneto-Dynamic" pickup cartridges—a special pilot model hand-built to zero tolerances by Europe's most renowned electro-acoustic research team. This reference standard must, of necessity, be a shade superior to the production models, which are constantly quality-controlled against it. It is an indispensable laboratory tool that obviously cannot be sold. But the world's second finest pickup cartridge—meaning any and every NORELCO production model—can be and is sold by leading hi-fi outlets everywhere, for the astonishingly low price of $29.95.



THE MAGNETO-DYNAMIC PRINCIPLE—The armature is a thin rod M, 1/32" in diameter and approximately ½" long, made of "Ferroxdure," a special high-coercivity ferrite material developed by Philips. This armature is magnetized perpendicularly to its axis (s — n) and is rotated about the axis by the transverse vibrations of the cantilever stylus bar L, which is driven by the 1-mil diamond stylus N. This rotation induces a varying flux in the core J, which results in the development of a corresponding AC voltage in the coil S. The inherent advantages of the system include very high compliance (more than 5 x 10^{-6} cm/dyne), very low dynamic mass (2.8 milligrams), high output (35 millivolts at 10 cm/sec), low stylus force (5 grams), and vanishingly low distortion. Frequency response is flat within 2 db from 10 to 20,000 cps.

Norelco

NORTH AMERICAN PHILIPS CO., INC.
High Fidelity Products Division, Dept. PC
230 Duffy Avenue, Hicksville, L. I., N. Y.

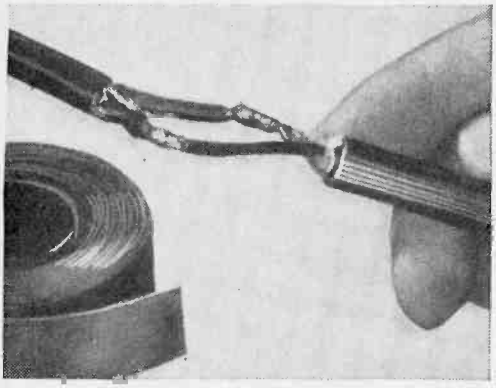
Tips

(*Continued from page* 30)

a time. When you have found the good phone, connect the wire jumper across the terminals of the bad phone securely, and leave it there. —*A. T.*

MAKING NEAT WIRE SPLICES

When making a splice in lamp or appliance cords, the connection will have a



neat, manufactured appearance if you cover it with a short length of rubber tubing. Slip the latter over the wire beforehand; after soldering the connections, cover the bare metal with rubber tape tightly wrapped so as to avoid a bulge. Apply talcum powder so that it will be easy to slip the tubing over the splice. The same neat finish can be secured by using small Bakelite tubes if you are sure they will not be stepped on when the cord is in use.—*K. M.*

INSULATING PIGTAIL FUSES

A blown pigtail-type fuse on a crowded chassis (especially if the equipment is mobile) can often be traced to shorting of the metal tip of the fuse to chassis ground or other nearby uninsulated components. There are several ways this can be prevented. Wrap the entire fuse with tape, slip a length of split spaghetti over the fuse, and so on. But about the best method to use in insulating the metal tips is to spray them with a coat or two of anti-corona dope. The dope will insulate the fuse but will not hamper visual observation of the fuse. —*J. A. C.*

BOTTLE SERVICE TOOL

Need an applicator with a long snout for squirting cleaner into noisy controls? A squeeze-type deodorant bottle with a few modifications will serve the purpose ideally. Carefully pry out the plug from the bottle's neck, remove the spray tube, and drill the hole in the plug slightly larger to receive the tube. Insert the tube and cement it in

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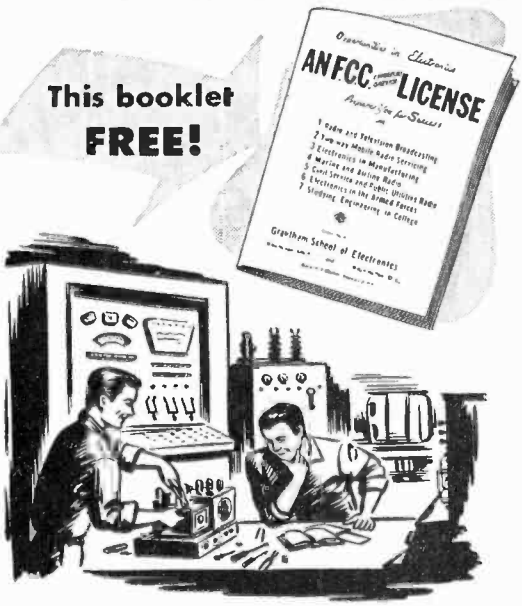

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Name_____ Age____

Address_____

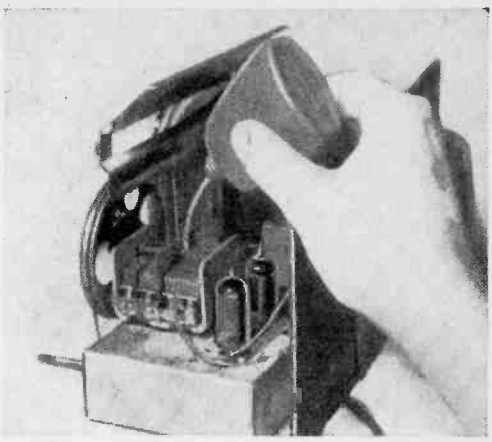
City_____ State_____

I am interested in: ☐ Home Study, ☐ Resident Classes

Tips

(Continued from page 32)

place. Fill the bottle with solvent and snap the plug assembly back into the neck. You'll find that one light squeeze will put



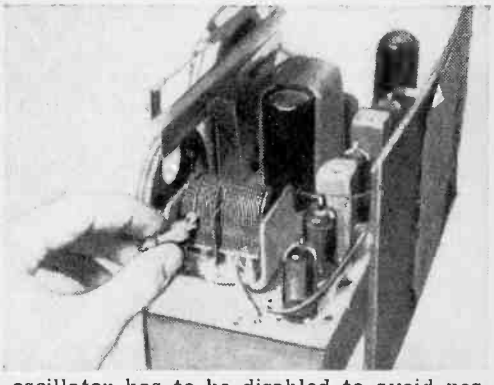
a tiny stream of cleaner in just the right place and in the right amount for proper cleaning. —*J. A. C.*

ARMORED CABLE

When short lengths of insulated wire should be protected from mechanical injury on a small wiring job, and it would not pay to buy a coil of armored (B.X.) cable, cover the regular wire or wires with inexpensive linoleum edge binding. This is a metal strip that is easily wound in a tight spiral which will remain in place. If desired it may be grounded. But use B.X. cable for 115-V. lines. —*K. M.*

CLIP DISABLES OSCILLATOR

When a superheterodyne receiver is aligned with a signal generator, the set's



oscillator has to be disabled to avoid possible interference. A simple way to do this is to clamp a test clip to one of the plates of the oscillator's tuning capacitor, and turn the dial until the clip makes contact with one of the stator plates. The clip won't bend the plates as a piece of solder, wire, or screwdriver might. —*J. A. C.*

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You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

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

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

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The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

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

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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- **SOLDERING IRON**
- **ELECTRONICS TESTER**
- PLIERS-CUTTERS
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- WRENCH SET
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- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

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

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

FROM OUR MAIL BAG

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

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

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At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

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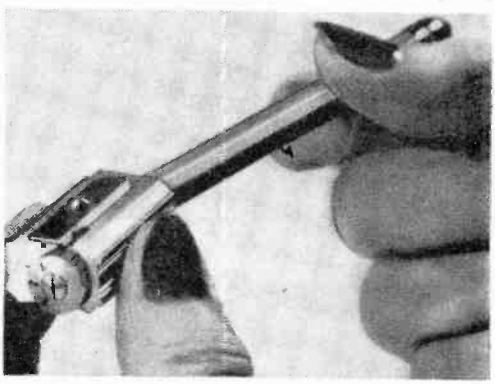

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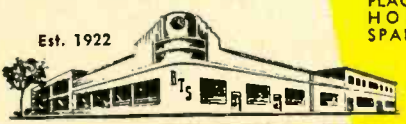

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Tools

(Continued from page 36)

sistor values through novel color-coding and labeling while giving the resistors and their leads full protection against damage and careless handling. These Stackpole resistors meet EIA, MIL and ASESA specifications.

An all-metal bench or wall rack to hold the resistors is furnished free of charge with the kit (Catalog No. 5245), which is available through leading electronics distributors. Net price, $18.00. *(G-C Electronics Mfg. Co.,* Div. of *General Cement—Textron Inc.,* 400 S. Wyman St., Rockford, Ill.)

MULTIPLE CONNECTOR

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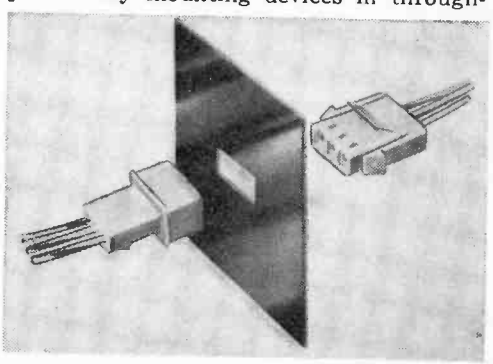

panel applications. Its contacts are identical and self-cleaning. Recessed for safety, the AMP-lok is polarized to eliminate circuit error. And it is designed to accommodate a wide spread of panel thicknesses—only one simple mounting hole is required. *(AMP Incorporated,* Harrisburg 20, Pa.)

RIPPLE FILTER KIT

The Heathkit Model BF-1 is an L-type filter circuit designed primarily for use with the Model BE-4 battery eliminator or comparable units. Adding extra filtering to the d.c. output for powering transistors and "hybrid" automobile radios, it functions at 6 or 12 volts, and will supply up to 5 amp. current —which is adequate for most transistorized equipment. Price, $10.95. *(Heath Company,* Benton Harbor, Mich.)

-30-

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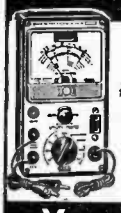

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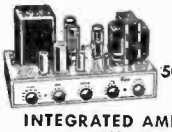

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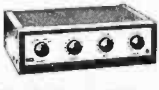

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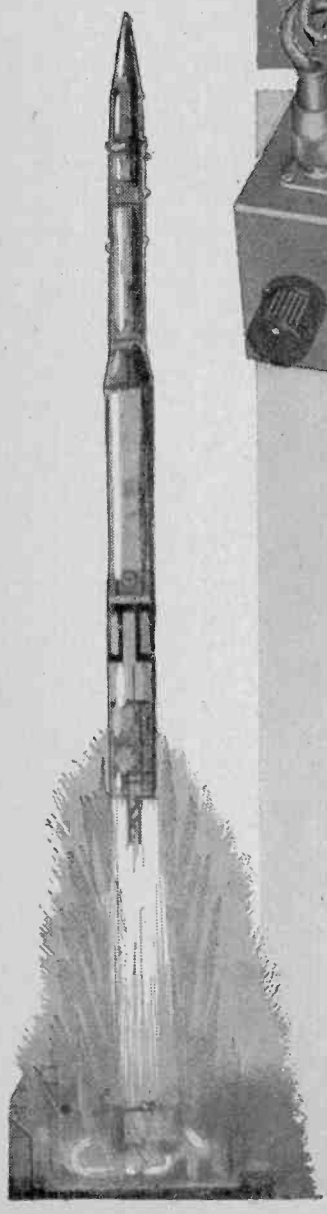
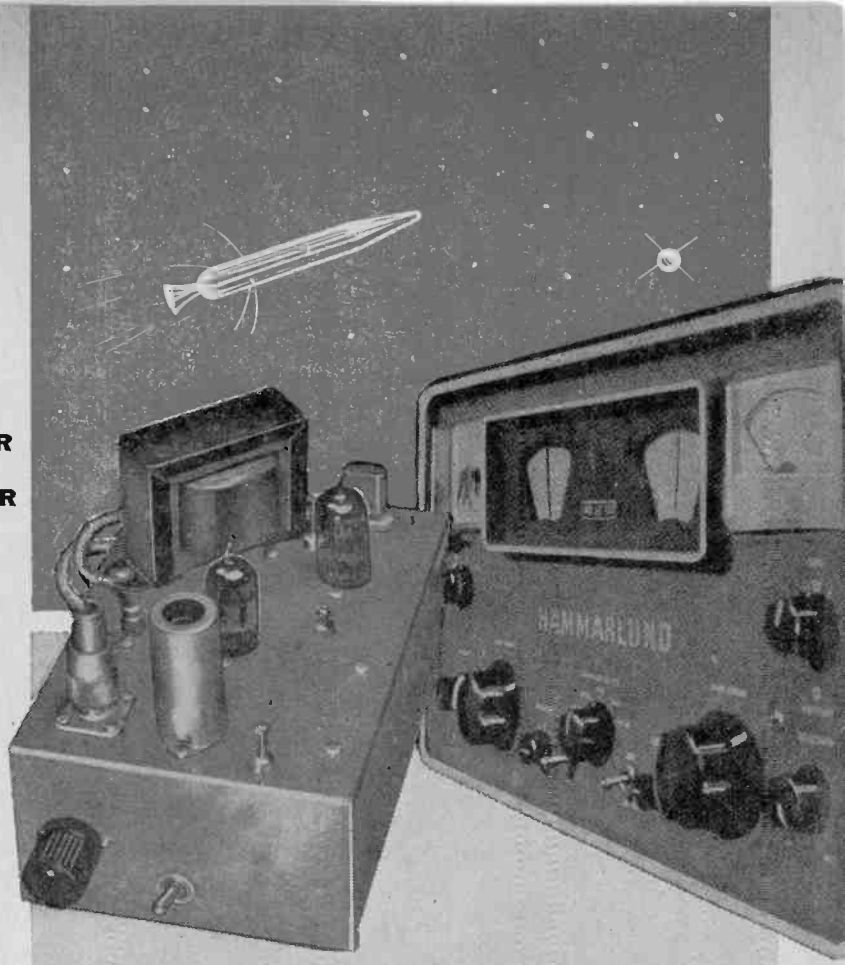




Listen to Satellites with 108-mc. Converter

THIS three-tube satellite converter (SC-3) is a highly sensitive unit that will receive and amplify the 108-mc. telemeter signal of an earth satellite or missile and *convert* it to a frequency that can be found and *identified* on the dial of your short-wave receiver.

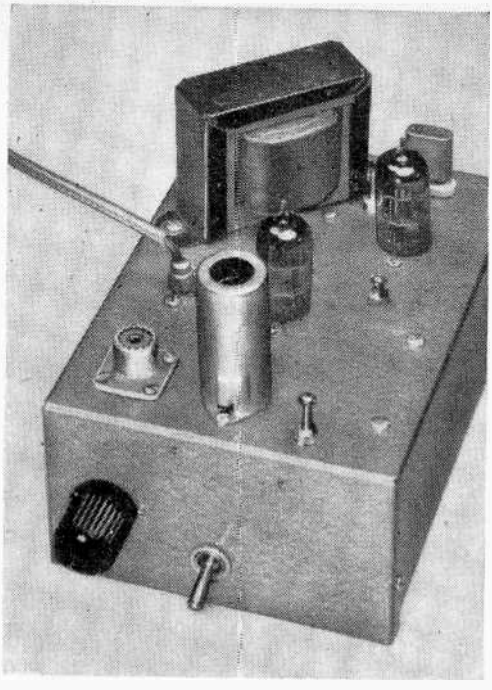
Figure 1 (on page 42) is a block diagram of the converter circuit. Accuracy of the frequency of reception is determined by the frequency of the conversion crystal (fixed by the manufacturer) and the precision with which you tune your receiver to the conversion frequency of 10 megacycles.

If you tune your receiver near the easily identified signals of Station WWV (whose operating frequency is 10 mc.), you can obtain optimum 108-mc. reception with the SC-3. A simple connection between converter and receiver will feed the signal into the antenna circuit of your receiver.

Assembly

Before starting to assemble the converter, the chassis should be completely drilled according to the layout in Fig. 2. To insure proper wiring and assembly, the

Above-chassis view of completed converter. Tube line-up from front to rear is 6BS8, 6AN8, and 12AT7.



following instructions are given in a step-by-step sequence. The notation (NS) indicates that a connection should *not* be soldered, as other wires or components will be added shortly. The notation (S) indicates that a connection should be soldered before starting the next step. Mark each step off in the space provided when you have completed it, and always check your work against the schematic diagram (Fig. 3). A drawing of the terminal strips (*TS1* and *TS2*) is shown in Fig. 4. Use a clean, hot iron, and beware of "rosin" joints!

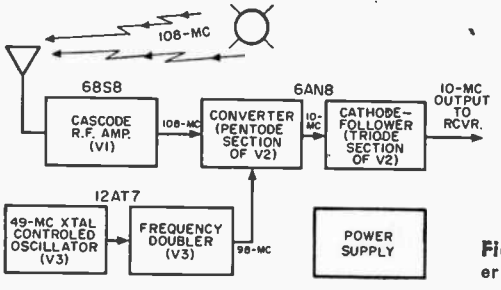


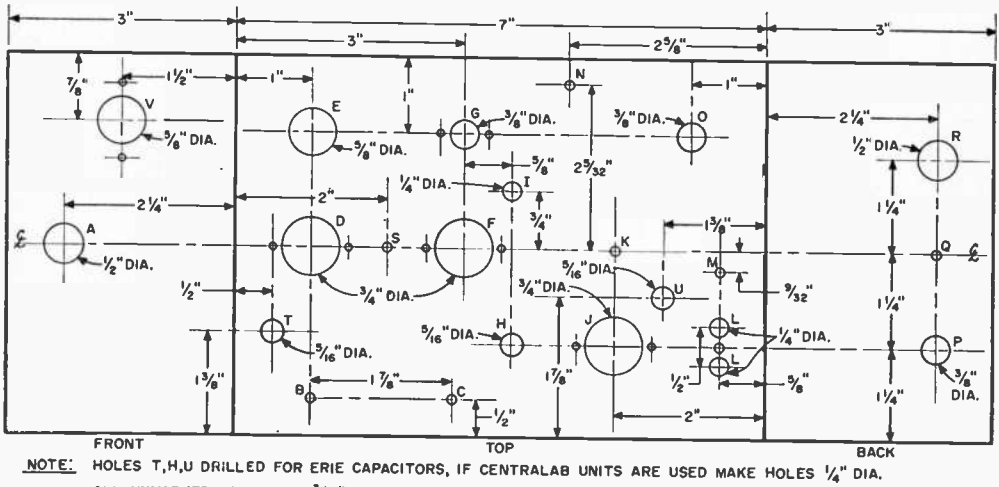
Fig. 1. Block diagram of converter chassis showing tube function.

( ) Mark the drilling layout (Fig. 2) on the paper wrapper of the chassis. Drill the chassis as shown. Remove the paper and clean away all burrs.

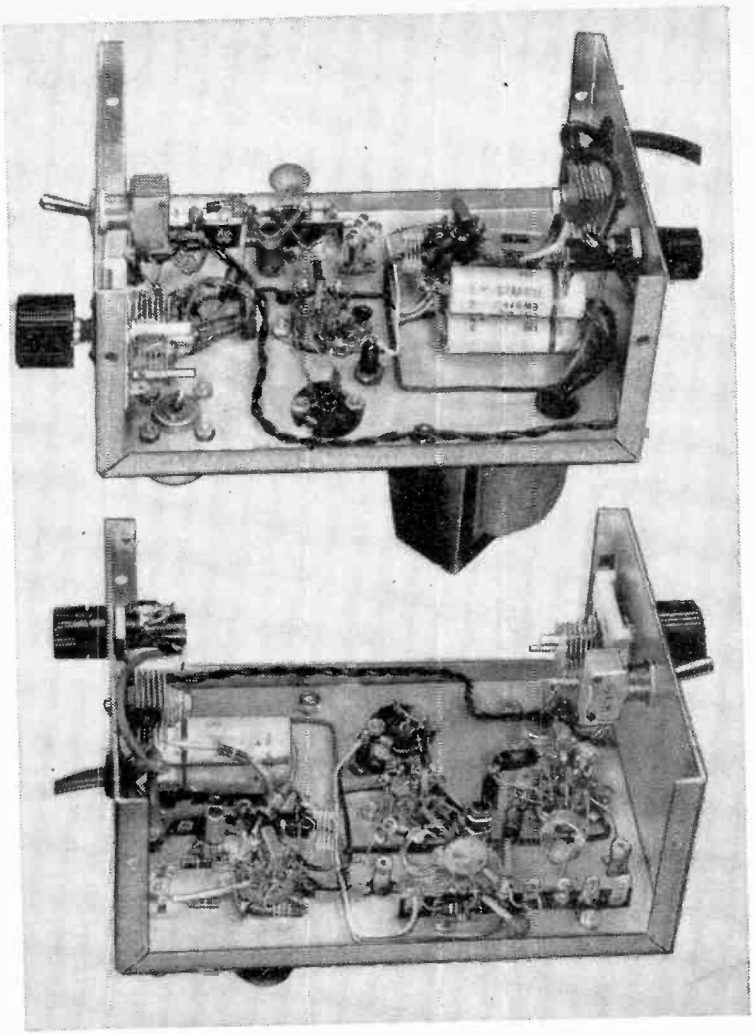
( ) Install 9-pin sockets in holes *D*, *F*, and *J*, using *4-40* hardware. The blank pin of each socket faces the rear of the chassis. Place a metal tube shield base above chassis on socket *D*. Install coaxial connector *J1* in hole *E*, using *4-40* hardware. Place a ground lug under connector nut closest to ground lug 2 of socket *D*.

( ) Install output receptacle *J3* in hole *G*, using *6-32* hardware. Mount test jack *J2* in hole *I*. Mount the 8-lug insulated terminal strip *TS1* in holes *B* and *C*, using *6-32* hardware. Position lug terminals facing socket *F*. Mount crystal socket at position *L*, using *4-40* hard-

Fig. 2. Drilling template. Holes D, F and J mount the 6BS8, 6AN8 and 12AT7 respectively.



NOTE: HOLES T,H,U DRILLED FOR ERIE CAPACITORS, IF CENTRALAB UNITS ARE USED MAKE HOLES ¼" DIA. ALL UNMARKED HOLES ARE 3/32" DIA. DRILL SOCKET AND PLUG BOLT HOLES TO FIT.



Two views of the underside of the converter. Note point-to-point wiring and the short component leads. Follow layout shown as closely as possible to reduce possibility of spurious oscillations and regeneration.

EDITOR'S NOTE

The construction of this project has been simplified as much as possible, but at the high frequencies involved there are many intangible pitfalls. For example, mounting wire connected to a grid or plate circuit close to the chassis might add enough capacitance to prevent the tuned circuit from being adjusted properly later. An extra half inch of wire connected to a coil might similarly prevent proper operation.

If you have built units operating at similar frequencies, you have learned how to handle such critical circuits. Equipped with a VTVM and a grid dip oscillator, you are off to a good start.

ware. Mount the 5-lug insulated terminal strip *TS2* in hole *K* using *6-32* hardware. Position terminals facing socket *J*.

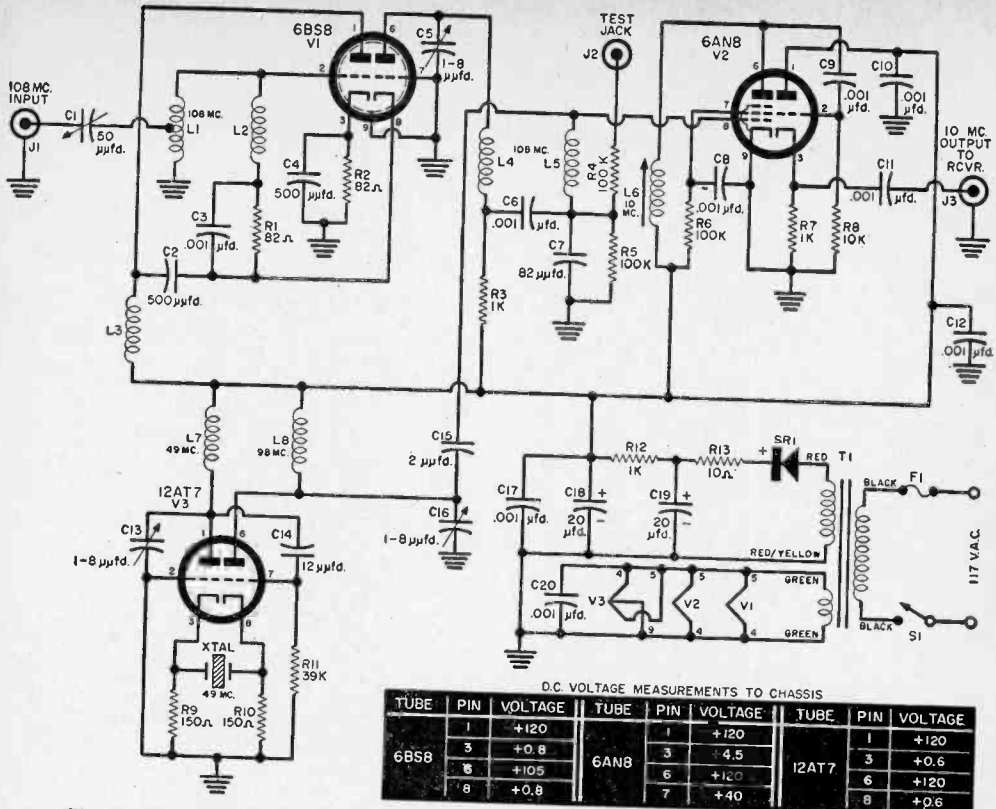
( ) Install switch *S1* in hole *A* using hardware provided with switch. Place ⅜" rubber grommets in holes *O* and *P*. Install holder fuse for *F1* in hole *R*. Mount selenium rectifier *SR1* in hole *Q* using 1¼" *6-32* bolt. Position lugs of *SR1* toward *TS2*, with positive terminal (cathode) toward retaining nut.

( ) Pass leads of transformer *T1* through grommet *O*. Mount *T1* above chassis, using *6-32* hardware through holes *M* and *N*. Install ground lug under nut *M*. Mount the single-terminal tie point in hole *S* behind socket *D*. This completes the mounting of the larger components.

Wiring

The ground leads should be wired with #22 tinned, solid wire, as follows:

( ) Connect a wire between lug *E* at receptacle *J1* (NS) and ground lug 2 (NS) of socket *D*. Pass a wire through the center stud of *D* (NS), through pin 4 (NS) to ground lug 2 (S). Pass a second wire through the center stud of *D* (NS),



D.C. VOLTAGE MEASUREMENTS TO CHASSIS

TUBE	PIN	VOLTAGE	TUBE	PIN	VOLTAGE	TUBE	PIN	VOLTAGE
6BS8	1	+120	6AN8	1	+120	12AT7	1	+120
	3	+0.8		3	+4.5		3	+0.6
	6	+105		6	+120		6	+120
	8	+0.8		7	+40		8	+0.6

Fig. 3. Complete schematic of converter shows how dual tubes give six-tube performance.

PARTS LIST

C1—50-μμfd. variable capacitor (Bud LC-1644)
C2—500-μμfd. ceramic disc capacitor (Centralab DD-501)
C3, C6, C8, C9, C10, C11, C12, C17, C20—0.001-μfd. ceramic disc capacitor
C4—500-μμfd. feedthrough capacitor (Centralab ZB-501)
C5, C13, C16—1-8 μμfd. variable trimmer capacitor (Erie 532-10 or Centralab 4324)
C7—82-μμfd. ceramic disc capacitor, 5% tolerance (Centralab DTZ-82)
C14—12-μμfd. capacitor
C15—2-μμfd. capacitor (Centralab TCZ-1R5)
C18, C19—20-μfd., 150-volt electrolytic capacitor
F1—1-ampere, 250-volt fuse with holder
J1—Coaxial receptacle (Amphenol 83-1R) with plug (Amphenol 83-1SP)
J2—Insulated pin tip jack
J3—Phono-type jack with plug
L1 through L8—See COIL DATA
R1, R2—82-ohm, ½-watt resistor
R3, R7—1000-ohm, ½-watt resistor
R4, R5, R6—100,000-ohm, ½-watt resistor
R8—10,000-ohm, ½-watt resistor
R9, R10—150-ohm, ½-watt resistor
R11—39,000-ohm, ½-watt resistor
R12—1000-ohm, 1-watt resistor
R13—10-ohm, ½-watt resistor
S1—S.p.s.t. toggle switch
SR1—65-ma. selenium rectifier
T1—Power transformer, 135 volts at 50 ma., 6.3 volts at 1.5 amp., 117-volt primary (Triad R-30X or Stancor PA-8421)
TS1—8-lug terminal strip
TS2—5-lug terminal strip
Xtal.—49.0-mc. crystal (International Crystal Type FA-9)
V1—6BS8 tube
V2—6AN8 tube
V3—12AT7 tube
1—Miniature socket for FA-9 crystal (Millen 33302)
3—9-pin miniature sockets (one with shield)
1—3" x 5" x 7" aluminum chassis (Bud CU-2108)
Misc. line cord and plug, knob, 6-32 and 4-40 nuts and bolts, soldering lugs, #22 tinned bare wire, #22 hookup wire

COIL DATA

L1, L4, L5 and L8 are cut from sections of prefabricated air-wound coil stock, ½" in diameter, 16 turns per inch (Air-Dux #416—Illumitronic Engrg., Sunnyvale, Calif.). L1 has 4½ turns with ½" leads; L4 has 4-2/3 turns with ¾" leads, L5 has 2-2/3 turns with ¾" leads, and L8 has 3½ turns with ½" leads.

L2, L3, and L7 are close-wound with #30 enameled wire on 1-megohm, 1-watt resistors approx. 7/32" in diameter by 9/16" long (IRC Type BTA). Coil leads are soldered to resistor leads close to body of resistor. L2 has 15 turns of wire, L3 has 33 turns, and L7 has 10 turns.

L6 has a value of approx. 44 microhenrys (J. W. Miller adjustable r.f. choke #4562)

through pin 9 (S) to ground lug 4 (S). Pass a third wire through the center stud (S), through pin 7 (S) to socket mounting ring below pin 7. Solder wire and pin 7 to ring.

( ) Connect a wire from center stud of socket *F* (NS) through pin 4 (S) to ground lug 2 (NS). Connect a wire from ground lug 2 (S) to ground terminal (outer) of *J3* (S). Pass a wire through center stud of *F* (S), through pin 9 (S) to ground lug 4 (S). Connect a wire from ground lug 3 (NS) of *F* to nearby ground lug 7 of terminal strip *TS1* (S). Press this lead against chassis.

( ) Connect wire to ground lug 1 of socket *J* (S), pass through pin 2 (S) to center stud of socket (NS). Connect wire to center stud (S) and pass through pin 9 (S) to ground lug 4 (S).

Wire the filament and power leads next with #22 stranded, insulated wire. Make sure the wire ends are twisted to avoid an accidental short circuit.

( ) Run a wire from pin 5 of socket *D* (S) to pin 5 of socket *F* (NS). Run a wire from pin 5 of socket *F* (S) to pin 5 of socket *J* (NS). Install jumper of solid wire between pin 5 (S) and pin 4 (NS) of socket *F*. Run one *green lead* of transformer *T1* to pin 4 (S) of socket *J*. Attach other green lead of *T1* to terminal 3 (ground) of strip *TS2* (NS).

( ) Wire terminal 5 of *TS1* (NS) to terminal 1 of *TS2* (NS). Wire terminal 1 of *TS2* (NS) to pin 1, socket *F* (NS). Wire terminal 8 of *TS1* (NS) to test jack *J2* (S). Attach one *black lead* of *T1* to one lug terminal of fuse *F1's* holder (S). Attach the other *black lead* of *T1* to terminal 5 of *TS2* (NS). Attach the *red lead* of *T1* to the unmarked (negative) terminal of rectifier *SR1* (S). Attach the *red/yellow lead* of *T1* to terminal 3 (ground) of *TS2* (S).

( ) Twist together two 14" lengths of hookup wire. Strip and tin both leads at one end. Attach one lead to each terminal of switch *S1* (S). Press the leads along the chassis edge and back to *TS2*. Attach one lead to terminal 5 of *TS2* (S). Attach the other lead to terminal 4 of *TS2* (NS). Pass the 117-volt line cord through grommet *P*. Tie a knot near the end of the cord. Attach one lead of the cord to the free terminal of fuse *F1's* holder (S). Attach the other lead to terminal 4 of *TS2* (S).

Mounting

You are now ready to install some of the smaller components.

( ) *At socket D:* Install capacitor *C2* between pin 1 (NS) and pin 8 (NS). Trim leads as short as possible. (Lead length of all of the following connections should be kept at absolute minimum.) Install capacitor *C3* between pin 8 (NS) and the single terminal tie point *S* (NS). Install resistor *R1* between pin 8 (S) and tie point *S* (NS).

( ) Install coil *L2* between tie point *S* (S) and pin 2 (NS). Install coil *L1* between pin 2 (S) and ground lug *E* of *J1* (NS). Install capacitor *C20* between pin 4 (S) and pin 5 (S). Mount capacitor *C5* in hole *T*. Attach wire lead from stator of *C5* to pin 6 (NS). Mount coil *L4* between pin 6 (S) and terminal 3 of *TS1* (NS). Mount coil *L3* between pin 1 (S) and terminal 5 of *TS1* (NS).

( ) Examine capacitor *C4*. The outer ring is one terminal, and the *two inner lugs*

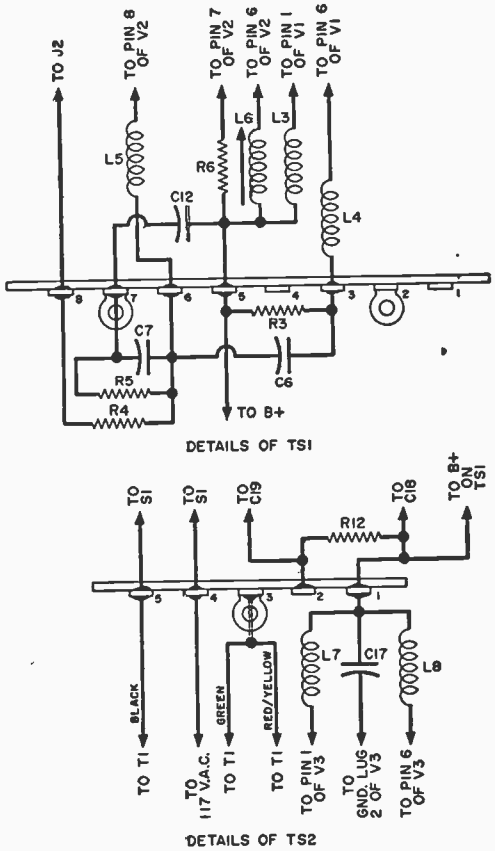


Fig. 4. Wiring of components on the two terminal strips should follow this layout. Make sure lugs 2 and 7 of TS1 and 3 of TS2 are well grounded to chassis.

comprise the other terminal. Slide one inner lug of *C4* through the hole of pin 3 of socket *D* (NS). Orient the outer ring of *C4* so that it touches ground lug 2 of socket *D*. Holding *C4* in this position, solder pin 3. Next, solder the outer ring to ground lug 2. Trim the leads of *R2* and attach one lead to the *free inner*

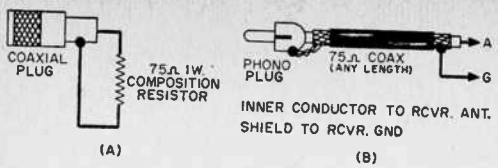
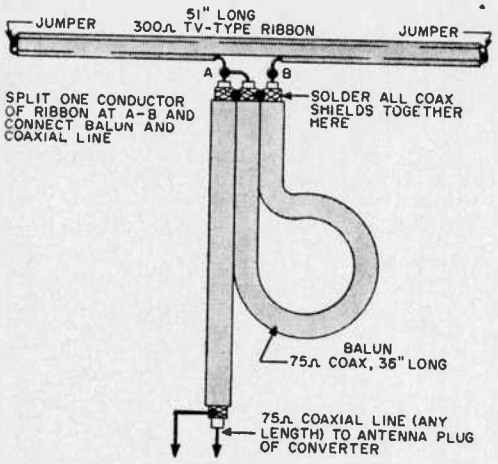


Fig. 5. Dummy load (A) for adjustment and interconnecting cable (B).

Fig. 6. On-the-air testing is done with a simple dipole antenna.



HOW IT WORKS

A high-gain v.h.f. dual triode *(V1)* operates as a neutralized cascode amplifier with the input circuit *(L1-C1)* and output circuit *(C5-L4-L5)* tuned to 108 mc. Neutralizing coil *L2* in conjunction with the grid-plate capacitance of the first triode section forms a parallel-resonant circuit at the operating frequency, preventing interstage feedback and parasitic oscillation of the stage. The noise figure (ultimate sensitivity) is optimum when this circuit is properly adjusted.

The second triode section of *V1* functions as a grounded-grid amplifier whose plate circuit is coupled to the pentode section of *V2* serving as a frequency converter from 108 mc. to 10 mc. The oscillator uses a 12AT7 *(V3)* in a "hot-cathode" crystal circuit, employing an overtone crystal oscillating at 49 mc. *V3*'s second section acts as a frequency doubler, delivering 98-mc. energy which is capacitively coupled to the input grid circuit of *V2*.

A 10-mc. "difference frequency" is created between the incoming signal and the local oscillator signal (108–98=10) in the mixer circuit, and is extracted across the tunable plate circuit inductor, *L6*. This 10-mc. signal is coupled into the triode section of *V2* which serves as a cathode follower, providing a low-impedance signal source suitable for coupling the output signal of the converter into the antenna terminals of your receiver. When the latter is tuned to 10 mc., it will "hear" the 108-mc. signal received by the SC-3 converter.

Half-wave power transformer *T1* and selenium rectifier *SR1*, together with a simple resistance-capacitance filter system, provide approximately 120 volts d.c. required to operate the converter. Filament power is also supplied by *T1*. The converter is designed to operate from the normal 117-volt, 60-cycle power line.

lug of *C4* (S); attach the other lead to ground lug *E* of *J1* (S).

( ) *At terminal strip TS1:* Install resistor *R3* between terminal 3 (NS) and terminal 5 (NS). Install capacitor *C6* between terminal 3 (S) and terminal 6 (NS). Slip insulated tubing over capacitor leads. Install resistor *R5* between terminal 6 (NS) and terminal 7 (ground) (NS). Install *R4* between terminal 6 (NS) and terminal 8 (S). Install capacitor *C12* between terminal 5 (NS) and terminal 7 (ground) (NS). Slip insulated tubing over leads. Install *C7* between terminal 6 (NS) and terminal 7 (S).

( ) *At socket F:* Install capacitor *C11* between center terminal of *J3* (S) and pin 3 of socket *F* (NS). Install *C10* between ground lug 1 (NS) and pin 1 (S). Install resistor *R8* between ground lug 1 (NS) and pin 2 (NS). Install capacitor *C9* between pin 2 (S) and pin 6 (NS). Slip insulated tubing over capacitor leads.

( ) Install resistor *R7* between ground lug 1 (S) and pin 3 (S). Install coil *L6* between pin 6 (S) and terminal 5 of *TS1* (NS). Use lengths of solid wire for coil leads. Install capacitor *C8* between ground lug 3 (S) and pin 7 (NS).

( ) Install resistor *R6* between pin 7 (S) and terminal 5 of *TS1* (S). Slip insulated tubing over resistor leads. Install coil *L5* between pin 8 (NS) and terminal 6 of *TS1* (S).

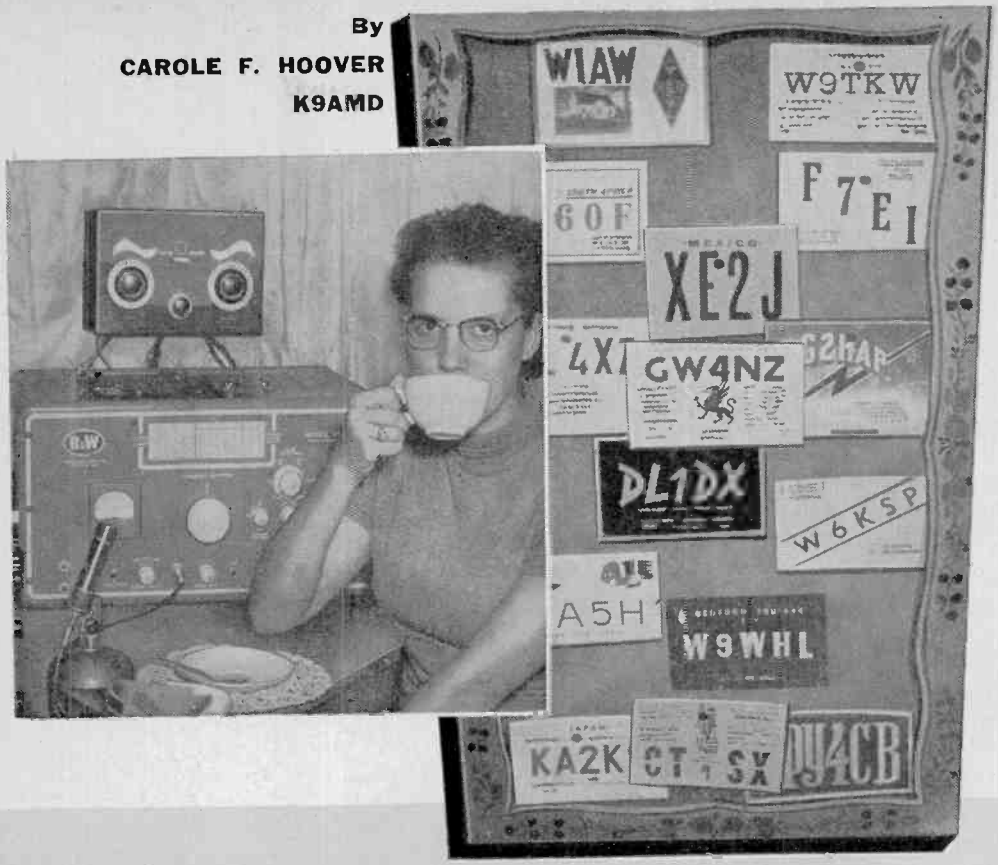
( ) *At socket J and TS2:* Install capacitor *C16* in hole *H*. Attach wire lead from stator of *C16* to pin 6, socket *J* (S). Install capacitor *C15* between pin 8 of socket *F* (S) and the lead of *C16* (S). Install resistor *R12* between terminal 1 of *TS2* (NS) and terminal 2 of *TS2* (NS). Install coil *L8* between terminal 1 of *TS2* (NS) and the lead of *C16* (S). Install capacitor *C14* between pin 1 (NS) and pin 7 (NS). Install resistor *R11* between pin 7 (S) and ground lug 4 (S).

( ) Install capacitor *C17* between terminal 1 of *TS2* (NS) and ground lug 2 of socket *J* (S). Insert capacitor *C13* in hole *U*. Attach lead from stator of *C13* to pin 1, socket *J* (NS). Install coil *L7* between pin 1 (S) and terminal 1 of *TS2* (NS). Install resistor *R9* between ground lug 1 of socket *J* (S) and adjacent pin of crystal socket (NS). Install *R10* between ground lug 4 (S) and free pin of crystal socket (NS).

( ) Run wire from pin 3 (S) to nearest pin of crystal socket (S). Run wire from pin 8 (S) to remaining pin of crystal socket (S). Install capacitor *C18*. Attach negative lead to ground lug *M* (NS) and positive lead to terminal 1 of *TS2* (S). Install capacitor *C19*. Attach negative lead to ground lug *M* (S) and positive lead to terminal 2 of *TS2* (NS). Install resistor *R13* between pos-

(*Continued on page* 103)

By
CAROLE F. HOOVER
K9AMD



The Lady is a Ham

Her rig is a magic carpet to a Caribbean cruise, a moonlit night on the Moroccan desert, and other exciting places

HERE I AM, a young Midwest secretary with an average salary and no inheritance. Yet just last week I passed the time of day with a Buckingham Palace guard on his day off . . . discussed monsoon weather with a sailor in Yokohama . . . debated the advantages of an ocean cruise with the purser of a luxury liner basking in the Caribbean . . . and listened eagerly while an enthusiastic young Frenchman in Paris tried to explain to me precisely why his city is the only place in the world to be in the spring. What's more, I confidently expect this week and all the weeks to follow to be just as filled with exciting globe-trotting as was the last.

How is it done? It's easy. My flying carpet is a neat collection of electronic equipment in one corner of the dining room, and my passport is a small, official-looking bit of paper issued by the Federal Communications Commission stating that I am the holder of an Amateur Radio License and have been issued the call letters K9AMD. Yes, I am proud to say I am a "ham," for in this case the term does not mean a poor actor, the second son of Noah, or the southwest corner of a porker. It means that I am a radio amateur, one of 160,000 people in this country alone who engage in this fascinating hobby; and there are thousands more of us scattered all over the globe.

It's a Personal Thing. Amateur radio offers a wide variety of attractions and interests. But to me, a woman, its main

attraction is a personal thing. While I am perpetually thrilled by the globe-shrinking magic of electronics, the warm companionship of friends scattered all over the face of the earth means still more. And I may as well confess that the exaggerated, flattering chivalry with which I am treated by fellows on the air does wonderful things for my ego—even though I know in my heart that most of it is due to the novelty arising from a 30-to-1 ratio. Yes, that's right: there are 30 men amateurs to every woman. Competition is stimulating, but having it ease off now and then can be pretty refreshing, too!

If you want proof that men amateurs pamper the girls in their midst, hear this: in abbreviated ham lingo an unmarried woman, whether 16 or 60, is called "YL" for "Young Lady." A male ham calls himself an "OM," or "Old Man." But when a YL marries an OM, does she become an "Old Woman?" She does not! She becomes an "XYL," or "Ex-Young Lady," and she stays one the rest of her life! How's that for chivalry?

What do hams talk about? Practically every subject under the sun! The only limitations are those of good taste. Tuning across one band, I can hear a woman in Hawaii frankly admitting to a Minnesota housewife that on first contact the famed native *poi* may look and even taste a little like wallpaper paste. A gardener in Belgium is swapping tulip-raising tips with an amateur in Holland, Mich., and a grandmother vacationing in Florida is describing her seashore cabin to her grandchildren back in Kansas. Poetry, fashions, children, pets, television programs—these and a hundred other topics are discussed.

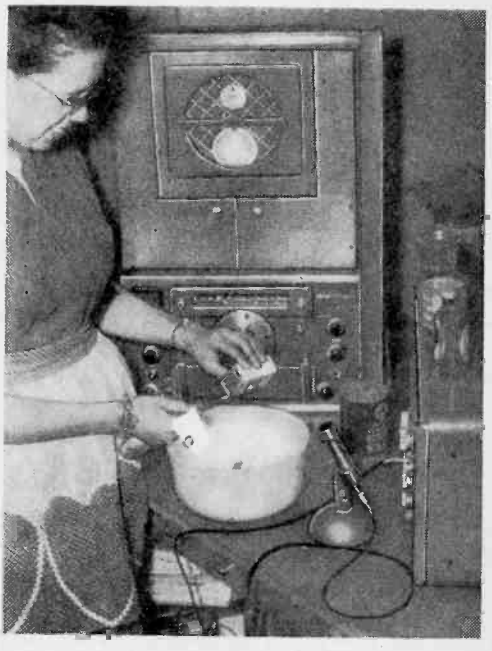
A Participation Hobby. Usually I do not listen for long. After all, amateur radio is primarily a participation hobby. If I choose, I can take part in the conversations, sure that I shall be welcome, for amateurs are the friendliest group of people in the world.

Often, though, I prefer to start a conversation of my own, so I switch on my transmitter, pick up the mike, and say, "CQ, CQ, CQ; this is K9AMD calling CQ and standing by." This means that I will talk to anyone who hears me and answers.

I have called "CQ" hundreds of times, but I still can't help holding my breath in anticipation when I switch the transmitter off and the receiver on. I may hear the lonesome voice of a GI in Germany repeating my call letters . . . they may be spoken in a Cockney accent from the shadow of Big Ben . . . or the call may come in the deep caressing tones of a *caballero* from Argentina.

Many times the conversation that follows is more entertaining than an evening at the movies. I still recall vividly the contact I had with the wife of a mining engineer in South Africa one Saturday at lunch time. She had a way with words that lifted me right out of my chair and transported me to her side. It was already 9 p. m. there, and we both peered apprehensively at the dark and forbidding jungle surrounding us in the moonlight as she explained that we were the only white women within a hundred miles.

Static broke the contact, and what a



relief it was to be called by a ham aboard a liner cruising in the sunny Caribbean! He was the purser of the ship, and as he described the gay captain's party he was planning—complete with dining, dancing, and champagne—I pictured myself in a pale pink chiffon evening gown whirling about the dance floor in the arms of my handsome escort. We had just stepped outside for a stroll on the moonlit deck where the gentle lapping of the waves blended with the muted strains of the orchestra when the shrilling of the telephone brought me back to land with a thud!

Cooking Lessons. Another thing I like about my hobby is the way it abets my other interests. Shortly before Christmas I struck up a conversation with two Scandinavian homemakers who talked surprisingly good English. Before I knew it I was in my apron dashing madly back and forth between the kitchen and the transmitter as

Not only does Carole have a fixed station—she also has a mobile rig in her car (left), which she uses to contact fellow hams while traveling.

Carole leaps into the breach with fellow hams during emergency, when other communications break down (below, left).

During another emergency (of sorts), Carole jumps into the fray. She keeps tabs on the first Sputnik, tracking its position on the globe (below) as she monitors the "beep-beep."

It may seem a trifle odd, mixing cookery with ham radio (left), but Carole lands many strange and exotic recipes this way, though she may have to clean up a trail of flour afterwards. Just think of that *streusel kuchen* and *bouillabaisse!*

the delighted pair gave me spoon-by-spoon instructions for producing their own extra-special *streusel kuchen*. It turned out to be so delicious that I didn't even mind mopping up the trail of flour between the microphone and the mixing bowl.

Alma, a housewife on a large Nevada ranch, has taught me how to prepare barbecued ribs in true Western style. And my *bouillabaisse* recipe comes directly from a ham in a French seaport village who fiercely assures me that all others are barbarian imitations of his savory fish stew. Radio has developed into such a fascinating way of learning to cook that my conventional cookbook now gathers dust.

One day, on impulse, I turned my beam antenna south and brashly called CQ in my high-school Spanish. Immediately I got an answer in Spanish spoken so rapidly that it sounded like a stick dragged along a picket fence. After I managed to convey to the Bolivian *senor* that I spoke his language only *un poco,* he slowed down and we had a delightful chat. Upon its completion, I dug out my Spanish book and started a serious review of the language.

Lots of Traveling. But I do not want to leave the impression that ham radio is purely an indoors, sit-at-home hobby. It is far from that. Traveling is lots more fun in our car which is now equipped with a complete mobile station. It's a real thrill on a trip to make contact with a ham a hundred miles ahead, accept an invitation from him to stop by for a cup of coffee, and then have him "talk you in" right to his front doorstep.

During the summer months, amateurs

(*Continued on page* 109)

All About Satellites

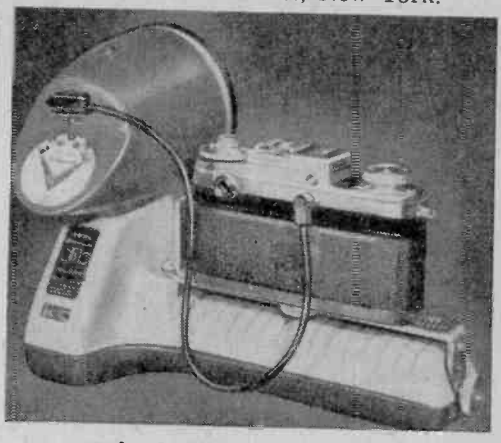
The story of man's attempts to conquer space is being told to a vast audience in department stores, schools and fairs by the traveling show "Earth Satellites." Produced with the assistance of the U. S. Armed Forces and manufacturers, the show traces man's efforts to break the chains of gravity that bind him to Earth. Balloons, gyroscopes (above), satellite models, an animated solar system, working models of a satellite tracking system and Sputnik recordings are used. The show has been commended by the American Rocket Society.

Portable Stereo System

A complete, portable stereo system, designed for all-purpose use, has been introduced by Bell Sound Systems, Columbus, Ohio. It consists of a tape transport unit and two matched amplifier-speaker systems (above). The setup allows recording and playback monaurally as well as recording and playback in stereo. The unit has inline heads as well as provision for offset tape. Each of the amplifier-speaker systems can be used separately with a tuner and record player to make a complete music system.

New Transistor Flash Unit

The newest in transistor flash units (below) has an unusual feature—built-in rechargeable batteries. The hermetically sealed nickel-cadmium Voltabloc unit provides up to 300 average flashes per charge and can be recharged from any 110-volt a.c. line. Two power transistors in a novel circuit are used in the Vanguard, made by Romal Electric Products, New York.



Birdman's Helmet

It may look as if the U. S. Army pilot below is wearing a Navy pilot's helmet. He is. But he's also wearing an electronic package. Design of the helmet calls for a dynamic, noise-cancelling mike which can swing out of the way. Dynamic earphones, cushioned to cut noise, are adjusted to head size. Work continues on making the headgear protective against shrapnel and small arms.

IMPROVED THREE-WAY CROSSOVER

By LARRY KLEIN
Technical Editor

IN RESPONSE to numerous requests from our readers, we are presenting an improved version of the three-way crossover described in the November, 1957, issue of POP'tronics. The second inductance mentioned in the text, but not shown in the original diagram* of the crossover, has been added for sharper frequency separation between the tweeter and mid-range speaker; and to eliminate interaction between the "brilliance" and "presence" adjustments, the level control circuitry has been redesigned. See Fig. 1.

The crossover construction table has been extended downward toward the lower frequencies for those who wish to "cut off" their woofer at about 250 cycles, as shown in Table 1. The advantage of a lower crossover will usually be realized in a "cleaner" lower mid-range. Values of components for 500 and 1000 cycles have also been shifted slightly to improve response. See original table for values above 1 kc.

Speaker Phasing. Several readers have mentioned that there seems to be relatively little material available explaining the "why's and wherefore's" of speaker phasing. Most writers on the topic tell you that speakers *should* be phased properly—and little else.

In simple terms, the story is this. Sounds (music, voice, etc.) at the frequency of the crossover issue from *both* speakers. For example, the crossover frequency between your woofer and mid-range speaker might be 800 cycles. This would mean that in the area of the crossover, if the speakers are

(*Continued on page* 116)

* The schematic and pictorial on page 66 of the November issue should have shown the plus (+) terminal of the tweeter connected to the capacitor, *not* to the center arm of the control. Inductor winding data is correct.

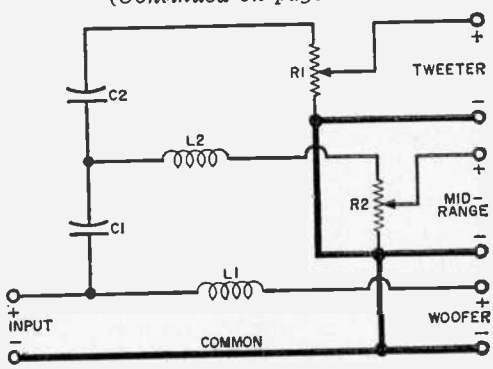


Fig. 1. Schematic of improved crossover. Resistance of R1, R2 is about five times the speaker impedance.

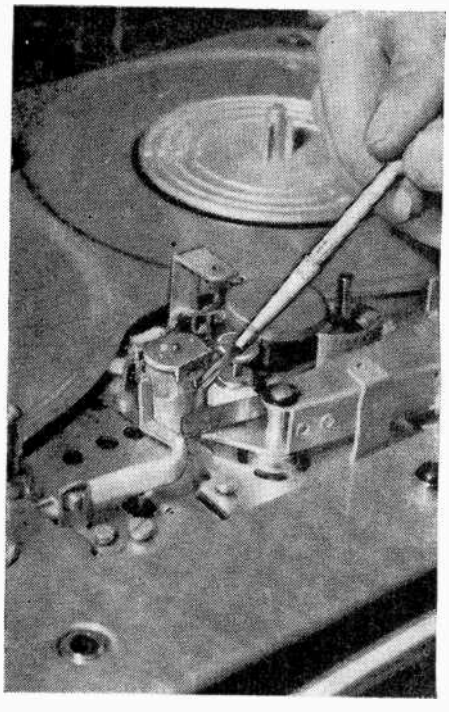
CROSSOVER FREQUENCY (cps)	REQUIRED CAPACITANCE AND INDUCTANCE					
	16 ohms		8 ohms		4 ohms	
	C	L	C	L	C	L
250	40	10	80	5	175	3
500	20	5	42	2.5	80	1.3
1000	10	2.5	22	1.2	41	.65

C is in microfarads; L is in millihenries.

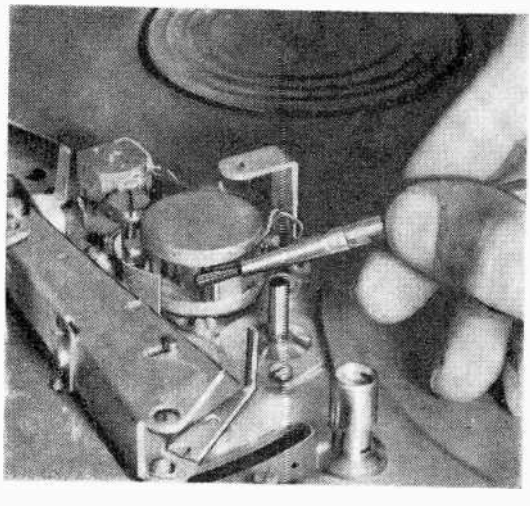
Table 1. Calculate L1-C1 for a lower crossover, L2-C2 for a higher crossover.

Get the Most from Your TAPE RECORDER

PREVENTIVE maintenance can save dollars and headaches for the tape enthusiast. That goes without saying. But to save *time,* there is a certain amount of such work that can be done in the home—if you know how to do it. In this picture story, a Precision Labs technician demonstrates proper preventive maintenance on a Tandberg tape recorder. If you follow these simple steps, you will add years to the life of your own machine, in addition to obtaining better sound reproduction from it. -30-

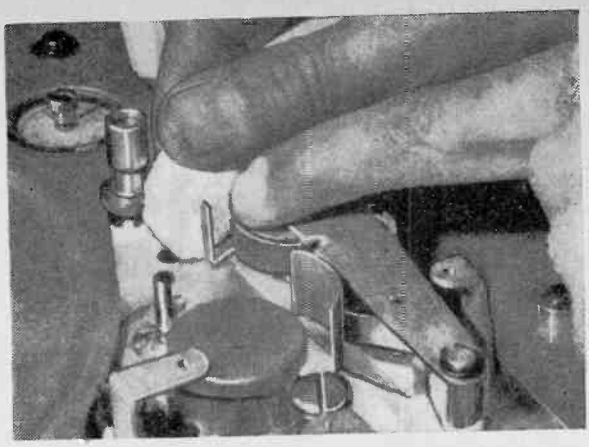


1 You'll have to remove the dust cover to get at the heads, pressure rollers and tape guides. Carefully inspect the area for dust and bits of tape. Blow out as much as you can, then use a small artist's brush (above) to brush away any remaining dirt or foreign matter. Next, dip the brush in alcohol (Tandberg recommends this, but the manufacturer of your tape recorder may advise some other cleaner), and carefully wipe down the erase head of your machine.

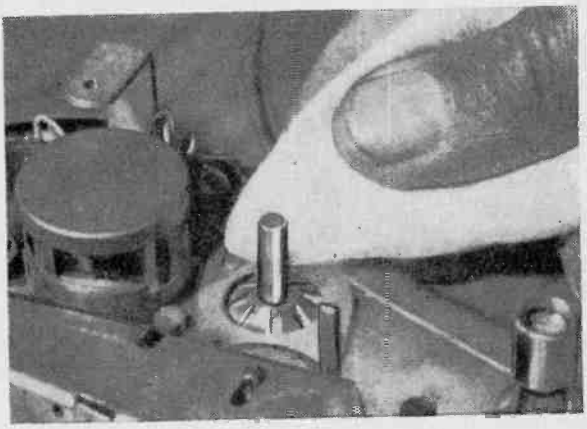


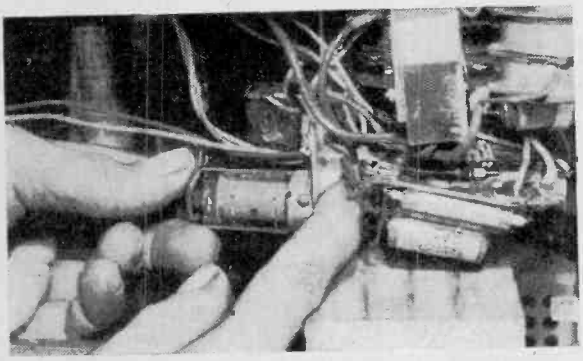
2 Follow the same procedure with the record head (above), making certain in both cases that you don't use too much cleaning fluid. And remember to clean just the faces of the heads.

3 Hold the rubber pressure roller with the index finger of your left hand, and clean the roller with a piece of cheesecloth or similar material dipped in the fluid, rotating the roller slowly with your finger as you work.



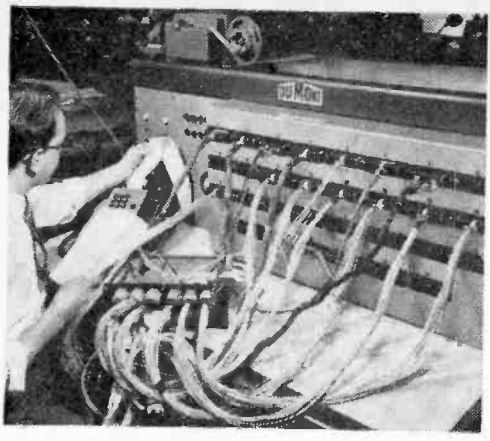
4 In the same manner, clean the capstan and the tape guides. Only a minimum amount of cleaner should be employed in each step.





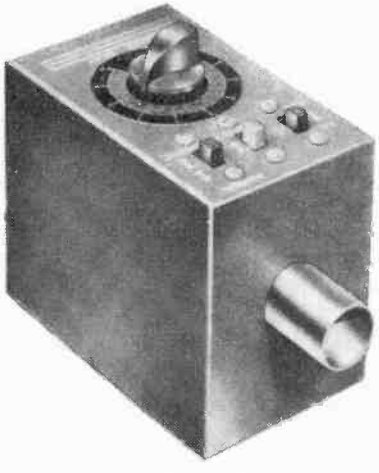
5 There may come a time when you will want to check your tubes. To do this, you'll have to pull the chassis. This procedure will vary with the machine (with the Tandberg, the whole chassis comes out of the case) but in most instances it will require removal of several bolts from the top. When you pull or replace a tube (left), be sure to support the socket mount with your fingers to prevent it from breaking or bending.

6 Warped reels may damage tape and mar the recorder. Frequently you can hear a warped reel scuffing the machine or rubbing against the tape. To check, line up your eyes with the reel and start the machine. You should be able to detect significant warping. Replace any such reels, and the job is completed.



Automatic Wiring Tester

Developed to speed testing of junction boxes, Du Mont's new multiple-function automatic tester makes up to 30 individual wiring checks a minute. Previously, an operator had to check as many as 300 wires and 30 connectors individually. The unit consists of a tape reader which programs the operation on tape, the main machine whose selector switches receive and follow the instructions, and a readout printer which records results.

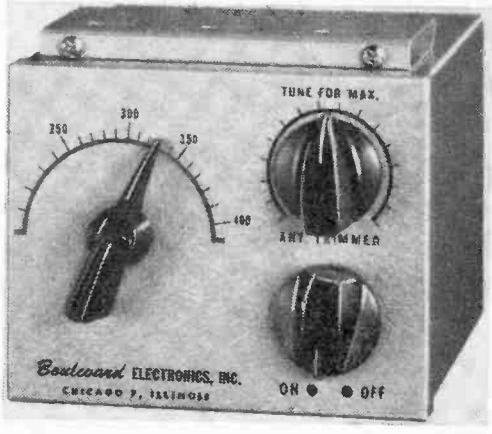


Photocell Relay Kit

A photocell relay is the newest in the line of Lafayette Radio kits. This versatile light-controlled switching device (see photo above) can be used in constructing burglar alarms, door openers, automatic controls for lights, counting devices and other such gadgets. The cadmium sulfide photocell has high sensitivity and requires no special high-intensity light source. It can operate on a flashlight beam at 250 feet, and has a sensitivity adjustment as well. The kit comes complete with all parts at $12.95.

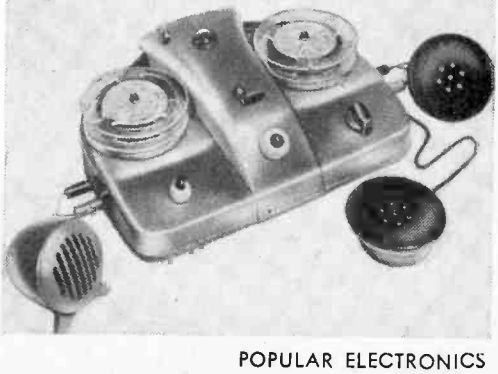
Low-Frequency Converter

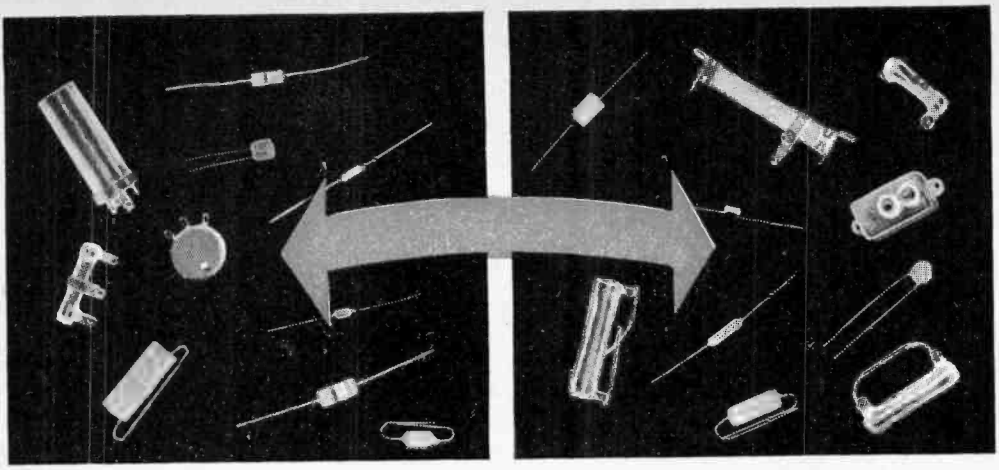
Pilots and others to whom up-to-the-minute weather information is essential will find the Boulevard Electronics TC-1 converter just the thing. The transistorized unit hooks into an auto antenna and to the auto radio, and tunes the 200 to 400 kc. band. Self-contained and easily mounted under the dash, it picks up weather broadcasts, radio range stations, beacons and control towers. Price is $44.95. See photo below.



Transistor Tape Recorder

Weighing less than two pounds, Tel Tape, a transistorized tape recorder, is now on the U. S. market. Imported from West Germany by Filnor Products, this portable device (shown below) records, plays back and erases—all off battery power. It even has variable speed controls. Included in the package are earphones and a microphone at a total price of $29.95. Available accessories are a patchcord at $2 for playback through radio, phono or TV, and a lightweight headset—which leaves the hands free to type—at $6.95. Included with the recorder are two tape reels and a small sample of tape as well as batteries—four C cells. The device measures about 8" x 6" x 2".





How to Make PARTS SUBSTITUTIONS

Part 1—Resistors and Batteries

By EUGENE RICHARDSON

MOST electronics hobbyists have several junk boxes full of perfectly good electronic components, including resistors, capacitors, and all kinds of hardware. Yet these home builders often have given up or postponed construction projects because they didn't have enough "long green" in the kitty to purchase all the parts specified.

The designer, when developing a new project, generally will use parts he already has on hand in preference to buying new ones. Thus, while it is always best to use the exact parts specified by an author when assembling a project, you often can make substitutions which will not affect performance, yet which will reduce your cash outlay considerably. In fact, by making judicious use of your junk box you may be able to find enough "on-hand" parts to limit your purchases to just three or four essential items.

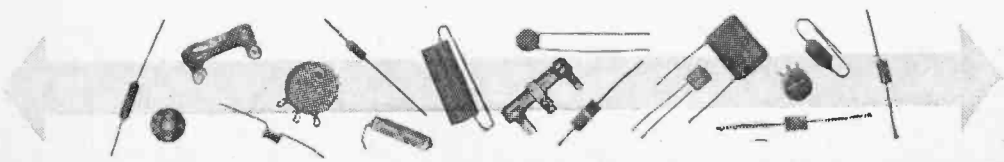
In describing an electronic circuit, we identify components by names which indicate their use or function. For example, in receiver and amplifier circuits, we may speak of a tuning capacitor, a grid resistor (or grid-leak), a coupling capacitor, plate load resistor, bypass capacitor, decoupling resistor, filter capacitor, and a bleeder resistor.

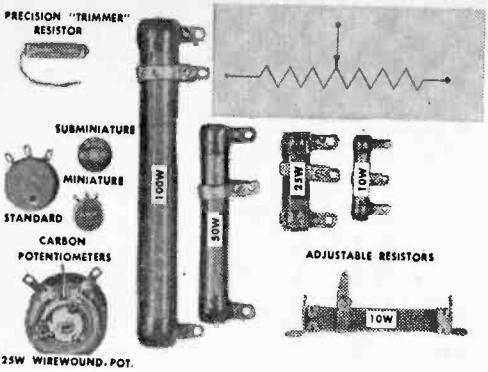
These functional names may give a clue to the value of the parts, but they don't identify them specifically. To identify a component properly, we need to know its basic electrical specifications, its type (fixed, variable or adjustable), and, often, its construction. With this information, we can decide on possible substitutes.

RESISTORS

There are three specifications which apply to all types of resistors: resistance, tolerance, and wattage rating.

The *resistance* is the opposition the unit offers to a flow of current and is given in ohms or megohms (millions of ohms). Generally, symbols are used to simplify



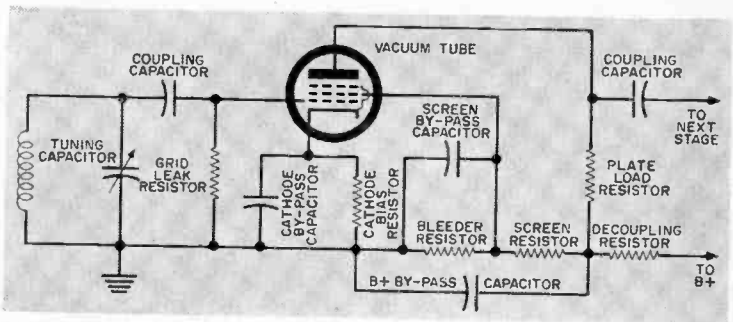


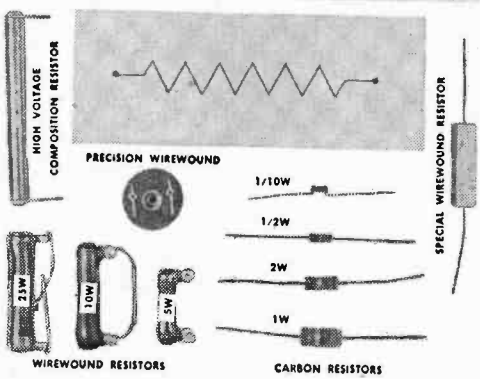
Resistors are also identified according to the resistance material employed in their manufacture. Two basic materials are in common use—a composition, which may include carbon, and high resistance wire, such as Nichrome. Resistors of the former material are known either as *composition* or *carbon* resistors, the terms being used more or less interchangeably. If the resistance element is wire, the resistors are called *wire-wound* units.

Both types are available in a wide variety of styles, resistance values, tolerances, and wattage ratings.

Regardless of type, if the resistor's value

Various types of variable resistors and potentiometers are shown above together with the symbol used for them, while the photo below shows fixed resistors and their symbol. The schematic diagram at right illustrates typical functions of various parts in a vacuum-tube circuit.





writing large numbers. For example, resistors rated at 250,000 ohms, 250K, or 0.25 megohm all have the same value.

Tolerance is given as a percentage figure and indicates the possible variation in the actual value of a resistor from its specified value. For example, a resistor with a specified value of 100,000 ohms, 10% tolerance, may actually range in value from 90,000 to 110,000 ohms. Typical tolerance values are 1%, 2%, 5%, 10%, and 20%. The more critical the resistor's value in a specific circuit, the smaller the allowable tolerance.

A resistor's power-handling capacity is indicated by its *wattage rating,* which usually varies directly with its physical size. Wattage rating is independent of a unit's resistance.

cannot be altered without physical damage, it is a *fixed* resistor. If its value can be varied easily, it is a *variable* resistor. These are made in two styles—continuously variable resistors (rheostats or potentiometers), and semi-fixed adjustable resistors. The latter have movable "taps" which, once set, are left fixed in position.

Continuously variable resistors have an additional specification which sometimes proves confusing to the beginner, especially since such resistors are widely used as volume and tone controls. This is *taper.*

Taper is the relative variation in resistance as the control is turned through its range, and is independent of the unit's total resistance. For example, if we have a potentiometer with a value of 500,000 ohms, and we measure 10% of this value (50,000 ohms) at 10% rotation, 20% (100,000 ohms) at 20% rotation, 50% at 50% rotation, and so on, the control has a *linear* taper.

While most controls are made to one of about a half-dozen standard tapers, two are of maximum importance in most electronics work—the linear (described above) and *audio* tapers. When a control has an audio taper, its resistance variation with rotation follows a more or less logarithmic curve.

If a *linear* taper potentiometer is used as an *audio volume* control, the effect is as if all the control is concentrated at one

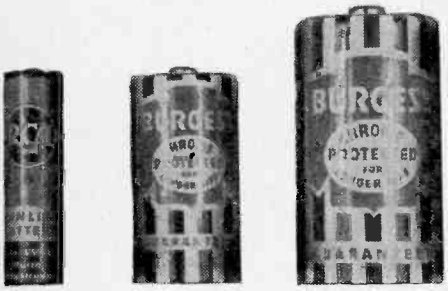
end—the volume seems to jump from "zero" to maximum with relatively little rotation of the control. This is because apparent loudness is not a direct function of the voltage tapped off by the volume control. It is approximately logarithmic.

Making Substitutions. First, except in critical circuits—such as r.f. amplifiers and oscillators—you can use fixed wirewound and carbon resistors interchangeably. When a potentiometer is specified as a volume or tone control, however, it is best to stick to a composition resistor to minimize noise.

You can always use a higher wattage resistor of the same resistance value in place of a lower wattage unit. Suppose a circuit calls for a 47,000-ohm, ½-watt resistor, and you have several 47,000-ohm, 1-watt resistors on hand, but no ½-watt units. You can use the 1-watt resistors—or even 2- or 5-watt resistors if space permits!

A series, parallel, or series-parallel combination of resistors can replace a single resistor as long as the net resistance is the correct value and relative wattage ratings are maintained. Suppose you needed a 100,000-ohm, 1-watt resistor, but had only 50,000-ohm and 200,000-ohm resistors on hand. You would have a choice. You could use two 50,000-ohm resistors in *series* to obtain 100,000 ohms, as long as both resistors were rated at ½ watt or larger (1 watt total), or two 200,000-ohm resistors in *parallel,* again as long as each was rated at ½ watt or larger. You could even use five 500,000-ohm resistors in parallel.

Often, a resistor with a higher (or lower) rated value but a closer tolerance



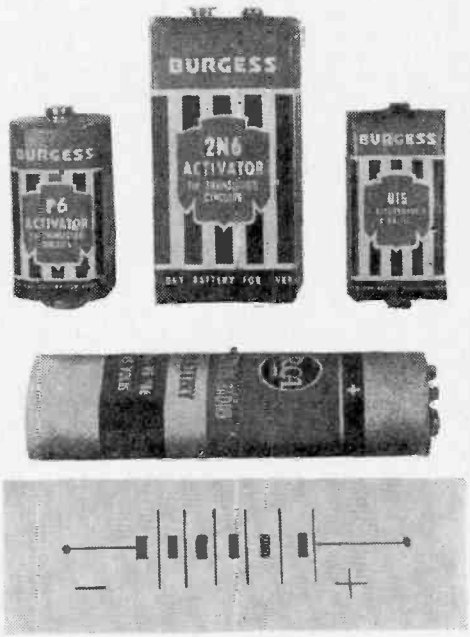
can be substituted for a specified unit. Say that your parts list calls for a 220,000-ohm resistor, 20% tolerance. With this tolerance, its actual value can range from 176,000 to 264,000 ohms. You can use either a 240,000-ohm or a 200,000-ohm resistor for the specified unit, provided the substitute has a 10% tolerance. Similarly, a 47,000-ohm resistor can be substituted for a 50,000-ohm unit, and vice versa.

Finally, in the case of potentiometers, we can substitute a unit with the same total resistance but a taper different from the one specified, if we want a different type of control action.

BATTERIES

Dry-cell batteries are used extensively in transistor circuits and portable vacuum-tube equipment. Strictly speaking, a single cell, such as a common flashlight "battery," should be called a *cell,* with the name *battery* reserved for a "battery" of individual cells connected together. But, today, it is common practice to say *battery* for both individual cells and true "batteries."

The voltage delivered by a cell (or battery) depends on its chemical composition, while the power it can deliver, in general, depends on its physical size. The larger the battery, the greater its capacity.



Typical multicell batteries appear above with the schematic symbol used for them. At left are three sizes of cells, each of which supplies 1.5 volts.

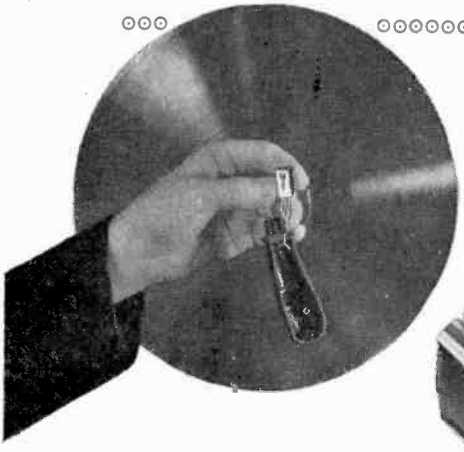
A battery's capacity is generally specified in ampere-hours or in milliampere-hours. This figure indicates the product of current drawn by hours of operation under normal operating conditions. A battery with a capacity of 500 ma./hr. (milliampere-hours) could deliver a current of 1 milliampere for 500 hours, or a current of 5 ma. for 100 hours.

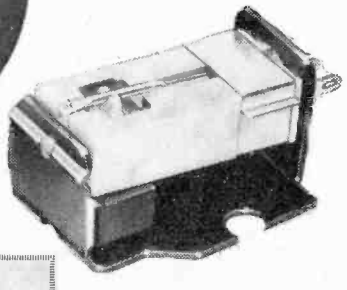
Aside from physical size and shape, the

(*Continued on page* 105)

for playing STEREO RECORDS

By ERWIN JOHN DREISKE





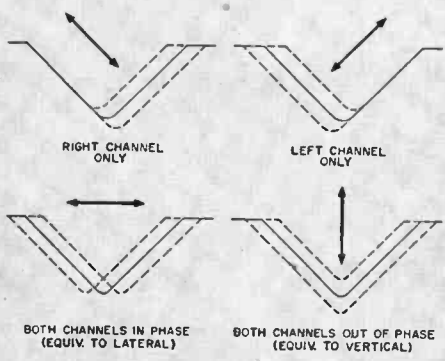
Stereo cartridge developed by Electro-Voice will play either the new stereo records or conventional discs.

UTILIZING two separate amplifier and speaker systems, stereophonic music literally surrounds the listener and provides that elusive third dimension. The difference between "stereo" and even the best "hi-fi" is said to be the difference between listening through an open window in a concert hall and actually sitting in front of a live orchestra.

Stereo music has been available only on experimental tapes. Recent developments of experimental stereo discs have now made possible the mass production of stereo records.

"Compatible" Cartridge. But stereo discs cannot be played on conventional phonographs without ultimate damage to the records since ordinary styli are too big and not compliant enough for the grooves of the stereo disc—they would tend to erase the stereo effect. Featured on the cover this month is a cartridge developed by Electro-Voice Inc. which is completely "compatible"—it can be used to play either an owner's present library of records or stereo discs.

The new stereo records, which are identical in appearance to existing LP records, contain a single groove. Two separate microscopic music tracks are cut into the sides of the one groove. The Electro-Voice stereo cartridge contains a single diamond stylus and two high-fidelity ceramic ele-

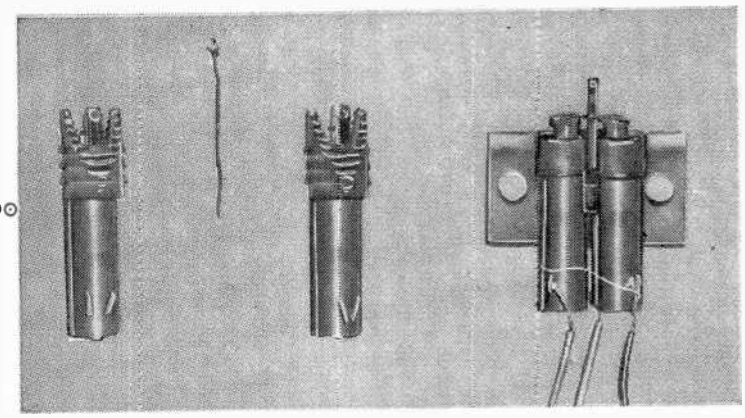


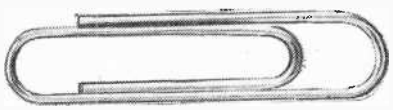
HOW IT WORKS

This type of stereo recording and reproduction is called the 45-45 method, illustrated above. The groove is V-shaped with an included angle of 90°. The left channel is recorded with a motion parallel to the right side of the groove and the right channel with a motion parallel to the left side of the groove; hence, one channel is recorded on each side of the groove.

To reproduce such a recording, we need a cartridge which will give an output from one channel when displaced in a direction 45° on one side of the vertical, and an output from the other channel when displaced in a direction 45° on the other side of the vertical. The easy way to accomplish this is to link, to a single stylus, two conventional pickups whose axes are parallel and whose directions of movement are perpendicular to each other.

Make your own PICKUP





Two Power Points and an additional stylus are combined to produce a stereo pickup. Paper clip at left is for size comparison.

ments. In playing, the stylus "rubs" against both tracks and feeds the separate music signals through the separate amplifiers and to the properly spaced speaker systems.

Motor Rumble Conquered. One of the worst bug-a-boos confronting phono turntable manufacturers, particularly in the case of record-changer mechanisms, has been motor rumble. This is compounded in the stereo disc which involves vertical play of the needle in the groove. However, the vertical rumble component is claimed to be virtually eliminated from playback by the characteristics of the new cartridge.

After the E-V cartridge is made available in production quantities to phonograph set manufacturers, it will go on the market for $19.50—the approximate cost of a conventional hi-fi cartridge with diamond stylus. Hi-fi owners can adapt their present equipment to stereo by the simple addition of a second amplifier and speaker system, plus the new cartridge. Existing home record collections will not be obsoleted by the new stereo developments since the coming stereo phonos will contain completely compatible cartridges.

DO IT YOURSELF

In one evening, you can put together the necessary parts of a pickup for playing the new stereo records. The parts are readily obtainable and, although tiny, they can be assembled without much more than a steady hand and a bit of patience.

The pickup unit uses two standard Electro-Voice Power Points and a replacement stylus for an Electro-Voice Model 84 cartridge. If you buy the parts new, the cost will be about $7.50 (for sapphire styli).

Power Points are color coded to indicate the size of styli with which they are supplied. Any of the following types are recommended for this cartridge: Model 51-1, red, .001-.001 sapphire; Model 56, blue, .001-.003 sapphire; Model 56DS, orange, .001 diamond-.003 sapphire.

Assembly. Begin by carefully cutting off the end of each case as shown in Fig. 1(A). Use a sharp knife, and take care that no damage to the ceramic element results. With a heated knife, or razor

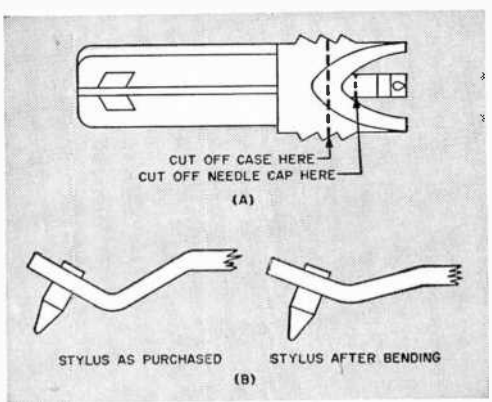


Fig. 1. Mechanical modification of Power Points and stylus before assembly as a stereo cartridge.

blade, cut ⅛" off the end of each needle cap. Bend the stylus shank almost straight, as shown in Fig. 1(B).

With an epoxy-type cement, or with a rubber type cement such as Pliobond, or

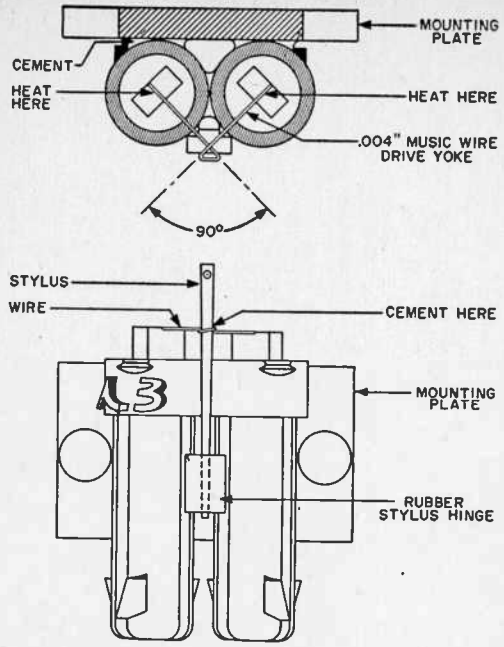


Fig. 2. Assembly of modified parts should be done carefully.

imbed itself in the soft plastic. The stylus should be a snug fit in the drive yoke. To remove the possibility of rattles, place a small amount of cement at the junction of the yoke and stylus.

Connections. Lead wires can be soldered directly to the contacts if the Power Points have metal contact blades. If your Points have conductive rubber contacts, a fine wire may be inserted between the blades and case to make contact.

The frequency response of the cartridge built by the author is shown in Fig. 3. On most musical selections, distortion is inaudible.

A standard monaural record can be played with this pickup, but no attempt should be made to play a stereo record with a standard cartridge. Damage to the stereo record will result. Standard monaural cartridges have a vertical compliance which is too low to follow the modulation on a stereo record.

Figure 4 shows the method of connection to two amplifiers. The stereo-monaural switch allows the two channels to be connected together when monaural records are played. —30—

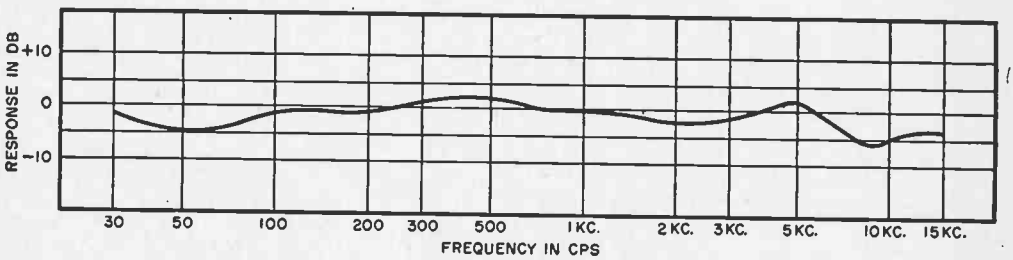


Fig. 3. Frequency response curve of home-built cartridge on a standard LP test record.

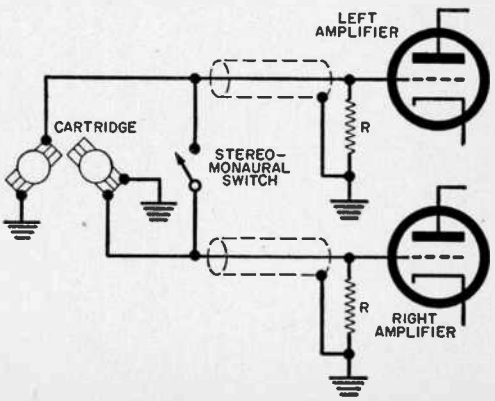
with one of the contact cements now available, fasten the two Power Points together and to the mounting plate. The plate is a small piece of plastic about 1/16" thick, with holes drilled to match the pickup mounting in your old tone arm. Make sure that the needle caps are oriented 45° each way from the surface of the mounting plate.

Do not turn the elements in the cases, but rotate the whole case to get the proper angle. Attempting to turn the elements may result in fracture of the ceramics.

The rubber stylus hinge is cut from inner tube stock. After sharpening the small end of the stylus shank, pierce a hole with it through the length of the rubber hinge. Then cement the hinge to the Power Points, as shown in Fig. 2.

Bend the drive yoke from .004" music wire around the stylus. Fasten it to the Power Point needle caps by heating the needle caps and wire yoke with a small soldering iron, and allowing the wire to

Fig. 4. Method of switching from stereo to monaural. Resistor R should be at least 3 megohms.



Getting the News — Fast!

Model radio room is maintained by top newspaper and supervised by one of the nation's earliest amateurs

By MIKE BIENSTOCK
Associate Editor

TIME WAS when the carrier pigeon provided the fastest link between a newspaper reporter and his editor. But while the use of birds had the advantage of speed, it suffered from a major drawback. Rival papers hired marksmen to wing the birds in flight. Result—no story.

Today the press has grown with the times—and the *New York Times* has grown even faster. There are those who complain that the *Times* is somewhat antique, but there is nothing old-fashioned about its newsgathering system.

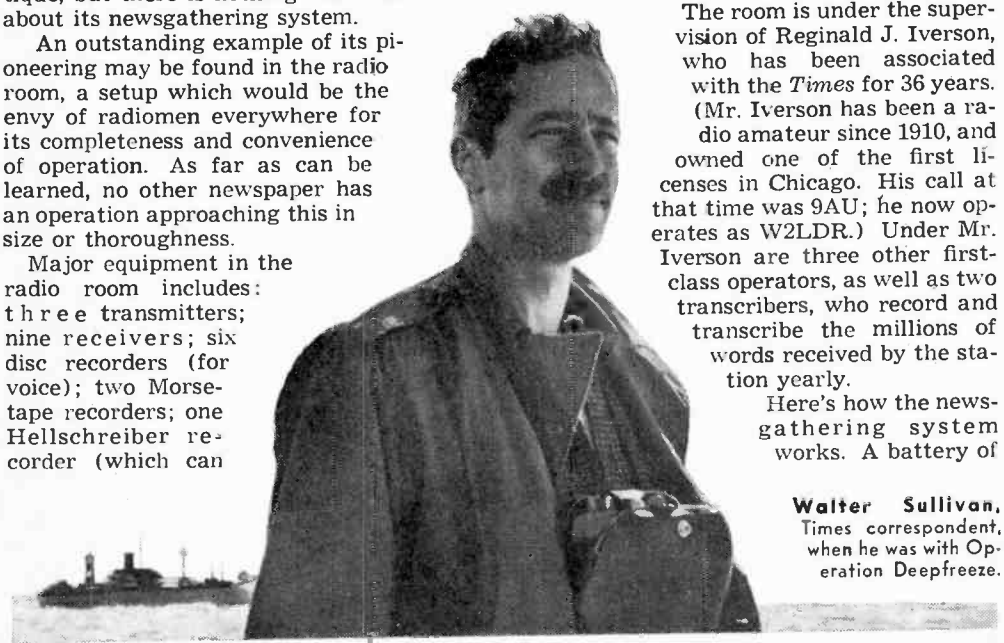
An outstanding example of its pioneering may be found in the radio room, a setup which would be the envy of radiomen everywhere for its completeness and convenience of operation. As far as can be learned, no other newspaper has an operation approaching this in size or thoroughness.

Major equipment in the radio room includes: three transmitters; nine receivers; six disc recorders (for voice); two Morse-tape recorders; one Hellschreiber recorder (which can receive teletypewriter transmission under adverse conditions); and two television receivers.

Finger on the Pulse. The radio room serves a dual purpose: it takes the pulse of the news by monitoring the transmissions of the official radio stations in many of the important world capitals—especially Moscow—and it transmits news summaries to outposts and out-of-the way areas such as ships at sea, remote air strips, lighthouses, and the like.

The room is under the supervision of Reginald J. Iverson, who has been associated with the *Times* for 36 years. (Mr. Iverson has been a radio amateur since 1910, and owned one of the first licenses in Chicago. His call at that time was 9AU; he now operates as W2LDR.) Under Mr. Iverson are three other first-class operators, as well as two transcribers, who record and transcribe the millions of words received by the station yearly.

Here's how the newsgathering system works. A battery of

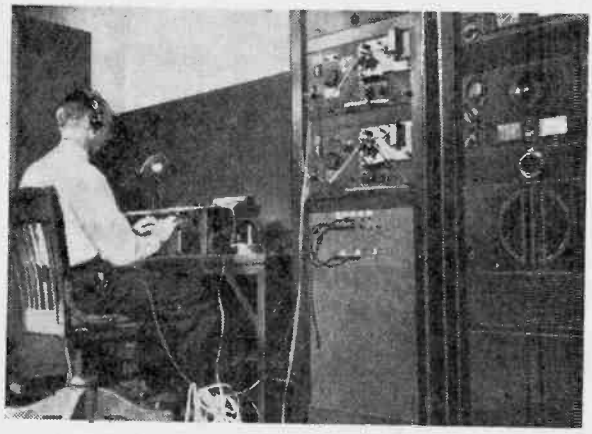


Walter Sullivan, Times correspondent, when he was with Operation Deepfreeze.

nine short-wave receivers—mostly Collins 51J4's and National HRO's—are used to listen to the radio transmissions of such cities as Moscow, London, Paris and other vital news centers. This material is summarized and serves as a check on the regular news stories filed by the paper's own correspondents and the news services.

From time to time such information serves as a tip on an important story before the local man gets it, and he will be apprised of the "break." At other times, if the information is considered reliable, it is used to fill in the background of the news.

The Army-McCarthy hearings were recorded on disc machines and printed the following day. Here, Reginald J. Iverson, head of *Times* radio room (center), checks the recording.



Mr. Iverson cuts a Morsetape news summary which is fed directly to one of three 1-kw. transmitters. Such summaries are sent to outposts all over the world as a public service.

Printing Complete Speeches. The *Times*, of course, is noted for printing the complete texts of important speeches. For instance, when Nikita Khrushchev, Soviet "boss," makes an important declaration, a *Times* man will take it off the air on one of the disc recorders, and it will be translated and run complete in the next day's paper. Other newspapers must be satisfied with the frequently incomplete texts transmitted by the news services.

In this country, when President Eisenhower, for instance, speaks to the nation, his address is recorded from the audio circuit of one of the two *Times* TV sets. It is then transcribed and run complete. This is in contrast to many other papers which run the official release distributed in advance. Such releases sometimes differ from the addresses delivered.

The radio room also maintains direct radio contact with some of its correspondents. For instance, when one of its top-flight men, Walter Sullivan, was with the Navy in the Antarctic, he set up a regular daily transmission schedule from the icebreaker "Atka." He filed stories daily over 14,000 miles of land, sea and ice. The *Times* radio room maintained contact with him by using one of the battery of three 1-kw. transmitters built by Mr. Iverson. They operate on 4, 6, 8, 13, 16 and 22 mc., and use the call WHD.

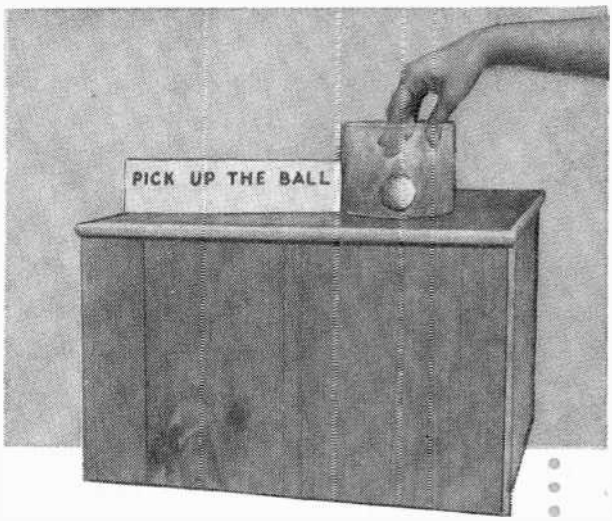
Most of the major expeditions of this century have been followed by the *Times* in the same manner, including the Byrd Antarctic expedition in 1928, and Operation Deepfreeze currently. It is the only newspaper which gives such coverage.

The transmitters are also used to transmit news summaries in code twice daily, as a public service. Reports are sent at 1900 Greenwich Mean Time on 13.02 and 16.96 mc., and at 0500 GMT on 6.51 and 13.02 mc. Letters have been received from outposts in all parts of the world thanking the *Times* for this service, since in many areas it is impossible to receive directly news broadcasts by radio from cities involved.

"Doria" Signal Heard. One of the nine receivers constantly monitors the 500-kc. distress band. In 1956, a *Times* operator picked up the distress call of the "Andrea Doria" when the big liner was struck and sunk by the "Stockholm." The operator remained on duty for the full time the ship

(*Continued on page* 109)

Catch the Vanishing Ball



Wooden cabinet conceals electronic and mechanical components. Dimensions of cabinet are not critical.

It eludes your grasping hand as it gets whisked away by electronics

By HARVEY POLLACK

THIS proximity-activated ping-pong ball is guaranteed to startle and amuse young and old alike. It sits quietly on its little box—sits quietly, that is, until a grasping hand approaches, and then—PLOP—it's gone! When the hand is withdrawn, the ball reappears. It's as simple as that, and the small cost of construction will more than be compensated for by the delight of the youngsters and the mystification of adults.

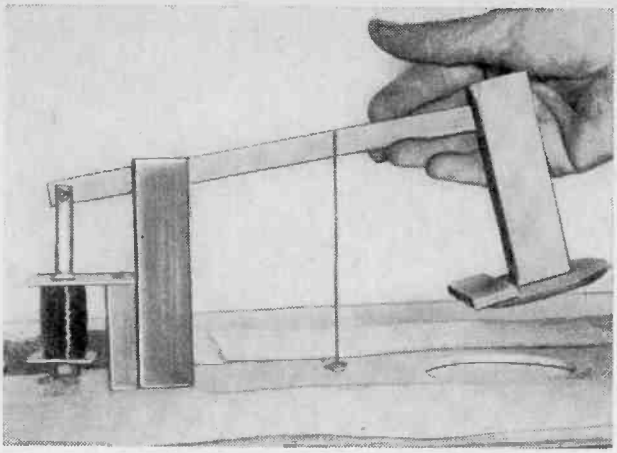
All of the parts for this project are easily available. Most of them probably can be found in your junk box. Of course, many variations on the setup shown are possible as long as the basic principles are observed.

The mechanical section can be built first. Start by cutting a 3″ circle out of the top panel (see drawing on page 64). The center of the circle is midway between the two long sides of the panel, 5½″ from either short side. If a good circle cutter is carefully used, the cutout disc can later serve as the ping-pong ball platform.

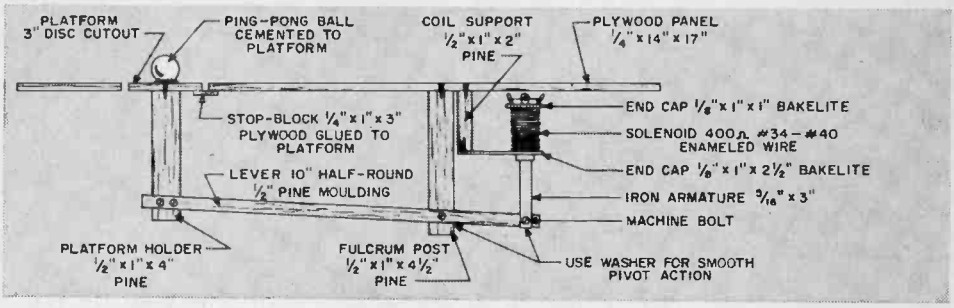
Wind the solenoid coil on a commercially available coil form. After the Bakelite capping squares have been cemented in place and allowed to dry, wind on the enameled magnet wire. Use a B & S gauge (between #34 and #40).

If the coil form is chucked on a 2″ bolt, and you use your electric drill to wind it, you'll find that it goes very fast. Since the coil should measure about 400 ohms, wind several hundred turns, check the resistance, then continue until the ohmmeter shows that you've arrived. If no ohmmeter is available, try about 1000 feet of #36 wire. Scramble-winding works just as well as any other kind, so you needn't be fussy.

Cut and assemble the wood parts as shown. Drill the iron armature ¼″ from one end to take a *6-32* 1″ machine screw. Correct alignment of the lever and lever



The mechanical assembly is shown at left (upside down) and in the drawing below (right side up). Rubber band which returns platform to the "up" position should be adjusted carefully. See text for details.



posts is essential for smooth action. Cement the return stop block along the circumference of the disc platform to prevent the platform from swinging above the panel.

The last step in the mechanical construction is the adjustment of the return elastic band. See photo above for details of its placement.

With the panel assembly complete, the table side walls may be cut and secured to the top panel. To test the action, connect the coil leads to a 117-volt line cord through a switch. Each time power is applied, the ball platform should drop at least three inches; the return should be smooth and accurate when power is removed.

The electronic construction is not very critical but certain mounting and wiring precautions should be observed for sensitivity and stability. Keep stray capacitance between the probe or sensor connection and the ground at a minimum! Careful isolation of the sensitivity control and rigidity of component mounting are important. The layout shown should be followed as closely as possible.

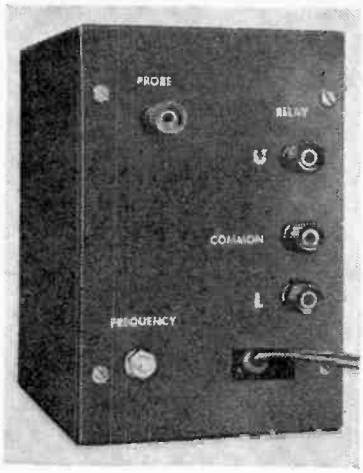
Variable capacitor *C2* is secured to the chassis by means of its built-in mounting bracket. Set it as far back from the front panel as possible with its shaft connected by a ¼" to ¼" metal coupling and a ¼" Bakelite rod long enough to pass through the front panel bearing. Homemade coil *L1* mounts on the rear apron of the chassis with its tuning slug projecting through the back of the case.

Three adjustable clips which come with the coil form are set in place and 50 turns of #40 enameled wire are wound between either end clip and the center one. A center-tap connection is made to the middle clip, and another 50 turns are added between the center and the remaining clip.

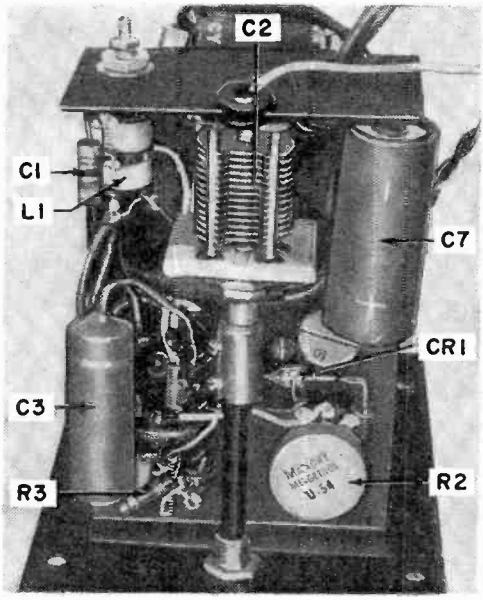
Make sure that the mounting of the re-

BILL OF MATERIALS

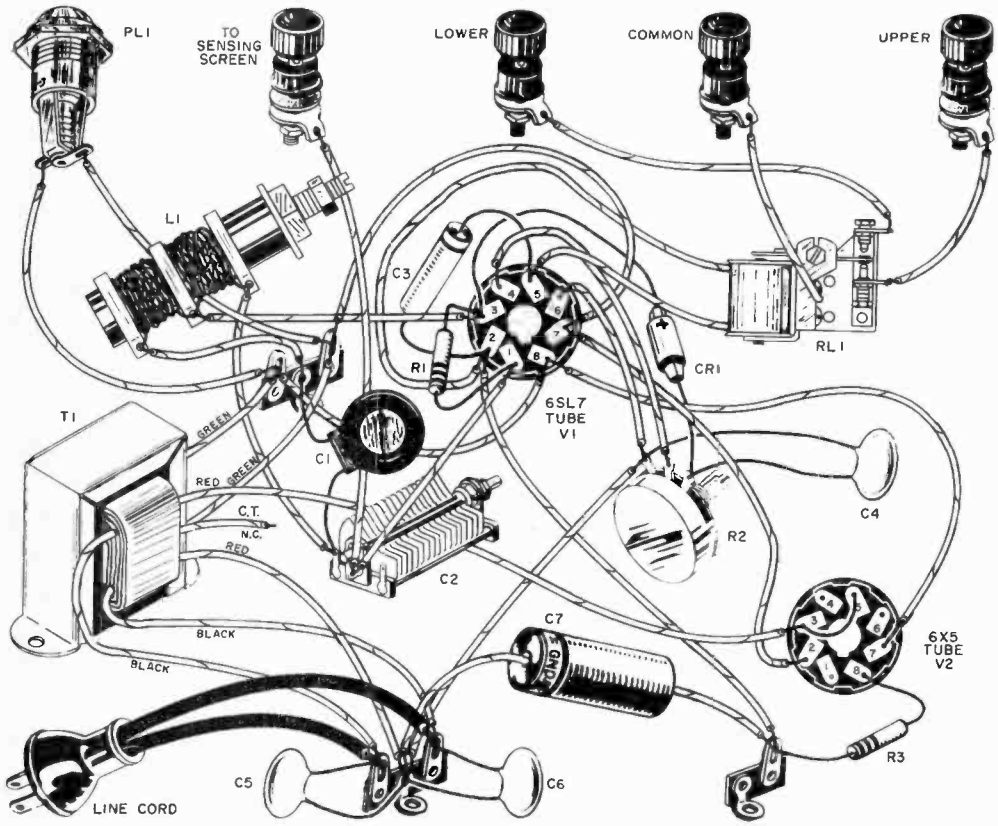
1—17" x 14" section of ½" plywood (top panel)
2—6" x 17" x ¾" lengths of pine (1 each for back and front panel)
2—6" x 12½" x ¾" lengths of pine (1 for each side)
1—1' x 1" x ½" piece of fir or pine (cut to dimensions given in drawing, for three support posts)
1—1" x 3" x ¼" piece of plywood (stop block)
1—½" half-round molding, 10" long (lever)
1—2" x ½" paper base phenolic coil form for solenoid (Cambridge Type LS-4)
1—Roll of #34 to #40 enameled magnet wire
1—3" length of round iron stock, 5/16" in diameter (curtain rod iron)
1—Piece of aluminum screening, approx. 2 sq. ft.
2—4" long x 1¼" wide sections of Bakelite (coil end caps)
Misc. rubber band, wood screws, etc.

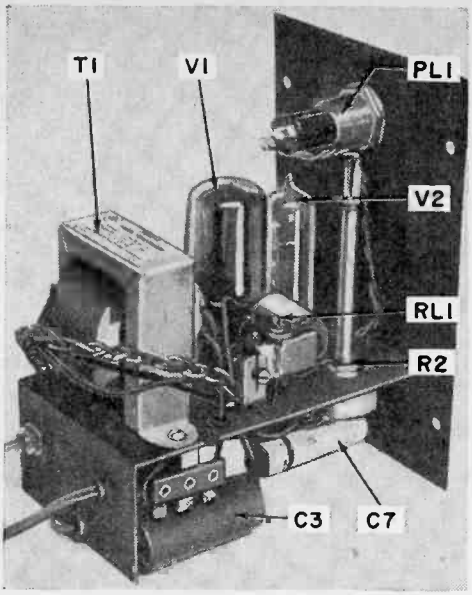


Rear and interior views of relay assembly. Front panel, not shown, mounts sensitivity control and pilot lamp. Note insulated shaft extension and panel bearing used with frequency-adjusting capacitor C2.



Pictorial diagram of the unit. Mounting lugs of the two-terminal tie points are used as circuit grounds and must make good chassis connection.





After installation, potentiometer R2 is adjusted through hole in cabinet top. Note use of half-wave rectifier in proximity relay schematic at right.

PARTS LIST

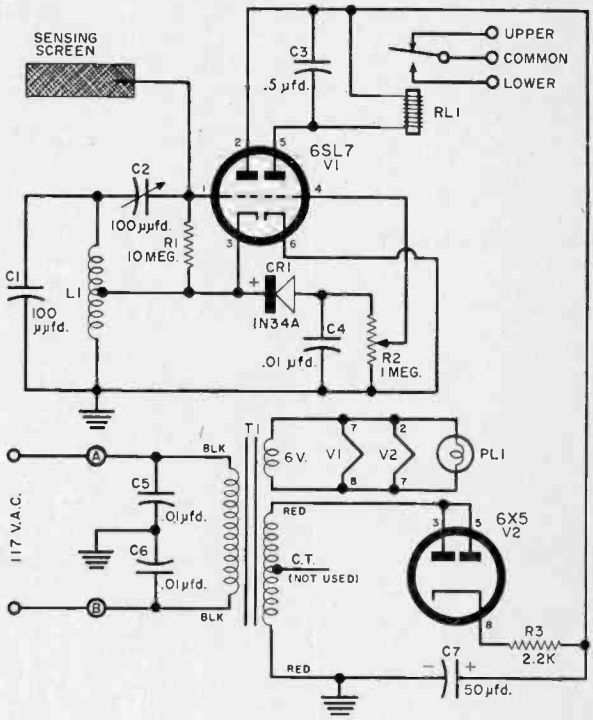
C1—100-μμfd. ceramic capacitor
C2—100-μμfd., ¼"-shaft variable capacitor (Hammarlund HF-100)
C3—0.5-μfd., 400-volt capacitor
C4, C5, C6—0.01-μfd., 600-volt disc capacitor
C7—50-μfd., 350-volt electrolytic capacitor
CR1—1N34A or CK705 germanium diode
L1—Coil form, slug-tuned, with movable clips (Cambridge LS-3)
PL1—6.3-volt pilot light assembly
R1—10-megohm, ½-watt resistor
R2—1-megohm linear taper potentiometer
R3—2200-ohm, ½-watt resistor
RL1—8000-ohm relay (Sigma 4F or equivalent)
T1—Power transformer; secondary, 125-0-125 volts at 25 ma., 6.3 volts at 1 ampere (Stancor PS8416)
V1—6SL7 tube
V2—6X5 tube
1—4" x 5" x 6" miniature cabinet, black crackle steel, with built-in chassis (ICA 3819)
4—Five-way binding posts
1—Coupler, ¼" to ¼" shafts
1—Phenolic extension rod, 6" long, ¼" in diameter
1—Panel bearing for ¼" shaft
Misc. #40 wire for coil, decals, tube sockets, hardware, line cord, hookup wire, etc.

HOW IT WORKS

The left-hand 6SL7 triode is a Hartley oscillator using *C1* as a coupling capacitor. *C1* is also part of a voltage divider; the probe-to-ground capacitance forms the second part.

With no grounded object near the probe sensor, the probe-to-ground capacitance is quite small while *C1* is relatively large. Most of the r.f. energy from the *L1* tank circuit is therefore applied to the grid of the oscillator. The large r.f. voltage which appears at the cathode of the oscillator tube is rectified by the crystal diode and applied as negative bias to the grid of the d.c. amplifier 6SL7 section through control *R1*. This bias keeps the plate current of the right-hand part of the tube well below the pull-in point of the relay.

Should a grounded body come into the vicinity of the probe screen, the effective probe-to-ground capacitance increases, causing a voltage-radio change which bypasses more of the r.f. to ground. The rectified voltage from the diode therefore decreases, the grid of the d.c. amplifier becomes less negative, and increasing the plate current energizes the relay. *R1* determines the fraction of the voltage applied to the d.c. amplifier as bias and is used as a fine adjustment.



maining parts does not interfere with the free action of variable capacitor *C2*. It is important that the wire connecting to the probe terminal be kept clear of other leads. Check the polarity of the crystal diode (*CR1*) and electrolytic capacitor *C7*.

Adjust the relay by setting *R1* fully clockwise (wiper farthest from ground) and *C1* at minimum capacitance. Screw the coil slug about half-way in. Connect a wire from the probe terminal to any point on the screening material under the ball panel. Apply power and allow about 30 seconds for warm-up; during this interval you will hear the relay click in as the d.c. amplifier portion of the 6SL7 begins to draw current through the relay coil.

Now slowly rotate *C1* toward maximum capacitance. At some point in the rotation,

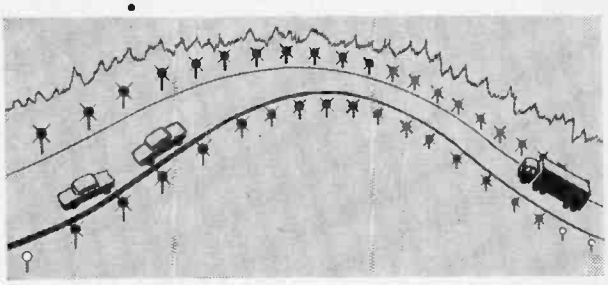
(*Continued on page* 115)

Electronics Aids Highway Safety

Test roadway points way to extensive changes which may make driving safe, automatic

WITH THE NATION launching a multi-million dollar superhighway building program, it becomes important to examine the problem of road safety. Such highways seem to exert a hypnotic effect on the ordinary driver, which frequently leads to chain collisions. Perhaps with the expenditure of just a few extra millions—a drop in the bucket compared to the over-all cost—these concrete ribbons might be made as nearly foolproof as possible through the use of a new safety system proposed by Dr. Vladimir K. Zworykin of Radio Corporation of America.

Heart of the setup would be an electronic warning net which would tell drivers the position of cars ahead and behind them by means of a string of lights at intervals along the side of the road. An additional safety factor would be a guidance system to keep cars centered in their lanes.



Proposed highway safety system would prevent collisions on hills. In diagram above, truck climbing hill lights warning lights ahead, over the brow of the rise, so that cars approaching will stay in their lane. It would work on curves, too.

While the setup would be used initially to flash warning signals to drivers, later changes could actually control the vehicles if auto manufacturers build in the necessary servo equipment. A special test installation has been completed near Lincoln, Neb., by the State Department of Roads, using equipment designed and built by RCA.

Warning Net. In such a network, detectors consisting of rectangular wire loops are buried in the pavement. Each connects to an associated circuit at the edge of the road. A 300-kc. voltage is applied to each loop. When a vehicle passes over a loop, it causes a variation in current which is detected by the associated circuit. The result is an output signal which controls an indicating device, such as a warning light, and at the same time switches on a radio warning system for following cars.

The radio warning system includes a transistor switch and an antenna extending back under the pavement from each of the detectors for any desired length. When the detector responds to a passing vehicle, the switch is closed and power is supplied to the antenna, causing it to radiate a 110-kc. signal.

The switch remains closed for an interval after the car has passed. During this time the antenna continues to radiate, forming a radio "tail warning" behind the car. This "tail" could be used to actuate warning lights along the side of the road or it could be picked up by following cars with properly tuned receivers. The length of the "tail" might be preset or controlled by the speed of the vehicle.

In the present system, the signal actuates lights alongside the road, but ultimately it could be used to control acceleration or brakes—or both—in following cars.

Guidance System. This consists of a cable laid down beneath the center of a traffic lane, continuously radiating another signal. To use the system, a car is equipped with two pickup loops, one mounted on each end of the front bumper.

(*Continued on page* 98)

Transistor Topics

By LOU GARNER

THE NUMBER of transistor applications in non-entertainment commercial electronic equipment is increasing by leaps and bounds. For instance, two firms are now marketing fully transistorized business dictating machines. A Dictaphone unit, intended for office use, operates from a standard power line outlet, while a battery-operated SoundScriber machine is suitable for portable use.

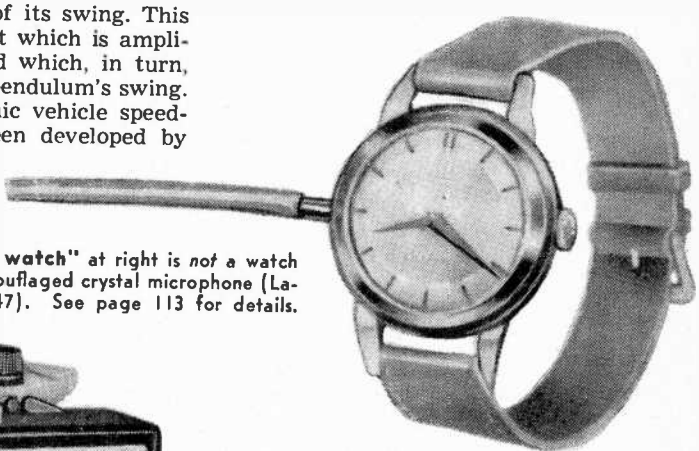
Several transistorized clocks are available on the domestic market. You'll even find some listed in the catalogs of the larger mail order "department" stores. A transistorized clock developed in Germany requires so little current that its single self-contained dry cell has an operating life equal to its shelf life (about five years). A permanent-magnet gravity pendulum moves into a coil at the extreme end of its swing. This action generates a current which is amplified by the transistor and which, in turn, provides a "kick" for the pendulum's swing.

In England, an electronic vehicle speed-measuring system has been developed by Venner Electronics, Ltd. which uses 54 transistors. Basically, it is an electronic counter. The circuit is designed to measure the number of pulses which a crystal-controlled oscillator delivers during the time it takes an automobile or truck to pass over a pair of rubber tube switches laid parallel to each other a measured distance apart across a road or highway. This instrument has an accuracy of ± 1% at 100 mph, and is even more accurate with lower speeds.

A fully transistorized portable paging device, called the "Transi-page," has been introduced by the Irwin Products Co. of Chicago, Ill. A self-contained weatherproof unit, it is equipped with microphone, handle, carrying strap, and volume control.

On the Civil Defense front, a transistorized Dosimeter Charger has been ordered into production by the Federal Civil Defense Administration in Battle Creek, Mich. These units are being made by Universal Transistor Products Corp., Westbury, N. Y.

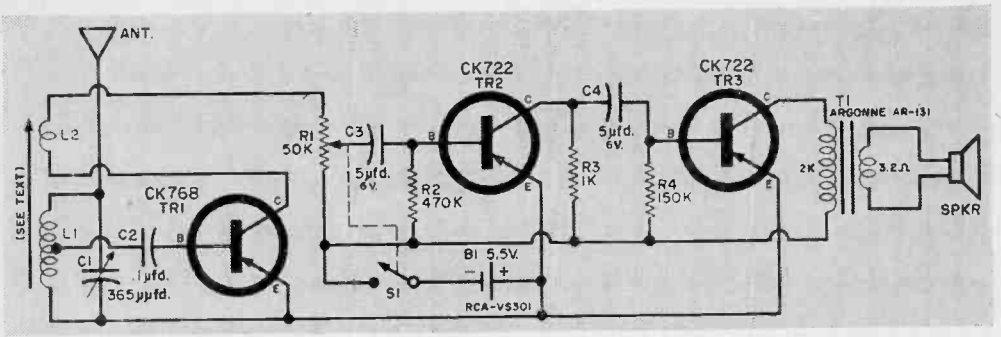
One of the "brightest" items is a transistorized lighting system developed by Westinghouse Electric which should be available commercially within a few months. Basically, it is a high-frequency (1500-cps)



The "wrist watch" at right is *not* a watch —it's a camouflaged crystal microphone (Lafayette PA-47). See page 113 for details.

Slightly larger than a pack of cigarettes, the "Trans-Midge" is a low-cost, one-transistor radio kit (Allied Radio 83 Y 767).

fluorescent lighting system. In operation, the a.c. line power is converted to d.c. by a bridge rectifier. This d.c. power, in turn, operates a 1500-cps transistorized power generator. The resulting high-frequency a.c. power operates the lighting system. Compared to conventional fluorescent lighting, the new system is much more efficient. In addition, the bulk, weight, and heat losses of the ballasts can be reduced appreciably.



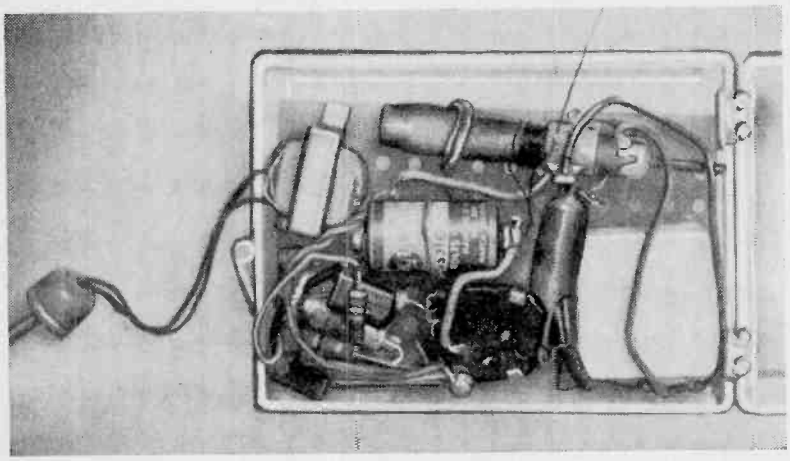


Fig. 1. Schematic diagram of the "Simplatran" three-transistor receiver designed by reader Forrest H. Frantz, Sr.

Assembled on small perforated Bakelite board, the "Simplatran" was mounted in plastic case as shown at left.

Reader's Circuit. Many readers like to dream up interesting names for projects they assemble. Last month, you may recall, we featured the "Handy Audi," developed by S/Sgt. Jack W. Yundt. The three-transistor radio receiver shown in Fig. 1 this month is called the "Simplatran" by its designer, reader/author Forrest H. Frantz, Sr., of 105 W. Park Row, Arlington, Texas. According to Forrest, it will provide usable loudspeaker volume on strong local stations without an external antenna and can be assembled in an hour or so.

This receiver achieves its high performance by using an r.f. transistor as a regenerative detector, with the audio output signal fed to a two-stage resistance-coupled audio amplifier. The second stage of the amplifier drives a PM loudspeaker.

In operation, signals are picked up and selected by the *L1-C1* tuned circuit (or picked up by an external antenna, if one is used). A tap on *L1* provides an impedance match to the comparatively low input impedance of the first stage. The r.f. signal appearing at the tap is coupled through capacitor *C2* to the base electrode of a Raytheon Type CK768 r.f. transistor.

Some detection as well as r.f. amplification takes place in the first stage, which is operated without base bias. The r.f. component of the amplified signal is coupled back to the tuned circuit by feedback coil *L2*, strengthening the original input signal and thus providing the regeneration necessary for increased sensitivity.

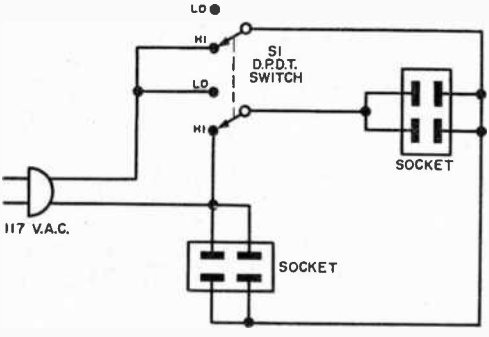
The audio component of the detected signal appears across volume control resistor *R1* and is coupled through capacitor *C2* to the base of the first audio stage. Base bias current for this stage is supplied through *R2*, while *R3* serves as the collector load resistor.

The amplified audio signal appearing across *R3* is coupled through *C4* to the base of the second audio stage. Bias for the second stage is supplied through *R4*. An impedance-matching transformer (*T1*) serves as the collector load for the second

(*Continued on page* 112)

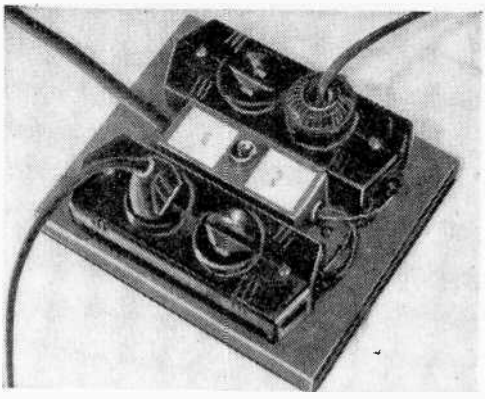
Photoflood Light Saver

Constructed from simple, easily obtainable parts, the "light saver" will greatly increase the normally short life expectancy of your photoflood lamps. It can be mounted breadboard style or enclosed in a plastic cabinet. The d.p.d.t. toggle switch (*S1*) should have a rating of 6 amperes at



125 volts. Number 16 or larger gauge wire should be used.

Test the light saver by plugging each of two floodlights of *equal* wattage into the separate sockets, then plugging the unit into a 117-volt outlet. With *S1* in one position (*High*), the two lamps are wired in parallel and light with full power. Throwing *S1* to the opposite position (*Low*) will connect the lights in series, causing them to light dimly. Because of the series circuit in the *Low* position, neither bulb will light if one is burned out. When four lamps of equal wattage are used, the unit operates in a similar manner.

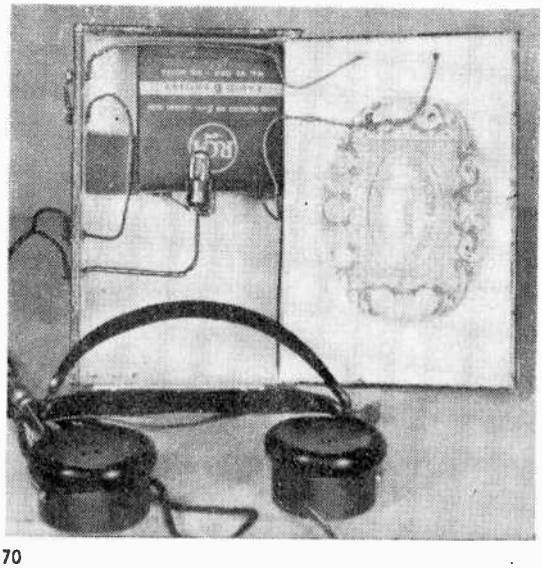


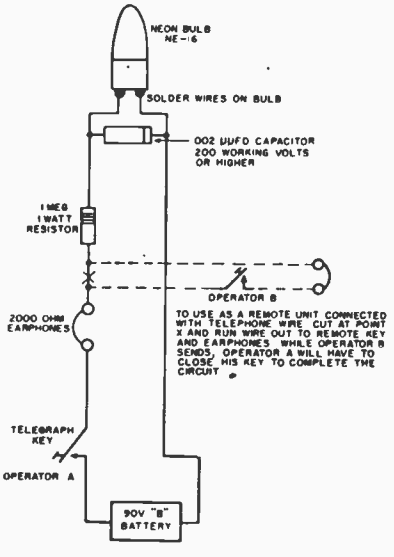
Use the light saver at the *Low* position for setting up and focusing the camera and subject, snapping it to *High* before taking the picture. —*Carleton A. Phillips*

"Cigar Box" Code Practice Oscillator

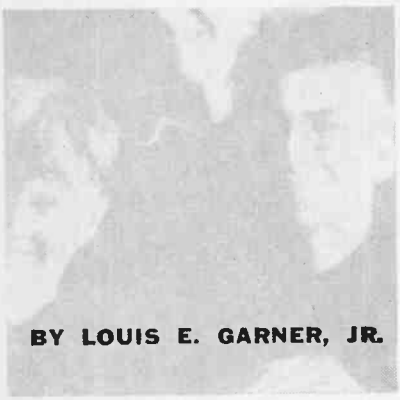
Since most boys play out-of-doors, a code oscillator that has to be plugged into the a.c. line becomes a nuisance. Simple to build and carry, this battery-operated unit can be mounted in a cigar box. It's ideal for the kids.

In order to set up a station at a remote position, twisted-pair wire can be connected to the two terminals on the side of the cigar box that is normally shorted when the unit is used as a straight code practice oscillator. At the remote end, a telegraph key and 2000-ohm earphones are added in series across the twisted wire. To receive at the remote end, the key is held closed, and vice versa. —*Edward H. Marriner*





How to Plan a P.A. System

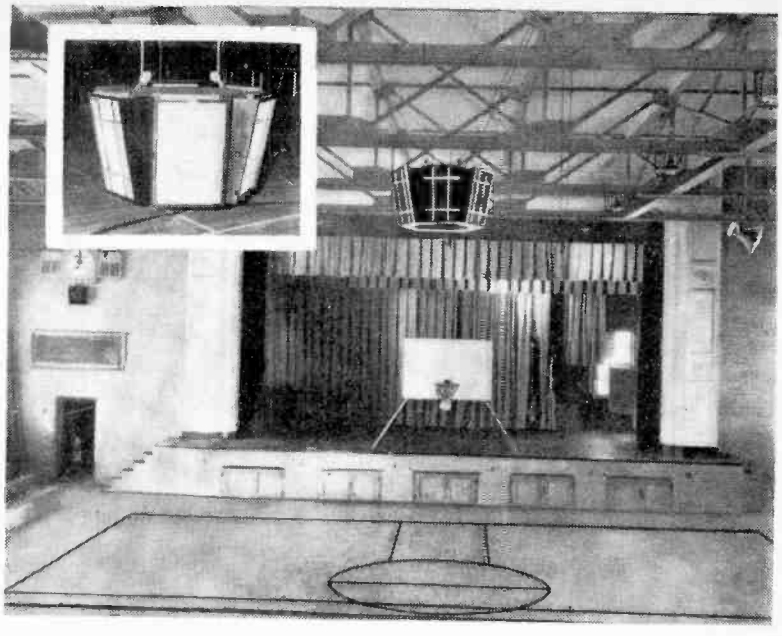


BY LOUIS E. GARNER, JR.

Selecting equipment to fit the sound requirements of location and program

SUCCESSFUL public address installations don't just "happen." They are carefully planned in advance. The designer-installer must consider many factors when choosing a system: area to be covered, background noise, type of service needed (voice only, voice and music, etc.). and economics. It is just as poor design to "over-install" a system, using too much power, too many loudspeakers, and so on, as it is to skimp, installing an undersized and inadequate system.

Any p.a. system contains three major sections: input equipment, amplifier, and output equipment. The input equipment consists of one or more microphones and, often, such accessory items as a phonograph or broadcast-band tuner. The audio amplifier is the heart of the public address system—it receives the weak electrical signals delivered by the microphone (or microphones), record player, or



Unusual p.a. installation at right is in the gym of a New York public school. Note nest of Aristocrat enclosures by Electro-Voice in inset. Work was handled by Casey Sound.

tuner, then amplifies and in some cases modifies these signals (by means of tone controls), delivering a powerful audio signal to the sound reproducing equipment. The output equipment is an electromechanical sound-reproducing device of some type: a cone-type loudspeaker similar to those used in home radios or hi-fi installations or a horn or trumpet-type speaker.

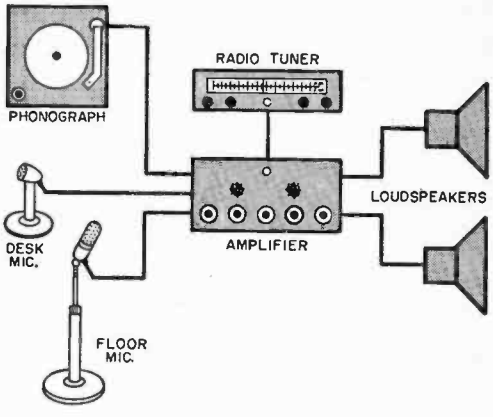
CHOOSING A MICROPHONE

Aside from differences in design, microphones can be classified in two ways: according to principle of operation and according to their pickup or polar response pattern. Basic popular types include *carbon, velocity* (or ribbon), *dynamic, ceramic, crystal* and *condenser* microphones. All of these convert sound vibrations into weak electrical signals.

Principles of Operation. The *carbon* mike depends on the alternate compression and release of carbon granules for its operation. Although it has the highest output level of any standard type, it is inherently noisy and has relatively poor frequency response.

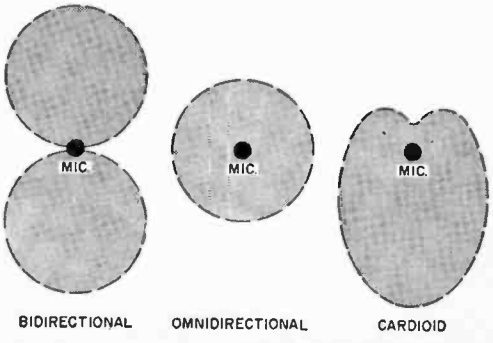
Consisting of a corrugated "ribbon" of metallic foil suspended between the poles of a permanent magnet, the *velocity* mike has excellent frequency response and low noise level, but its output signal level is also low. A rather fragile instrument, it can be permanently damaged by a sudden puff if a performer blows against it.

The *dynamic* type operates much like a miniature loudspeaker in reverse. Its basic element is a small coil attached to a dia-



Usual p.a. installation is shown in block diagram above. Not included is a mixer, which is optional.

Typical response patterns of microphones. See text for proper use.



phragm and arranged to move back and forth in the gap of a permanent magnet. When sound vibrations strike the diaphragm, the coil moves, generating an appropriate electrical signal. It has good frequency response, moderate output level, low noise, and is fairly rugged.

Both *ceramic* and *crystal* microphones depend on the compression or twisting of a piezoelectric element attached to a small diaphragm. They feature a moderately high output level, low noise, fair-to-good frequency response, and high output impedance. Of the two, the crystal mike is the least rugged and can be damaged by excessive moisture or high temperatures.

The *condenser* type, while it has high performance characteristics, is not generally used in p.a. work, as it is too expensive. It operates on the principle of the capacitor, using the diaphragm as one plate with a heavier plate backing it up. Vibration of the sound waves causes the diaphragm to vary in its distance from the second plate, thus varying the capacitance of the system. An amplifier is usually mounted in the same housing with the pickup unit to obtain sufficient output and low impedance.

For general p.a. work, the usual choice is either a good-quality dynamic or a ceramic microphone. Crystal mikes can be used in lower cost installations if care is taken to avoid hot or humid environments.

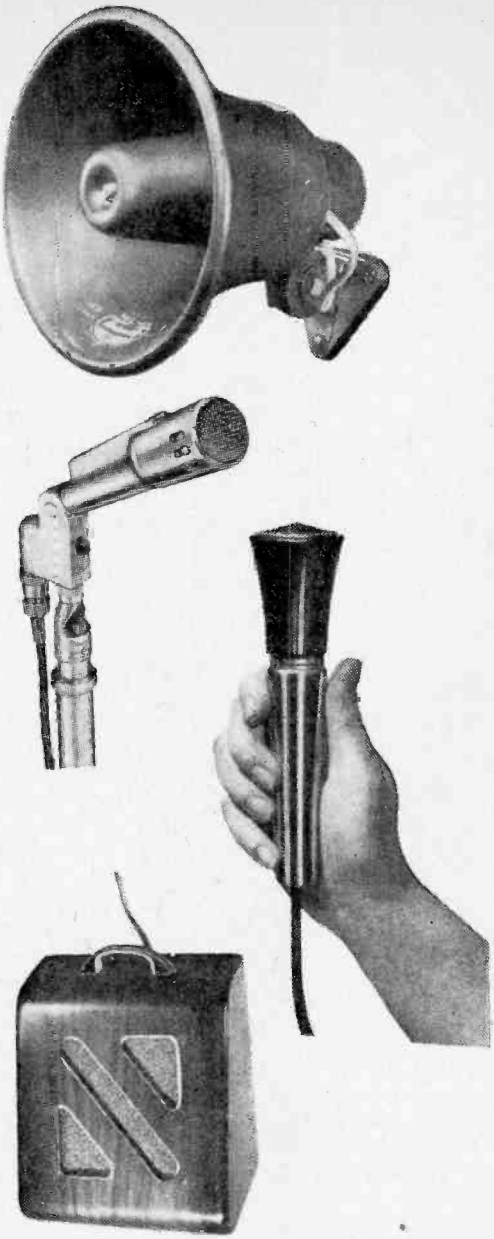
Polar Patterns. The second important factor in choosing a microphone is the *polar pattern* of the unit, for a microphone does not have the same sensitivity in all directions. Looking down from the top, we can measure the radial distance from the instrument at which a given sound will always produce the same output. A graph drawn around the microphone as a nominal "center" showing these relative distances is called the polar pattern of the unit. The three basic polar patterns are: cardioid, bidirectional, and omnidirectional.

A unit having a *cardioid* (heart-shaped) response has maximum sensitivity directly in front, with a dropping off in pickup of sounds from the sides and very little pickup to the rear. With a polar pattern similar to a figure "8," a *bidirectional* microphone responds equally well to sounds coming from the front *or* back, but is relatively insensitive to sounds from the sides. If a microphone responds equally to sounds from all directions, its polar pattern is essentially a circle, and it has an *omnidirectional* response.

Microphones with a cardioid pattern are useful for solo performances, for talks, or whenever you want to reduce the pickup of sounds from the audience. A bidirectional microphone is best for person-to-person interviews, or where pickup of audience applause is desirable. Omnidirectional microphones are good for general pickups, as in the middle of an orchestra, band or chorus.

For most p.a. work, both cardioid and

(*Continued on page* 106)

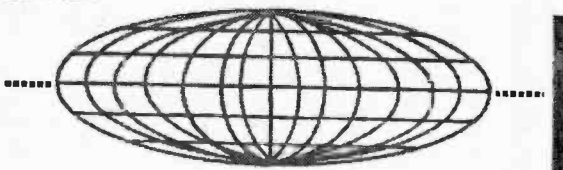


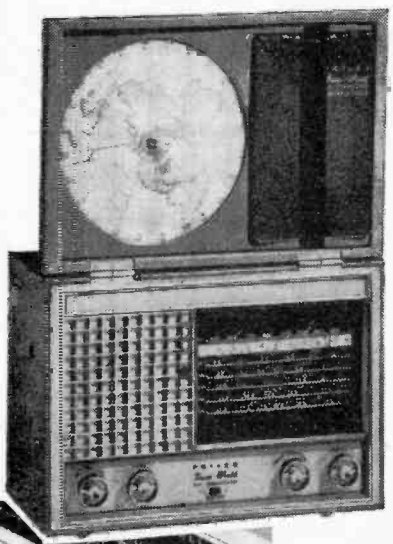
Several typical p.a. components are (top to bottom) a University reflex trumpet, dynamic Electro-Voice cardioid mike, controlled-magnetic Shure omnidirectional mike, and cone speaker in standard wall baffle.

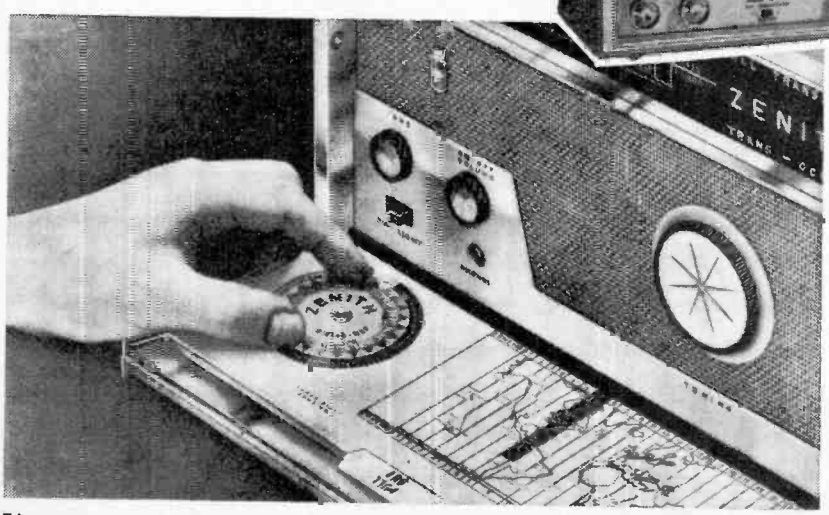
Transistor Portables for the SWL

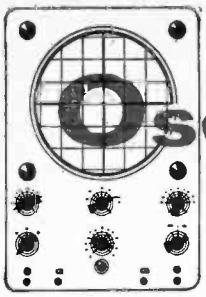
THE SWL's will have a field day with this new crop of transistor portables. Motorola's Weatherama (left) covers the broadcast band as well as the long-wave aircraft and beacon band. It has six transistors and three germanium diodes. Cost is $79.95. Philco's Trans-World (below) covers the broadcast band and a total of six short-wave bands from 2 to 18.2 mc. The lid carries an unusual polar projection world time map. This set employs six surface barrier and three audio-frequency transistors. Cost is $225. Zenith's Trans-Oceanic (bottom) covers the broadcast band and seven short-wave bands from 2 to 22.4 mc. It utilizes nine transistors and contains a unique built-in logging compartment with time dial and also space for a personal station log.

-30-









Oscilloscope Traces

Accessories

Special input adapters multiply the usefulness of the standard oscilloscope

By HOWARD BURGESS

AN ENGINEER may call them accessories or an experimenter may call them gadgets but by any other name they can be just as handy. Your 'scope's usefulness can be extended many times over by special probes and input devices.

Basically, the probe is a means of coupling a signal from the equipment under test to the input of the oscilloscope in such a way that no useful information is lost. At the same time, it will protect the input circuits of the 'scope from overload and damage. Some of the traces illustrated on these pages during the past months have required the use of such probes.

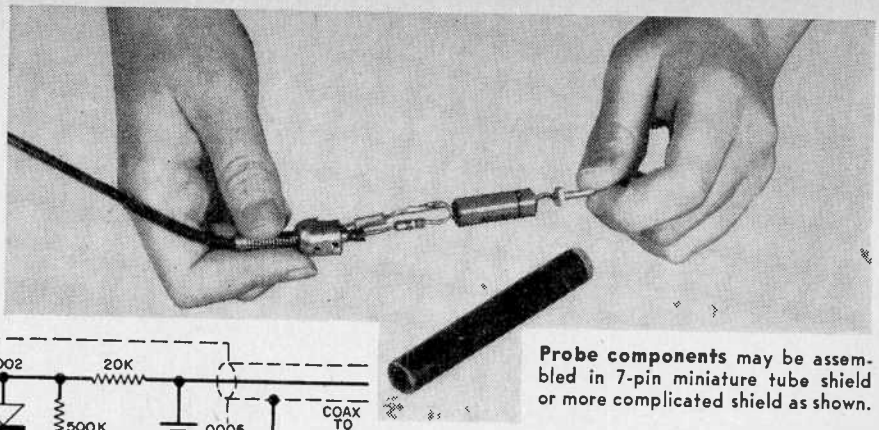
To enable 'scope users to become better acquainted with these attachments, we will describe two probes and a calibrator that can be easily assembled. Even though very simple, they are necessary for many special measurements.

Demodulator Probe. Many times it is desirable to check v.h.f. or microwave signals at frequencies above the range of the 'scope. Or you might want to be able to view the audio or video component that is modulating a high-frequency carrier. A demodulator probe is illustrated in Fig. 1.

This type of probe makes a very good signal tracer on any modulated carrier up to several hundred megacycles. The oscilloscope used must be capable of displaying the modulating frequency.

All parts can be mounted in a piece of

Probing in high-frequency equipment with a demodulator type probe.



Probe components may be assembled in 7-pin miniature tube shield or more complicated shield as shown.

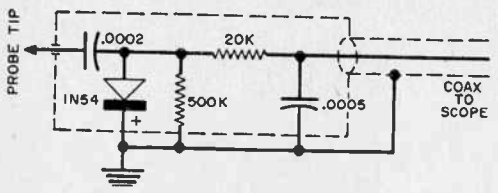


Fig. 1. Simple demodulator probe for use with high-frequency voltages.

½" fiber tubing several inches long. Maximum voltage applied to the probe is determined by the type of crystal diode used, but in most cases it should be limited to 20 volts or less.

High-Impedance Probe. If unshielded leads are used to the input of a 'scope, noise and hum pickup will usually make the trace unreadable. If shielded leads are used, complex waveshapes may have their high-frequency components distorted and their true shape may never appear on the face of the 'scope tube. A high-impedance (low-capacitance) probe, as in Fig. 2, will eliminate these problems.

Full details on this probe were contained in the November, 1957, issue of POP'tronics, but sufficient information for the experimenter is given in the schematic. It can be constructed in a tube shield. The padder capacitor is adjusted to give the correct waveshape with a square-wave input to the probe.

Voltage Calibrator. If the amplifier gain of an oscilloscope remained constant, the 'scope could be used as an excellent a.c. voltmeter with wide frequency range. Although very few 'scopes can be calibrated for input voltage, this can be overcome by the use of a "calibrator." A calibrator is another accessory, not a probe, that is used to supply a known a.c. voltage to the 'scope.

In use, the unknown signal voltage is applied to the 'scope and the height of the trace measured. The unknown signal is then removed and the calibrator voltage fed to the 'scope and adjusted to provide the same trace height as that of the unknown voltage. The voltage read on the calibrator scale will be equal to the unknown voltage.

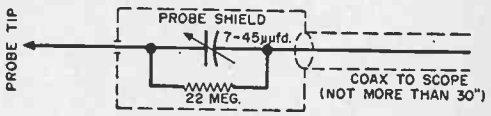


Fig. 2. In the high-impedance probe, the capacitor shunting resistor should have a value approximately 10 times that of the input impedance for a set attenuation factor of 10.

Although the more complicated calibrators using square waves are desirable, a less expensive unit can serve for most applications. With a little care in calibration and construction, the one shown in Fig. 3 will give very good results.

Transformer *T1* must supply at least 70

(*Continued on page* 102)

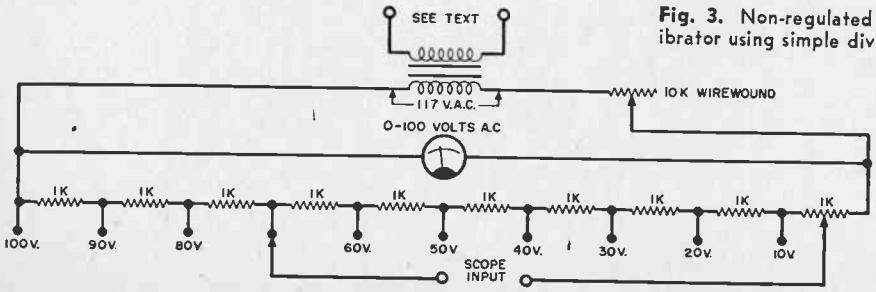


Fig. 3. Non-regulated voltage calibrator using simple divider network.

SYNCHRO FUNDAMENTALS

AS OUR NATION plunges deeply into the serious business of building satellites and guided missiles, it becomes increasingly urgent that every technically minded American devote some of his time to the fundamentals of these potential civilization-wreckers. There is much to learn! But an excellent beginning can be made by studying the devices that actuate the missile's aerodynamic control surfaces and thrust gear. These are the synchros, the "muscles of the beast."

Fundamentally, synchrcs may be described as either electric motors or generators, depending upon their position in the system. A synchro comprises a *stator,* or stationary set of coils, and a *rotor* that can turn freely on its bearings. The most common synchro type employs a stator with three magnetic poles and a two-pole, bobbin type of rotor (Fig. 1).

Current Paths. Consider first the magnetic effect of passing an alternating current through only the rotor coil while the stator terminals are disconnected. With the flow of current, an alternating magnetic field will develop in the rotor core; and since the stator core-irons are physically close to the rotor, this field will follow the permeable paths they offer (Fig. 2). Note that the direction of the field indicated by the arrows is the *instantaneous* direction selected at random during one part of the a.c. cycle.

As the rotor's field passes back and forth through the stator cores, an alternating e.m.f. is induced across each stator winding by transformer action. No current flows in the stator coils, however, since the terminals are open. To see what happens next, let us connect the inside stator terminals together to form a so-called "wye" (like the letter "Y") and add a "load box" to complete the stator circuits (Fig. 3). It doesn't matter what the load box contains—resistors, capacitors, inductors, etc.—because we are interested only in current *directions* at this time.

Current paths now exist for each of the stators of the synchro. In accord with Lenz' law, we know that the induced currents in the stators must flow in such a direction as to produce a new magnetic field that op-

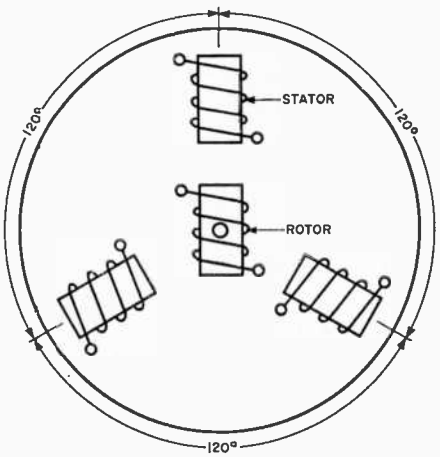


Fig. 1. A common type of synchro motor or generator. The stator consists of three windings spaced 120° apart with three poles facing inward toward the two-pole rotor.

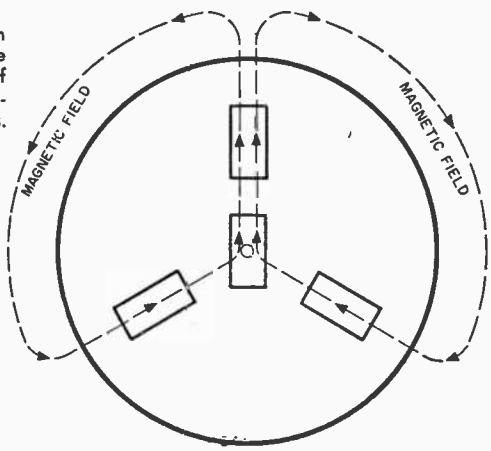


Fig. 2. One part of cycle in which the magnetic field produced by the a.c. in the rotor follows path of least "resistance" through the permeable cores of the stator windings.

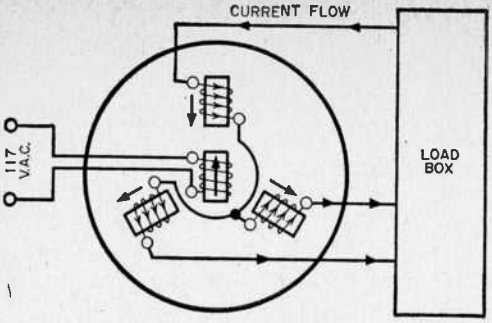


Fig. 3. Currents induced in stator windings by a.c. flowing in rotor have directions shown. Electron flow direction is taken as current direction in this discussion.

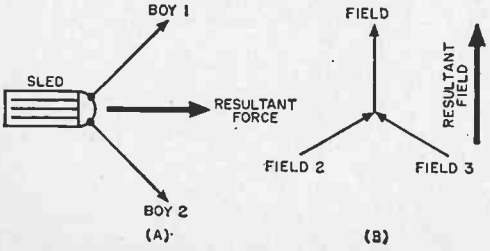
poses the original field. Thus, the stator magnetic fields must oppose the rotor field, and the current that flows in the stator must have the direction required to give rise to this opposition. To check the current directions as given in Fig. 3, apply the left-hand rule: wrap the fingers of the left hand around the coil in the direction of the indicated current, and the thumb, held perpendicularly to the hand, will point in the direction of the field. (This rule is explained in most physics textbooks.)

Combined Effects. Magnetic fields are capable of exerting forces along the field. Like any other forces, those due to magnetic fields produce a certain *net effect* or resultant force when they act in combination. Think of two boys pulling a sled by means of two ropes that make an angle with each other. The net effect or resultant of this double pull can be represented by a single force in the direction shown in Fig. 4(A). Similarly, three magnetic fields acting at an angle may also be summed up by replacing them with a single resultant magnetic field, as in Fig. 4(B).

Applying this idea to the fields induced in the three stator cores of Fig. 3, it is evident that the resultant stator magnetic field may be represented by an arrow pointing in a direction opposite from that of the rotor field (Fig. 5).

Our next step is to replace the load box

Fig. 4. Forces and magnetic fields may be summed up to obtain a "resultant."



with another synchro *identical to the first* and connect all three corresponding stator points together (Fig. 6). Observe that we have changed nothing else; the stator currents now flow through three corresponding pairs in the same directions as before. Applying the left-hand rule to the newly added synchro, however, demonstrates that the magnetic fields in the second set of stators are opposite to those of the first set, producing thereby a resulting magnetic field opposite to that of the resultant in the original stators.

It is also important to note that the direction of the field in the *first rotor is exactly the same as the field direction of the resultant for the second set of stators.* No matter how the original rotor is twisted and turned, the magnetic field resultant of the new set of stators will always line itself up in the same direction.

As a final maneuver, we connect the rotor

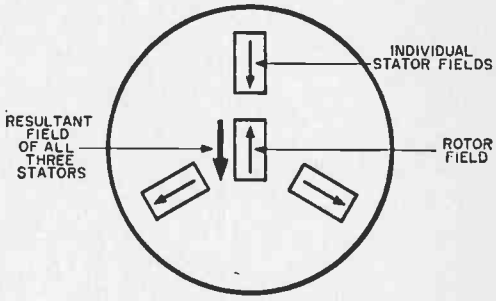


Fig. 5. The resultant field of all three stator fields is exactly opposite in direction from that of the rotor field.

of the second synchro in parallel with the first, adjusting our connections so that the fields of both are in the same direction, as shown in Fig. 7.

Synchro System. Now we shall be able to see what a synchro system like this can accomplish. Suppose that the first rotor is straight up-and-down, as in Fig. 7, and that its field is in an upward direction as we have been assuming all along. The magnetic field of the second rotor is, therefore, also vertical and in line with the resultant of its stators. When magnetic fields are aligned in this fashion, they are in a state of equilibrium and there is no tendency for motion.

Now assume that we take hold of the first rotor shaft and twist it through 45°. The currents induced in the stator windings of the first synchro will change, causing a similar modification in the second set of stators which, in turn, *causes the second rotor to line itself up* so that it points in exactly the same direction as the first, i.e., 45° from its initial position. Thus, such a synchro system provides a means whereby an

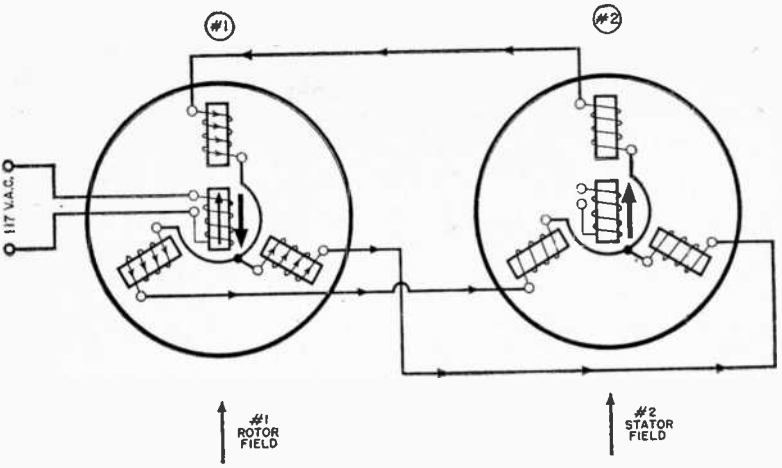


Fig. 6. When the second set of stator windings is joined to the first, the stator field in #2 is opposite to that in #1, and therefore in the same direction as the rotor field of #1.

angular change in the position of one shaft can be made to duplicate itself at some remote point with *only electric wires between the two points.*

This is a really significant achievement. For example, imagine that you want to know the position of your rotary beam antenna at a given instant. One synchro, which we may now call the *generator,* is coupled to the antenna so that its shaft turns with the rotation of the beam; the other is in your operating room with its shaft terminating in a direction-indicating compass needle. As the beam is made to rotate by its drive-motor, you know at a glance just what its orientation is with respect to compass direction.

Without a synchro system, remote indications of any angular position would necessitate a solid connecting shaft between the driven device and the indicator. More often than not, this kind of mechanical connection is very inconvenient if not impossible.

The Missile Picture. Returning to missile control now, we might ask: "Just how do synchro systems enter the missile picture?" A simple example will demonstrate one such function.

Consider a missile that is flying a predetermined compass course, say directly west. Assume that it has been driven off course a few degrees to the north by a sudden gust of wind. In the body of the airframe is a gyroscopic compass that was initially adjusted to point due west; and as the missile begins to deviate from its course, this compass remains steadfastly pointing in the direction for which it was set. Thus, the missile has turned under the gyroscope so that, effectively, the gyro compass makes an "error" angle with the air-frame.

If the gyro is coupled to a generator synchro that in turn is connected to a motor synchro, the latter may be used to move the appropriate air-foils so that the missile be-

(*Continued on page* 111)

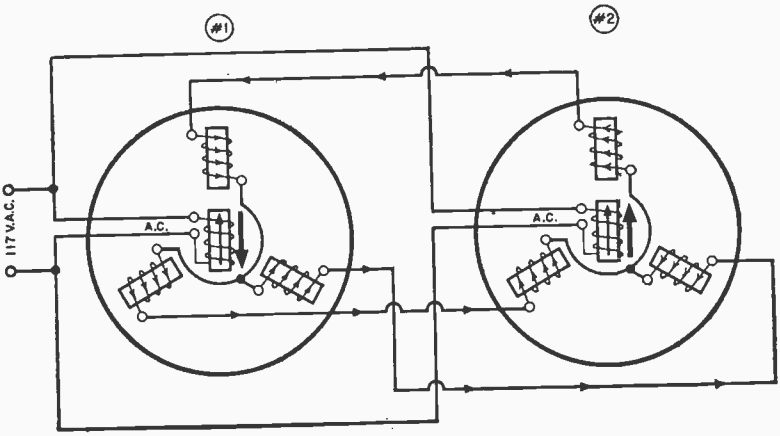
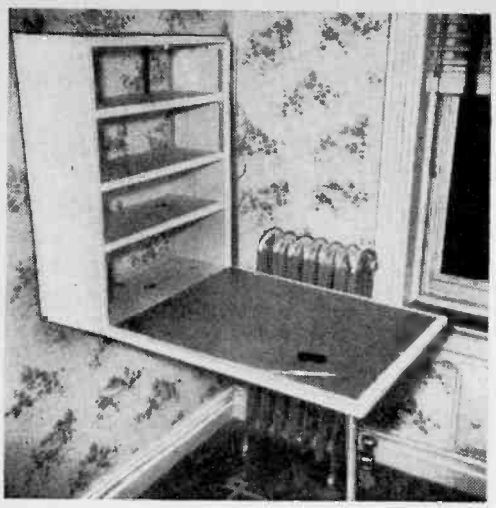
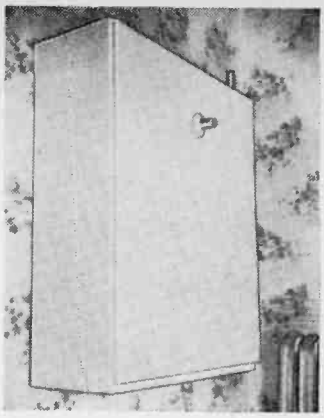


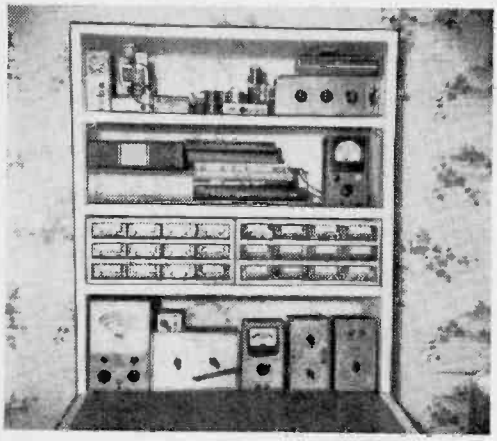
Fig. 7. After connecting the rotor of #2 with the rotor of #1, the second rotor will line up so that its own field matches that of its stator. This means that the first and second rotors always point in the same direction.





By MARTIN SCHECTER

Hide Your Bench Until Needed



A compact folding workbench for the crowded hobbyist

THE ELECTRONIC HOBBYIST without a cellar or workroom has a problem. His test equipment is apt to be stored in a closet, his resistors and capacitors in a drawer, and his tools—heaven knows where! The kitchen table is his usual workbench, and he's forced to compete with Junior's homework and Mother's cooking for a space to work.

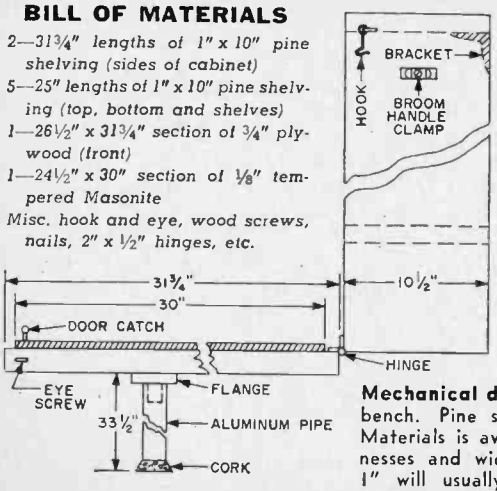
What is needed is a workbench which is out of the way when not in use and yet provides sufficient elbow room when required. The solution to the problem is a wall unit with a drop-leaf "door" as shown in the photographs. When the door is open, a Masonite work surface is revealed which can stand plenty of abuse from soldering irons and tools. The front of the door has a small ¾" flange into which an aluminum leg is fitted for support.

Storage Space. Test equipment can be stored on the bottom shelf. There is an a.c. outlet near the rear which is very handy and offers space for several plugs.

(*Continued on page* 98)

BILL OF MATERIALS

2—31¾" lengths of 1" x 10" pine shelving (sides of cabinet)
5—25" lengths of 1" x 10" pine shelving (top, bottom and shelves)
1—26½" x 31¾" section of ¾" plywood (front)
1—24½" x 30" section of ⅛" tempered Masonite
Misc. hook and eye, wood screws, nails, 2" x ½" hinges, etc.



Mechanical drawing of the "hidden" bench. Pine shelving listed in Bill of Materials is available in nominal thicknesses and widths. Board specified as 1" will usually be ¾" thick; widths specified as 10" will be 9½" to 9¾".

TAPE TIPS TRICKS TECHNIQUES

Tape recording hobbyists run into a number of technical problems while in pursuit of their hobby. The recorders will sometimes act up in weird and disturbing ways—emitting squeals, squeaks, quavers and hisses. Or a machine which has been operating perfectly for a number of years will suddenly go completely dead—on record, playback, or both.

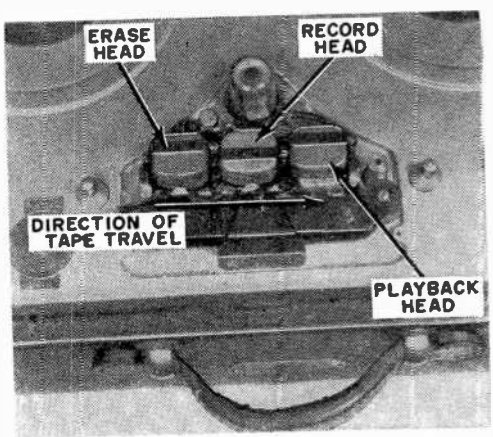
What can you do about it? What tests can you make? And more important, what cures can you effect?

Troubles and Cures

By WARREN J. SMITH

A PROBLEM that has many a tape-recorder enthusiast biting his nails in frustration is tape sticking to the recording and playback heads. This difficulty usually appears as a squeak or "pig squeal" in the playback, but later it may become so severe that it actually stalls the transport mechanism. Cleaning the heads with solvents, lubricants, and so forth, is a temporary remedy at best and may result in making the sticking more troublesome.

Sticking tape is generally due to nothing more than a type of adhesion. After the heads have become smooth with wear, intermolecular forces of considerable magnitude develop between the moving tape and the heads, giving rise to spurious sounds in the playback and quite often broken tape. To remedy this situation, carefully burnish the heads with a piece of good grade crocus cloth; then clean thoroughly with the fluid recommended by the manufacturer. Do *not* assume that either carbon tet or alcohol is the proper cleaner.



Head line-up on a recorder with a separate playback monitor. Inexpensive recorders will have a combined playback-and-record head.

Worn Erase Heads. A worn erase head which does not make complete contact with the tape over the entire area may cause an increase in the playback noise level, or if badly worn, allow portions of previously recorded material to remain audible.

If your erase head can be disassembled, as it can in the Magnecord recorder, for example, remove the section containing the surface which contacts the tape, and carefully hone it flat with a fine-grit honing stone or 00-sandpaper backed by a piece of smooth hardwood. The head will work like new.

Speed Instability. There are many portable tape recorders of the Minitape variety now in general use whose owners frequently complain of the difficulty of maintaining speed stability once the machine begins to age. After much experimentation, it has been found that carefully cleaning the motor armature (especially between the commutator segments) with carbon tet and installing a new set of brushes after each 35 to 40 hours of opera-

tion will keep the recorder running with almost 100% speed stability.

Tape Storage. Metal cabinets for storing 8-mm. motion picture film also make very convenient containers for magnetic recording tapes. Available at nearly every photographic supply house, they come in a variety of sizes and price ranges, some holding up to 12 of the common reels.

Stored in these cabinets, tapes are always ready for immediate use and, because the cabinets are usually made of a ferrous metal, the tapes are not only protected from dust and dirt but from stray magnetic fields as well. I use Brumberger #1010 cabinets which were originally made to hold 400′ reels of 8-mm. film but now hold 12 7″ reels of tape.

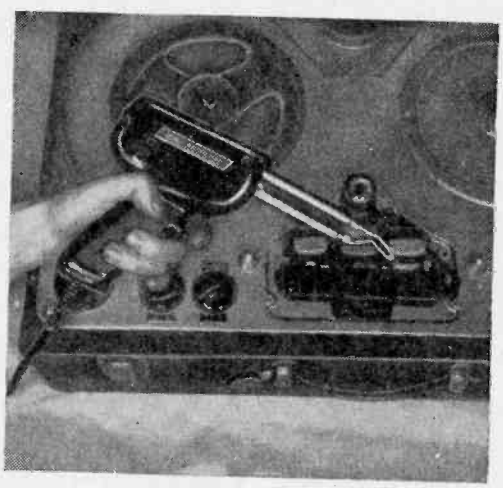
If more than one cabinet is needed and they are stacked to conserve space, rubber feet can be added to allow the doors to swing open without interference.

Check Your Recorder Heads

By EUGENE F. CORIELL

DON'T use an ohmmeter to check continuity of recorder heads suspected of being open-circuited. The d.c. from the ohmmeter battery may magnetize the heads. Use the checks described below.

Most home recorders have a single recording-playback head. There may be separate coils in the head for each function, or a single winding may serve both purposes. Check your recorder wiring schematic when testing these circuits.



Test playback head with the a.c. field around a soldering gun tip. Remove the gun from close proximity to head before releasing trigger. Take care not to heat up the head.

If there is only one winding and the machine will record but not play back, or vice versa, obviously neither the head winding nor the common record-playback amplifier which serves both functions is at fault. The trouble may be in the switching circuits. Some record-playback heads have a separate winding for the bias current; in such a case, an a.c. milliammeter inserted in series with this winding will indicate current flow and hence continuity in the bias winding.

Record Head Check. If the head has separate windings for record and playback, test the record winding by having someone talk into the microphone with the recorder controls set for "record" and connect a pair of phones *across* the record head terminals.

If the signal can be heard in the phones but does not produce even a distorted recording on the tape, the head winding is at fault. Absence of signal in the phones would indicate trouble in the amplifier or in the record-playback switching circuits. However, dead phones might also indicate a *shorted* recording winding; you can check this possibility by determining if there is a signal in the phones *after* the head winding is disconnected.

Playback Head Check. Test the separate playback winding by bringing the tip of a plugged-in soldering iron or gun (a.c. only) near but not too close to the head with controls set for playback. Proper functioning of the entire playback system will be indicated by a hum in the speaker. Assuming that the common record-playback amplifier and switching circuits were found to be okay during the recording winding checks described above, absence of hum points to a defective playback winding on the recorder.

While an ohmmeter would cause less trouble in the erase head than in the record-playback head, it is still a good idea to keep ohmmeters away from all of the heads. See if the head will erase a recorded tape run through the machine set up for recording with the volume control turned down. Failure to erase with proper erase voltage on the head indicates an open or otherwise defective head. —30—

Among the Novice Hams

By **HERB S. BRIER,** W9EGQ

SEE NEXT PAGE FOR
list of those who request help in obtaining their ham licenses

WHEN their amateur licenses arrive, many new amateurs—Novices and Generals—make a surprising discovery. They realize that they have only a very hazy idea of how to make contacts with other stations.

In theory, this is an easy thing to learn. It is only necessary to imitate more experienced amateurs. In practice, this theory has a serious defect. Experienced operators usually send so fast that a beginner just cannot copy them. Therefore, he must imitate amateurs who send slowly. Unfortunately, such hams are usually newcomers themselves and *their* operating procedures are not too good either. The net results are some of the weird calling procedures that are often heard on the amateur bands.

Fortunately, it is not hard to learn good calling procedures. And it pays to do so, because they produce the best results with the least effort. Therefore, let us outline the proper techniques for working other amateurs from the initial call to the final sign-off. In the process, we will use the following standard procedure signals: CQ (meaning "general call"); DE ("this is" or "from"); $\overline{AR}$* ("end of transmission"); K (invitation to transmit—"go ahead"); $\overline{SK}$* (end of work). Also, of course, there will be your own call-sign and the call and sign of the station you wish to work.

Calling "CQ." For example, say that W9EGQ wishes to talk to any station within range and transmits a "General Call," as follows: "CQ CQ CQ CQ CQ DE W9EGQ W9EGQ CQ CQ CQ CQ CQ DE W9EGQ W9EGQ CQ CQ CQ CQ CQ DE W9EGQ W9EGQ K." The ending signal "K" means: "Go ahead any station. I am listening for replies."

If another amateur, W9XXX, hears the CQ and wishes to answer, he will transmit: "W9EGQ W9EGQ W9EGQ DE W9XXX W9XXX AR." He uses the ending signal "$\overline{AR}$" to indicate that two-way contact has not yet been established.

W9EGQ will then respond: "W9XXX DE W9EGQ;" and start the conversation. In the initial transmission, which is usually quite short, he will probably give W9XXX a signal report, his location and name, and will stand by to find out how well W9XXX

(*Continued on page* 117)

Two amateurs (?) and their equipment. Ron, KN7BYZ, above, uses a 33' vertical transmitting antenna in conjunction with his DX-20 transmitter and SX-99 receiver (see page 119). And with the help of John (3), Vince, KNØLHG (38) has worked 37 states with his WRL Globe Chief and Hallicrafters SX-100.

* Letters overlined are sent together—not as separate letters. Thus, $\overline{AR}$ is sent as "ditdahditdahdit" rather than "ditdah space ditdahdit."

HELP US OBTAIN OUR HAM LICENSES

Prospective amateurs requesting help and encouragement in obtaining their licenses are listed here. To have your name listed, write to Herb S. Brier, W9EGQ, % POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

K1/W1 CALL AREA

Thomas Lacouture (14), 293 Coe St., Woonsocket, R. I. Phone: PO 2-2769. (Code, theory, and selection of equipment)

Ted Melinosky, 22 Tulip St., New Britain, Conn. (Code and theory)

Bob Reader (16), 71 Ellington St., Dorchester 24, Mass. (Code and theory)

Peter Katz (14), 48 Harwood St., Lynn, Mass. (Code, theory and selection of equipment)

Carl Fredrickson, 36 Andrea Rd., Waltham 54, Mass. (Code and theory)

Ronald Rondeau, 37 South St., Waltham 54, Mass. (Code and theory)

K2/W2 CALL AREA

Victor Spelman, 1738 Fillmore St., Bronx 60, N. Y. Phone: TA 8-8056. (Code, theory and regulations)

Sheldon Schulman (14), 535 S. 10th St., Newark 3, N. J. Phone: BI 3-5242. (Theory and selection of equipment)

Ronald Ontell, 418 E. 40th St., Paterson 4, N. J. (Code)

Bill Mark (14), 36 Edi Ct., Plainview, L. I., N. Y. Phone: WE 5-1578. (Code, theory and selection of equipment)

Robert Schultz (14), 146-27 60th Ave., Flushing 55, N. Y. Phone: FL 3-1811. (Code, theory and selection of equipment)

Alan Jones, 10 Lackawanna St., Bath, N. Y. Phone: PR 6-2984. (Theory and selection of equipment)

Harry Appel, 640 West 153 St., New York 31, N. Y. Phone: AD 4-5928. (Code and theory)

Martin Freeman (13), 377 15th Ave., Paterson 4, N. J. (Code, theory and selection of equipment)

Ronald Wescott, 6 Pelham Ave., Nixon, N. J. (Code and selection of equipment)

Larry Kulick (10), 222 Penn St., Brooklyn 11, N. Y. Phone: EV 8-6225. (Code, theory and selection of equipment)

K3/W3 CALL AREA

Walter N. Ballard, 952 N. Farson St., Philadelphia 31, Pa. (Code and theory)

David LaBarre, R.D. #1, Wysox, Pa. (Code and theory)

Dick Neidhardt (15), 206 Montclair Ave., Pittsburgh 29, Pa. Phone: WE 1-3193. (Code)

Clyde R. Broadus, Jr., 1508 West 11th St., Chester, Pa. (Code)

Denison Rich, 7180 Brighton Rd., Pittsburgh 2, Pa. (Code and theory)

Stan Goldberg, 1525 Newport Ave., Northampton, Pa. Phone: CO 2-2193. (Code, theory, regulations and selection of equipment)

K4/W4 CALL AREA

David G. Young, Box 93, Penney Farms, Fla. (Code and theory)

Charles Rhodes (15), 308 West Main St., Huntingdon, Tenn. (Code, theory and selection of equipment)

William E. Adams, 708 Madison Rd., Williamsburg, Va. (Regulations and selection of equipment)

Dick Korgan (15), Box 1355, Sanford, Fla. Phone: FA 2-3036. (Theory)

Jeff Jacobs, 602 E. 5th St., Cullman, Ala. Phone: 2121. (Code)

Otis Nealous, 2521 Mt. Auburn St., Augusta, Ga. Phone: 3-7157. (Code, theory and regulations)

J. Emanuel Beimkampen (13), Box 222, San Antonio, Fla. (Code and theory)

K5/W5 CALL AREA

Jax Clarkson, 5170 Huckelberry, Houston 27, Texas. (Code and theory)

Bruce Dishman, 8619 Midway Rd., Dallas 9, Texas. (Code)

Van Stayton, 951 Church St., Paris, Texas. (Code, theory and selection of equipment)

A. E. Terflinger, 4149 Milton, Houston 5, Texas. (Code and theory)

K6/W6 CALL AREA

Bill Remhild (14), 2135 N. Evergreen St., Burbank, Calif. Phone: TH 5-2736. (Code and theory)

Richard Eisman (13), 5756 Cleon St., N. Hollywood, Calif. Phone: PO 1-9863. (Code and theory)

George L. Gonsalves (14), 13427-C Riverside Drive, Sherman Oaks, Calif. Phone: SI 9-9306. (Code)

Warren Wayland, 900 Monterey Rd., Salinas, Calif. (Code, theory and regulations)

Lloyd Bayley, 836 Coolidge, Sunnyvale, Calif. (Code, theory, regulations and selection of equipment)

Tom J. Orzech, 78 Supron, Box 1277, Hamilton A.F.B., Calif. (Code and theory)

Randy Wolfe (13), 10 Wickham Pl., Hillsborough, Calif. Phone: DI 3-3567. (Code, theory and selection of equipment)

K7/W7 CALL AREA

Kelly Healy, 354 East 12 St., Orem, Utah. Phone: AC 5-0609. (Code)

Richard Young, 384 South Main, Tooele, Utah. (Code and theory)

Louise Hansen, 417 Orr, Miles City, Mont. (Code, theory and selection of equipment)

K8/W8 CALL AREA

John Fleming (15), North Main, Plainwell, Mich. Phone: MU 2-1651. (Code, theory and selection of equipment)

Dennis Sullivan (16), 1851 Newton St., Akron 6, Ohio. Phone: RE 3-6566. (Code and theory)

R. D. Rowan, 1342 W. 64 St., Cleveland 2, Ohio. (Code and theory)

Fred C. Scott, % Powerhouse, I.O.O.F. Home, Springfield, Ohio. Phone: FA 5-1538. (Theory)

Paul David Friend (14), 159 Hoffman Lane, Waverly, Ohio. (Code and theory)

K9/W9 CALL AREA

Larry Heyda, 8743 Branton Ave., Highland, Ind. (Code and theory)

Ellis Cohen, 5442 Hyde Park Blvd., Chicago 15, Ill. Phone: HY 3-0155. (Code and theory)

Larry M. Chrisman (15), R. R. #1, Box 126, Bryant, Ind. Phone: 2-6287. (Code and theory)

Bill Holt, R. R. 1, Veedersburg, Ind. Phone: CY 4-4141. (Code)

Dave Kazmark (15), 524 177 St., Hammond, Ind. (Code, theory and regulations)

Doug Jorgensen (15), 302 Riverside Dr., Prophetstown, Ill. (Code and theory)

Donald J. Hoffman (15), 4723 Greenwood, Skokie, Ill. (Code, theory and equipment)

Ronnie S. Vician, 3357 N. Kilpatrick Ave., Chicago 41, Ill. (Code)

George Urana, 639 Spring Rd., Elmhurst, Ill. (Code and theory)

KØ/WØ CALL AREA

John R. Hague, 2009 W. 15th Ave., Emporia, Kan. Phone: 1565. (Code)

Daryl Malena, Leigh, Nebr. Phone: 3-OF211. (Code and theory)

Jerry Carrett, 501 E. Seminole, Springfield, Mo. (Code and theory)

Thomas L. Lloyd (14), Green City, Mo. (Code, theory, regulations and equipment)

VE AND OTHERS

Frank Turcotte, 1287 Visitation St., Montreal, Quebec, Canada. Phone: 5-0147. (Code, theory and selection of equipment)

W. Bradley, 428 Burdick St., London, Ontario, Canada. (Code and theory)

To help prospective amateurs obtain their Novice licenses, the Electronic Industries Association (formerly RETMA) offers a set of code records (recorded at a speed of 33⅓ rpm) and a Novice Theory Course for $10.00, postpaid. The complete course or more information on it is available from EIA, 1721 DeSales St., N.W., Washington 6, D. C.

BARGAIN POWER FOR YOUR Transmitter

Increase your transmitter's effectiveness without adding higher power final amplifier

By GEORGE E. MOBUS, WØRXK

COST of establishing and maintaining an amateur station today has risen proportionately to other living costs; and in this era of "dollars per watt," any efforts aimed toward achieving a more potent signal are likely to become prohibitive—especially if there is an XYL in the background who is taking a narrow view of things.

However, hams are noted for their ingenuity and XYL's are born bargain hunters. Let's use these two traits to multiply our signal power many times and at a cost ratio more to our liking—"watts per dollar"!

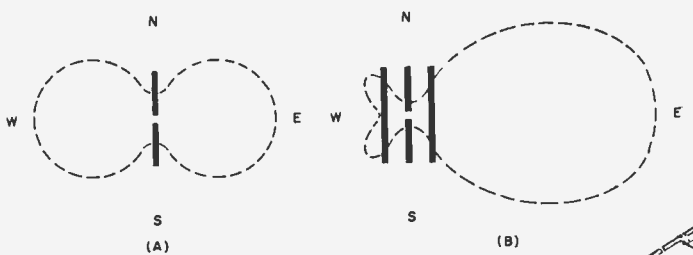
Effective Power. Many amateurs think of signal strength in terms of transmitter power. To get a stronger signal, they increase the power output. This is the "brute force method" and, generally speaking, will often do the job. However, it's an expensive way to increase the effectiveness of a transmitter.

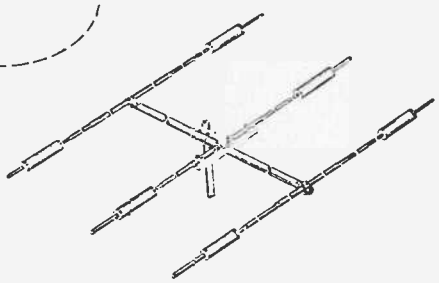
Hams seeking greater DX laurels might profitably take a tip from radio and television station engineers. These professionals cast their lot with "Effective Radiated Power," otherwise known as E-R-P. Skipping the mathematical formulas, E-R-P is simply the amount of signal power being radiated in the desired direction. Basically it is the E-R-P, and not necessarily the transmitter power, that must be increased in order to cut through QRM and work that DX.

How can E-R-P be increased without increasing transmitter power? It is done with the one piece of equipment solely responsible for the efficiency of signal radiation—the antenna.

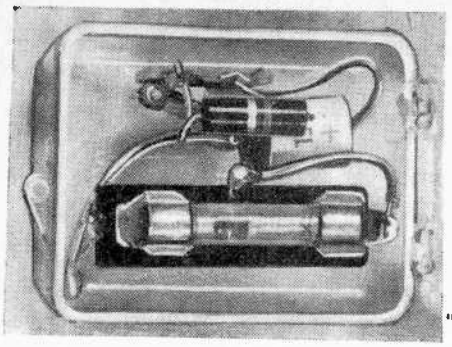
Loss Means Gain. There is no such thing as an antenna that radiates equally well in all directions. True, the antenna engineer has imagined such a paragon, which he fondly calls an *isotropic radiator,* and he treasures it because such an antenna makes a fine standard for comparison. But the isotropic radiator exists only in the engineer's fancy. So we must consider a practical antenna: the half-wave dipole.

(*Continued on page* 114)





Operating on the 10-, 15- and 20-meter bands with equal effectiveness, the Mosley TA-33 Trap-Master (above) is a typical modern rotary beam antenna. It gives signals an 8-db boost and provides 25 to 30 db front-to-back discrimination. The radiation patterns (above, left) are typical for (A) a dipole and (B) a beam antenna.



Complete timing unit, with built-in rectifier and pilot light, fits inside plastic box. This is its actual size.

How Long Did You Use It?

Miniature electroplating unit shows the length of time your electronic equipment is operated

A "CHRONISTOR" is a tiny elapsed-time indicator with the size and appearance of a glass clip-mounting radio fuse. It is suitable for direct wiring into a home or industrial device, and it mounts in a standard fuse clip for convenience of observation and replacement.

By means of a time scale calibrated in hours which is printed directly on its glass side, the Chronistor indicates by an electroplating process the amount of time current has been applied. With a d.c. flow of about 1 milliampere through the unit, metal ions from the anode are carried through the electrolyte and deposited on the cathode. The "growth" of the cathode provides the visible indication of elapsed time. Standard ranges are 500, 1000 and 2500 hours; other ranges are available on special order.

Current Requirements. Current needed to activate the Chronistor can be obtained from any d.c. source. The better regulated the current source, the higher the accuracy of the indicator. In most applications, however, an unregulated supply will be adequate.

A resistor in series with the indicator in conjunction with the applied d.c. voltage will determine current flow through the plating unit and hence its elapsed time indication. See Table 1. Resistors shown are all 5% 1-watt units and calculated to the nearest EIA (RETMA) value.

The Chronistor cartridge is available separately from Bergen Laboratories, 247 Crooks Ave., Clifton, N. J., or as part of a complete assembly known as a "Chronostat." Packed into the 2¼"x1¼"x1⅝" plastic case of the Chronostat is a 10-ma. rectifier, a pilot lamp, the indicator and its series-limiting resistor.

Shown in Fig. 1 is the circuit of the Chronostat. It operates directly from the a.c. line. The limiting resistor is chosen to

(*Continued on page* 104)

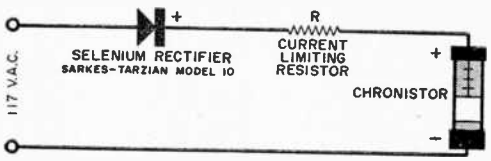
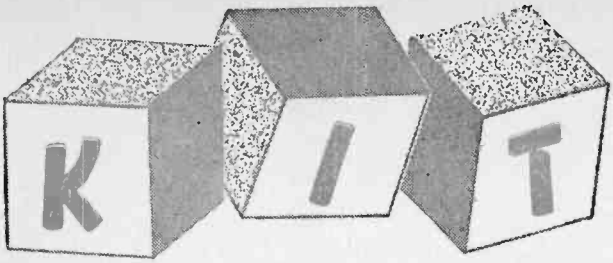


Fig. 1. Simple series circuit designed for direct a.c. line operation.

Table 1. Values of the series resistor used for various time indications and d.c. supply voltages.

D.C. Voltage Supply (volts)	Resistance (ohms)		
	500 hours	1000 hours	2500 hours
6	4,700	9,100	20,000
100	75,000	150,000	390,000
150	120,000	240,000	560,000
250	200,000	390,000	1 meg.
500	390,000	750,000	2 meg.
Current Flow (ma.) through Chronistor	1.3	0.65	0.26



BUILDER'S KORNER

MOST KITS are bought and assembled by people who have an intense interest in electronics: experimenters, servicemen or amateurs. They have at least a smattering of technical information; they have done considerable soldering while working on past projects; and they know how to think "electronically" when any little problems are encountered that need solving.

After taking a quick look at the Model 83Y766 Knight-Kit five-transistor portable radio (Allied Radio, 100 N. Western Ave., Chicago 80, Ill.), we were tempted to give it an acid test and let someone who had no experience whatever put it together. Design of the kit and the instruction manual looked good enough to suggest that a real beginner might be able to do a fair job.

Allied Radio
Model 83 Y 766
Transistor Radio

The kit was presented to a young man who had never connected wires to even a battery and buzzer, never soldered any portion of an electrical circuit, nor assembled any type of construction toy as a boy. No special warnings were given to him, and the only instruction he received took about five minutes. That concerned the use of a small soldering iron of the pencil type.

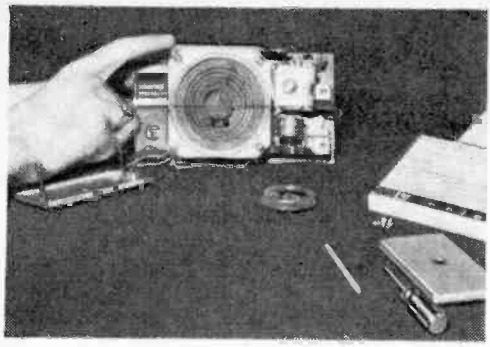
The assembly of the kit took him one evening and part of an afternoon. Here are his comments on the job.

Putting It Together. The parts of the Model 83Y766 Knight portable radio kit come carefully packed in a cardboard carton. Most of them are packed separately to avoid damage in shipping. For example, the loudspeaker was in a cardboard sleeve to protect the cone from damage, and the tuning capacitor was in a small box to prevent the plates from becoming bent.

The chassis is a printed-circuit board with letters or numbers on each hole and on each spot where ceramic disc capacitors, resistors, transistors, and transformers are mounted.

Five transistors and one diode are em-

Completion of assembly and soldering takes a beginner about seven hours. The handle at the left side of the cabinet pulls out for carrying the set. Springs inside cabinet retract it automatically when set is placed on table.



Front view of the radio chassis shows wrap-around spring assembly that holds cabinet pieces together. Large bolts hold end pieces against plastic panels and thread into turns of springs.

ployed in the superheterodyne circuit. The transistors include a 2N252 converter, a 2N308 i.f. amplifier, a 2N238 audio amplifier, two 2N185's for the audio output stage. The detector diode is a 1N257.

On the whole, the construction of the set was simple although some problems arose during the process. Resistor *R4* (100,000 ohms) was mounted too close to the board. Later, when a nearby capacitor lead was inserted in a hole under the resistor, it was a tight squeeze to pull it through. The lead can be bent over the copper section of the printed circuit, however, and soldering it is not difficult.

Another problem which arose was the mounting of the gang tuning capacitor. Two of the three holes on the capacitor aligned perfectly with the holes on the printed-circuit board, but the third pair of holes did not line up. It was decided that the two screws would provide enough support.

Comment. The instructions are simple and easy to follow, with ten pictorial diagrams showing the various steps in the assembly.

When the kit was completed, about seven local stations could be picked up before alignment. After alignment, 21 local stations were picked up with good volume.

THE TV SERVICEMAN would be lost without his tube tester, and even the home repairman who finds himself looking after three or four TV sets can find a tube tester to be a time- and money-saving investment. Since most TV service calls require only the replacement of a tube, a portable tester can be a handy part of a serviceman's tool kit.

The Paco Model T-60 tube tester is a unit flexible enough to test the latest TV tube or the old 5-pin tube from Grandpa's favorite radio. Construction of the kit is fairly easy, and with the exception of some minor details, to be described later, this builder found little difficulty in putting the kit together.

Since there is little close wiring, this kit is ideal for the beginner who wants to acquire some equipment and also some experience in soldering. Most of the wiring consists of interconnecting pins of the eight different size tube sockets with the set of control switches at the front panel. This group of three-position switches selects the pins to which test voltages will be applied and is also used to connect the tube heater voltage to the proper pins. Settings of these switches are determined from numbers on a built-in roll chart.

With the switches in position, the tube is connected as a diode with plate and grids as one element and the cathode as the second element. The indicating meter on the front panel is connected in series with the tube so that the current through the diode-connected tube is indicated. This shows the general condition of the tube. Another position permits checking for shorted elements in the tube.

Putting It Together. Assembly of the tube tester took about three evenings' work. Some difficulty was encountered in installing the tube sockets on the front panel. The sockets are of the snap-ring type with a groove on the side to accept a circular snap-ring. After attempting unsuccessfully to install the snap-ring on two sockets, it was found that the panel hole had been cut slightly smaller than the base of the socket and would not let the socket seat far enough into the hole to permit the snap-ring to be installed. A little filing with a half-round file solved the problem.

Installing roll chart (left) is one of the final steps in the behind-the-panel assembly of the tube tester. All wires should be taped together to make a neat appearance and keep them from rubbing against the paper roll chart. After the tester is installed in the cabinet (above), a trial run should be made using a group of tubes that you know are good. This will show up any errors that might have been made in wiring the sockets or power supply.

You might use one of the corrugated cardboard panels that come with the packing as a work surface for installing parts on the panel. This prevents the face of the panel from being scratched on the work table.

When installing the 300-ohm power potentiometer, be sure to select the right one, since two 300-ohm potentiometers are used. The unit with the ceramic housing is the power-handling unit.

Wiring is fairly repetitive for each pin on the tube sockets, and it seemed faster, after wiring one or two rounds, to wire a set of pins without referring to the manual and then use the instructions as a check on the wiring. This is not usually good practice, but the type of wiring used here is easy to follow once the pattern is known.

Two resistors were found with no value marked on them. Fortunately they did have part numbers and it was possible to identify them from the parts list.

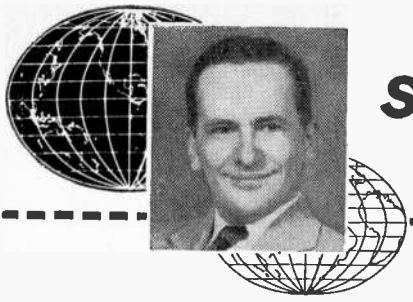
In wiring the transformer, be sure to follow instructions as given in the manual. Placement of this wiring is quite important for proper installation of the transformer.

The roll chart caused little trouble in installation, but care must be taken to get it on the rollers straight. Otherwise it can jam against the sides of the track. Be sure that all of the wiring is placed away from the chart so there is no chance of wires rubbing against it.

Comment. The Paco T-60 tube tester operated well as soon as it was completed. Only minor problems were encountered during assembly of parts.

This reviewer would have liked to see a precut wiring harness for the tube-socket leads. It could have cut considerable time from the wiring and might have resulted in a much neater job.

The kit itself is well designed and quality components are used throughout. I doubt if even a beginner in kit building would find any of the difficulties encountered too much to handle. —30—



Short-Wave Report

By HANK BENNETT

VERIFICATIONS, or QSL's—as they are often called, are letters (or cards) issued by short-wave stations in reply to reception reports sent to them from listeners all over the world. Many are fancy while others are plain, but they are all welcome additions to the listener's collection.

Some DX'ers try to collect a QSL from every station in the world. While this probably has never been accomplished, there *are* SWL's who have amassed hundreds of confirmations from nearly every type of station ranging from privately owned ones to the largest of the short-wave broadcast stations.

If you include the following points of information in your reception reports, it will help you to enlarge your collection while, at the same time, the stations will receive reports of maximum use to them. Keep in mind that a station is not obliged to verify; however, if your report is of sufficient value to a station, you'll be fairly certain to receive a QSL.

First, mention the name of the station (slogan or call-sign) and its location. Give the exact frequency whenever possible. State the exact times that you heard the station, and show the time in GMT (Greenwich Mean Time: Eastern Standard time plus five hours). If you cannot compute the correct time in GMT, be sure that you state in which time zone you live.

Your report should be based on a listening period of at least 30 minutes unless the station is on the air for a shorter period. Give a resume of what you heard, and give the time for each item. (Sample: "News in English at 1848-1855, marimba music to 1900 station break, with a Spanish program following to 1930.") A report which is broken down in this manner will convince the station personnel that you were listening to *their* station and not tuning in a different station with similar programing.

Include a signal strength and readability report. If there was any interference or jamming, try to learn the identity of the offending station. Many reports of interference will often result in a station altering frequency slightly to make reception better for listeners. Also mention any peculiar effects noted, such as deep fading, distortion, over- or under-modulation.

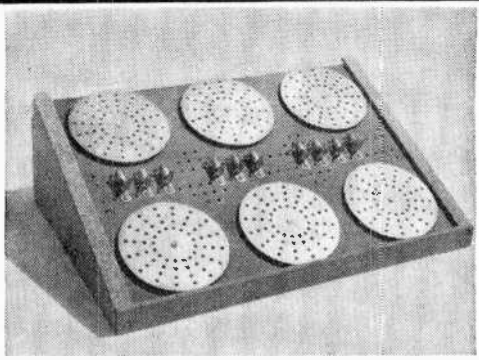
Give the station a brief resume of your equipment, including the make and model of your receiver and the number of tubes in it. Tell your general location and the type of terrain surrounding your area (mountainous, flatlands, etc.). If you liked or disliked any particular program, say so, along with your comments on the programing in general.

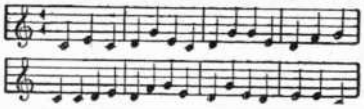
The report should be made in letter form and should be as interesting and informative as possible. Postcard or SWL-card reports usually contain little useful information. Do not *demand* a verification but rather suggest that your report be verified

(*Continued on page* 122)

Bernard Koenig, of Regina, Saskatchewan, who listens with a Hallicrafters SX-25 and an RCA AZ5, has collected verifications from 34 countries. His antenna is a 100' long wire.

New! A MACHINE THAT COMPOSES MUSIC





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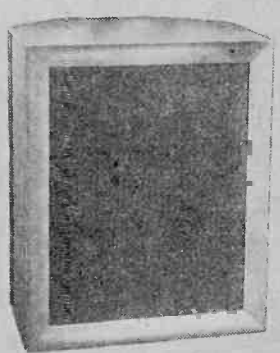
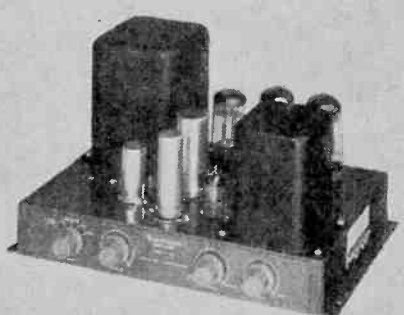


RANGE EXTENDER



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(with cabinet less batteries)

HEATHKIT BROADCAST BAND RADIO KIT

Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5½" PM speaker for good tone quality. Features transformer power supply and built-in antenna. Signal generator recommended for alignment. Cabinet, as shown, available separately. Shpg. Wt. 10 lbs.

Model BR-2

$18.95

(less cabinet)

HEATHKIT CRYSTAL RADIO KIT

Features a sealed germanium diode to eliminate critical "cats whisker" adjustment. Employs two tuning condensers for good selectivity, and covers the broadcast band from 540 to 1600 kc. Requires no external power. Kit price includes headphones. Shpg. Wt. 3 lbs.

Model CR-1

$7.95

HEATHKIT ENLARGER TIMER KIT

The dial of this handy timer covers 0 to one minute calibrated in five-second gradations, so that the timing cycle of a photographic enlarger can be electronically controlled. Built-in relay handles up to 350 watts, and enlarger merely plugs into receptacle of front panel. Also provision for plugging in safe-light. An easy-to-build device that makes a fine addition to any dark room. Shpg. Wt 3 lbs.

Model ET-1

$11.50

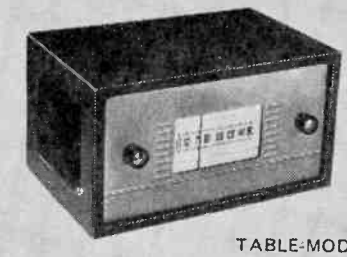
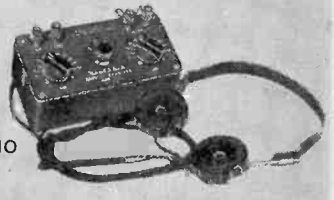


TABLE-MODEL RADIO



CRYSTAL RADIO

ENLARGER TIMER

HEATHKIT FUEL VAPOR DETECTOR KIT

The FD-1 is a safety device to detect fuel vapor in the engine compartment or other sections of your boat. The detector unit mounts in the area to be checked, and the indicating meter and controls mount on the control panel. Will operate intermittently or continuously, and indicates dangers of fire or explosion to protect your boat and its passengers. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from boat batteries. Kit even includes spare detector unit. Shpg. Wt. 4 lbs.

6-volt FD-1-6, 12-vt. FD-1-12

$35.95 each

HEATHKIT RF POWER METER KIT

This handy device measures the RF field in the vicinity of a transmitter, whether it be marine, mobile, fixed, etc. Requires no electricity, nor direct connection to the transmitter. Provides a continuing indication of transmitter operation. Merely place it in proximity to the transmitter antenna and it will produce a reading on its 200 ua panel meter when the transmitter is in use. Operates with any transmitter between 100 kc and 250 mc. Includes a sensitivity control for meter. Shpg. Wt. 2 lbs.

Model PM-1

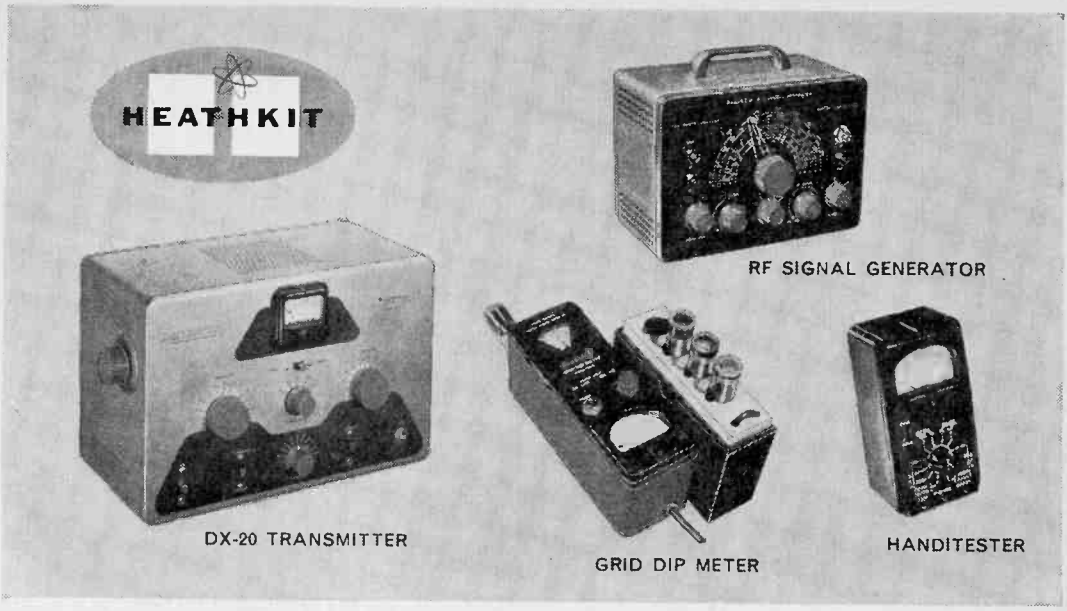
$14.95

HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5⅜" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

Model DF-1

$54.95



HEATHKIT DX-20 CW TRANSMITTER KIT

This Heathkit straight-CW transmitter is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. It employs a 6DQ6A tube in the 50-watt final amplifier circuit, a 6CL6 oscillator and a 5U4GB rectifier. Single-knob band switching covers 80, 40, 20, 15, 11, and 10 meters. The DX-20 is designed for crystal excitation, but may be excited by an external VFO. Pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms.

Model DX-20

Shpg. Wt. 18 lbs. **$35.95**

HEATHKIT GRID DIP METER KIT

An instrument of many uses for the ham, experimenter, or service technician. Useful in locating parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 mc to 250 mc with prewound coils. Use to beat against unknown frequencies, or as absorption-type wave meter.

Model GD-1B

Shpg. Wt. 4 lbs. **$19.95**

HEATHKIT RF SIGNAL GENERATOR KIT

Produces rf signals from 160 kc to 110 mc on fundamentals on five bands, and covers 110 mc to 220 mc on calibrated harmonics. Output may be pure rf, rf modulated at 400 CPS, or audio at 400 CPS. Prealigned coils eliminate the need for calibration after completion.

Model SG-8

Shpg. Wt. 8 lbs. **$19.50**

HEATHKIT HANDITESTER KIT

Measures AC or DC voltage at 0—10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

Model M-1

Shpg. Wt. 3 lbs. **$14.50**

HEATHKIT ETCHED-CIRCUIT VTVM KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit board. AC (RMS) and DC voltage ranges are 0—1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC ranges are 0—4, 14, 40, 140, 400, 1400 and 4000 volts. X1, X10, X100, X10k, X100k, and X1 megohm.

Model V-7A

Shpg. Wt. 7 lbs. **$24.50**

HEATHKIT ALL-BAND RADIO KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image projection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical band spread—antenna trimmer—separate rf and af gain controls—noise limiter and headphone jack. Built-in BFO for CW reception. Cabinet, as shown, available separately.

Model AR-3

Shpg. Wt. 12 lbs. **$29.95**

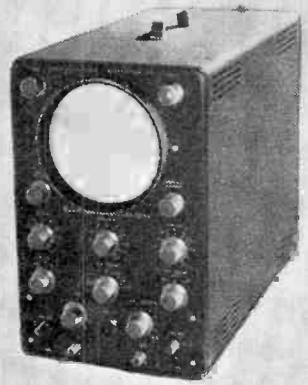
(less cabinet)

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position step attenuated input, and many other "extras."

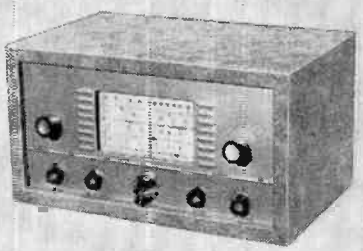
Model OM-2

Shpg. Wt. 21 lbs. **$42.50**



"GENERAL-PURPOSE" SCOPE

VACUUM TUBE VOLTMETER



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Hide Your Bench

(*Continued from page* 80)

The a.c. line has a 5-ampere fuse on each side for safety.

The second shelf has room enough for 24 parts drawers to store resistors, capacitors, hardware and miscellaneous items, while the third shelf will hold copies of P.E., books, schematics and catalogs.

At the top is an adjustable shelf that you will find handy for storing larger tools and projects. The adjustment feature can be installed using commercially available shelf supports.

Assembly. Comparatively simple to put together, the unit should take only three or four hours to construct. The entire cabinet is made of 1" by 10" pine shelving and assembled using nails (8d or 10d size) and wood glue. The drop-leaf door is ¾" plywood.

When the door is closed, it is held tight by a hook-and-eye catch. Brass hinges 2"x½") are screwed to the *front* of the bottom shelf so that the door will close flush with the shelf. Glue a ⅛" piece of tempered Masonite to the back of the door to serve as the work surface.

Mount a ¾" flange on the front panel into which an aluminum pipe can be inserted. The pipe shown was cut from a discarded antenna mast and a cork was set in one end to prevent marring the floor. When not in use, the pipe can be stored on the side of the unit and held there by a broom-handle clip. You can determine the exact length of pipe needed after mounting the cabinet.

The cabinet is held on the wall by means of brackets and rawl plugs and screws, Moly or toggle bolts. The type of fastener used will depend upon the type of kitchen wall you have. If in doubt, consult your landlord or superintendent.

As a finishing touch, the outside of the cabinet can be covered with wallpaper or painted to match the wall. —30—

Electronics Aids Traffic

(*Continued from page* 67)

They are connected to a "differential" receiver, which responds only when it receives two signals of differing intensity.

As long as the car is centered over the cable, the signals balance and nothing happens. As the car moves right or left, one signal increases and the other decreases, causing a response in the receiver. In the test system, this unbalance is registered on a meter in the test car, but eventually it might be used to guide the

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1X2
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2D21
2X2
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3AU6
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3CB6
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3Q5GT
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5AN8
5AQ5
5AT8
5AW4
5AZ4
5J6
5T4
5T8
5U4G
5U8
5V4G
5V6GT
5Y3
5Y4G
6AB4
6AC7
6AG5
6AF4
6AH4GT
6AK5
6AL5
6AM8
6AN4
6N8
6AQ5
6AQ7GT
6AS5
6AS7G
6AT6
6AU4GT
6AU5GT
6AU6
6BU5GT
6AV6
6AX4GT
6BA6
6AX5GT
6BC5
6BC7
6BE6
6BF5
6BG6G
6BH6
6BJ6
6BK5
6BK7
6BN6
6BL7GT
6BQ6GT
6BQ7
6BY5G
6BZ7
6C4
6CB6
6CD6G
6CF6
6CS6
6CU6GT
6E5
6H6GT
6J4
6J5GT
6J6
6K6GT
6L6
6N7GT
6S4
6S7G
6SA7
6SB7Y
6SC7
6SF5
6SF7
6SG7
6SH7
6SJ7GT
6SK7GT
6SL7GT
6SN7GT
6SQ7
6SV7
6SS7
6T8
6U4GT
6U7G
6U8
6V3
6V6GT
6W4GT
6W6GT
6X4
6X5GT
6X8
6Y6G
7A5
7A7
7B5
7B7
7C5
7C6
7C7
7F7
7F8
7N7
7Q7
7Y4
7Z4
12A6
12AH7GT
12AT6
12AT7
12AU6
12AU7
12AV6
12AV7
12AX4GT
12AX7
12AZ7
12B4
12BA6
12BE6
12BH7
12BY7
12CU6
12SA7
12SG7
12SH7
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steering of the car, to keep it automatically on course.

Using such techniques, it would be possible for a car moving in a fog to light a series of lights for about 400 feet behind it, warning approaching cars to slow down. In the same way, a car ascending a hill can light a series of lights ahead of it, over the brow of the hill, not only warning drivers approaching on the opposite side of the oncoming vehicle, but also, by the rate at which the lights go on, giving the drivers an idea of the speed of the other car. This system could well eliminate the passing hazard on hills. The same technique could be used around hazardous curves, of course.

Eventually, these visual signals could be replaced or supplemented by a radio signal which could act on the controls of a car in a dangerous situation to prevent a collision. —30—

Oscilloscope Traces

(*Continued from page* 76)

volts at 10 ma. to the meter circuit. This can be obtained from a 1 to 1 isolation transformer or by using a 6.3-volt filament transformer connected in reverse, with the 6.3-volt winding fed from the heater supply of the 'scope and the primary winding supplying the meter.

In use, the a.c. meter is set at 70 volts by the 10,000-ohm potentiometer. This is an r.m.s. value and is equivalent to 100 volts peak across the divider network. A linear wire-wound control (1000-ohm) adjusts the output from 0 to 10 volts.

The scale can be divided into 100 divisions of 0.1 volt each. Each step of the tap switch will add 10 volts to the output. Any peak voltage value between 0 and 100 volts can be obtained in steps of 0.1 volt.

The voltmeter in the calibrator is used only as a reference setting. Voltages applied to the 'scope are read from the position of the scale and step switch. Peak values of voltage are used because the 'scope trace responds to peak values of a signal.

Accuracy of measurement will depend upon the type of resistors used and the voltmeter. Any ordinary multimeter can be used if set on the appropriate scale. A vacuum-tube voltmeter is *not* recommended because of grounding problems that may occur.

Although the circuits covered above are not complicated, they will add considerably to the number of measurements possible with your 'scope. Additional uses will be suggested in the near future. —30—

Listen to Satellites

(*Continued from page* 46)

itive terminal (cathode) of rectifier *SR1* (S) and terminal 2 of *TS2* (S).

( ) *Final connections:* Install antenna compensating capacitor *C1* in panel holes using *4-40* hardware. Make sure rotor of capacitor does not touch chassis. Install wire from rotor lug of *C1* (S) to center terminal of *J1* (S). Install wire from one stator terminal of *C1* (S) to tap point on coil *L1* (S). Place knob on shaft of capacitor. Install tube *V1* in socket *D* and place shield over tube. Place tube *V2* in socket *F* and tube *V3* in socket *J*. Place overtone crystal in socket. Place 1-ampere fuse *F1* in fuse holder.

Circuit Adjustment

Before applying power to the converter, check your wiring against Fig. 3. For circuit adjustment, you will need a high-impedance vacuum-tube voltmeter and a grid dip oscillator.

Plug a dummy antenna, as shown in Fig. 5 (A), into receptacle *J1*. All of the following tests should be conducted using the dummy antenna.

Turn on the converter and make sure that all tubes light. Measure the various d.c. voltages as indicated at the bottom of Fig. 3; a reading within 10% or so of the indicated value will be considered normal. Finally, adjust the VTVM to the −5 volt scale, and insert probe in test jack *J2*. This reading gives an indication of the oscillator injection into the converter stage.

Capacitor *C13* should be slowly adjusted until a reading is obtained on the meter. The multiplier stage capacitor, *C16*, is now tuned to maximize the reading. With proper adjustment of these two controls, a reading of −3.5 volts should be obtainable. Under proper operating conditions, circuit

SATELLITE PATHFINDER

You can calculate precisely when a satellite will pass over any particular spot in the Northern Hemisphere with a "Satellite Pathfinder." Consisting of two rotatable discs mounted on a base card, this device is available from the Library of Science, 59 Fourth Ave., New York 3, N. Y., or from leading book and department stores for $1.98.

The top disc of the Pathfinder, clear acetate, is for plotting the orbital paths of satellites. The second disc, a map, is rotated beneath the acetate disc, showing how the earth rotates beneath the satellites. You plot an orbit from information given out by the radio and newspapers. Anyone can do it.

C13-L7 is tuned to 49 mc. and circuit *C16-L8* to 98 mc.

Because of minute variations in tubes and components, and because the trimmer capacitors (*C5, C13, C16*) cover only a limited range, the resonant frequency of a circuit might fall just outside the range of adjustment of the trimmers. Under normal circumstances, the trimmer slugs should resonate about half-way in the capacitor. If the slug appears to reach resonance when it is fully within the capacitor, it indicates that inductance of the coil is a little too low. The addition of one turn to *L7* (if the setting of *C13* is out of line), or the addition of ¼-turn to *L8* (if the setting of *C16* is out of line) will bring the circuit into alignment. Conversely, if the slug of either capacitor resonates when it is fully withdrawn from the shell, the inductance of the associated coil is a little too great. Turns should be removed as suggested above. When both tuned circuits are "on the nose," the required voltage will be obtainable at the test jack.

When the converter is connected to your receiver, as shown in Fig. 5 (B), the "background noise level" of the receiver should increase sharply. A random-length wire can be attached to input receptacle *J1* for this test. If the GDO is now tuned to 108 mc., its signal should be audible in the receiver. Many cities have test transmitters operating on 108 mc. If one is available in your locality, you may be able to hear it by tuning your receiver a few kc. either side of 10 mc.

The test signal will resemble an unmodulated carrier. When you find it, tune capacitors *C1* and *C5* to enhance the signal level. Resonate the slug of coil *L6* to 10 mc. to provide maximum signal into the receiver. A slight adjustment (perhaps ½-turn) of coils *L1* and *L2* may be required for exact resonance.

A simple dipole antenna, (Fig. 6) can be used for testing the converter on the air and listening to test signals. Next step is to construct a high-gain beam antenna suitable for satellite tracking. —30—

How Long Did You Use It?

(*Continued from page 86*)

compensate for the use of *unfiltered* d.c. from the half-wave rectifier used as the current source. Its value is 75,000 ohms.

Construction. If you would like to build your own Chronostat, you can use the circuit in Fig. 1. Make sure that the rectifier and indicator polarities are correct.

This simple series circuit should present no difficulties, but it *is* necessary to use

the rectifier specified to insure accurate timing. A higher or lower efficiency rectifier will require a different value of limiting series resistor.

When using a d.c. supply, the best way to determine the needed resistance value is to insert a d.c. milliammeter in series with the indicator and adjust a *variable* series resistor for the correct current flow as shown in Table 1.

The 1000-hour Chronistat shown will

find its most useful application as a diamond stylus life timer for your hi-fi record player. Most diamonds have a playing life of about 1000 hours, and the connection of a 1000-hour indicator across your turntable motor leads will indicate when it's time to check or replace your stylus. —30—

Parts Substitutions

(*Continued from page* 57)

factors governing the choice of a battery are the voltage required, and the life desired under the expected load. When selecting a substitute for a specified battery, simply choose one supplying the same voltage and with a capacity equal to or greater than that of the original unit. If you use a larger battery, you can expect a longer operating life.

If a higher voltage battery is needed, you can obtain it by connecting lower voltage batteries in series. For example, four Burgess Type Z miniature (Eveready Type 915) cells, connected in series, will supply the same voltage with about the same life as the popular Burgess Type Z4 (RCA Type VS068) 6-volt "A" battery.

When similar batteries are connected in parallel, the available voltage remains the same as for a single battery, but the power-handling capacity is increased in proportion to the number of batteries used.

In some cases, you can substitute a

smaller battery of the same voltage for the specified unit. But the battery operating life will be reduced. In addition, discretion must be exercised in choosing a substitute.

For example, an automobile storage battery, rated at approximately 6 volts, can supply a steady drain of 10 to 20 amperes. The Z4, mentioned earlier, would be exhausted rapidly by a current drain of as little as half an ampere. Thus, the Z4 would not be a suitable substitute for a storage battery, even though both units are rated as 6-volt batteries.

Part 2 of this series will deal with the substitution of capacitors. —30—

How to Plan a P.A. System

(*Continued from page 73*)

omnidirectional microphones should be available. If you are limited to a single unit, a cardioid mike is your best choice.

CHOOSING AN AMPLIFIER

An audio amplifier in a p.a. installation need not meet the stringent requirements of one designed for hi-fi work. It should, however, provide ample power, have acceptable frequency response, and introduce a minimum amount of distortion.

Frequency Response. If it is to be used only for voice reproduction, as in a paging system, the amplifier should be reasonably "flat" (within 2 db) from 100 to 8000 cps. If it is intended for both voice and music, it should be flat from about 40 to 15,000 cps.

Distortion. For voice work only, distortion levels up to 10% can be tolerated but, in general, a p.a. amplifier should have less than 5% distortion at full output.

Hum. This should be as low as practicable, at least 50 db below rated output. Even lower levels are preferred, and many quality units are available with hum levels of 70 to 80 db below rated output.

Inputs. At least two are mandatory, one for a microphone and one for a phonograph, with separate controls. For a larger installation, two or more mike inputs should be available, with separate gain (fader) controls, plus phono and tuner inputs. Where more than one microphone input is provided, there should be a master gain control. A tone control is also desirable.

Gain. This will vary with manufacturers' specifications, but most commercial units will supply sufficient gain for normal applications. In general, the unit should provide at least 100-db gain in the mike channel or channels and at least 65-db gain in the phonograph channel.

Output Impedances. Since a p.a. amplifier might be used in a variety of installations, each requiring a different number

of speakers, several output impedances ought to be available. Typical units should provide taps at 4, 8, 16, 250 and 500 ohms.

Power Rating. The power required will depend on several factors: whether an indoor or outdoor installation is planned, background noise which the p.a. system must override, and efficiency of sound reproducers used. A good rule-of-thumb is to allow one watt for each 200 sq. ft. of floor area on indoor installations using cone-type loudspeakers, and 1½ watts for each 200 sq. ft. when using trumpets outdoors. In noisy locations, these figures might need to be doubled or tripled.

For example, if you plan on covering a small auditorium or club room measuring 50′ x 40′, the total area would be 2000 sq. ft., and a 10-watt amplifier would be used. In a noisy location, a 20- or 30-watt unit might be necessary.

Small differences in amplifier power rating are relatively unimportant. A 3-db change in power is required for the human ear just to notice a change in sound level. To obtain a 3-db increase, the power level must be *doubled*. For practical purposes, there is little or no difference between, say, an 8- and a 10-watt amplifier, or between a 24- and a 30-watt unit. When in doubt, use an amplifier with the next highest power rating above that calculated by the rule-of-thumb.

CHOOSING THE LOUDSPEAKER

For an indoor installation, 4″ to 8″ (diameter) *cone-type loudspeakers* can be used for paging and similar voice-only applications, but 10″ or 12″ speakers are preferred for voice-and-music work. Usually, large speakers are more efficient. A small cone-type loudspeaker has an efficiency of about 2%, a 12″ speaker about 5%.

Regardless of speaker size, a suitable baffle must be provided. Small wall baffles or ceiling-installed radial baffles may be used for general installations. Where the system is primarily for background reproduction, better quality sound can be obtained with wall-mounted bass reflex or similar enclosures.

A *trumpet* can have an efficiency ranging up to 15%. Over-all frequency response depends directly upon the length of the trumpet's air column and on the final bell diameter. The *lower* the frequency response, the *larger* the trumpet. Because of this, small paging trumpets for indoor use generally cut off at about 300 to 500 cycles (upper frequency range may be 10,000 to 15,000 cycles), thus limiting their application to voice reproduction. Outdoors, large

trumpets are preferred over cone-type loudspeakers because their higher efficiency minimizes the amplifier power required to overcome the higher background noise.

In addition to the type of program material—voice or music—and the place of installation, choose your speaker or speakers according to the amount of power needed. In general, a speaker system should be capable of handling the *full output* of the amplifier.

ACCESSORIES

Although the microphone, amplifier and speaker make up the basic p.a. system, a number of accessories should be considered when planning an installation.

Mixer. An accessory for an amplifier having a limited number of inputs, this unit has several inputs with separate gain controls, and is used to combine the outputs of several microphones.

Phonograph. This provides background music. Often, a "phono top" can be purchased which fits on the amplifier. A manual record player (turntable and pickup arm) is preferred for general applications, or where records are played between voice announcements. For continuous background music, a record changer is useful.

Radio Tuner. Used both for background music and the distribution of special news broadcasts, a tuner is a radio receiver less its audio amplifier and loudspeaker. For most p.a. work, either an AM or FM tuner is satisfactory, but a combination AM-FM unit may be preferred for de luxe installations and varied programing.

Stands. Except for hand-held and lapel microphones, a mike must be equipped with a stand of some type for support. Three basic ones cover most needs. A desk stand holds the mike from 4" to 10" above a table or desk top, and is used by someone sitting at the table. A banquet stand holds the microphone from 12" to 18" above a table top for someone standing at the table—an "after-dinner" speaker, for example. A floor stand holds the mike up to 65" above the floor for a standing speaker or singer.

The well-equipped p.a. installation should also include spare shielded microphone cables, extension power line cords, and "spares" for any parts likely to become defective in use—fuses, vacuum tubes, and so on—and might include a tape recorder as well. —30—

In a future issue we will discuss actual techniques of making a p.a. installation . . . how and where to place microphones, loudspeakers, and amplifiers . . . how to run the various connecting cables . . . and how to make special installations.

Getting the News—Fast!

(*Continued from page* 62)

kept up transmissions, and his paper was the only one to print the full log of messages.

The roof of the *Times* Building on West 43rd Street is a maze of antennas, all installed under the direction of Mr. Iverson. They are 380 feet above ground.

Although he admits that Midtown New York is not the best site in the world for a radio station, Mr. Iverson finds that cutting his half-wave dipole antennas for the frequency to be monitored gives satisfactory reception. He has installed a large four-element beam antenna for working a specific area—such as the South Pole. For most news transmissions, doublets are used. To increase efficiency, antennas are fed through coaxial cable from the third floor, where the radio room is located, to the 13th floor roof.

The *Times* has come a long way from the carrier pigeon in its striving to gather "All the News That's Fit to Print." Its radio room is one important link in making certain that this newspaper *gets* "all the news." -30-

The Lady Is a Ham

(*Continued from page* 49)

and their families attend all-day "hamfests" held at picnic areas across the country. There are games for the children and prizes for all, but the chief attraction is the opportunity to meet face-to-face the people *with whom* you've talked. Rarely does one's mental picture match up with the real thing: you find that the deep, resonant voice which thrilled you so much came from a little, dried-up man, while the fellow you have been more or less passing over on the air because his voice sounded monotonous and uninteresting may turn out to be a real dreamboat.

But that just makes hamfests all the more interesting. In fact, it is this business of never knowing whom you are going to meet next on the air that makes the hobby so stimulating.

One experience of a friend of mine, a radio operator on an oil tanker, illustrates what romantic surprises the ham bands can hold. He was chatting with an amateur in Saudi Arabia who mentioned that he was the Minister of Communication in that country and who extended an invitation to my friend to visit the capital city the next time the tanker was in port. It was not until my friend received a handsomely engraved card verifying the contact that he

learned that "Talal" to whom he had been talking was actually Prince Talal, son of King Saud. Now I ask you: where else but in ham radio would a poor working girl have a chance to talk to a real live prince?

Public Service. We have been talking mostly about the sheer fun of ham radio, but it is more than that. Whenever a flood, tornado, sleet storm, or other disaster disrupts communications, hams always take over and provide emergency communication. When the first Sputnik started circling the globe without warning, hams leaped into the breach and collected valuable information on the orbiting satellite until Moonwatch could take over.

Slightly less tangible than public service but just as important is the way this hobby pulls people together for mutual enjoyment and better understanding. My own family is united by the hobby, for the frisky little "hambug" which first bit Dad was not satisfied until my mother, brother, sister-in-law and I were all enthusiastic hams. More husband-and-wife teams are heard on the amateur bands each day. It's not at all unusual to hear the wife at the home station talking with her husband as he drives back from work, relaying to him the small events of the day or asking him to stop at a store for a loaf of bread.

The friends of an amateur are not confined to his neighborhood, his town, his state, or even his country. One time he talks to a chum across town, the next time he may be exchanging views and ideas with someone halfway around the earth. This brings home most forcibly how *alike* people and their problems are, no matter where they live, and the regional and national differences between them shrink to insignificance.

Thinking about these things makes me proud of my hobby, but most of the time I am content just to enjoy it. Half the fun comes from telling the girls at the office about my "ethereal" adventures. You should have seen Marcia, who works at the desk next to mine, the winter morning I casually mentioned that I had just kept a rendezvous in Casablanca.

While she listened breathlessly, I related how I sipped my morning coffee at my transmitter as I kept an early morning schedule with Greg, a young research scientist on a special mission in Morocco. This boy really has a line; and as I nibbled my toast he told me of beautiful desert nights and the sight of a full African moon shining on the white sand. He hinted strongly that only one thing was lacking to make such a night perfect.

Of course, I guessed that he meant cit-

ronella, and we laughed and joked the minutes away until I had to go or be late for work. I took my necklace and earrings from where they had been warming atop the transmitter, and as I put them on I signed off with "88", which means "love and kisses" in ham parlance; but I lingered long enough to hear Greg say hastily: "Roger, Carole, and I'll be looking for you tomorrow, same time, same frequency," before I snapped off the switches and dashed for the door.

My Other World. After one of these interesting conversations with someone in a faraway place, it is often almost a physical shock to come back to the everyday world. But it is wonderful to know that my other world is always there, waiting for me. While I'm transcribing dictation at the office, battling through the lunch line at the cafeteria, or helping Mom with the supper dishes, there is always the warm knowledge that whenever I wish I can step onto my electronic flying carpet, rejoin my waiting friends, and roam the world.

If you are looking for a hobby that is truly different, one that will broaden your horizons, spice your conversation, and enable you to make friends by the dozen . . . if you want a hobby that is as interesting as people and as glamorous and exciting as world travel . . . then I most heartily recommend amateur radio. -30-

After Class

(*Continued from page 79*)

gins to rotate back toward the east. Here a synchro system starts the correction action by accepting the gyro's error angle, transmitting it to the synchro motor in the form of electrical "information," and adjusting the position of guidance surfaces to correct the error.

Servomechanisms. Synchro motors are not very powerful devices. They are quite adequate for moving light loads such as pointers, dials, and small control surfaces. If the working load is a heavy one, however, such as the rudder of a passenger ship or a large bomber, the synchros cannot operate it directly. In such cases, the synchro motor is used to control the power input to and the direction of a driving motor of greater horsepower.

In such applications, the synchros form only a part of a larger and more complicated system termed a *servomechanism*. Servomechanisms often contain, as part of the complete system, devices called differential generators and control transformers. These will be described and explained in a future issue. -30-

Transistor Topics

(*Continued from page* 69)

stage. This transformer couples the amplified audio signal to a small PM loudspeaker. Note that *p-n-p* transistors in the common-emitter arrangement are used throughout the receiver.

L1 is a Vari-Loop transistor antenna coil (Lafayette No. MS-299). Feedback coil *L2* is wound on the form of antenna coil *L1*. First unwind the short antenna lead provided with *L1*, then wind about eight turns of #28 enameled wire *loosely* on *L1*'s form, twisting the output leads together so there is no tendency for *L2* to unwind. Make sure that *L2* is readily movable along *L1*'s form, but the winding should not be so loose that it tends to wobble.

With wiring completed and checked for errors, the battery can be installed. The receiver is then turned on and volume control *R1* turned full "up." After tuning to the weakest local station that can be received, *L2*'s leads should be interchanged, with the final connection made using the arrangement which gives maximum volume. If oscillation occurs, *L2* is moved away from *L1*'s winding. If there is no change in volume when *L2*'s leads are interchanged, this coil should be moved closer to *L1*. Once *L2*'s optimum position is determined, it may be secured with a drop of cement.

For maximum performance, you may also want to experiment with the adjustment of *L1*'s tuning slug. Forrest indicates that he obtained good results with about ⅝" of the slug's screw protruding from the coil.

A few tips, Forrest . . . it might be a good idea to add a base resistor to the CK768 stage. Try a 1-megohm resistor, connecting it first between base and emitter, then between base and the minus side of *B1*, using as the final connection the arrangement which gives the best results. In addition, you may find it worthwhile to connect a 0.005-μfd. r.f. bypass capacitor across *R1*.

Transistor Biasing. The base bias current supplied to a transistor amplifier is extremely important in determining such things as stage gain, collector current, power output, and overload points. If *too little* bias current is supplied to a common-

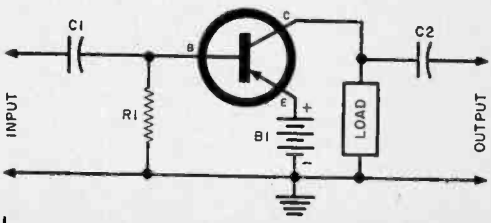

Fig. 2. Basic transistor amplifier stage. See text.

emitter stage, for example, the collector current may be cut off on alternate half-cycles of the input signal, severely distorting the amplified output signal. If *too much* bias is supplied, the collector current may be so high that most of the supply voltage is dropped across the collector load. This, in turn, can cause "clipping" of the amplified signal on alternate half-cycles.

A basic transistor amplifier stage is shown in Fig. 2. In this case, base bias current is supplied through resistor *R1*. The input signal is applied to the stage through d.c. blocking capacitor *C1*, with the amplified output signal obtained through *C2*. Operating power and bias current is supplied by battery *B1*. The output *load* can be a resistor, the primary winding of a transformer, or an i.f. or r.f. coil, depending on the application of the circuit.

If you have trouble in obtaining good performance from home-built equipment, you may find it worth your while to experiment with the size of base bias resistor *R1*. In most cases, this resistor will have a value of from 100,000 ohms to 1 megohm, depending on the transistor used and on the value of the power supply voltage.

The simple biasing circuit in Fig. 2 gives satisfactory results in home-built experimental equipment. In commercial and military circuit design, more complex biasing techniques may be used to improve the stability of circuit operation.

Product News. Magnavox has introduced a fully transistorized portable short-wave receiver which retails for about one hundred dollars *less* than the Zenith and Philco receivers mentioned last month.

On the components front, Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has introduced two components which should be of interest to every transistor experimenter. One item is a new subminiature PM loudspeaker measuring only 1 3/16" in diameter by 9/16" deep. This loudspeaker (SK-96) is supplied complete with a matching output transformer having an 8000-ohm primary impedance, and nets for $1.95 complete. It can be used either as a subminiature loudspeaker or as a miniature dynamic microphone.

The other Lafayette item (PA-47) is an ingeniously camouflaged crystal microphone, which looks and is worn like a real wrist watch. The watch case is chrome-plated with modern gold-finish numerals and hands and is equipped with a tan leather wrist strap. It comes complete with a thin, flexible, light-colored cable about 6½' long.

Allied Radio (100 N. Western Ave., Chicago 80, Ill.) has released its new low-cost

"Trans-Midge" radio kit. Another item in the growing line of Knight-Kits, the Trans-Midge (83 Y 767) is slightly larger than a package of cigarettes and is assembled in an attractive plastic case. Operating power is supplied by a single penlight cell which has a life of many months. Requiring an external antenna and headphones, this kit should be a good "first project." Net price is $2.45 (plus postage).

One further thought before I sign off . . . with Spring approaching . . . and Summer close behind . . . *now* is the time to start that transistorized portable receiver you've been planning to build. . . .

Lou

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Bargain Power

(*Continued from page* 85)

The half-wave antenna has a radiation pattern possessing two lobes (favored directions) of equal intensity, with the greatest field strength appearing at right angles to the wire axis. In other words, a dipole running north and south will radiate best and with equal efficiency to the east and to the west. As the angle of direction from right angle decreases, the intensity of radiation drops off until at the ends of the antenna, north and south, there is minimum radiation.

Now we come to an interesting characteristic of antennas. The power that is *not* radiated to the north and south is actually *added to* the power that is radiated to east and west, and we have achieved a *power gain* in signal strength.

Redesign. We refine our antenna until we finally arrive at a design that squirts the signal in just one general direction. We then construct it, hook on the feedline, crank up the rig, and our E-R-P has been multiplied fully six and one-third times.*

Is the signal actually 6.3 times better than it was with the old half-wave dipole? Yes! At least, it is 6.3 times more *effective,* and that's what we want.

If we shove 100 watts of transmitter power into the new little antenna, we will have just as good a signal *at any given point of reception* as the fellow down the block who is running 630 watts into his half-wave dipole. This is only true, remember, if both antennas are oriented so that their favored directions are toward this point of reception and if both are the same height above ground.

We haven't made something from nothing. We have simply taken most of the

* An antenna with 8-db signal gain gives a power gain of 6.3.

signal radiation away from unwanted directions and added it to the radiation in the wanted direction, thus multiplying its strength and effectiveness.

As a sort of bonus, in the process of redesigning the antenna we made it so compact and easy to handle that it can actually be *rotated,* and the favored direction of maximum signal strength can be in any compass direction we choose.

Bargain Beam. This miracle antenna is a rotary beam, of course, and we'll guarantee that you can increase the effectiveness of your station with it at far less cost than that of multiplying your transmitter power for equal results using the "brute force method."

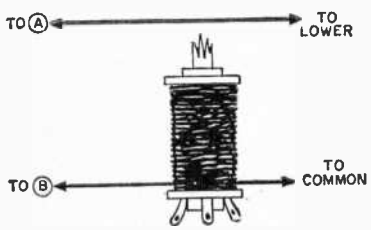
Your XYL will practically insist that you put up a beam when you read this article to her. If she is still hard to convince, here's the clincher! A beam antenna also does wonderful things for your receiver. It will *reject* or, at least, greatly attenuate signals from all directions but the wanted direction! Think what that will do to QRM. -30-

Catch the Vanishing Ball

(*Continued from page* 66)

the relay will release. Then *R1* should be adjusted until the relay just operates, and rotated back until it releases again.

When a hand is brought within six inches of the screen cylinder, the relay should pull in. If it remains latched when the hand is removed, back *R1* off slightly and try again. With careful adjustment of *C1* and *R1,* reliable sensitivity will be obtained for distances of about one foot. Now the leads from the ball solenoid should be connected in series with the relay contact binding



posts (*Lower* and *Common*) and the a.c. line cord as shown in diagram above.

The device you've just built is a gadget and its basic purpose is amusement. But notice that we've designed the relay section so that it can easily be removed and utilized elsewhere. Sales displays can be activated by people approaching store windows, burglar alarms can be set off, safety systems for machine shops can be devised. With a little ingenuity, you'll find that its possibilities are limitless! -30-

Improved Three-Way Crossover

(*Continued from page* 51)

connected *in* phase, both cones (or diaphragms) will push and pull the air in unison. See Fig. 2 (B). However, if an out-of-phase hookup is used, there will be a dip in the output in the region of the crossover frequency because one speaker will "pull" the pressure wave while the other speaker "pushes" it. See Fig. 2 (A).

Few experimenters are aware of the best way to check for improper phasing. All you need is an audio generator with a range covering the crossover frequencies. Hook up your speakers and connect the generator to the input of your crossover (or amplifier). Then sweep the generator's frequency dial through the crossover point. If a drop in volume is heard in the area of the crossover frequency, you can bet you're misphased somewhere!

Solving the Problem. The solution, happily enough, is a simple one. In a two-way system, it's only necessary to switch the leads of *one* of the improperly phased speakers to fill in the "hole" in response. In a three-way system, the job may be a little bit tricky, because as you bring the woofer and mid-range *into* phase you may throw the tweeter *out*. However, keep switching, and you'll make it.

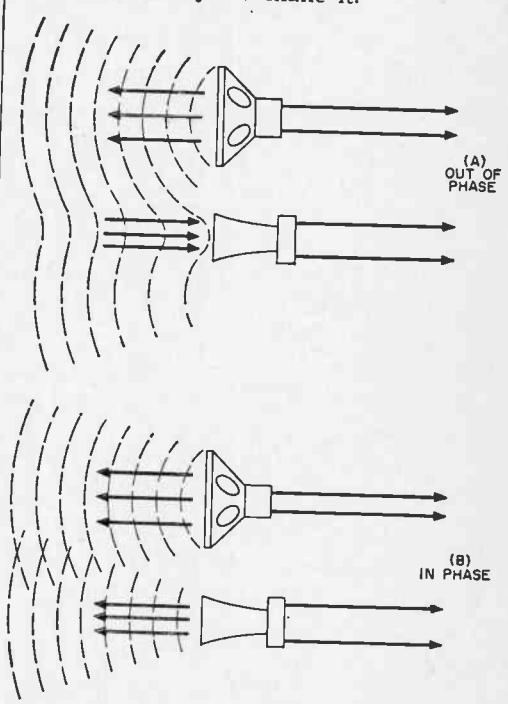


Fig. 2. In systems using a crossover network, cancellation due to misphasing will occur primarily at the lower crossover point. In a two-speaker non-crossover system, bass response is less.

In general, it's a good idea to mount the speakers all in the same plane—and fairly close together. Installing the speakers too far apart might actually throw them out of phase.

In some instances you'll find that with certain types of crossover networks, such as a series quarter-section, it's advisable to mount the tweeter three to ten inches *behind* the plane of the woofer mounting, to compensate for phase shift in the crossover itself. The audio fan, however, needn't concern himself with crossover phase shift when using a circuit such as that in Fig. 1.

For those who don't have an audio generator, the standard battery phase testing technique is recommended. Touch leads of a flashlight battery directly to the voice coil terminals of your speaker. The speaker cone will move in *or* out when contact is made. Mark the terminal connected to the positive pole of the battery with a spot of fingernail polish. Then check the midrange and tweeter in the same manner, making sure that the cones move in the same direction each time. You can check a horn-type tweeter (in which the diaphragm isn't visible) by covering its mouth with thin tissue paper and noting the direction of its deflection when battery connection is made. —30—

Among the Novice Hams

(*Continued from page 83*)

is receiving him, in this manner: ". . . AR W9XXX DE W9EGQ K."

The "AR" between the comments and the call signs indicates that the call signs are not an integral part of the remarks, and the "K" tells W9XXX to transmit. W9XXX will then transmit "W9EGQ DE W9XXX," make his remarks, and stand by for W9EGQ exactly as above.

These two amateurs will then alternately transmit and listen to each other until they have finished their conversation, when they will sign off with each other, so: ". . . AR SK W9XXX DE W9EGQ," and "SK W9EGQ DE W9XXX."

Length of Call. The above "CQ" is known as a 5X2X3 call—CQ five times, the call-sign twice, and the combination repeated three times. Five CQ's to two call-signs is a good ratio, as it results in the letters "CQ" being sent for almost half of the entire call. More than five CQ's before sending your call-sign is undesirable, as the listening operator wants to know who you are without too long a wait.

Sending your call-sign more than twice per round is unnecessary. If conditions are too poor for it to be copied in two attempts,

a successful contact is highly doubtful, anyway.

Theoretically, a long CQ will be heard by more stations than a short one. However, as soon as a prospective customer tunes in your CQ, he wants you to stand by so he can answer you. If the CQ drags along too long, he will usually tune away, looking for another CQ, or he will call CQ himself. Also, when a CQ is too long, interference frequently builds up around it so badly that no operator can tell when the transmission is finished.

The 5X2X3 CQ is a good compromise length. It is long enough to give a listener a reasonable time to locate it, yet not so long that he will get tired waiting for it to end. Another popular length of CQ is the 3X3X3 one, which takes about the same time to send.

Answering CQ's. In answering a CQ, the length of your call should depend upon how far your frequency is from the frequency of the CQ'ing station and how much activity there is on the band at the time. After calling a CQ, most operators listen first on their calling frequency and then on either side of it for replies. Thus, if you reply on or near that frequency, you will be heard quickly if you are going to be heard at all. But if you call on a different frequency, it will take a slightly longer call, to give the operator time to tune to your frequency.

When a band is crowded, answering a CQ more than 20 kc. away from the CQ'er's frequency is usually a waste of time. If he is getting out, he will probably receive a reply very near his own frequency. If not, most operators do not think the results justify the time and effort necessary to comb through a mess of signals off their frequency looking for stations that probably are not there anyway.

When the band is lightly occupied, however, it is usually possible to raise stations quite a distance from the calling frequency. Even then, a long call is not required, as it does not take much time to cover 50 or 100 kc. in a lightly occupied band. A single 5X2 call is usually sufficient. If it is not, you can always make a series of short calls, pausing between them to see if you are successful.

Individual Stations. Whether it is more productive to call CQ or to call an individual station depends on many variables.

If all hams called CQ when they wanted to make a contact, there would be no one to answer them. On the other hand, if they all *waited* for CQ's, there would be no one to call.

If you have a stronger-than-average signal, a good receiver to dig out the replying stations from the interference, and an easy-

to-read "fist," you will normally get excellent results from calling CQ's, especially if you have several transmitting frequencies in the bands you work and try to use the one with the least interference on it.

With a strong signal, your results from calling individual stations will also be good. Being able to select the stations you wish is particularly helpful when you are looking for DX or new states to work. Foreign stations, especially, are much easier to contact by individual calls than by calling CQ.

In any event, your percentage of replies to DX calls is going to be less than to "local" calls because of heavy competition. An important thing to watch out for with foreign DX stations is whether or not they are answering calls on their own frequencies.

If your signal is a bit weak, because you have a very low power transmitter or a poor antenna system, you will get many more replies from calling individual stations than you will from CQ's. Many amateurs who hesitate to answer weak CQ's, because of the possibility of losing them in interference, will reply to any station they hear calling them directly, no matter how weak the signal may be.

A Good "Fist." The value of a good "fist" can never be overestimated in making successful contacts. This is especially true when calling CQ, for if an operator cannot copy your call letters, he cannot answer you. Or, if it is difficult to copy them, he will probably decide that it wouldn't be much fun to try to work you, since you cannot even send your own call letters well.

If you send too fast, many listeners will be unable to copy you, no matter how good your sending is. Also, if you send faster than you can receive, the replies will usually be too fast for you to copy, because good operators adjust their speed to that of the other fellow's CQ.

News and Views

It took six weeks for **Ron, KN7BYZ,** to receive his Novice license. But in his first week on the air he made 26 contacts in five states. He excites a 33′ vertical "ground plane" antenna with a Heathkit DX-20 transmitter running 50 watts and receives with a Hallicrafters SX-99 connected to a 136′ receiving antenna . . . . . **Bill, W7ZDP,** must be a DX chaser. His Heathkit DX-35 transmitter and National NC-98 receiver have accounted for 25 countries in all continents, but his WAS total is only five states! Africa was the hardest continent for him to work—he did it with a 75-meter dipole antenna . . . . . **Al, K2UNR,** has worked 46 states, 45 confirmed, and six countries—including Hawaii, England, Italy, and Germany—in 14 months on the air. He transmits with a WRL Globe Scout feeding an 80-meter "Windom" or a 20-meter folded dipole, and receives with a

RME-69, plus a preselector. Al has a 25-wpm code certificate and would like to arrange schedules with North Dakota and Wyoming to complete his WAS.

Paul, KN8DJF, lost his Novice license recently but hopes to get his General soon. As a Novice, he worked 32 states, Canada, and Mexico on 40 meters. Most of his contacts were made using a Knight "Ocean Hopper" receiver. Now he has a Heathkit AR-3 and a DX-20 transmitter . . . . . **Marge,** who forgot to include her address, reports that **KN9HOB** made 71 contacts in 14 states in his first month on the air and wonders if he should get any credit for it. Well, the record speaks for itself, and KN9HOB must have had a lot of fun making so many contacts . . . . . **Bud, KN4SSM,** works 15 meters almost every afternoon and has worked 11 states. He runs 75 watts to his WRL Globe Chief transmitter and receives with a National HRO-60. He has that "beam gleam" in his eye, as he wonders how a Cubical Quad would work with the Globe Chief.

Richard, WN6NQM, decided while reading the *News and Views* section of this column before getting his license that 15 meters was the band for him. In three and a half months on the air, all on 15 meters, of course, he has made 90 contacts in 30 states, Hawaii, and two Canadian provinces. Dick is a junior in high school and does most of his operating Saturdays. The equipment at WN6NQM includes a Heathkit DX-100, running 75 watts and feeding a 15-meter folded-dipole antenna. He receives on an AR-3, and there is a 15-wpm code-proficiency certificate on his shack wall. Flash! Dick just put up a Cubical Quad antenna and added two new states to his total with the first two contacts on it. And, as soon as he gets a 40-meter antenna, he will be on 40 meters, too.

From Anchorage, Alaska, **Jim, WL7CIW,** has worked 32 states, Russia, Holland, and a large number of Japanese amateurs in three months on 15 meters. He uses a Globe Chief transmitter feeding a 15-meter dipole. Jim is looking for schedules in the fourth and fifth call areas. About all he has been able to work there so far is Texas . . . . . **Doug, KN4QDZ,** has two peeves. They are hams who won't "rag-chew" and those who have never tried to learn anything about good operating procedures and apparently do not intend to do so. He has worked 15 states in a couple of months on 40 meters and is about ready to try 15 meters with his DX-20 and old RME-69 receiver.

Stissing Lake Camps is looking for an amateur with a General Class license and at least 20 years old who will come up for the summer. This is a co-ed camp, with radio as one of the activities. Previous camp experience is desirable but not essential. If you are interested, write to: Norman B. Weingrow, Director, 70 Stratton Road, Scarsdale, N. Y.

Pat, KN4RWO, who is *not* a YL (young lady: girl), runs 75 watts to his Globe Chief transmitter to excite a 67' antenna on 40 and 15 meters, and receives through an SX-99. In a few weeks, he has worked both coasts . . . . . **Bob, KN3BYV,** averages about two

hours a day on the air and has worked 29 states with 25 confirmed, mostly on 15 meters. When he gets "brave enough or crazy enough to fight" the QRM (interference), he operates on 40 meters, too. Bob's transmitter is a Johnson Adventurer and his receiver is a Hallicrafters SX-100 . . . . . **Pete, KNØMGA,** has been beating a hole in the 40-meter band with his "Sandwich Box" transmitter running 10 to 12 watts input. In 3½ weeks of operation, Pete has made 63 contacts in 13 states. He drags in the stations he works with a Hallicrafters S-85, and the signals get in and out of KNØMGA through a 40-meter dipole, 30' high.

Frank, KNØJPJ, is now a member of MARS (Military Affiliate Radio System) with the call letters of AAØJPJ and WR10AA, and is active in traffic work. He has a selection of six antennas to feed his Johnson Adventurer into, and he receives on an S-85. His DX record is Hawaii, Alaska, Puerto Rico, Canada, and Newfoundland . . . . . **Rusty, K4QIF,** received his General ticket after five months as a Novice and offers to help prospective Novices get their licenses. He will sked anyone needing a North Carolina contact and card. Rusty is now on 40 meters but will be on all bands when his new Adventurer transmitter comes . . . . . **Nick, KN9KLR,** jumps around between 15, 40, and 80 meters. In a month of jumping, he has worked 30 states, 22 confirmed. His transmitter is a WRL Globe Scout-66, feeding a 40-meter doublet 30' high. He receives on an S-85 with a Heathkit Q-Multiplier added for additional selectivity. Nick also offers to help prospective amateurs get their licenses.

Stephan Cohen, K2CYZ, 1900 Quentin Road, Brooklyn 29, N. Y., offers to help prospective amateurs with theory, and **John A. Barolet, W3BUD,** 32 Salamaua Court, Lexington Park, Md., reports that St. Marys County, Md., RACES program needs more hams. John, who can be reached by telephone at C.D. headquarters, Leonard Town, offers help and advice to prospective amateurs too.

Contributors to News and Views: **Ron Childs, KN7BYZ,** RR. #2, Davenport, Wash.; **Bill James, W7ZDP,** Rt. 6. Box 335, Vancouver, Wash.; **Alan D. Robinson, K2UNR,** 1234 Long Pond Rd., Rochester 15, N. Y.; **Paul F. Piotrowski, KN8DJF,** Box 387, Amsterdam, Ohio; **James T. "Bud" Johnson, KN4SSM,** 815 Coleman St., Raleigh, N. C.; **Richard Degerman, WN6NQM,** Route 1, Box 26-B, Hughson, Calif.; **Jim Sutton, WL7CIW,** (15), 1705 Lake Otis Rd., Anchorage, Alaska; **Douglas Jordan, KN4QDZ,** (13), 4052 Allison Ave., Memphis 17, Tenn.; **Pat Burke, KN4RWO,** (11), 1000 McMahon Ave., Nashville 6, Tenn.; **Bob Mantell, KN3BYV,** Box 47, Gambrills, Md.; **Pete Black, KNØMGA,** 5730 Riggs, Mission, Kans.; **Frank Gilmore, KNØJPJ,** Route 2, Box 286A, Springfield, Mo.; **Rusty Holshouser, K4QIF,** Route 1, Box 212, Salisbury, N. C.; **Nick Lash, KN9KLR,** (14), 4360 Massachusetts St., Gary, Ind.

Write in and tell us about your station. Until next month, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 90)

if it is considered of value to the station.

Be sure to include return postage. In letters going to other countries, an International Reply Coupon—which costs only a few cents and is available at your Post Office—should be enclosed. There are some stations that do not require return postage but many of the smaller stations are operated on a limited budget.

The most agonizing part of the short-wave hobby is waiting to receive that verification. How fast your reply comes often depends on how much a station values your report. Subsequent reports are always appreciated for they tell the station owners whether their signals are still reaching into your area.

Current Station Reports

The following is a compilation of the latest reports received. All times shown are Eastern Standard and the 24-hour system is used. Although all schedules are as correct as possible at time of writing, we cannot guarantee 100% accuracy as stations often change their schedules with little or no advance notice being given.

Afghanistan—A verification from Kabul lists the Eng. session as being at 1040 on 18,640 kc. They state that their reception in Texas and other southern states is satisfactory but that they receive only occasional reports. *(DT)*

Andorra—*Radio Andorra* can be heard daily in Spanish from 1530 fade-in to 1730. ID is a gong followed by the anmt: "Aqui Radio Andorra—Roc de les Anelletes Andorra la Vieja—Principado de Andorra." This one is on 5978 kc. *(104)*

Angola—CR6RF, *R. Clube de Benguela,* Benguela, 9502 kc., reports that they have been undergoing a reorganization and have been unable to answer reports during the last few months. QSL cards are on order in Lisbon and will be sent out upon arrival. *(7)*

Australia—VLX6, Perth, (Home Service regional station), has moved from 6130 kc. to 6140 kc. and operates as follows: 0520-1030 weekdays (Sundays from 0430) and 0515-1100 on Saturdays. *(61)*

British Guiana—ZFY, Georgetown, is widely reported on 5981 kc. with commercial programs in English. News at 0545. *(DF, RM, 298, 348)*

Canary Islands—*Radio Atlantico,* REM34, Las Palmas, sends a nice QSL card showing a relief map of the Canary Island chain. The schedule is: 0800-1030 and 1400-1900 on 7000 kc., 30 watts; and 0800-1030 and 1700-1900 on 9490 kc., 300 watts. *(MEC)*

China—Peking is being noted at 2000-2100 on 17,745 and 15,060 kc. to South America in Spanish and Portuguese. This is especially strong on the West Coast. *(400)*

Costa Rica—TIFC, San Jose, 9645 kc. (good), and 6037 kc. (rarely heard), carries an Eng. program at 2300-0000. They are ask-

ing for reports, especially for the m.w. outlet on 990 kc. Reports should go to Box 2710, San Jose. *(CK)*

Ecuador—An easy station to log is HCJB, Quito. They carry "Ecuadorian Echoes," a religious program in Eng., at 2100-0000 on 15,115, 11,915, and 9745 kc., and also on 6050 kc. at 2300-0000. Address for reports is: Casilla 691, Quito. *(BK, BS, 336, 348)*

Egypt—Cairo is being noted on 6970 kc. from 1703 and on 7318 kc. from 1623 with Arabic chanting. The latter outlet has QRM from London on 7320 kc. *(166)*

Another Cairo outlet on 11,990 kc. is noted at 1525 in German and at 1600-1615 in English with news at opening. *(AN)*

The 17,915-kc. outlet for Cairo also carries Eng. at 1500-1520 with news to 1510 and various short items to closing. *(CK)*

El Salvador—A rarely reported station is YSS, *Alma Cuscatleca*, San Salvador. On 6010 kc., it is tuned at 0105-0135 with classical music and Spanish. Listeners must dig deep in the QRM to find this one! *(BP)*

Formosa—*The Voice of Free China* is scheduled as follows: to N.A. and Hawaii at 2030-2100 (news at 2030) on 17,810 and 15,345 kc.; to Japan and Korea at 0530-0640 (Eng. news at 0600-0620) on 11,815 and 15,345 kc.; to Southeast Asia at 0700-0800 with "The Little Dragon" show in Eng. on 11,815, 15,345, and 15,225 kc. and at 0800-0900 in Mandarin on 11,815, 15,345, 15,225, and 11,840 kc. The 0900-1100 segment in Chinese dialects is carried only on 11,840 kc. An Arabic xmsn to the Middle East is carried on 15,225 and 11,815 kc., Monday through Saturday, at 1420-1440. The address for reports is: *Voice of Free China*, New Park, Taipei, Taiwan, Formosa. *(SZ, 126, 158)*

France—*Radio Paris* is easy to log during the 1230-1250 French xmsn to Canada on 17,850 and 21,740 kc. They have one Eng. period, 0900-1000, on 7240 kc. *(SW, 313)*

French West Africa—*R. Dakar* now has a new Eng. news broadcast on Tuesday, Thursday, and Saturday at 1730-1740 on 11,895, 7171, and 5960 kc. Reports go to: *Radiodiffusion Federale De L'Aof*, 58 Avenue de la Republique, Dakar, Senegal, F.W.A. An International Reply Coupon is required. *(104)*

Germany—*R. Deutsche Welle*, Cologne, is operating on the following new schedule: 1700-2000 to South America and 2030-2330 to N.A. on 15,375 and 11,795 kc.; 0200-0500 to the Far East, N.Z., and Australia on 21,650 and 11,795 kc.; 0930-1230 to Near East on 21,490 and 17,815 kc.; and 1300-1600 to Africa on 17,815 and 15,275 kc. *(JA, AR, RS, 61, 330)*

Greenland—*Grønlands Radio* will have no

xmsns in the s.w. bands during 1958, according to a letter from the station. The only outlets are from Godthab (570 kc.), Godhavn (650 kc.), and Frederikshab (630 kc.). The s.w. outlet formerly was on 9526 kc. *(7)*

Guatemala—TGNA, Guatemala City, has an Eng. religious program at 2200-2345 on 5952.5 and 9668 kc. Other outlets are on 11,850 and 720 kc. The stations on 15,100 and 17,870 kc. are inactive. Spanish broadcasts from TGNA were noted at 0730-2200 (replacing 0730-0900 and 1730-2200). *(WD, JF, JM, 196, 223, 348)*

Honduras—*R. Morazan*, HRNQ, Tegucigalpa, moved from 6200 kc. to 6086 kc. and is being well heard at 1900-2300. *(AN, 100)*

India—*All India Radio*, Delhi, has Eng. newscasts on 15,105 kc. at 1045, on 11,710 and 9595 kc. at 1445 (to United Kingdom), and on 17,850 and 15,105 kc. at 2130-2145. *(348, 400)*

Iraq—Baghdad has a new high-power xmtr on 6190 kc. that is being noted well in Arabic at 2255 s/on, in parallel to the new 7180-kc. channel. *(100)*

Italy—*Radio Roma* operates to N.A. at 1930-1950 with Eng. news and music and from 1950 with French to Canada on 15,400 and 11,905 kc. Reports go to *Radio Roma*, P. O. Box 320, Rome, Italy. *(CK, 286)*

Kashmir—*R. Kashmir*, Srinigar, has moved from 4860 kc. to 3277 kc. and operates in Kashmiri, Urdu, and Eng. at 0930-1230. Eng. news at 1030. Stateside listeners won't stand much of a chance of hearing this but reports from Europe indicate fairly good reception. Before the change of frequency, the station was noted on the West Coast at about 0830 with *All-India Radio* relays at times. *(31, 61, MEC)*

Liberia—ELWA, Monrovia, is being tuned in western states as follows: 1100-1430 on 11,980 kc. with Eng. news at 1300; 0000-0130 on 11,980 kc. with Eng. to 0100 and French to s/off; 0145-0230 on 4770 kc. with Eng. news at 0200 and fade-out by 0230. *(400)*

Libya—*Radio Tripoli* is heard weakly from 1428 but with a better signal at 0015 s/on to 0100 s/off. This xmsn is also in Arabic. *(AN, 166)*

Luxembourg—*R. Luxembourg*, Villa Louigna,

Henry Lehmberg, Feasterville, Pa., uses a Hammarlund HQ-120 receiver and a RME DB-22A preselector.

is noted on 6090 kc. with religious and musical programs in Eng. to England until 1930 s/off. *(324)*

Madagascar—The latest schedule of *Radio Tananariva* is: French network—at 2230-0030, 0400-0600, and 1000-1430 weekdays and 2300-0245, 0330-0600, and 0915-1430 Sundays on 9515, 6172, and 3232 kc. (3232 kc. is 5 kw., the others 1 kw.); Malgache Network—at 2230-0000, 0320-0530, and 0900-1200 weekdays and 2300-0045, 0330-0600, and 0900-1200 Sundays on 7155 and 3386 kc., both 1 kw. *(MEC)*

Malaya—British Broadcasting Corporation Far Eastern Service, Singapore, is noted on a new channel of 11,780 kc. at 0615 with BBC news relay. *(158)*

Radio Malaya, Singapore, 9650 kc., is tuned from 0815 with classical music but covered by the VOA-Honolulu outlet from 0825. *(166)*

Morocco—*Radio Sebaa-Aioun*, Rabat, has been tuned on 5968 kc. from 0225 in Arabic to 0330 s/off. Listen carefully for the Arabic ID *Huna Sebaa-Aioun Maroc. (61)*

Norway—*R. Norway*, Oslo, is heard daily to Norwegians Abroad at 0600-0700 and in the Home Service at 0700-0720, Sundays with "Norway This Week" in Eng. at 0700-0725, all programs on 11,735, 15,175, 17,825, 21,760, and 25,900 kc. *(CG)*

Pakistan—*R. Pakistan*, Lahore, is on the air with three xmsns as follows: 4807 kc. at 2100-2230 weekdays, 2100-0030 Saturdays; 7225 kc. at 0130-0330 daily; 7096.6 kc. at 0630-0815 and 4807 kc. at 0830-1200. The xmtr used on 4807 kc. is a 1-kw. RCA unit. *(MEC)*

Karachi is being heard on the following channels: 15,280 and 11,915 kc. at 1030-1045 with dictation-speed Eng. news; 15,335 and 11,885 kc. at 1930-2015 and 2045-2200 with Eng. news at 2000 and 2130; 21,580 and 17,750 kc. at 2245-2345 in Urdu; and 11,674 and 9705 kc. at 1315-1400 with Eng. news being broadcast at 1330. *(400)*

Another new outlet for Karachi has been noted on 15,155 kc. at 0845-1015 with a Home Service relay. *(100)*

Portugal—Lisbon is now using 6374 kc. for the 1300-1900 Home Service relay, replacing 11,996 kc. *(100)*

Spain—*Radio Nacional Espana*, Madrid, has returned to 9363 kc. in the N.A. service at 2215-2250, 2315-2350, and 0015-0050, and has vacated 9585 kc. for the time being. The 9363-kc. channel is dual to 6130 kc. *(EL, AN, MR, DS, 59, 61, 192, 223, 298, 333)*

Another xmsn is noted from the *Voice of*

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corporation
Eng.—English
ID—Identification
kc.—Kilocycles
m.w.—Medium wave (broadcast band)
N.A.—North America(n)
N.Z.—New Zealand
QRM—Station interference
QSL—Verification
R.—Radio
s/off—Sign-off
s/on—Sign-on
VOA—Voice of America
xmsn—Transmission from station
xmtr—Transmitter used by station

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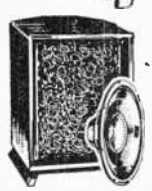

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Spain at 1545-1800 with Eng. news and music at 1545, French to 1620, German to 1640, then into Spanish. *(234)*

Sudan—According to a recent letter from N. A. Khangi, Controller of the *Sudan B/C Service*, new studios and xmtrs are presently under construction and should be inaugurated by July, 1958. No further details were supplied. *(MEC)*

Surinam—*R. Surinam*, Paramaribo, is being heard very well on 15,406 kc. at 2000 with American pop records and the ID *Radio Surinam. (286)*

Sweden—*R. Sweden*, Stockholm, has two sessions to N.A. daily, at 0900 on 17,840 kc. and at 2030 on 11,810 and 9620 kc. Both programs consist of news and comments. *(303)*

Syria—The Syrian B/C Service, Damascus, is heard well with Eng. news at 1515-1530 on 15,165 kc. Reports go to the SBS at Rue de la Victoire, Damascus. *(348)*

SHORT-WAVE CONTRIBUTORS

John Arendt *(JA)*, Aurora, Ill.
William Donoghue *(WD)*, West Chester, Pa.
Doug Ferris *(DF)*, Bakersfield, Calif.
John Fredricks *(JF)*, Yakima, Wash.
Chuck Gilmore, Jr. *(CG)*, Boston, Mass.
Bob Kinnear *(BK)*, Cornwall, Ontario
Chuck Kershner *(CK)*, St. Albans, Vt.
Earl Lafon *(EL)*, Oklahoma City, Okla.
Joseph Merritt *(JM)*, Atlanta, Ga.
R. M. Mainwaring *(RM)*, Woodhaven, N. Y.
A. R. Niblack *(AN)*, Vincennes, Ind.
Bob Palmer, *(BP)*, Spokane, Wash.
Chris Pamataitis *(CP)*, Chicago, Ill.
Adolf Roehl *(AR)*, Torrington, Conn.
Mike Reagan *(MR)*, Cincinnati, Ohio
Bill Schmidt *(BS)*, St. Joseph, Mich.
David Schob *(DS)*, Chicago, Ill.
Riley Sundstrom *(RS)*, Stockton, N. J.
Dave Thomas *(DT)*, Proctorville, Ohio
Sherman Warner *(SW)*, Honolulu, Hawaii
Stanley Zagaski *(SZ)*, Norwich, Conn.
Bill Flynn *(7)*, Pittsburg, Calif.
Gordon Nelson *(31)*, Inglewood, Calif.
Grady Ferguson *(59)*, Charlotte, N. C.
John Beaver *(61)*, Canon City, Colo.
Roger Legge *(100)*, McLean, Va.
Ed Kowalski *(104)*, Phjladelphia, Pa.
Bob Derabertis *(126)*, New Hyde Park, N. Y.
Albert K. Saylor *(158)*, Quantico, Va.
George Cox *(166)*, New Castle, Del.
Danny Ferguson *(192)*, Columbia, S. C.
Richard Woodyatt *(196)*, Scranton, Pa.
David Crockett *(223)*, Winston-Salem, N. C.
Jack Hughes *(234)*, Montreal, Quebec
Maurice Ashby *(286)*, Wichita, Kansas
Robert Miller *(298)*, Philadelphia, Pa.
Hank Reixach *(303)*, Springfield, Md.
Denny Avers *(313)*, Keyser, W. Va.
Richard Miller *(324)*, Englewood, N. J.
Cleveland Billey *(330)*, Mahaica, British Guiana
Ken Bakhaus *(333)*, South Lyon, Mich.
James Bannister *(336)*, Brampton, Ontario
Glenn Cuthrell *(348)*, Maxton, N. C.
August Balbi *(400)*, Los Angeles, Calif.
A Middle East Correspondent *(MEC)*

Tahiti—News and music from the South Pacific can be heard over *R. Tahiti*, Papeete, 6135 kc., at 0230-0245 daily. S/off is at 0245 in French. This one usually has a strong signal with little or no QRM. *(CP, 298)*

Silent Station—Regular readers and contributors to this column will be saddened by the news of the death of Bill Berger, reporter No. 8, Fairfax, Oklahoma. Bill passed away unexpectedly while attending the University of Oklahoma. Our sympathy is extended to his parents, Mr. & Mrs. Roy Berger. —30—

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Model 76 ..... $26.95

Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

Superior's New Model **76**

IT'S A CONDENSER BRIDGE
IT'S A RESISTANCE BRIDGE
IT'S A SIGNAL TRACER
IT'S A TV ANTENNA TESTER

Specifications

✓ CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the *power factor* of all condensers from .1 to 1000 Microfarads.

✓ RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ SIGNAL TRACER SECTION
With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, locate distortion and hum, etc.

✓ TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

Complete with R.F. and A.F. probes and test leads $26.95 Net

Model 670-A $28.40

Terms: $7.40 after 10 day trial then $3.50 per month for 6 months.

Superior's New Model 670-A

SUPER-METER

A Combination VOLT-OHM MILLIAMMETER PLUS Capacity, Reactance, Inductance and Decibel Measurements

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts • A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts. • D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes • RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms • CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad-scale for checking quality of electrolytic condensers.) • REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms • INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries • DECIBELS —6 to +18, +14 to +38, +34 to +58.

Complete with test leads $28.40 Net

Model TV-60 ..... $52.50

Terms: $12.50 after 10 day trial then $8.00 per month for 5 months.

Superior's New Model TV-60

20,000 OHMS PER VOLT

ALLMETER

Includes services never before provided by an instrument of this type. Read and compare features and specifications below!

FEATURES:
- Giant six inch 40 Microampere meter with mirrored scale.
- Built-in Isolation Transformer.
- Use of the latest type printed circuit and 1% multipliers assure unchanging accurate readings.

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1,500/7,500/30,000 Volts.

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2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES: —6 db to +58 db.

RF SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R. F. Signal Tracer Probe and Audio Signal Tracer Probe. Pilofilm bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY $52.50 Net

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Superior's New MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

- Model 77 completely wired and calibrated with all accessories (including even portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN AC VOLTMETER: Measures RMS value if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

SPECIFICATIONS

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak) — 0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench — use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only ..... **$42.50 Net**

Model 77 ..... $42.50

Terms: $12.50 after 10 day trial then $6.00 per month for 5 months.

Superior's New Model TV-40

PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY $15.85

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

- Tests all magnetically deflected picture tubes from 7 inch to 30 Inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube case (Ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only **$15.85 Net**

Model TV-40 ..... $15.85

Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

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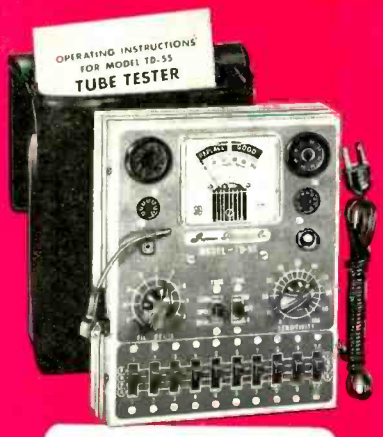

Model TD-55 ..... $26.95

Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

Superior's New Model TD-55

EMISSION TYPE TUBE TESTER

FOR { **The Experimenter or Part-time Serviceman**, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Testers for its field men.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar ty es.

You can't insert a ube in wrong socket It is impossib to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum.

Checks for shorts and leakages between all elements

The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

Elemental switches are numbered in strict accordance with R.M.A. Specifications. The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case **$26.95 Net**

Model TW-11 ..... $47.50

Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

- **Tests all tubes, including** 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Navals, Subminars, Proximity Fuse Types, etc.
- **Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system. Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.**
- **Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.**

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet **$47.50 Net**

TRY FOR 10 DAYS

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