

14 Construction Articles

POPULAR ELECTRONICS

SEPTEMBER
1958

35
CENTS

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Converting to Stereo

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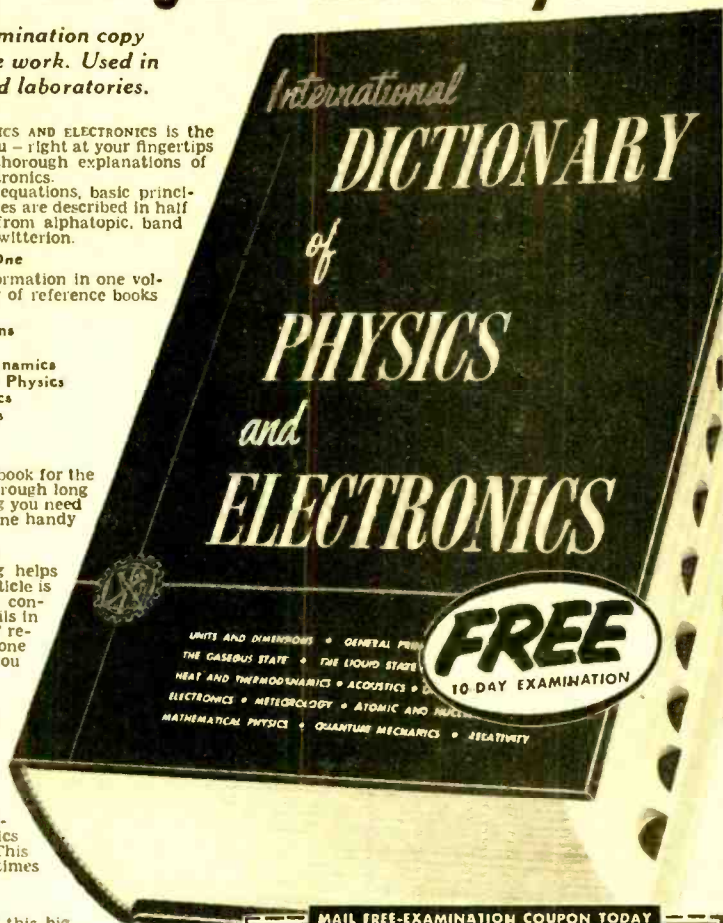
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SEPTEMBER 1958



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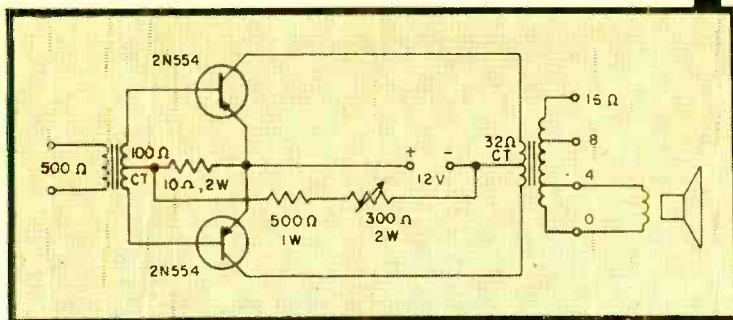
Symbolic of the Space Age to come is next month's cover. The accompanying article gives the lowdown on electronic equipment inside an Earth-bound satellite—as constructed by a reader. Completely workable in every respect except that it will never be launched, Argus I took second prize at the recent National Science Fair. At the mere pressure of a button on the radio control transmitter (at left), the transistor circuits in the satellite—modified from designs originally published in POP'tronics—reel off a series of outer space facts in code form. This information is picked up by a Heathkit receiver.

How to . . . steal power radiated from a nearby radio station and use it to power a batteryless transistor receiver . . . build a switching system for setting up a stereo hi-fi system . . . and make an efficient Yagi antenna for listening to satellites . . . these are some of the projects planned for the October issue.

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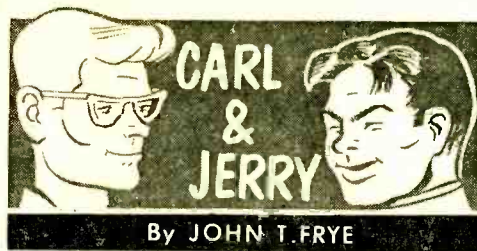
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Vox Elektronik

JERRY was looking for his pal, Carl. The latter's mother said she had not seen her pride and joy for a couple of hours. And Bosco, the dog, only yawned widely when ordered: "Go find Carl!"

This was puzzling. Losing big, rambunctious, noisy Carl was like misplacing a B-47 on a small-town airfield. As Jerry stood in the back yard mulling over the mystery, he heard faint, strange sounds coming from the garage on the rear of the lot. He tiptoed across the grass and placed his ear against the closed door. A strangled, falsetto voice inside was piping:

"The little boy threw the onions into the river because he wanted to see the River Kwai."

Not waiting to hear more, Jerry threw the door open and beheld a strange sight in the shadowy interior. Carl was sitting Indian-fashion on the garage floor. Perched on his knee was a very battered, limp-legged ventriloquist's dummy, and on the floor at his side was spread open a small booklet boldly entitled *Throw Your Voice*. Carl's mouth was drawn back in a horrible grimace and the leaders in his neck stood out like ropes as he tried to project his voice into the slack-jawed dummy.

"Oh, it's you," Carl greeted Jerry. "I might have known a man couldn't have any privacy. But since you're here, take a listen and see if it sounds as if my voice were coming out of this refugee from a toothpick factory."

He screwed his face back into its former distorted shape and grated: "Pancakes are like der sun because they rise in der yeast and set behind der vest."

Jerry shook his head emphatically from side to side. "Nope; it sounds as if you were trying to talk as you went under for the last time."

"Yeah, I know what you mean," Carl said disconsolately as he released the dum-

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






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Carl & Jerry (Continued from page 8)

my and let its wooden head bang on the concrete floor. "But I've simply got to do something to show Linda that this new guy, George, isn't the only satellite in orbit."

Jerry's round face puckered into a worried frown.

"How come that's important? What do you care what a girl thinks?"

"Well, this George really sears me. At Linda's party Saturday night, I was telling her about how we helped the sheriff catch those moonshiners when this George character drags out his dummy and begins to carry on a corny dialogue with him. After that, Linda just couldn't seem to see anyone but George.

"I've simply got to show her that I could be a ventriloquist too—and a much better one than George—if I really wanted to. That's why I swapped Milo Perkins my trumpet for this bunch of kindling and the book to go with it. Milo said he got everything he knew about ventriloquism out of this book."

"Did you ever hear Milo do any voice throwing?" Jerry wanted to know.

"Why, come to think of it, no! Why, that dirty crook!"

"From the little I've read about ventriloquism, it takes a long time to learn to create the illusion, unless, of course, you have a natural talent," Jerry said.

"Frankly, Carl, I take a dim view of the whole business. I thought we felt the same way about girls: there will be plenty of time for them later, but right now you and I can have lots more fun with electronics."

"I know," Carl said miserably; "but I still can't stand being made to look like a dope in front of Linda—at least not by a porch-swing poodle like George. Anyway, we're pals, aren't we?"

"You know we are," Jerry answered in gruff embarrassment.

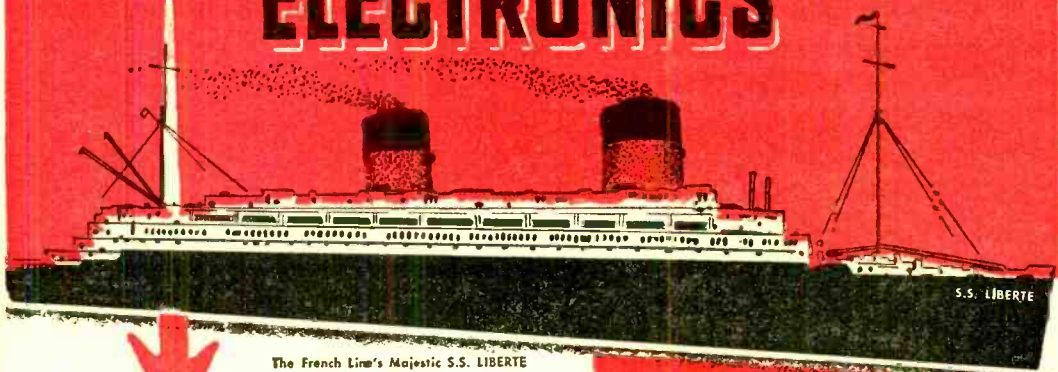
"Well, a pal helps a pal, no matter whether the pal likes what the pal is doing or not," Carl said with more conviction than clarity.

Jerry heaved a sigh of submission and picked the dummy off the floor. "Hm-m-m," he mused, "there's plenty of room inside the body for a transistorized receiver and a miniature loudspeaker. We can spring-load his jaw so that it's nor-

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Carl & Jerry (Continued from page 10)

mally closed and a pull on this cord will open it. Audio voltage picked off the receiver and rectified with a germanium rectifier will produce pulses of d. c. which can drive a high-current transistor with a solenoid in its output circuit. This solenoid will give a yank on the jaw cord with every syllable of the voice picked up by the receiver."

"**I** GET IT!" Carl said, jumping to his feet. "You're *really* going to throw your voice, right through the ether waves! You'll be hiding somewhere and talk back to me through the little transmitter."

"Uh-uh!" Jerry denied. "You're *really* going to throw *your* voice. You'll wear a throat mike concealed by your collar. A switch will cut this mike in when the dummy talks and cut it out when you talk. All you have to do is learn to talk without moving your lips very much when the dummy is supposed to be talking. The little transmitter in your pocket and the receiver inside the dummy will take care of the actual voice-throwing."

"That's the end, the absolute end!" Carl applauded excitedly. "Let's get going on it. George and I are both supposed to go over to Linda's tonight to plan a class picnic. Think we can have Splinter here wired for sound by that time?"

"I don't see why not," Jerry said listlessly. "We can use the transmitter and receiver we fixed up for that Santa Claus caper last Christmas. Of course, we'll have to do a little modifying on the transmitter to make it work with that surplus throat mike, and we'll have to rig up the



. . . "The transmitter in your pocket and receiver in the dummy will take care of the voice-throwing" . . .

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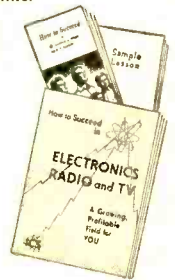
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Carl & Jerry (Continued from page 12)

solenoid circuit on the receiver; but it shouldn't take long."

And it didn't. Everything, for once, worked just as Jerry planned. The installation was finished as Carl's mother gave him the first supper call. Splinter was propped up on the bench of the laboratory in Jerry's basement, and Carl fastened the throat mike in place and recited: "One, two, three, four; testing!"

The words came from the dummy! True, the voice was muffled and deep-sounding because of the throat mike, but the high volume from the speaker overrode the slight sound escaping from Carl's lips. Best of all, though, was the realistic way the dummy's jaw worked with every syllable.

"Wow! Does that ever work smooth! Thanks a million, Jer. I've got to go now because Mom sounded pretty mad on that last call; but if you're still up when I get home, I'll tell you what happened."

As he said this, Carl grabbed Splinter unceremoniously by the neck and pounded up the basement stairs. Slowly and

thoughtfully, Jerry went about the business of putting away the tools and brushing off the littered bench.

AFTER SUPPER Jerry tried to read an article on analog computers, but the meaning of the words kept slipping out of his attention. He tossed the book aside and wandered aimlessly about the house. Finally he went outside and sat on the front porch in the moonlight. He felt strangely lonely as he leaned back and listened to the chirping of the nocturnal insects.

He jumped as a cold, moist nose touched his hand. "Hi, Bosco," he whispered, clamping the dog between his knees and beginning to rub the animal's ears affectionately; "I'll bet you would never let any old girl spoil our friendship!"

At that instant the stillness of the evening was broken by a sound that could be one of two things: a steam calliope with a flat wheel or Carl walking along the sidewalk whistling off-key.

"Hi, Jer," he greeted gaily as he collapsed on the steps beside his chum and tossed Splinter onto the porch.

"How did you manage to tear yourself

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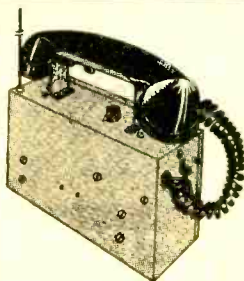
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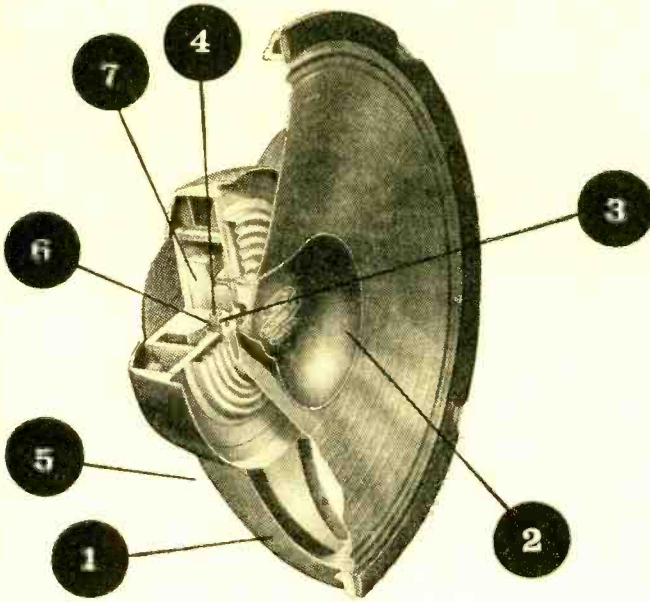
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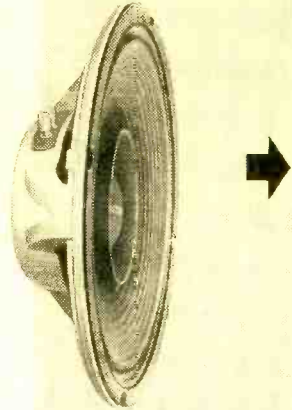
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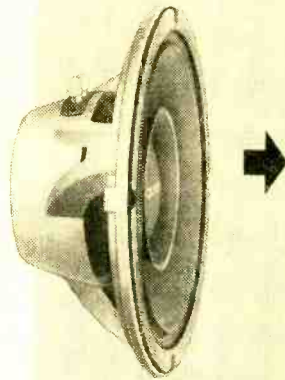
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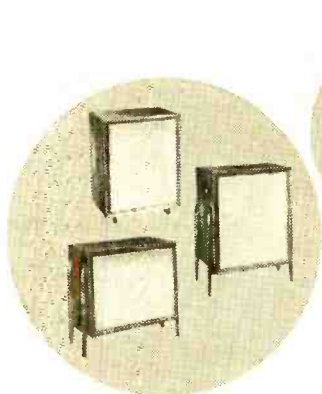
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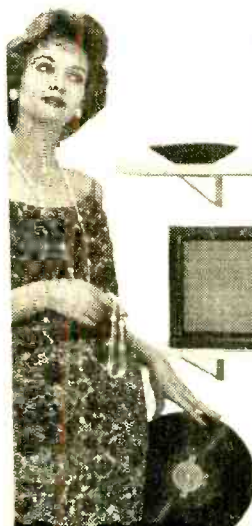
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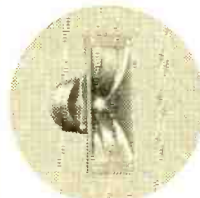
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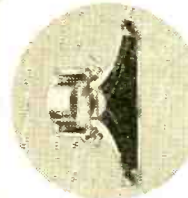
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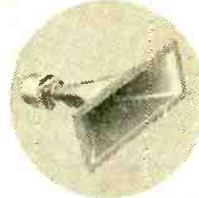


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Carl & Jerry (Continued from page 14)

away from the fascinating Linda so early?" Jerry asked sarcastically. "Did Splinter let you down?"

"Oh, no, Splinter was a howling success. When I got there, George and Linda were sitting in the porch swing, and good old George had already gone into his act. He and the dummy were talking up a storm, and Linda was giggling admiringly at every word. I listened politely for a while and then I innocently asked George how far he could throw his voice. He laughed in a snotty sort of way and said it wasn't really a case of throwing the voice—he merely created an illusion.

"Well, I said that might be all right for amateurs but that I had noodled around with ventriloquism a little myself and thought I did a pretty good job of projecting my voice. George boy gave a big scornful laugh at this, and Linda joined in—although she whispered to me afterward that she was just trying to be polite.

"SO I TOOK good old Splinter out of the sack in which I had been carrying him

and propped him up against the honey-suckle vines at the end of the porch. Then I stepped back about ten feet and asked him how he felt. He snapped right back that he felt fine and wanted to know who the pretty girl in the swing was.

"I'll not bore you with details of the rest of the dialogue, but honestly it wasn't too bad. I really felt good, and it seemed to roll out all by itself. George's face was something to look at, especially when he saw Splinter's jaw flapping away in the moonlight. Linda was thrilled to pieces.

"She couldn't keep her hands off Splinter; so I told her she could hold him while I tried something really difficult—throwing my voice behind me. I walked out to the gate, and Splinter and I still carried on. Linda made George touch Splinter so he could actually feel my voice vibrating inside the dummy's body.

"George looked like a whipped dog. 'I simply can't understand it,' he kept muttering over and over. Actually I began to feel sorry for him, especially after Linda got out of the swing and sat down on the edge of the porch with me. I mean she couldn't dig anyone but me and Splinter;

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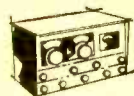
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knight-kit 12-Watt Hi-Fi Amplifier Kit
Y-784 \$19⁹⁵



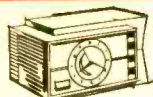
knight-kit "Ranger III" AC-DC Radio Kit
Y-736 \$16⁹⁵



knight-kit "400" Tube Checker Kit
Y-707 \$19⁹⁵



knight-kit "Span-Master" 4-Band Receiver Kit
Y-258 \$24⁹⁵



knight-kit "Ranger" Clock-Radio Kit
Y-737 \$24⁹⁵



knight-kit "Ranger" Radio-Intercom Kit
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knight-kit 12-in-1 Electronic Lab Kit
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Carl & Jerry (Continued from page 18)

George had to say something two or three times before he got her attention."

"That must have made you feel just wonderful," Jerry said wistfully.

"No, it didn't. It made me feel kind of sick and ashamed. If Linda was as fickle as all that, I decided George could have her. Just as I reached this conclusion, George got up from the swing and mumbled something about three being a crowd and said perhaps he had better go. Linda said if that was the way he felt, perhaps he had.

"That was when I got up. I told George that he could stay because I was going; and since Linda was so interested in ventriloquism, he was the one to tell her about it because I actually knew from nothing.

"Then I explained how I had tricked them with electronics. Actually, I don't think they had the foggiest notion of how Splinter works when I got through—you know how little most people know about electronics. At any rate, I grabbed up Splinter and took off like a big bird, leaving George and Linda standing there on the porch. She had the funniest look on her face."

FOR A LITTLE WHILE both boys sat silent in the soft light of the moon, enjoying the warm feeling of restored comradeship.

"Hey, Jer," Carl exclaimed, jumping to his feet and dusting the seat of his trousers.

"Yeah?" Jerry asked.

"Let's go down to the lab and get started on some really big electronic project, something that's real gone."

"Okay," Jerry said happily.



... "Then I actually began to feel sorry for George, especially after Linda got up out of the swing and sat down on the edge of the porch with me" ...

BUILD 125 COMPUTERS AT HOME WITH GENIAC®

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With the 1958 model GENIAC®, the original electric brain construction kit including seven books and pamphlets, over 400 parts and component rack, and parts tray, and all materials for experimental computer lab plus DESIGN-O-Mat®.

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The GENIAC Kit by itself is the equivalent of a complete course in computer fundamentals, in use by thousands of colleges, schools and industrial training labs and private individuals. Includes everything necessary for building an astonishing variety of computers that reason, calculate, solve codes and puzzles, forecast the weather, compose music, etc. Included in every set are seven books described below, which introduce you step-by-step to the wonder and variety of computer fundamentals and the special problems involved in designing and building your own experimental computers—the way so many of our customers have.

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You can build any one of these 125 exciting electric brain machines in just a few hours by following the clear cut step by step directions given in these thrilling books. No soldering required... no wiring beyond your skill. But GENIAC is a genuine electric brain machine—not a toy. The only logic and reasoning machine kit in the world that not only adds and subtracts but presents the basic ideas of cybernetics, boolean algebra, symbolic logic automation etc. So simple to construct that a twelve year old can build what will fascinate a PhD. In use by thousands of schools, colleges etc. and with the special low circuitry you can build machines that compose music, forecast the weather, which have just recently been added.

TEXT PREPARED BY MIT SPECIALIST

Dr. Claude Shannon, known to the readers of *Popular Electronics* for his invention of the electronic mouse, that runs a maze, learning as it goes, formerly a research mathematician for Bell Telephone Laboratories is now a research associate at MIT. His books include publications on Communication theory and the recent volume "Automat Studies" on the theory of robot construction. He has prepared a paper entitled "A Symbolic Analysis of Relay and Switching Circuits" which is available to purchasers of the GENIAC. Covering the basic theory necessary for advanced circuit design it vastly extends the range of our kit.

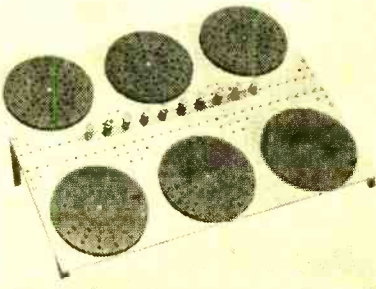
The complete design of the kit and the manual as well as the special book DESIGN-O-Mat® was created by Oliver Garfield, author of "Minds and Machines," editor of the "Gifted Child Magazine" and the "Review of Technical Publications."

KIT IS COMPLETE

The 1958 GENIAC comes complete with the following books and manuals and over 400 components.

- 1) A sixty-four page book "Simple Electric Brains and How to Make Them."
- 2) Beginner's Manual—which outlines for people with no previous experience how to create electric circuits.
- 3) "A Symbolic Analysis of Relay and Switching Circuits" By Dr. Claude Shannon provides the basis for new and exciting experimental work by the kit owner who has finished book No. 1.
- 4) DESIGN-O-Mat® introduces the user to over 50 new circuits that he can build with GENIAC and outlines the practical principle of circuit design.
- 5) GENIAC STUDY GUIDE equivalent to a complete course in computer fundamentals, this guides the user to more advanced literature.
- 6) A Machine to Compose Music shows in an actual circuit what other GENIAC owners have been able to do on their own in designing new devices.
- 7) A Machine to Forecast the Weather—again a new adventure in scientific thinking created by one of our users who was trained on his GENIAC Kit.

Plus all the components necessary for the building of over 125 machines and as many others as you can design yourself.



OVER 20,000 SOLD

We are proud to announce that over 20,000 GENIACS are in use by satisfied customers—schools, colleges, industrial firms and private individuals—a tribute to the skill and design work which makes it America's leading scientific kit. People like yourself with a desire to inform themselves about the computer field know that GENIAC is the only method for learning that includes both materials and texts and is devoted exclusively to the problems faced in computer study. You are safe in joining this group because you are fully protected by our guarantee, and have a complete question and answer service available at no cost beyond that of the kit itself. You share in the experience of 20,000 kit users which contributes to the success of the 1958 GENIAC—with DESIGN-O-Mat® the exclusive product of Oliver Garfield Co., Inc., a Geniac is truly the most complete and unique kit of its kind in the world.

COMMENTS BY CUSTOMERS

We know the best recommendation for GENIAC is what it has done for the people who bought it. The comments from our customers we like best are the ones that come in daily attached to new circuits that have been created by the owners of GENIACS. Recently one man wrote: "GENIAC has opened a new world of thinking to me." Another who designed the "Machine that Forecasts the Weather" commented: "Several months ago I purchased your GENIAC Kit and found it an excellent piece of equipment. I learned a lot about computers from the enclosed books and pamphlets and I am now designing a small relay computer which will include arithmetical and logical units... another of my pet projects in cybernetics is a weather forecaster. I find that your GENIAC Kit may be used in their construction. I enclose the circuits and their explanation." Eugene Dowling, Malden.

Oliver Garfield Co., Inc.

Dept. PE-98

108 East 16th St., N. Y. 3, N. Y.

Please send me at once the GENIAC Electric Brain Construction Kit, 1958 model. I understand that it is guaranteed by you and may be returned in seven days for a full refund if I am not satisfied.

- I have enclosed \$19.95 (plus 80c shipping in U. S., \$1.50 west of Mts., \$2.00 foreign). 3% New York City Sales Tax for N. Y. City Residents.
- Send GENIAC C.O.D. I will pay postman the extra C.O.D. charge.

Name

Address

GENIAC

An interesting kit builds circuits that solve problems and play games.

"ELECTRIC BRAINS" THAT WORK in much the same manner as giant computers can now be built quickly and cheaply by the novice using the new Geniac Construction Kit.

One of the most remarkable kits ever introduced to the public, the Geniac kit provides material and instructions for building 125 separate circuits for operating as many "brain machines." Among the devices that may be built are logic machines for comparing and reasoning; cryptographic machines for coding and decoding; games such as tic-tac-toe and nim; arithmetic machines for both decimal and binary computations; puzzles such as "the space ship airlock," "the fox, hen, corn, and hired man;" and miscellaneous devices such as a burglar alarm, an automatic oil furnace circuit, etc.

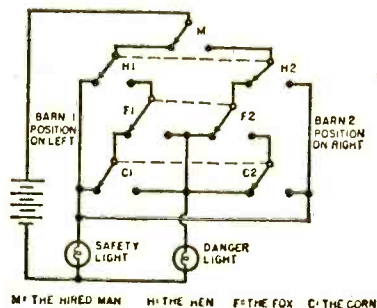
In addition to a complete assortment of all necessary parts is a carefully prepared instruction manual which explains in detail how to wire each circuit. The 63-page manual also furnishes basic information on the application of symbolic logic to circuits, which is the basis of the Geniac kit.

The kit is completely safe for anyone to use. No soldering is required, and every circuit operates on one common flashlight battery.

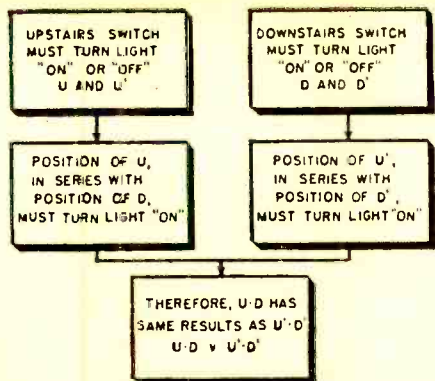
By the use of ingeniously designed parts, such as a new type multiple switch and special circuit jumpers, the kit provides circuits that "act out" or "prove" the truth of verbal statements about certain situations. One of the most popular of these circuits is the machine for the two jealous wives. In this problem, a "brain machine" must be devised that will inform either or both wives of unfaithfulness on the part of their husbands.

Mathematical basis for the Geniac circuits is the application of "Boolean algebra" to circuit design. George Boole, a nineteenth century British mathematician, evolved a system of logic in which symbols represent specific possibilities of things happening one way or another, such as A and B, or, A or B, etc. Certain types of information, when stated verbally, can be analyzed and reduced to simple statements. These statements, or "elements," are, in turn, expressed in symbols. The symbolic statement or "formula" then represents the verbal statement. From the symbols, it can be determined what circuit components are needed and how, to a large extent, they must be arranged in order to provide a circuit that "acts out" the original statement. The gigantic computers that solve complex problems in the twinkling of an eye are based, in part, on these principles.

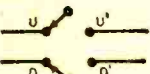
The Geniac circuit shown below represents a robot watchman. It warns the farmer when his corn is in danger of being eaten by the hen. It also warns him when the hen is in danger of being devoured by a fox. Circuit takes into account the possibility that the hired man may not be present at all times to prevent trouble. This ingenious circuit also informs the farmer when all is safe.



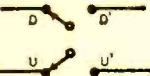
M: THE HIRED MAN H: THE HEN F: THE FOX C: THE CORN



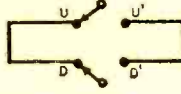
U AND U' INDICATE A SINGLE-POLE, DOUBLE-THROW SWITCH.



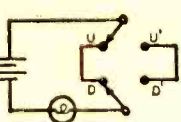
D AND D' INDICATE A SINGLE-POLE, DOUBLE-THROW SWITCH.



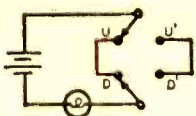
U-D INDICATES POSITIONS U AND D ARE IN SERIES.



U'-D' INDICATES POSITIONS U' AND D' ARE IN SERIES.



v INDICATES THE SETS OF U-D AND U'-D' ARE IN PARALLEL IN THE FINAL CIRCUIT.



This diagram shows how Geniac solves "the problem of the hall light." Verbal statements are broken down into algebraic symbols which, in turn, indicate the number and type of circuit components required.

A good illustration of how this system works is the problem of the hall light, one of the circuits included in the kit. The problem, stated in normal language, is this: a man wants to turn off or turn on a hall light either from downstairs or from upstairs. A circuit must be devised so that if either switch is turned the light will go off if it was on, and will go on if it was off.

This is a practical problem and involves a kind of wiring that may be familiar to many readers. It implies a switching arrangement in which either of two switches may be "off" or "on" in any position, depending on the relative position of the other switch.

The circuit solution to this problem evolves logically from stating the problem in Boolean symbols. U represents the upstairs switch in one position, and D represents the downstairs switch in the same relative position. U-D represents the two switches in series and in positions that permit the flow of current to light the bulb. U' and D' represent both switches in their respective opposite positions. Thus, U'-D' also represents a flow of current. U'-D

and U-D' both represent the switches in such relative positions as to break the circuit and permit no current to light the bulb.

Stating this in Boolean symbols: U-D v U'-D'. The "v" stands for an expression similar to "and/or" and implies a state of parallelism between the two expressions it connects. Thus, the formula tells us that two series switches are needed in parallel with each other. Since each switch must perform one of two possible functions (the "either-or" element), each switch must be a double-throw switch. The diagram and schematic shown here illustrate this reasoning process.

In every application of Boolean logic to a verbal statement, the circuit must prove the truth of the statement. In this case, the final circuit fulfills the requirements of the man with the upstairs and downstairs halls. In other circuits which can be built with the kit, a similar proof is achieved.

For instance, the kit may be used to construct an electronic version of tic-tac-toe. Now, anyone who has played this game knows that if you make the first move, regardless of what your opponent does, you must either win or draw, provided you make the best possible move following each of your opponent's moves. In other words, the player who goes second cannot win unless the first player commits an error. The Geniac circuit for this situation is a complex one, but once constructed, proves infallible. In a word, you can't beat the machine!

The underlying principles of the Geniac kit have been in development and research for a number of years. One of the best known pioneers in this country in the application of algebraic analysis to the problems of telephone circuitry is Dr. Claude Shannon of *Bell Telephone Laboratories*, whose "magnetic mouse" was described in *POPULAR ELECTRONICS*.

In addition to its value as a source of amusement and education, the kit exhibits certain technological features that may have widespread implications in other areas. The switches themselves are designed for simplicity and economy. Where the equivalent of several banks is needed, which ordinarily requires a multi-deck or multi-wafer switch built up vertically, the Geniac method uses a single wafer. Contacts on this wafer provide the equivalent—laterally—of what conventionally ganged switches do. This single wafer unit is an exclusive Geniac development.

Geniacs are manufactured by Oliver Garfield Co., Inc., 108 East 16th St., N. Y. 3, N. Y. and are available for \$19.95 postpaid.

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LETTERS FROM OUR READERS

Tunable Antenna for City Folk

■ Here's a suggestion for apartment dwellers who want a fair-sized outdoor antenna but have difficulty in setting up one. My solution is simple and functional. I just put up a "clothesline" antenna.

It sounds ridiculous but it works. I took a long piece of wire and clipped it to my clothesline with a clothespin and wheeled it out. When it was at the desired distance, I clipped the other end with another clothespin and pulled it tight. Upon connecting it to my AR-3 receiver, I found it to be better than a piece of wire around the room.

The advantages are that it is outdoors, adjustable in length (to suit various SWL bands), out of sight, and no trouble to install. Its drawbacks are that you can't change its direction, and it must be removed when hanging clothes. But you can't be fussy when you live in a city apartment.

VIC COMMISSO
Brooklyn, N. Y.

P.S. This is useless if you have an electric clothes dryer!

WWV and Special World Intervals

■ Concerning WWV, I'm sure that you and the readers of POPULAR ELECTRONICS would be interested in some additional information that the National Bureau of Standards' radio station broadcasts.

During the International Geophysical Year, certain days or intervals are designated as Special World Intervals (SWI). A period of alert will be declared by the World Warning Agency in the U. S. whenever solar activity is unusually high and significant geomagnetic, auroral, ionospheric, or cosmic ray effects are probable.

During the period of alert, an SWI may be declared whenever the probability is high that an outstanding geomagnetic storm, with associated effects, will begin within a few hours. Radio messages of alerts and SWI are broadcast by WWV in Morse code twice hourly, at four and 34 minutes after the hour, according to the following codes:

AGI—AAAAA: State of Alert

AGI—EEEEEE: No state of Alert

AGI—SSSSS: SWI will begin at 0001 UT following day

AGI—(Three long dashes): SWI in progress

AGI—TTTTT: SWI terminates 2359 UT same day

I received my information from the IGY Bulletin published by the National Academy of Sciences.

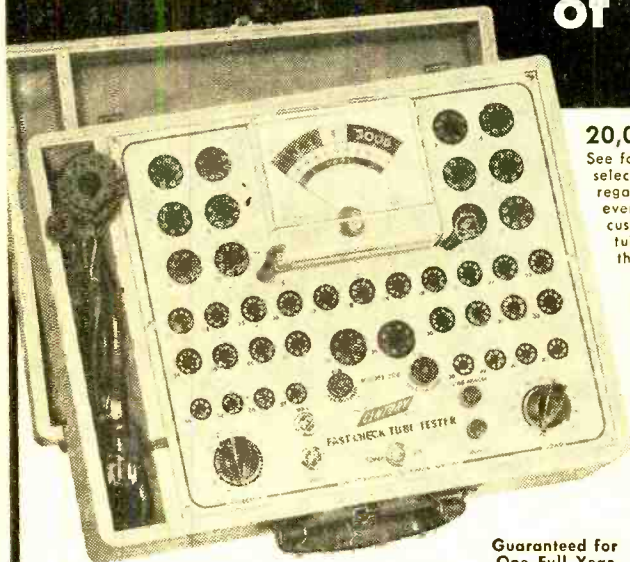
JOHN H. BLANKENSHIP
Ponca City, Okla.

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■ We are actively engaged in the training of electronics teachers for high school industrial education courses, and we are constantly looking

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Circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.
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Tube chart listing over 650 tube types is conveniently located inside FAST-CHECK cover. New tube listings are easily added without costly roll chart replacement.

Dimensions: Width: 14 $\frac{1}{8}$ "
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Special compartment accommodates line cord and Picture Tube Test Adapter

Picture Tube Test Adapter Included With Fast-Check

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy... also to rejuvenate weak picture tubes. This feature eliminates the need of carrying extra instruments and makes the FC-2 truly an all-around tube tester.

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RANGE OF OPERATION

- ✓ Checks quality of over 650 tube types, which cover more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

IMPORTANT FEATURES

- Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● Less than 10 seconds required to test any tube ● 41 long lasting phosphor-bronze tube sockets accommodate all present and future tube types... cannot become obsolete ● 7-pin and 9-pin straighteners mounted on panel ● Large D'Arsonval type meter is extremely sensitive yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● New tube listings furnished periodically at no cost ● Compensation for line voltage variation.

Other testers may have some of the above features... but only the **FAST-CHECK** has them all!

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Try the FC-2 before you buy it! No obligation to buy.

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Easy to buy if you're satisfied. Pay at net cash price... no financing charges.

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Rush the FAST-CHECK for a 10 day trial period. If not completely satisfied I will return the instrument within 10 days without further obligation. If fully satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. No financing charges are to be added.

MODEL FC-2 . . . \$69.50 — Pay \$14.50 within 10 days.
Balance \$11.00 monthly for 5 months.

Name

Address

City State

F. O. B., Mineola, N. Y.

Letters

(Continued from page 24)

for new ideas for projects as well as methods of teaching and demonstrating the fundamentals of electronics. Therefore, we find POPULAR ELECTRONICS to be a valuable aid in our work.

Your June 1958 issue has a brief article on a demonstration technique that would make an excellent device for use in our high schools.

FRED W. CULPEPPER
Instructor of Electronics
Southern Illinois University
Carbondale, Ill.

New Use for Correction Fluid

■ You and your team have started me out on a profitable and entertaining business. My customers have ordered many of the projects from your pages from me, and sometimes I feel bad about them missing out on the fun of "building the gadget" themselves.

In addition to project building, I have done a bit of SWL'ing. My QSL cards include *Radio Moscow*, Budapest, and several hams. One letter from the BBC in London informed me that they do not confirm reports due to the many relay stations now on the air.

Here is a little tip that I would like to pass on to your readers. A small bottle of mimeograph correction fluid, which costs about 50 cents, is very handy around the bench for use as layout dye and for color coding. It is easy to apply as the cap contains a brush, and it is easy to

remove the fluid with a bit of fine steel wool.

Many thanks for the best 35-cents worth of fun and education I've ever seen.

FRED FREIBERGER
Freiberg General Service & Mig. Co.
Hartford, Conn.

Coil-Winding Problem

■ I am now a regular reader of your magazine, and though I don't understand all of it, I enjoy it very much. At present I like the home build-it-yourself projects best.

In your February 1958 issue there is a sentence which reads: "Oscillator coil *L*₁ consists of 200 turns of enameled No. 30 wire, center-tapped and scramble-wound on a 3/8" form." What does center-tapped and scramble-wound mean? Also what is the form to be made of? Would a 3/8" wooden dowel do? And, once the coil is scramble-wound, whatever that means, how does one keep it that way?

RONALD STROER
Jennings, Mo.

To center-tap a coil, wind half the number of turns desired, then twist a 1/2" loop in the wire, external to the form. Continue winding on form. When finished, remove insulation on protruding loop, squeeze sides together, tin and use as terminal.

Most coils should be wound with turns in a single layer. Insulated wire is used and the insulation automatically spaces the turns. If bare wire is used, space between turns is air and must

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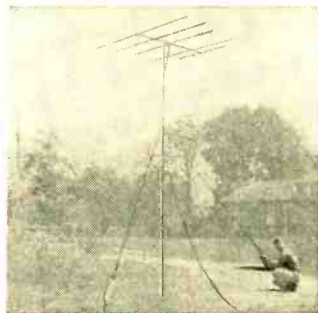
The most famous broad-band antenna in the country. Unparalleled gain on channels 2 through 13.

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10 models
from \$6.95



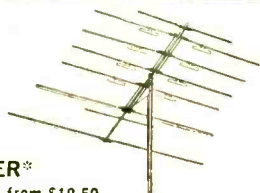
The new members of the famous Taco family. Destined to set new performance and price standards—nationwide. A great antenna at moderate cost



PROOF YOU CAN SEE

Your Taco antenna dealer has the exclusive Comparison Kit which demonstrates the superiority of a Taco antenna in minutes—right on your own set. Ask him for a demonstration today!

*Available in kits and gold anodized.



TRAPPER*

12 models from \$10.50

The original patented broad-band antenna and the favorite in all sections of the country. Extra-rugged, low-wind resistance design.

UHF*

Models from \$3.50

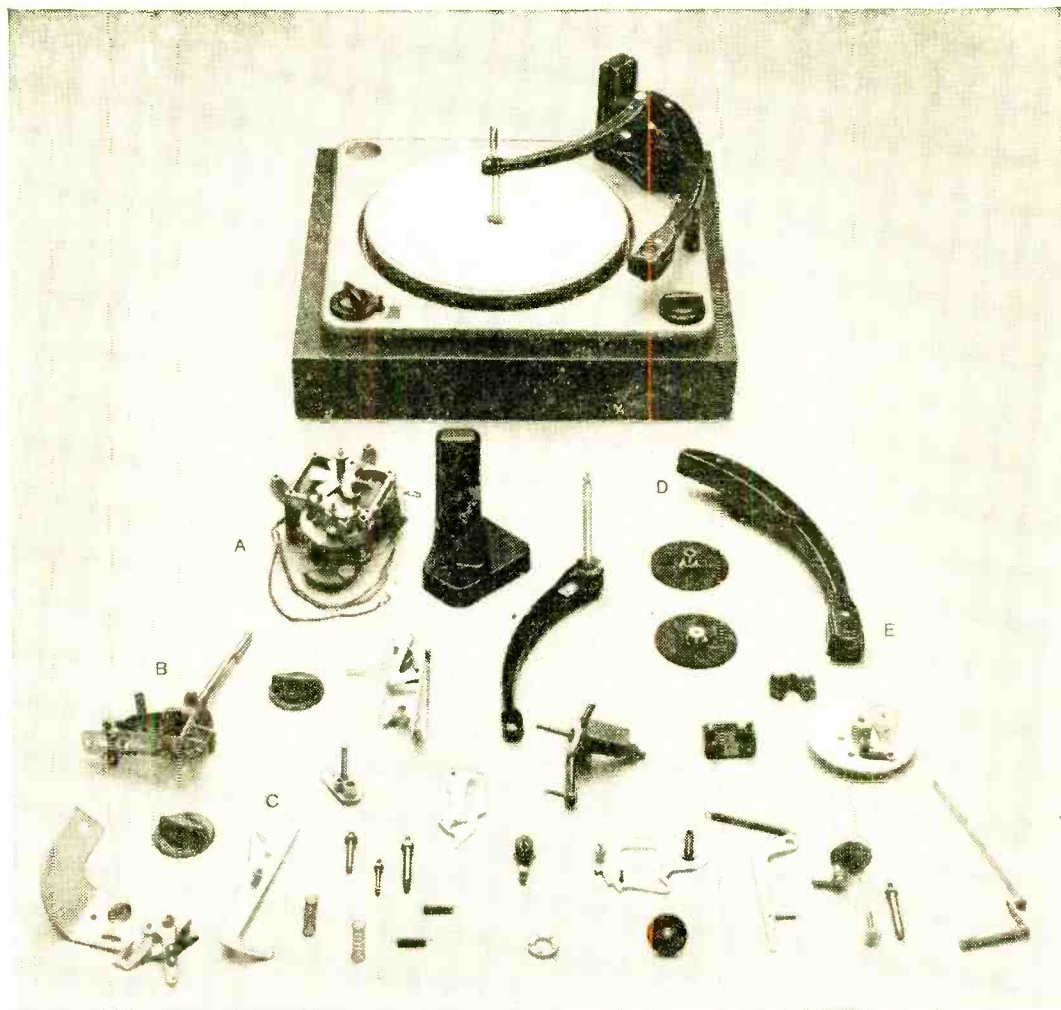
First in UHF antenna design, Taco has a complete line of broad-band bow-ties, screen reflectors, all-welded yagis, and a 4-foot UHF dish.



Taco manufacturers a complete line of quality multi-set and antenna couplers.

TAACO SHOWS YOU HOW!

TECHNICAL APPLIANCE CORPORATION, SHERBURNE, N. Y.



Every part of every *Collaro* changer is precision-engineered to meet the rigid demands of Stereo

The new stereo records require a higher standard of performance from your record changer than do standard LP's because stereo cartridges are extra-sensitive to noise. That's why, in planning your stereo system, you begin with the Collaro. Every part of every Collaro changer is precision-engineered to meet the rigid quality demands of stereo.

The motor (see A above) is dynamically balanced, so rigidly mounted that wow and flutter specifications are superior to any changer.

The spindle assembly (B) reflects this precision quality in every part. The spindle itself is micro-polished for complete smoothness.

The sensitive velocity trip mechanism (part shown in C) has been designed so that the changer

can trip at extraordinarily light tracking pressures.

The exclusive Collaro transcription-type tone arm (D) with the new plug-in head (E) is designed to eliminate all resonances in the audio spectrum. The new four-pin head — the only high fidelity changer with this feature — provides the ultimate in noise-reduction circuitry.

There are three Collaro changers ranging in price from \$38.50 to \$49.50. No matter which you select, you're sure to start your system off right when you choose Collaro — the turntable that changes records.

For new Collaro catalog write to Dept. PE-9, Rockbar Corporation, Mamaroneck, New York.



Rockbar
is the American
sales representative
for Collaro, Ltd.

FULL-TIME classroom and
laboratory training for a

CAREER WITH A FUTURE

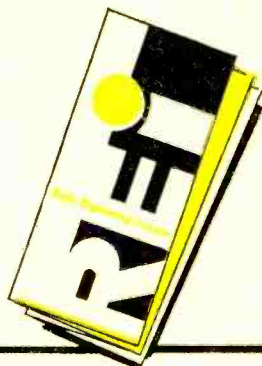
IN ALL PHASES OF
ELECTRONICS



Rapid strides in the development of TV, Radio, Radar, and Guided Missiles have made electronics the fastest growing technical career open to young men today . . . a career that offers high pay, security and rapid advancement.

The Radio Engineering Institute offers you an opportunity to be fully trained to take your place in this exciting, interesting field. REI is a full-fledged, recognized school where you can get proper training in classrooms, labs, and shops under the guidance of skilled, experienced teachers. Resident training is easier — more complete — and costs less than you may think.

If you are interested in a career with a future — higher pay — and have completed high school or its equivalent, send today for the new REI booklet. It contains complete information on courses offered at REI, facilities, equipment, fees, housing and lifetime job placement service. There's no obligation and no salesman will call on you.



FOR
INFORMATION
ON A CAREER
WITH A
FUTURE
SEND COUPON
TODAY!

RADIO ENGINEERING INSTITUTE, Dept. S-58
2610 Leavenworth Street, Omaha, Nebr.

Name..... (please print)

Address.....

City..... Zone..... State.....
(just paste on post card and mail)

HIGH PAYING POSITIONS WITH SOME OF THE NATION'S
LEADING MANUFACTURERS AWAIT REI GRADUATES

Letters (Continued from page 26)

be allowed for by grooves in form or spacing strips to hold turns apart.

Insulated wire is wound at random, without regard to order or spacing of turns, for a scramble-wound coil . . . like you wind spare string or twine. Fasten ends of winding to form through holes or cement in place.

Material for coil forms depends on circuit and frequencies involved. In general, the better the insulating material, the better the form. Wood is useful in d.c. circuits and at low frequencies. It should be dry, and kept dry by varnishing or other processing.

Help for FM in Cars

■ I have noted with interest several letters from your readers concerning the problems of FM reception in cars. I have made a considerable study of this field and will be happy to answer questions and make recommendations concerning installation and the operation of FM radio in automobiles.

ARTHUR J. SABIN
3417 W. Hollywood Ave.
Chicago 45, Ill.

Speaker Replacement Cones

■ I would like to obtain information on speaker replacement cones. I wrote to one mail-order jobber, but he does not carry them any more. Would any of your readers know where they can be obtained?

CALVIN STALEY
Daisytown, Pa.

Clubs for Tape Respondents

■ I notice that from time to time you have published letters from people seeking tape friends. The following clubs are actively engaged in the exchange of tapes: Tape Respondents International, Voicespondence Club, World Tape Pals, Inc., Australian Tape Recordists Association, United Recording Club, National Tapespinners, British Amateur Tape Recording Society, and American Tape Exchange.

I have been a member of World Tape Pals for one year and I send out 14 "foreign" tapes and five in the United States. At the present time, I exchange tapes with people in England (2), Ireland, Scotland, Denmark, Sweden, Netherlands (2), Germany (2), Aruba, Mexico, Puerto Rico and South Africa. My students at school send three foreign tapes and one in the United States, and they are working to build up their list.

I have written to Neil A. Kerr of New Zealand (his name appeared in the *Letters* recently) and given him the above information, which I hope will be helpful to him.

NORMAN KELLY
Ivyland (Bucks Co.) Pa.

■ As the result of a query about tape correspondence in April 1958 P.E., I recently joined TRI (Tape-Respondents International). It is a wonderful organization for tape-recording enthusiasts. For details contact: Jim Greene, Executive Secre-

JUST OUT! BIG NEW

GENERAL ELECTRIC TRANSISTOR MANUAL



Latest applications, circuit diagrams
and specifications

The greatly expanded new 3rd Edition of General Electric's Transistor Manual is just off the press. Throughout its more than 160 pages you'll find the very latest advances in the art of transistors and rectifiers.

There are 50% more pages . . . plastic binding which allows the manual to lie flat when open . . . expanded applications section including new Hi-Fi circuits and a complete stereophonic sound system . . . all the latest G-E transistor specs . . . list of over 175 new Registered JETEC types . . . many new circuits, with a new circuit index to make them easy to find. Parameter symbols are completely explained, with full instructions on how to read spec sheets.

The G-E Transistor Manual has become the most-used book in the transistor field. Get your copy from your G-E Tube Distributor—or by mailing the coupon below.

Partial List of Contents:

Basic Semiconductor Theory	Transistor Switching Circuits
Construction Techniques	Transistor Logic
Basic Amplifiers	Tetrode Transistors
Hi-Fi Circuits	Silicon Controlled Rectifier
Radio Circuits	Power Supply Circuits
Unijunction Circuits	Specifications

GENERAL  ELECTRIC

General Electric Company
Semiconductor Products Dept.,
Section 55898
Electronics Park, Syracuse, N. Y.

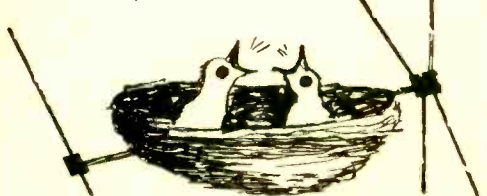
Rush me the new enlarged 3rd Edition of
G.E.'s Transistor Manual. I enclose \$1.00.
(No stamps, please.)

Name _____

Address _____

City _____ Zone _____ State _____

TV reception on the Blink?



could be your TV Antenna
is for the Birds!

REPLACE IT with a powerful new

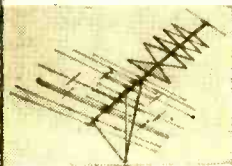


HELIX

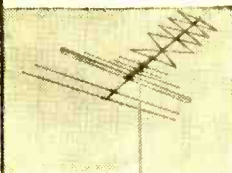
COLORETTENNA®

and see the wonderful difference in
your TV reception!

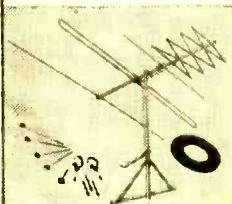
If you live in a deep
FRINGE area—install the
JFD Satellite-Helix
VX1111, the powerful
new TV antenna that
shrinks the miles... flat-
tens mountains.



If you live in a **FRINGE**
area—install the **JFD**
Star-Helix SX711 TV
antenna for crisp, clear
reception.



If you live in an **URBAN**
area—install the **JFD**
**Junior Helix Do-It-
Yourself Antenna Kit**
JX311TP, complete with
mast, mount, wire and
hardware.



See your JFD Service-dealer today or send coupon
for FREE set of "Better TV Reception Tips"

JFD Electronics Corp., 6100 16th Ave., Brooklyn 4, N. Y.

NAME

ADDRESS

CITY & STATE

"WORLD'S LARGEST MANUFACTURER OF TV ANTENNAS AND ACCESSORIES"

Letters

(Continued from page 28)

tary, Tape Respondents International, P. O. Box
125, Little Rock, Ark.

JOE BODJO
Jackson, Miss.

■ I am interested in corresponding by tape with
other tape recorder fans. Anyone interested in
corresponding by tape with me can do so by sim-
ply taping a letter (even a 3" reel will do) and
sending it to me. I will answer all tapes I receive.

TONY KRUPKA
125 Homewood Ave.
N. Providence 11, R. I.

The following readers are tape fans and would
like to correspond by tape with others.

C. R. MANN RICHARD FLAM
Davids Apts. 80-36 251 St.
Port St. Joe, Fla. Bellerose 26, N. Y.

JERRY COOK
738 W. 1st St.
Mesa, Ariz.

Help for Feathered Friends

■ Antenna designs are urgently needed that are
less deadly to our feathered friends than those
made of nearly invisible copper aerial wire. Heavi-
er wire or ribbons which the birds can see might
help, or colored markings similar to those used on
tall towers and chimneys for safer air travel. Per-
haps you, your contributors, or antenna suppliers
can make suggestions for reducing the casualty list
among birds resulting from careless antenna de-
signs.

GERGOR KUNTNY
Philadelphia, Pa.

Back Issues Needed

■ I am anxious to obtain the May 1955, December
1956, and February 1957 issues of Pop'tronics. I
will pay any reasonable price for these if any
of your readers have extra copies.

JOHN W. YOUNG (VE6XU)
Halkirk, Alberta, Canada

Out of Tune

Make the POP'tronics Secretary (June,
1958, page 79): Although the capacitors
used in this circuit are shown correctly
on the schematic diagram, the Parts List
should read as follows: C1—100 μ fd., 15
volts; C2—50 μ fd., 15 volts; C3—8 μ fd.,
15 volts; C4—100 μ fd., 150 volts; C5—500
 μ fd., 150 volts. The capacitor designations
should be changed accordingly throughout
the text. Resistor values shown in the sche-
matic are the correct values.

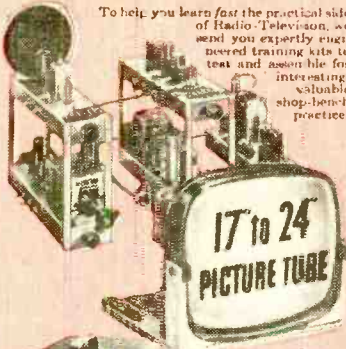
—50—

**WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID
RADIO-TELEVISION SERVICE TECHNICIAN**

**NOW - Just \$6 Starts You Training in
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**25 BIG, COMPLETE KITS
of PARTS & EQUIPMENT**

To help you learn fast the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!



- The new Sprayberry Training Television Receiver, built and tested in 5 sections
- Now offered... the fine modern octal-ray
- You build this powerful two-band superheterodyne radio receiver.



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AND
Sample Lesson
FREE!**



You build the new Sprayberry tester—a complete 18-range Volt-Ohm-Milli ammeter test tester.



**** This great industry is begging for trained men... to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!

Men by the thousands... trained Radio-Television Service Technicians... are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now—just \$6 enrolls you for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television must have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need... to step into a fine job or your own Radio-Television Service Business.

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Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once... mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—all free. No obligation... no salesman will bother you.

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Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

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Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. Just \$6 starts you! Mail coupon today... let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity in store for you!

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Mail This Coupon Now—No Salesman Will Call

Sprayberry Academy of Radio-Television

Dept. 105-L, 1512 W. Jarvis Ave., Chicago 26, Ill.


Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME..... Age.....

ADDRESS.....

CITY..... ZONE..... STATE.....

POP'tronics



BOOKSHELF

"NORTH AMERICAN AM-FM-RADIO-TV LISTINGS," published by Vane A. Jones Co., 3749 N. Keystone Ave., Indianapolis 18, Ind. 63 pages. Soft cover. 50 cents.

This is volume 1 (Summer 1958) of a new quarterly publication. Its title tells you just what the editors' intentions are—and they come through beautifully. The lists of AM, FM and TV stations are as complete and accurate as can be found anywhere. The stations are not only listed alphabetically, but geographically and frequency-wise as well. Actually the coverage is even more extensive than the title indicates. For you'll find listings not only for the U. S., Canada and Alaska, but also for the Virgin Islands, the Pacific Islands (Guam, Eniwetok,

Okinawa), Cuba, Greenland and all other territorial possessions and off-shore independents.

Recommended: to all the TV and BC DX'ers among POP'tronic's audience as an invaluable aid to spotting the frequency and location of broadcast stations on the North American continent and adjacent areas.



"ELECTRONIC PUZZLES AND GAMES" by Matthew Mandl. Published by Gernsback Library, Inc., 154 West 14th St., New York 11, N. Y. 127 pages. Soft cover. \$1.95.

Games for all kids interested in electronics—from 8 to 80—is the subject of Matthew Mandl's latest book. The author tells how to make 20 different games ranging from a simple knife switch puzzle to complex "space-travel" and "horse race" games. Each basic type of game is fully illustrated. Detailed diagrams and step-by-step instructions should make construction as easy and as much fun as the playing of the games themselves.

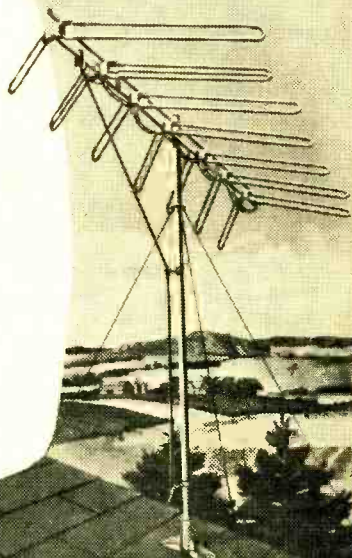
Recommended: to gamers of all ages. While this is an ideal book to give a boy a good start in electronics, it also offers the

Look familiar ?

It should. This antenna has been installed on more rooftops than any other fringe area antenna in the 12 year history of commercial television. It is nationally advertised. It is the most powerful antenna ever developed, and the most durable. It is the...

T-W TRAVELLING WAVE ANTENNA

BY **CHANNEL MASTER**



BIG NEWS!



A RONDINE TURNTABLE IN KIT FORM

only \$39⁹⁵

Also see the all-new, improved
factory-assembled Rondines at your dealer!

REK-O-KUT

HIGH FIDELITY TURNTABLES • TURNTABLE ARMS

Engineered for the Studio • Designed for the Home



A revolutionary breakthrough in the industry! A stereo turntable kit with traditionally superior Rek-O-Kut performance! It's engineered to give Rek-O-Kut's famous silent operation, eliminating all traces of record changer rumble in stereo disc playback.

The kit contains the same exclusive, precision-machined turntable and bearing-well used on all Rondine models. Assembles easily and quickly to the deck plate. The motor installs on a specially-made mounting plate.

A minimum number of working parts go together accurately, in 30 minutes or less... reflecting the simplicity and trouble-free operation of Rek-O-Kut design. This new Rondine offers you superb quality...unmatched performance, the kind you need for better monaural reproduction...the kind you must have for stereo!

ADVANCED FEATURES OF NEW RONDINE K-33 STEREO TURNTABLE!

- Single-speed (33 $\frac{1}{3}$) Crown-Spindle Belt Drive. Custom-made endless-woven fabric belt with thickness held to $\pm .001$. Adjustment for belt tension.
- Assembly time: about 30 minutes with simple tools.
- Noise level: 47db. (NARTB standards.)*
- Motor: 4-pole induction, designed and built to Rek-O-Kut specifications.
- Built-in strobe disc: for checking speed.
- Turntable: Heavy Cast Aluminum, lathe-turned. Tapered for easy disc handling.

*National Association of Radio and Television Broadcasters specifications.

PERFECT TURNTABLE MATE... AUDAX TONEARM the only stereo tonearm in kit form!



Assembles in just 15 minutes...no mechanical skill needed! A professional tonearm precision-engineered to highest broadcast standards. You save over 50% simply because you assemble it yourself. Ingeniously simple for foolproof operation, dependable performance. Takes all stereo cartridges. 12" arm—KT-12—\$15.50. 16" arm—KT-16—\$18.50.

Rek-O-Kut Co., Inc., Dept. P9, 38-19 108th St., Corona 68, N.Y.

Please send me your new 1958 Catalogs.

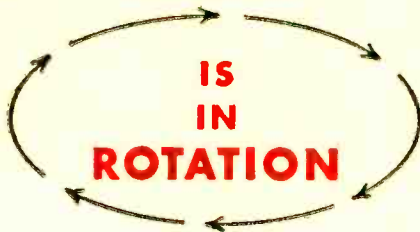
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ADDRESS _____

CITY _____ ZONE _____ STATE _____

PK27

**NEW
OR
REPLACEMENT
THE
BIG
ANTENNA
PROFIT**



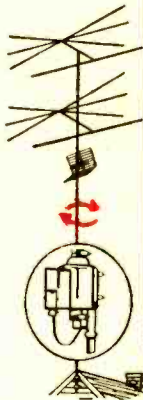
And the big name in rotation is



Critical Color-TV, channel changes, new stations—these are reasons why there's nothing like Alliance Tenna-Rotor for *lasting* customer satisfaction.

When you recommend and install an Alliance Tenna-Rotor you do the customer a favor and you boost your profits up into the big money class.

And it's easy to sell Alliance Tenna-Rotor because it's the leader. Customers know the name through years of consistent national advertising. Sell the name and idea first, then match the customer's budget with a model from the *complete* Alliance Tenna-Rotor line. You'll get plenty of sales helps and free ad mats to help build this profitable business. Write for complete dealer information.



The ALLIANCE Manufacturing Company
(Division of Consolidated Electronics Industries Corp.)
Alliance, Ohio

Bookshelf (Continued from page 32)

skilled electronics technician or hobbyist the prospect of many fun-filled hours of planning and building both the simple and the more complicated games.



"IMPEDANCE MATCHING" by A. Schure, Ph.D. Published by John F. Rider, Inc., 116 West 14 St., New York 11, N. Y. 119 pages. Soft cover. \$2.90.

One of the least comprehensible subjects to the newcomer to electronics is that of impedance. The simplest one-tube construction article is sure to have a few sentences devoted to "matching" of impedances at the particular operating frequency of the project. This book answers the questions that may have been piling up inside of you. It deals with the problems of impedance matching at audio, radio, and higher frequencies, and discusses the devices used as generator and load in electrical and electronic circuitry. The theory underlying questions of impedance matching is given as well as the solutions to the problems you may meet in the course of practical activity in the realm of L, Q and Z.

Recommended: to the newcomer and to the old-timer who may have been feeling a certain amount of resistance to dealing with problems of impedance.

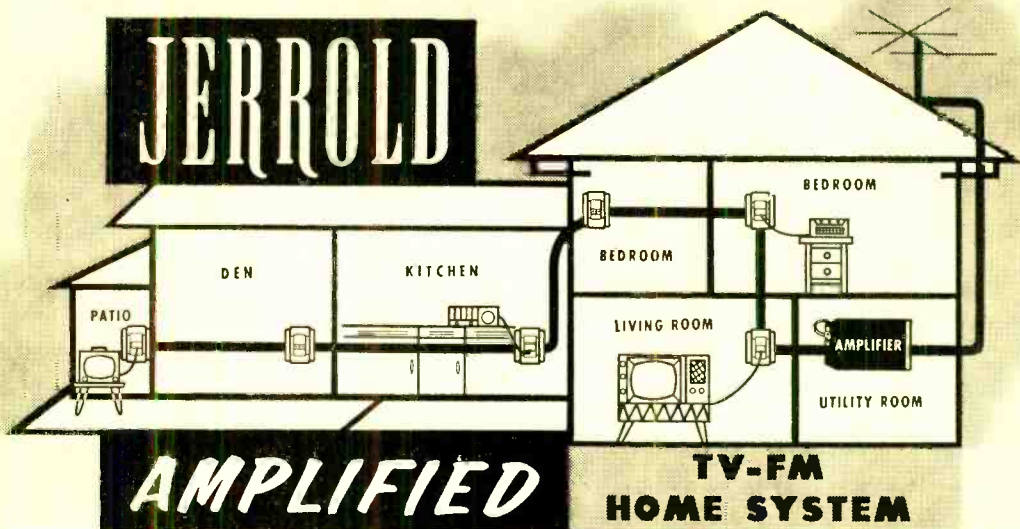
Free Literature Roundup

Bulletin BP958, available from the Superior Electric Company, Dept. BP, Bristol, Conn., covers the improved Superior 5-way binding post connectors for quicker, easier soldering, maximum electrical contact and longer life. Dimensions, features, methods of connection, and prices are included in this four-page booklet.

Illustrations and complete specifications covering 17 different types of chokes, including ferrite bead, ferrite core, MIL-inductance and r.f. chokes, are contained in a four-page folder available from National Company, Inc., Malden 48, Mass.

A four-page circular describing the development of the "comparison" method of radio servicing, its advantages and applications, has been released by Supreme Publications, 1760 Balsam Rd., Highland Park, Illinois.

It's Here! The First **AMPLIFIED** **PLUG-IN TV-FM HOME SYSTEM**



AMPLIFIED

TV-FM HOME SYSTEM

- Completely engineered, fully amplified System—Not a Multi-Set Booster!
- Simple—Solderless . . . 300 Ohm Twin-Lead Installation
- Sets Not "Tied Down"—Can Be Enjoyed Anywhere
- "Snow Free" TV and "Hiss Free" FM Reception!

The FIRST truly engineered, amplified system designed for the home! Supplies *Hi Fidelity* reception to TV and FM receivers in any room! New TV and FM receivers can be added with a simple plug-in connection!

Printed circuit TV-FM amplifier boosts weak signals . . . provides flat response across the entire (VHF) TV-FM band. Can operate continuously, has only two tubes, consumes only 18 watts. Surface or flush-mounted outlets supply clear strong signals without interference between sets, have Perma-Grip plugs for TV or FM sets.

HOME SYSTEM AVAILABLE IN READY-TO-INSTALL KIT!

CONTAINS EVERYTHING (EXCEPT ANTENNA) FOR COMPLETE 5-OUTLET SYSTEM—INCLUDING TWIN-LEAD. FOR NEW OR EXISTING HOMES. **\$67.75** LIST



Model HSA-46
Amplifier



Model HS-140
Flush Outlet



Model HS-135
Surface Outlet

HOME SYSTEM COMPONENTS
AVAILABLE SEPARATELY—FOR
COMPLETE DETAILS CONTACT
YOUR JERROLD DISTRIBUTOR
OR WRITE TO DEPT. PD 83

No Trimming of Wire
Necessary . . . No
Soldering! Quick Screw-
driver Installation!



JERROLD

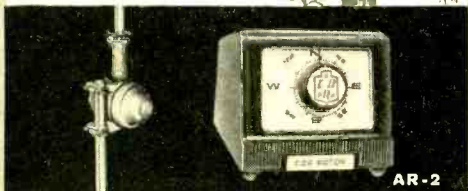
ELECTRONICS CORPORATION
The Jerrold Building, 15th and Lehigh, Philadelphia 32, Pa.

Jerrold Electronics Corp., Ltd., Toronto, Canada
Export Representatives, CBS International, New York 22, New York

LOOK TO JERROLD FOR AIDS TO BETTER TELEVIEWING

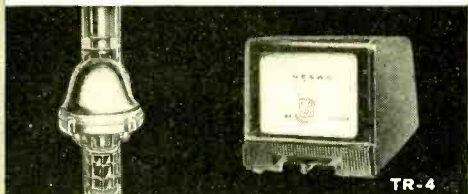
Improve your
TV picture with a
CDR ROTOR

There's one
to fit your
antenna and budget



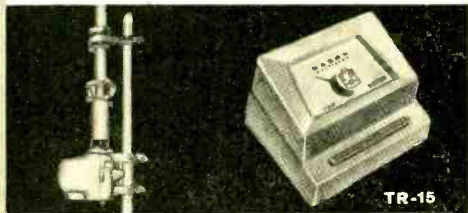
AR-2

AUTOMATICS Models AR-22 and AR-2 Just set the direction selector knob. Rotor automatically turns your antenna to the desired direction...then automatically locks into position.



TR-4

FOR EXTRA HEAVY-DUTY Models TR-2, TR-4, AR-22 Unique "bell-shaped" rotor supports heavy arrays, is completely weather-sealed, has low wind-resistance.



TR-15

LUXURY WITH ECONOMY Models TR-15 and TR-16 CDR's latest rotors. Streamlined design, improved mechanism, positive action, moderately priced.

DO IT YOURSELF! CDR Rotors are easiest to install. No loose parts to assemble. Complete instructions included with each rotor. Fit masts up to 1½" O.D.

CDR

ANTENNA ROTORS

CORNELL-DUBILIER ELECTRIC CORPORATION
South Plainfield, New Jersey

THE RADIART CORPORATION
Indianapolis, Indiana

TIPS and TECHNIQUES



CALKING COMPOUND

One-handed fitting of a bolt or screw into the recesses of a radio cabinet is easy if you wrap a bit of calking compound around the end of the screwdriver. The compound is very tacky and will not release the bolt or screw head until it is in place and the screwdriver is withdrawn. You can also



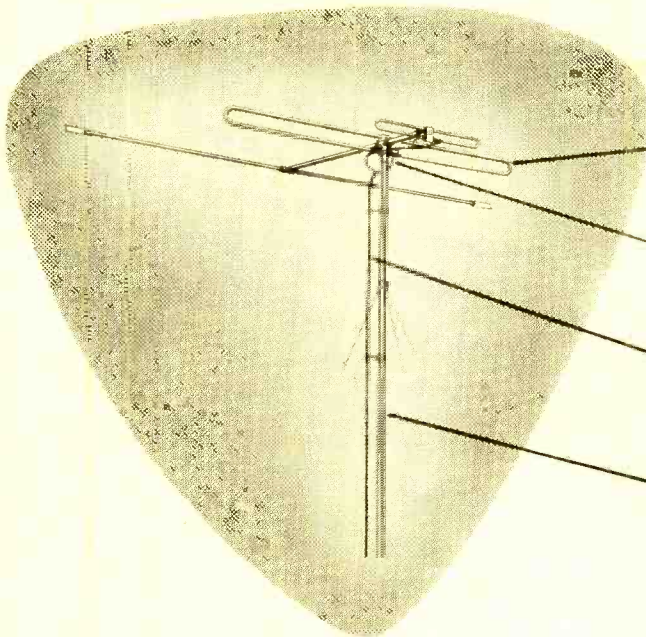
use the compound to hold a nut to the end of a screwdriver or even a piece of wood, such as a dowel, when the nut must be put into a location difficult to reach by hand. —K. M.

HANDLES FOR CHASSIS-CARRYING

Carrying a heavy radio or TV chassis by its sharp metal edges can be quite an uncomfortable experience. Try making a couple of chassis handles from two 5" lengths of broom handle. Clamp each



length in a vise and saw a small slot about ½" deep down the center. When you have to lift a heavy chassis, just slip these com-
(Continued on page 92)



Dipoles, reflector and crossarm are all made of Aluminum tubing with a wall thickness .049".

Cast aluminum center support "T" with a tensile strength of 45,000 psi.

300 ohm twin-lead transmission line made from virgin polyethylene.

Rust-resistant steel mast lends added strength to withstand any weather condition.

you get the true picture with AMPHENOL

IMPROVED T.V. RECEPTION

Any T.V. picture can be improved by simply installing AMPHENOL'S fine INLINE* VHF antenna. Engineered for maximum, balanced signal strength over all VHF channels, the INLINE brings in clearer, sharper pictures on your present television set.

PERMANENT AND RUGGED

The INLINE is the most permanent antenna available. Dipoles, reflector and crossarm are made of sturdy corrosion-resistant aluminum tubing and the cast aluminum center "T" has a tensile strength of 45,000 psi. The INLINE maintains a safety factor of better than 3 to 1, in a 70 mph wind and, combined with heavy ice loading on all elements, the INLINE still maintains a more than adequate safety factor.

IDEAL FOR COLOR TELEVISION

Because of its flat gain (no gain or loss greater than 1.5 db within 1.5 mc below and 0.6 mc above the color sub-carrier) the INLINE plays an important role in securing excellent color television reception.

QUALITY ANTENNA COMPONENTS

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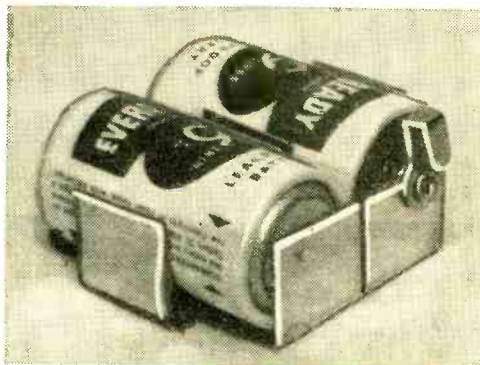
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(Continued on page 96)

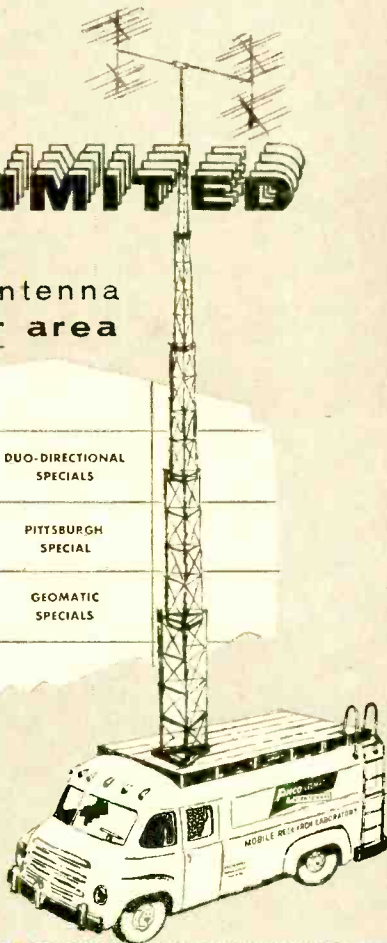
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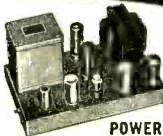
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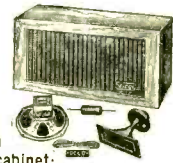
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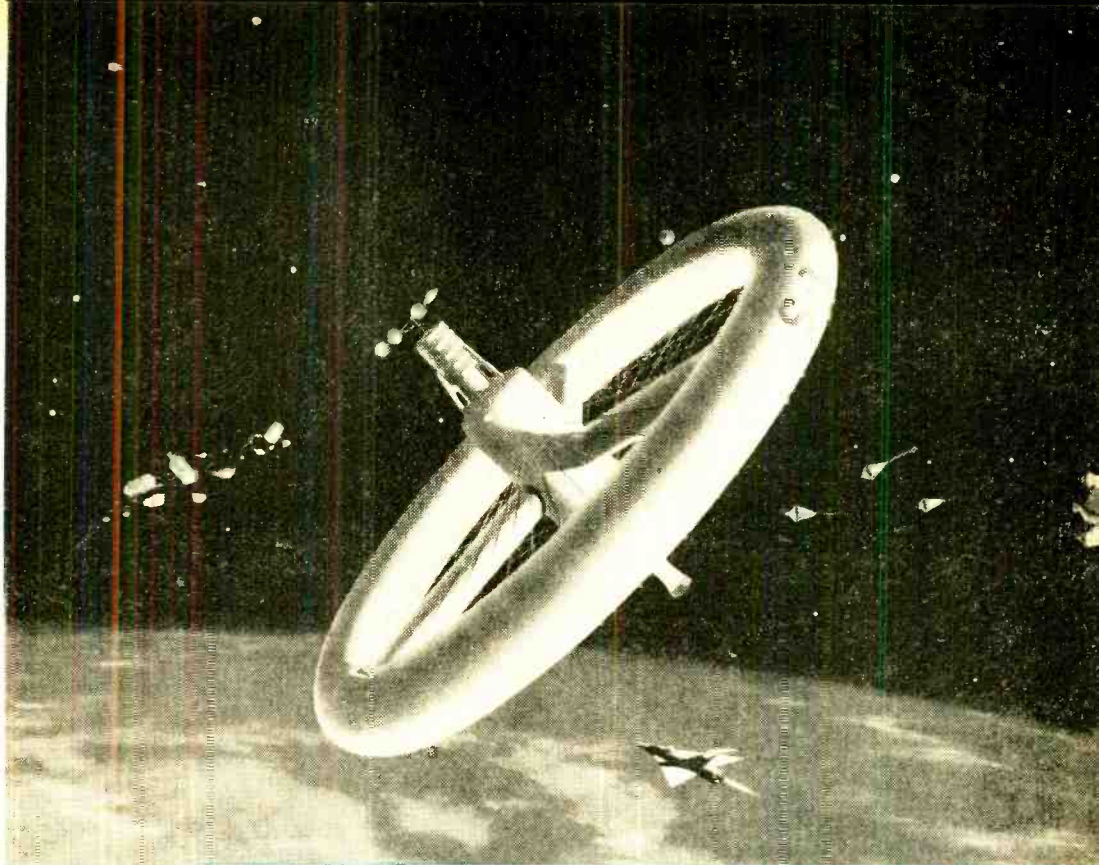


Photo courtesy Walt Disney Productions

Interplanetary Communication

***Simple demonstrations show how radio
works in space*** **By LOUIS E. GARNER, Jr.**

WITH THE LAUNCHING of Earth's first artificial satellites, man has taken a giant step towards one of his most ambitious dreams—the conquest of space. Man's first space ship should land on the Moon within the next few years, and there is a real possibility that physical contact will be made with our nearest planetary neighbors, Mars and Venus, within our lifetimes.

As man's expeditions reach deep into space and plant scientific research stations, military bases, and colonies on the planets and satellites of our solar system, there will develop a real need for reliable communication between Earth and its farflung space ships and colonies.

As a POPtronic reader, you probably have a

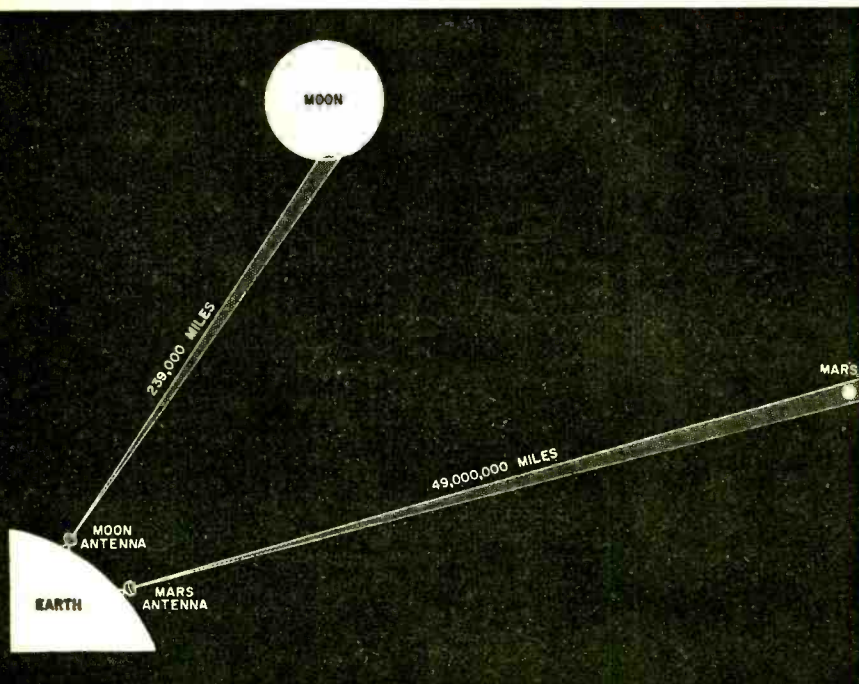


Fig. 1. This diagram shows why a narrow radio beam may cover only part of a nearby satellite (the Moon) but can cover an entire planet at a much greater distance (Mars).

greater than average interest in science and in the communication arts. Therefore, we have arranged an interview between a typical reader and an imaginary space communication expert. Here are some of "your" questions and the expert's answers.

Q. Is interplanetary communication practical?

A. Definitely. And it may not be as difficult as many people think. Radio-astronomers have already picked up radio signals from Mars and Venus. These signals are not sent by Martians and Venusians, of course, but are developed by temperature variations on the surfaces of the planets.

Q. What techniques will be used for interplanetary communication—flares, radio, giant signs, or some new method?

A. We can rule out giant signs immediately. However, flares *might* be used simply for signaling. The first unmanned rocket sent to the Moon, for example, may be designed to set off a medium-sized atomic bomb. The flare of such a bomb

on the Moon's surface could be seen quite easily with any of our medium-sized or large telescopes. But for honest-to-gosh communication, that is, the transfer of intelligence, radio will probably be used.

In many ways, interplanetary communication by radio will be simpler than point-to-point communication on Earth.

Q. That's a surprising statement. How can it be?

A. As you know, radio waves, like light rays, travel in essentially straight lines. To achieve long-distance communication on Earth, we "bounce" our signals against the electrically charged *ionosphere*, a layer or blanket of charged particles floating in our atmosphere. Reflected back and forth between Earth's surface and the ionosphere, radio signals can travel around the curvature of our planet.

Unfortunately, some signal strength is lost with each reflection. At the same time, the transmitted signal may be confused with all sorts of undesired signals—interfering radiation from other transmitters and from arcs and sparks in electrical equipment, noise from lightning and other atmospheric and ionospheric static. Thus, our Earth-bound signal has to hold out against losses due to signal absorption and reflection, and must maintain its strength against all kinds of radio noise.

On the other hand, when we send a radio

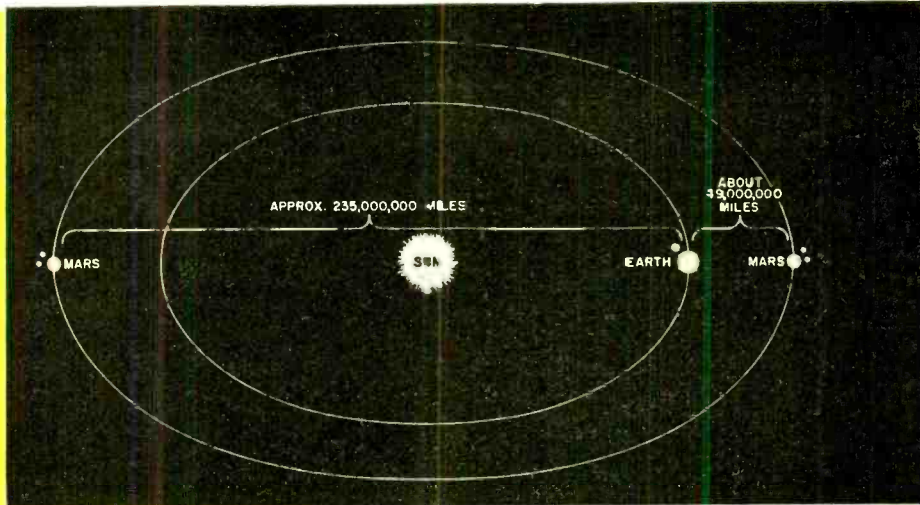


Fig. 2. Approximate distances between Earth and Mars (not to scale). Because of orbital eccentricities, the two planets may be as close as 35,000,000 miles every 16 years or so.

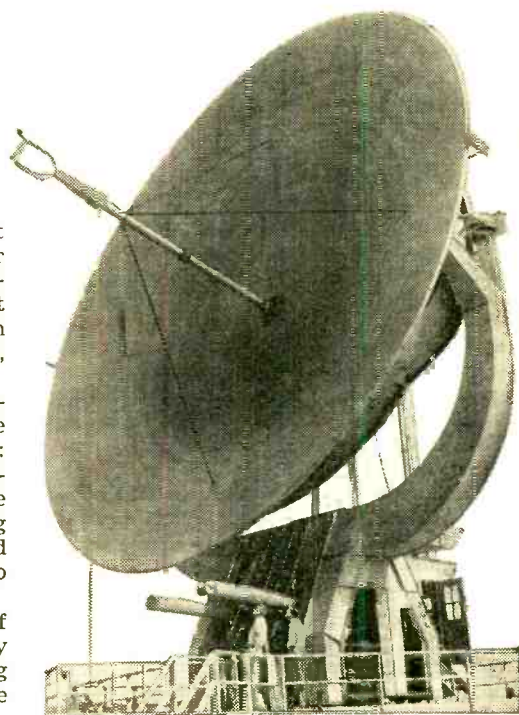
signal toward outer space, we can send it nearly straight up, passing through our noise-filled atmosphere for only a relatively short distance. And we needn't worry too much about signal loss through absorption and reflections by buildings, mountains and similar objects.

Of course, interplanetary radio communication is not *quite as simple* as we've made out. There are several problems: the vast transmission distances which permit a radio beam to *spread*; the relative movement of transmitting and receiving positions and, thus, proper *tracking*; and the *time lag* due to the finite speed of radio transmission.

Actually, you can demonstrate many of the problems involved in interplanetary communication in your own home, using familiar objects you'll find around the house.

Q. No static and little noise! That'll be fine. But your answer brings up a number of new questions. You say I can demonstrate some of the basic principles myself. How? And what do you mean by the "spreading" of a radio signal? And what is "tracking" and "time lag?"

A. One question at a time, please! First, as to demonstrating some of the problems, I'll outline a few experiments as we go along. For these, we'll let light represent high-frequency radio waves. As you



A giant parabolic antenna of this type may be used for interplanetary communication. This Naval Research Lab antenna was used to pick up radio signals from the planet Mars.

Using things you find around the house, you can demonstrate many of the basic principles on which interplanetary communication will be based . . . a toy car, a flashlight, a magnifying glass, and so on.



know, light—like radio—is an electromagnetic vibration, but of *much higher frequency*.

Using light, you can demonstrate most of the basic interplanetary communication problems with such objects as a toy automobile, a flashlight with removable lens and reflector, a lantern, a magnifying glass, and a photographer's exposure meter.

Now what was your next question?

Q. What do you mean by the "spreading" of a radio signal?

A. A simple experiment will demonstrate this action. Take your flashlight and project a beam against a flat wall, focusing to as sharp a spot as you can. Now back away from the wall, holding the flashlight steady. As you do, you'll see that the light spot becomes larger and larger, and also dimmer.

In the same way, as we get farther away from a transmitting antenna, our radio signal spreads to cover a larger area and becomes weaker. As a result, the signal strength of a radiated signal varies inversely as the square of the distance from our signal source.

Q. You mean that if we move twice as far away the signal is half as strong?

A. No. Signal strength varies inversely as the *square* of the distance. Thus, if we have a given radio signal strength at one point, and move away from the transmitting antenna to *twice* that distance, the signal will be *one-fourth* as strong. At three times the distance, the signal will be one-ninth its original strength.

You can demonstrate this effect, too, by using a light source and a photographer's exposure meter. Don't use a focusing flashlight for your light source as most of these have "hot spots" which may give false indications. A lantern will do fine.

Hold your exposure meter to measure the light's intensity at a fixed distance from the bulb, recording your reading in, say, foot-candles. Next, move the exposure meter back from the light source to twice the original distance and again note the

reading. Unless you've goofed in taking the readings, you'll find that the light level is now one-fourth the first reading.

To minimize the spread of a radio signal, and to concentrate the available energy in the direction of transmission, highly directional antennas will be used for communication between planets.

Q. What do you mean by a "highly directional" antenna?

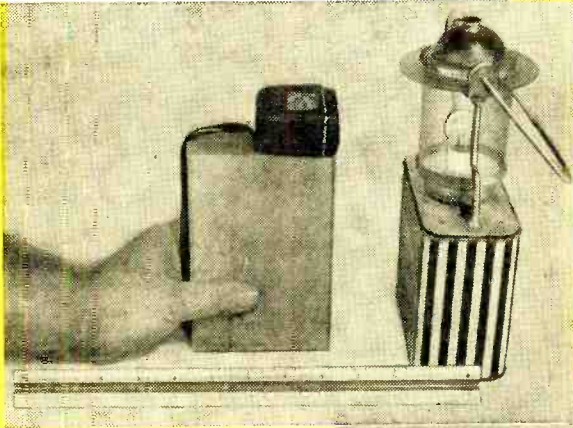
A. As far as the transmitter is concerned, this is an antenna which concentrates the radio beam in a specific direction, as opposed to a "broadcast" antenna which radiates in all directions. Highly directional antennas are used in radar.

To demonstrate the difference between directional and broadcast type antennas, again take your focusing flashlight. Remove its lens and reflector, leaving the bare bulb exposed, and turn the flashlight on in a darkened room. Some light will reach *every* corner of the room, but the average intensity—or "signal strength"—at any one point is relatively low. The light, so to speak, is "broadcast" over the entire room.

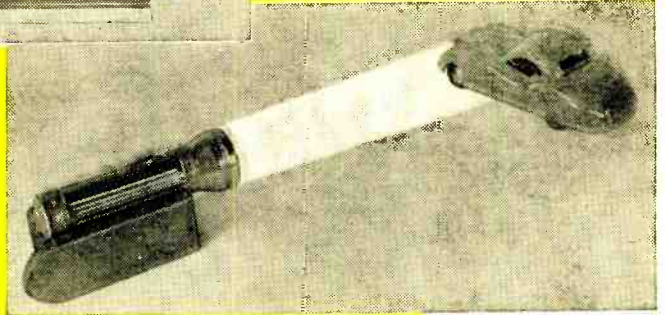
Next, replace the reflector and lens, focusing the light beam to a small spot. You are no longer "broadcasting" your light but are concentrating or focusing it in a specific direction. Instead of a weak light covering a large area, you have a concentrated beam covering a relatively small spot; but the rest of the room is dark. You have *not* increased the *total* amount of light available. You're still using the same power source (batteries) and the same light bulb. But you are aiming most of the light in a single direction.

One type of highly directional high-fre-

If you have a photographer's light meter, a rule, and a lantern (left), you can demonstrate how the intensity of a light (or radio signal) falls off at increasing distances from the source.



How to demonstrate the need for tracking . . . the flashlight at right, representing a transmitting or receiving antenna, must be moved continuously to keep a toy auto (representing a space ship or a satellite) centered in its beam. The farther away the auto, the harder it will be to track.



quency transmitting antenna system consists of a small antenna and a rather large reflector which closely resembles the giant reflector of a powerful searchlight. It looks somewhat like a very large "dish," but need not be of solid metal. It can concentrate a radiated signal in a very tight beam.

Q. Isn't that the type of antenna they use for radio astronomy? I read an article on this subject in the February 1958 issue of *FOP'tronics*. But I thought such antennas were for receiving only.

A. You're right. Large parabolic reflectors or "dish" antennas are used for receiving weak radio signals. In this case, the large reflector picks up weak signals

over a large area and concentrates them on a relatively small antenna. An ordinary magnifying glass works in an analogous manner, and can be used to concentrate light from the Sun into a small, intense, brilliant, and extremely hot spot.

Q. But will highly directional antennas, perhaps "dishes," be used both for transmitting and receiving signals?

A. Yes, and in most cases the *same* antenna will be used for both purposes. But because highly directional antennas are used, and because both the transmitter and receiving stations will be moving constantly with respect to each other, there must be an adequate tracking system.

(Continued on page 102)



MODERNIZE Your

MOST TV VIEWERS are not obtaining the best reception from their outdoor antenna systems. A look around your own neighborhood can tell you why. You will see antennas that have been bent, broken and otherwise disarranged from the effects of wind, corrosion, and even just old age. Some antennas will point to the sky, others to the ground, but not all will point properly to the TV stations.

You will probably find several antennas erected back in the early 50's whose elements are still directed toward a "one-station-only city" which has since set up additional stations. In such cases, satisfactory signal strength from all cannot be fed to the TV set if new station locations are ignored.

Include your own antenna installation in your survey. It may not look as bad to you as the others. Nevertheless, it will be to your advantage to examine the entire system carefully, paying particular attention to corrosion (especially if you are in a coastal area).

Preliminary examination can be made from a vantage point at an attic window or from your neighbor's attic. This should reveal major faults in the system. Check the antenna elements, the supporting mast, the lead-in, and the guy wires.

Many antenna faults are hidden, such as hinged or riveted joints, and a more satisfactory technique is to use your own TV set as a measure of antenna performance.

Look for Ghosts. After warm-up, tune each station very carefully for the best possible picture. Turn the sound volume



TV ANTENNA System

down, as it is not needed. Adjust the contrast control to your normal preference and look for a ghost image on the screen. Carefully examine all details of the picture, giving particular attention to eyes of actors and close-ups of printed matter, and notice whether or not there is any "smearing" of fine detail.

"Ghosts" can be caused by the reception of two signals—one the direct signal, the other the reflected signal which has been bounced from buildings or other obstructions, causing it to arrive at the antenna a split second after the original signal gets there. Sometimes the reflections will cause multiple ghosts. Any delay of the second signal can blur and distort fine details on the screen.

Keep a Record. Make notations of the quality or lack of quality on a pad for later reference. Then follow the same procedure with each channel received in your area.

You may be getting "snow" and a picture weak in contrast on some channels. This indicates a definite lack of signal strength of the received signal on that channel. Snow is not due to outside interference; it is created in the receiver and the antenna. It shows that there is not enough signal in microvolts from the station to produce a satisfactory picture.

If thin horizontal bars (like Venetian blinds) are present on any channel, they are probably caused by an interfering signal from an unwanted TV station. If this interference appears regularly, chances are that the interfering signal can be removed by using a more directive and improved antenna. Once properly oriented toward the wanted transmitter, the increased signal



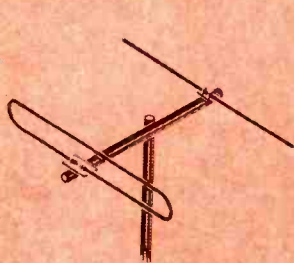
will usually offset such unwanted station interference.

Yardstick Needed. The signal voltage received at a TV antenna ranges from a "snowy" 50 microvolts up to thousands of microvolts, depending upon the distance

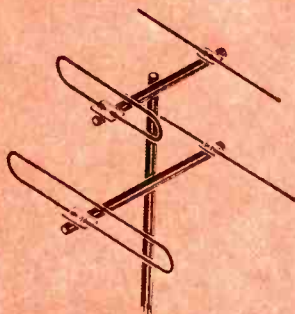
provides other features, such as video modulation output, sound output and percentage modulation.

Examine Your Antenna. Using proper safety precautions, you or a TV technician should examine your antenna closely.

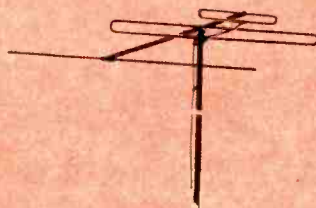
Basic Antenna Types Useful Up to 50 Miles from Station



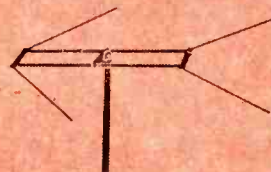
Folded Dipole and Reflector



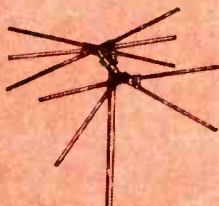
Piggy-Back



High-Low Coupled



Double V



Conical

from the transmitter. It would be useful if such signals could be measured with your conventional lab equipment.

Television technicians often use field strength meters, but there is some confusion in the proper use of such devices for antenna orientation and survey due primarily to misinterpretation of the instrument used. Such meters are of two general types—"relative" and "direct reading."

The "relative" meter is not usually flexible enough to give accurate readings at every frequency. Generally, these meters have discrepancies of 2 to 1 or more. They can be used with advantage if a correlation is made between the readings and the effect the signal has on the TV receiver. This must be done for each channel.

The "direct reading" meter is more elaborate and of greater accuracy. It usually

If the elements are dull and oxidized, they are surely cutting down on the signal. Pay particular attention to all hinges or riveted joints because, unless they are free of any corrosion, they can introduce considerable loss.

It is usually poor economy to attempt to rebuild a weather-worn antenna. A new improved type will prove much more efficient. Generally, an antenna that has been exposed to the elements for approximately three years can well stand replacement. Those used in saltwater areas should be replaced after two years.

Check all guy wires and other supports for the antenna. These, too, are subject to corrosion and, should failure occur, there

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Finney Co.
Jerrold Electronics Corp.
JFD Electronics Corp.
Technical Appliance Corp.

could be damage to your home. The accompanying check list will help remind you of items that might be overlooked.

With age and weathering, the plastic lead-in material cracks and fills with conducting deposits from smoke and foreign matter. The lead-in should be shiny and free of accumulated deposit. Rub the dirt off with your thumb (not the fingernail) and see if the plastic appears shiny. If it is dull, replace the whole lead-in.

The lead-in should be supported by stand-off insulators and kept clear of spouts, gutters, and other metal. Make a loop in it

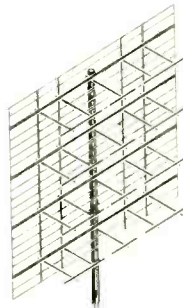
capable of much greater efficiency in your area. Several manufacturers have actually tested all principal TV areas and have designed antennas to provide greater signal strength based on their findings. The TV antenna manufacturers whose products appear in this publication can make recommendations based on field tests with mobile receiving units and with many types of systems. Drop them a line requesting information on models suited to your location.

Reception Zones. There are three general areas of reception. Local coverage of a station is up to 20 miles from the trans-

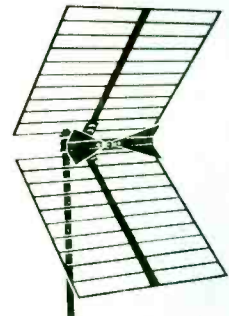
Basic Antenna Types for Fringe Areas and U.H.F.



Yagi



Colinear
and Screen



Corner
Reflector

before it enters the house to serve as a water drip for rain.

Which Antenna Type? Your choice of antenna depends primarily on the distance from the TV transmitters and the efficiency of your system. You can be guided somewhat by the types your neighbors are using. If one is getting excellent pictures on all available channels, it would be a safe bet that you could use the same type of antenna. The advice of your local TV technician can also be sought to advantage—he has installed antennas in your neighborhood and is familiar with the local problems.

Manufacturers have made extensive studies of areas throughout the country. Well qualified to recommend specific types, they have designs available not only for local, medium and fringe areas but also to overcome special problems near certain cities.

Perhaps an entirely different antenna type is now available which is known to be



Bow-Tie and Screen

mitting antenna; medium is between 20 and 50 miles; and fringe is from 50 to 100 miles and more. Such figures are based on level terrain—hilly country and mountains pose a different problem.

If you live in a local area, you probably will find a low-gain antenna to be adequate. Medium distance would require an antenna

WHAT ACCESSORIES TO CHECK*

Mast	Strap
Rotator	Rivets
Guy ring	U-bolts
Guy wire	Hinges
Ground rod	Lead-in
Mast clamp	Brackets
Guy anchor	U-clamps
Ground wire	Insulators
Ground clamp	Lag screws
Mast platform	Turnbuckles
Antenna joints	Strain relief
Wall mounting	Toggle bolts
Mast guy clamp	Lightning arrestor
Antenna elements	Lead-in feedthrough
Chimney mounting	

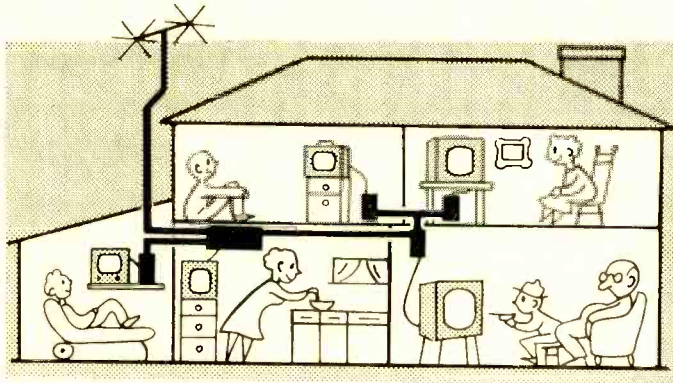
* No, all of these, naturally, will be found in every installation.

having more gain and perhaps better directivity. In fringe areas, however, the problem is much more complex.

Due to the curvature of the earth and other factors, it is sometimes necessary to use a tall tower to raise the antenna up where it can "see" the station. Modern TV towers for this purpose are well constructed, light, and treated to offset corrosion. These, in conjunction with high-gain antennas, can really pay off.

Steering the Antenna. The use of antenna rotors makes it possible to point the antenna where it will provide the most signal strength. They are of particular advantage in fringe areas where it is necessary to use directive antennas, but also where other widely scattered stations could be received if the antenna could be pointed towards them.

Household signal distribution system for feeding several sets is shown at right. The preamplifier in the large box may not be necessary if signals are strong.



The editors of POPtronics will be glad to see that you get complete antenna, rotor and accessory specifications and other data best suited for your particular area, whether it be local, intermediate or fringe. Just clip the coupon below, PRINT your name and address clearly, and mail to us.

ANTENNA DEPT.
POPULAR ELECTRONICS
ONE PARK AVENUE
NEW YORK 16, N. Y.

X

Gentlemen:

Please send me antenna specifications and other data so I will be able to pick the proper antenna and accessories for my own area. I understand I will be under no obligation.

NAME

ADDRESS

CITYZONE.....STATE.....

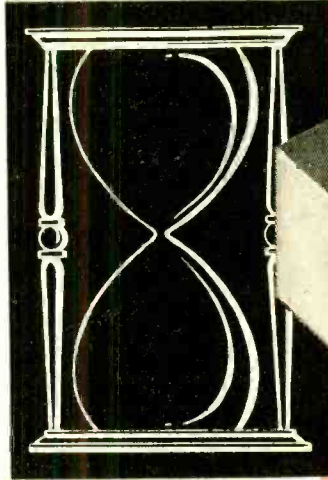
While you are planning an improved system, you might consider facilities for additional TV sets in other rooms. A modern signal distribution system with its greatly increased capabilities can feed several sets. Special couplers are available that isolate and distribute signals for two, three and more receivers. They also provide necessary isolation between sets so that one will not interfere with the other when they are tuned to different stations.

Modern preamplifiers do jobs like that of the early "boosters" but handle a wide band of frequencies and do not require continuous adjustment. Needed mostly in near-fringe areas and further out, they can be mounted in the house or at the antenna.

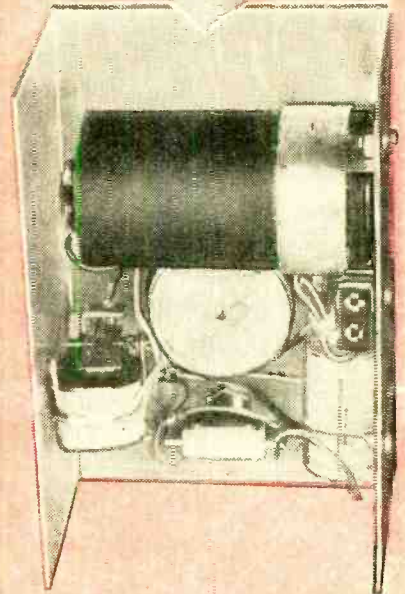
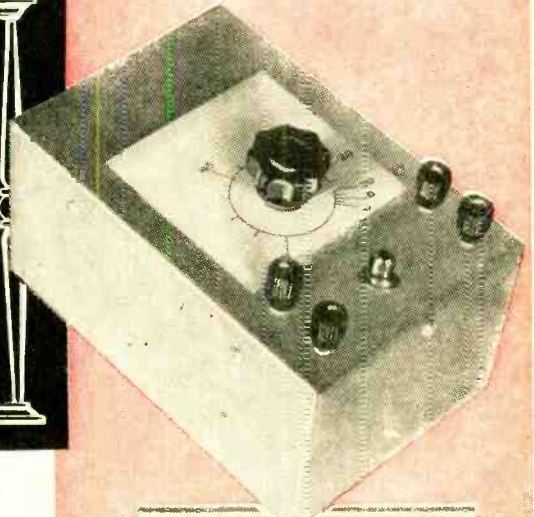
A new efficient antenna system is always a good investment and will provide greatly improved reception.

-50-

By
RUFUS P. TURNER



External and internal views of the timer are shown below. Note mounting of the large electrolytic capacitor.



Build the **Simpla-timer**

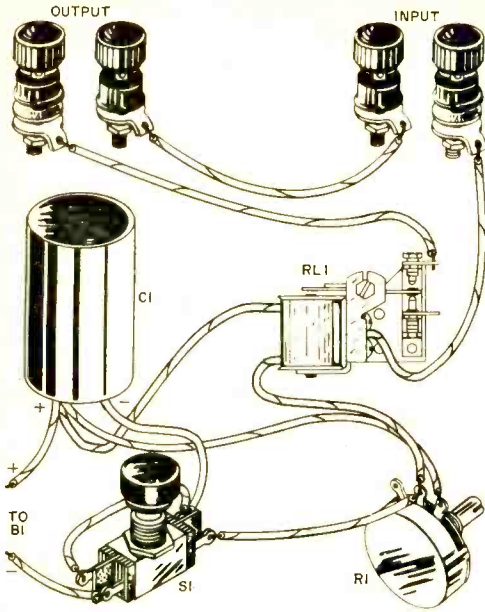
NO TUBES, transistors or neon bulbs are needed for this compact 5-to-50-second timer. Powered by a small battery, it is independent of power line fluctuations and will switch photoprinters, enlargers and other equipment requiring accurately timed operation.

The device to be controlled by the timer is connected to the *Output* terminals, and the power supply for this device is connected to the *Input* terminals.

Mechanical construction is easy. The timer is built in an aluminum chassis box 6" long, 4" wide, and 3" high.

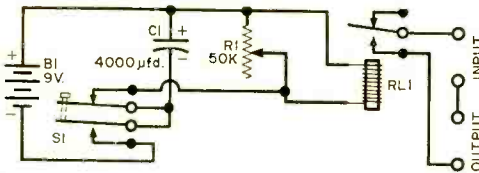
Mount capacitor *C1* on a side wall of the box with the mounting bracket supplied. If no bracket is supplied with *C1*, both *C1* and battery *B1* can be held in place by a short

**Reliable tubeless timer
uses minimum of components**



PARTS LIST

- BI—Miniature 9-volt battery (Eveready #226 or equivalent)
- C1—4000- μ fd., 10-15 volt electrolytic capacitor (Mallory HC-1040 or Sprague TVL-1173)
- R1—50,000-ohm wire-wound potentiometer
- RL1—8000-ohm relay (Sigma Type 4-F)
- S1—Push-button switch (H & H Type 3392 wired as s.p.d.t., or Olson Radio Warehouse #SW-109)
- 1—6" x 4" x 3" aluminum chassis box (LM #141)
- 4—Insulated binding posts
- 1—One-lug insulated terminal strip
- 1—Finger-grip knob with pointer
- 2—Snap-fastener connectors for battery BI



HOW IT WORKS

Operation is based upon the discharge of a large capacitance through the coil of sensitive d.c. relay *RL1*. Push-button switch *S1* is connected so that its two normally closed contacts keep capacitor *C1* connected to the relay coil.

When switch *S1* is pressed down, *C1* is connected through the two normally open contacts (but now momentarily closed) to the miniature 9-volt battery, *BI*, and becomes charged. When *S1* is released, *C1* is reconnected to the relay coil and discharges through it. The discharge current closes *RL1* until this current has decreased enough to release the relay.

The time interval during which *RL1* is held closed is governed by the setting of the 50,000-ohm control, *R1*. The scale of *R1*, therefore, may be calibrated directly in seconds. Parallel connection of *R1* and the relay coil resistance causes the nonlinearity of the time interval scale.

length of flexible, insulated hookup wire secured by a pair of 6-32 screws.

Connections are made to the battery by means of snap fasteners. No on-off switch is needed, since the battery is disconnected when *S1* is not pressed.

Draw the time scale on a white card which, after calibration and inking, should be protected with a transparent plastic spray or a coat of clear lacquer.

Wiring is straightforward. No special precautions are necessary, as this is a simple d.c. circuit and no trouble will be experienced from coupling, interaction, and such disturbances which must be avoided in a.c. signal circuits.

After construction is completed, the timer is calibrated with the aid of a stop watch. If one is not available, the second hand of an ordinary watch or clock can be used.

The calibration procedure is simple. Connect a wire jumper temporarily between the *Input* binding posts. Connect an ohmmeter to the *Output* posts. The meter will read zero ohms when relay *RL1* is closed, and infinite resistance when it is open. Set *R1* near its minimum resistance end.

Press *S1* for about four or five seconds. Release it and the stop watch at the same time. The relay will close, as indicated by zero-ohms deflection of the meter. When *RL1* opens, as indicated by the meter, check the reading of the stop watch.

If the time interval was not five seconds,

Simplicity of construction is evident from pictorial and schematic diagrams of the timer. Input and output terminals should be insulated from chassis. *S1* may be a standard s.p.d.t. push-button switch, if one is available.

readjust *R1* by a small amount and repeat the cycle until the relay remains closed exactly five seconds. Mark this setting as five seconds on the scale of *R1*.

Repeat the preceding steps to locate the 10-, 15-, 20-, 30-, 45-, and 50-second points and as many intermediate points as possible. Mark the low-limit setting of *R1* as zero. Remove the jumper from the *Input* binding posts, and the ohmmeter from the *Output* posts.

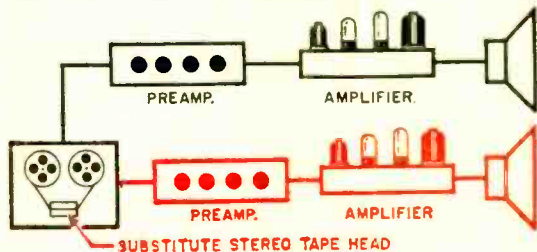
Now remove the scale and ink in the time graduations. Replace the scale. Set *R1* to its low limit, line up the pointer to zero on the scale, and the job is complete. —30—

START YOUR STEREO

...Here Are **3** Ways

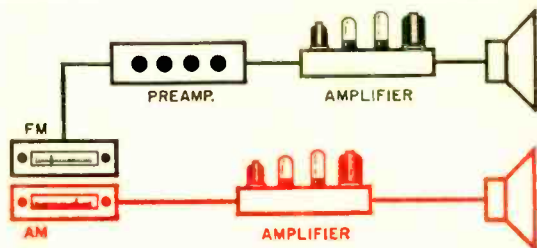
1

TAPE



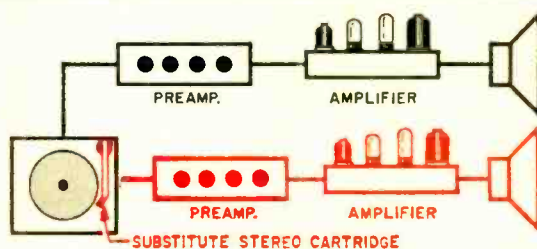
2

TUNER



3

DISC



By LEONARD FELDMAN

IF A QUICK LOOK at the price tags on the latest stereophonic sound equipment has resigned you to "one-ear" listening, take heart. This new sound experience may not be as far from your living room as you suppose. Virtually all manufacturers are working feverishly to bring stereo cost down to a level which won't require a second mortgage on your home.

For those who haven't heard stereo yet, a brief explanation is in order. When you hear a sound, you are usually able to judge its direction and approximate distance. You can do this only because you have *two* ears (just as you can judge the

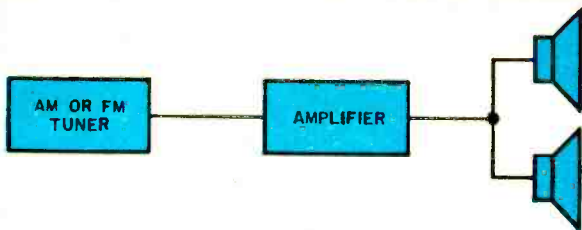
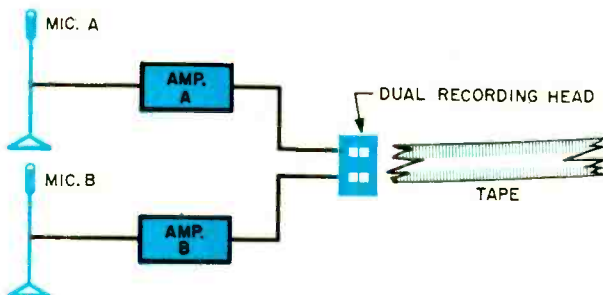


Fig. 1. Stereo is NOT just the addition of a second speaker (left). Two separate program sources played through separate channels feeding two speakers are needed.

Fig. 2. Method used to record stereo tape (right). Two tracks on tape contain two separate and complete recordings, one based on signal from mike A, the other from B. Latest development is recording of 4-track stereo tapes, which doubles playback time available.



distance of an object visually because you have two eyes).

The usual hi-fi system has *one* sound source. All the sounds present in a recording or broadcast are coming to you—but from a single small point in space, a condition which is not true to life and which deprives your two ears of the opportunity to use their innate talent.

Those who experiment with multiple speakers can testify that the addition of a second speaker adds a certain “something” to the total sound. But adding a second speaker will not give you stereo. It simply makes the sound originate from two points instead of one—but always with the same perspective.

Figure 1 shows that despite the use of two speakers on a single channel you still get monophonic sound with one source.

Separate Channels. The big jump to stereo is made when, in a two-speaker system, the left speaker provides that part of the program which would normally come from your left (first violins in a concert orchestra, for example) and the speaker on the right reproduces the instruments you would normally expect to come from your right (brass, tympani, etc.).

Fortunately, most of the directionality of sound is conveyed by the middle and higher pitched tones. Bass notes pervade the entire room and don't seem to be coming from anywhere in particular. It is this lucky situation which saves you money almost before you begin your switch to stereo.

If you have one good speaker system in your present setup, it is not necessary to duplicate it exactly for the second system. Your “primary” speaker will fill the room with solid bass, as it always has, and you're not likely to notice the absence of bass in the “economy model” with stereo. Even a good-quality 6” or 8” wide-range speaker, properly baffled, works amazingly well for the second channel of a stereo system.

Prerecorded Tape. There are, commonly, three stereo program sources. One is stereo prerecorded tape. While more expensive than discs, tapes last indefinitely and can be played on most tape recorders, provided they are converted for stereo. A number of adapter kits are made.

Since the tape has two recordings on it (A and B channels in Fig. 2), each recording must be picked up separately by the two-channel playback head, amplified and fed to its respective loudspeaker. One track on the tape can be fed through your tape recorder in the standard way and reproduced on the recorder's built-in speaker.

The second channel signal is fed to your present, separate hi-fi amplifier. A tape head preamp input usually is required. If no tape head input is present in your amplifier, you can feed the second channel to a magnetic phono input and adjust your tone controls for the best tape equalization. This method of conversion is shown in Fig. 3.

If you have a recorder without a built-in amplifier, you will need a second amplifier. If your tape recorder has its own preamp,

Fig. 3. In adapting your present tape recorder for stereo playback (right), be sure to check the present playback head for dimensions and type, so that the substitute head will fit in its place easily.

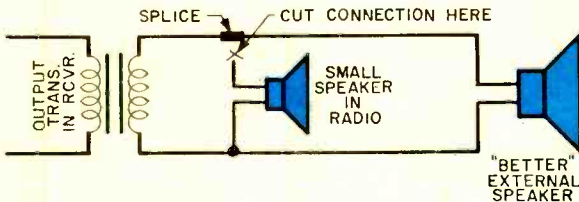
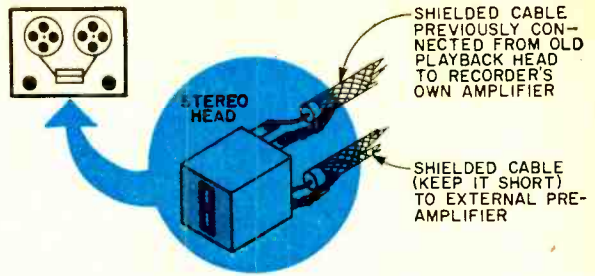


Fig. 4. For improved AM reception in your stereo, substitute a better external speaker (left). Modify the system by following the diagram, or install a shorting-type jack which will allow the internal speaker to play when the new one is removed from the circuit.

a basic power amplifier will suffice. If not, an integrated preamp/amplifier will serve. In any case, a 10-watt power rating will be ample. Remember, there will be two amplifiers supplying two speakers at all times, so the acoustic power required of each will not be as severe as with a single amplifier.

Stereo Broadcasting. Many stations have both AM and FM outlets. One microphone (or group of microphones) might pick up the "left" side of the program and send it out over the FM transmitter while the second, AM transmitter, is fed program material from the "right." You need only set up equivalent receivers to pick up this programming if it is available in your area.

Ideally, you would want to feed the AM channel through your hi-fi system in this setup. While the use of a small table-model AM radio will give some stereophonic effect, in conjunction with the FM signal fed to your rig, the difference in quality between the two channels might ruin the stereo effect. A simple solution would be to substitute a second speaker for the one built into the midget AM radio.

This simple wiring job is illustrated in Fig. 4. You'll be amazed at the improvement in sound of an a.c./d.c. five-tube when it is hooked up to a decent speaker.

One Groove, Two Sounds. The latest stereo method is the stereo disc, employing the 45-45 technique. In this system, a single recording groove actually contains two separate sound channels.

The only additional equipment you will

need, other than the items already discussed, is a stereo playback cartridge to replace the cartridge in your tone arm. Almost every cartridge manufacturer has a stereo model available.

Again, the two signals from the cartridge are fed respectively to your main system and second system. The nice thing about these stereo cartridges is that they play your old LP discs with equal facility.

Getting Better Stereo. It's worthwhile to experiment with your speakers for optimum placement. There is no simple rule to follow. Room size, location of the seating area, room acoustics and program material govern the distance between the two speakers. In general, the two speakers are best located along the long side of a rectangular room.

Start out by placing them at approximately the one-third and two-third points along this wall. It is not necessary or even desirable in all cases to place the speakers in corners. If your room is small and you find that in order to get proper separation you must "spread them out to the corners," try having them face in towards the seating area.

The stereo effect is dependent upon equal level from each speaker. It is important to adjust the volume control of each amplifier until the volume levels of the speakers are equal. A difference in level of 10 db can virtually destroy the entire effect and will shift the perspective toward the speaker which is turned up too high.

By
ART TRAUFFER



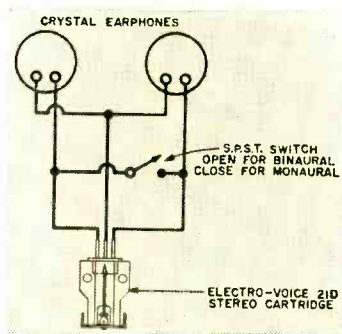
PERSONAL **STEREO** PLAYER

IF YOU ARE anxious to try the new stereo records, there's no need to wait until you can acquire a two-channel audio amplifier and a pair of speaker systems. This simple record player will give you thrilling earphone reproduction from the new Westrex-type stereo discs.

Besides being useful as a stereo disc demonstrator for entertaining friends, or for late evening listening without disturbing others, it should appeal to public library record loaning departments and record shops, where quiet listening and the saving of space are of prime importance.

As shown in the schematic diagram above, an Electro-Voice Model 21D ceramic stereo cartridge (or the build-it-yourself stereo cartridge featured in April P.E.) feeds directly into a pair of Brush Model BA-205B wide-range crystal earphones wired for binaural listening. One channel from the stereo groove is fed to one phone, the other channel to the other phone.

The volume is adequate and the reproduction is very clean due to the absence of amplifier and speaker coloration. An s.p.s.t. switch is included so that the cartridge and



Wiring of the complete player including the stereo/monaural switch.

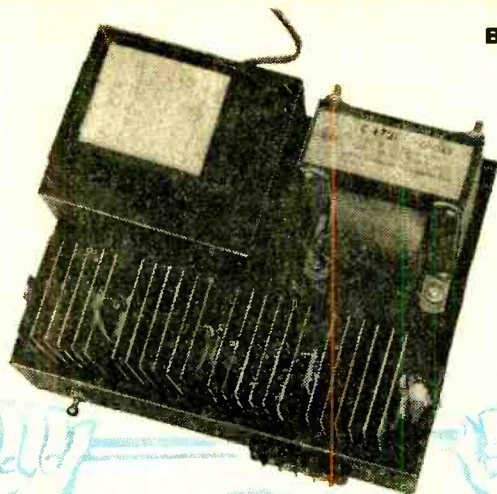
phones can be switched to monaural operation for other discs. As shown in the photo, the Brush crystal phones with binaural cords are connected to the three phone tip jacks.

A 33 $\frac{1}{3}$ -rpm phono motor and turntable was mounted on a homemade wood base covered with self-adhesive plastic material. The Electro-Voice 21D ceramic stereo cartridge can be mounted in any arm having standard $\frac{1}{2}$ " mounting centers and which can be adjusted for

about 6 grams of stylus force. The pickup arm must also have a two-conductor shielded cable to accommodate the dual stereo outputs of the cartridge. The writer used an Electro-Voice stereo cartridge because it was the first available, but other ceramic or crystal stereo cartridges are now made by Ronette, Brush, Sonotone, etc.

The more expensive Brush Model BA-206B crystal phones have somewhat higher sensitivity than the Brush Model 205B phones. Those of you who do not want to invest in high-quality crystal earphones will find that a pair of economical crystal earpieces (Lafayette Radio MS-111, \$1.19 each) will give satisfactory results.

-30-



Experimenter's Husky Power Supply

Television receiver components in voltage multipliers provide high d.c. power... details of a quadrupler are presented here

SELENIUM RECTIFIERS can be arranged in circuits that give you a choice of d.c. output voltages which are many times the a.c. line voltage input... without use of high-voltage transformers.

The circuits shown here provide d.c., at double, triple and four times the input voltage. They can be operated directly from the line or, preferably, from a safety standpoint, from a 117-volt to 117-volt transformer for isolation. Construction details are given for a heavy-duty quadrupler power supply that will be of particular interest to experimenters, hams, and hi-fi fans who have wanted such a unit.

Applications of the selenium rectifier have steadily expanded, and today it is accepted by industry as an efficient and economical means of converting a.c. to d.c. Over a period of years, such rectifiers have proved to be long-lived and dependable under severe operating conditions. The silicon type rectifier is starting to compete seriously with selenium but, at the present time, the majority of rectifiers in service are of the selenium type.

One of the major factors explaining the

low cost of the selenium rectifier is its simplicity of construction. A nickel-plated aluminum baseplate is coated with selenium. The selenium, in turn, is sprayed with a low-temperature alloy. The baseplate serves as the negative electrode and the alloy as the positive. Current flowing from base to alloy meets little resistance, but encounters high resistance in the opposite direction. This characteristic of high resistance in one direction and low resistance in the other enables selenium to act as a rectifier.

The simple single-phase selenium rectifier power supply in Fig. 1(A) is a half-wave type. Since rectifier *SR1* conducts once each cycle of the 60-cycle current, capacitor *C1* is charged once each cycle. The capacitor charge is dissipated by the load placed across its terminals.

If *C1* is large enough, it will act as a reservoir, maintaining the voltage fairly constant as shown in Fig. 1(B). Resistor *R1* limits the initial charging current of *C1* to prevent damage to the rectifier.

A voltage-doubler circuit (half-wave) is shown in Fig. 2(A). It provides slightly

more than twice the r.m.s. (root-mean-square) value of the input voltage. In this circuit, *C1* is charged on one-half of the input cycle. *C2* is charged on the other half of the cycle by the line voltage *plus* the charge across *C1*.

This technique can be carried several steps further. A voltage tripler is shown in Fig. 3(A) and a voltage quadrupler in Fig. 4(A). Each of these circuits depends upon large-value capacitors being separately charged, then discharged so as to add their voltages.

Theoretically, it is possible to add successive stages of rectifier-capacitor combinations to multiply the source voltage to extremely high values. However, from economic and efficiency standpoints, the practical limit in commercial applications is the voltage quadrupler.

A voltage quadrupler can be built which employs TV-type replacement selenium

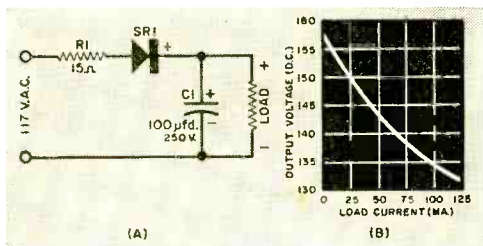
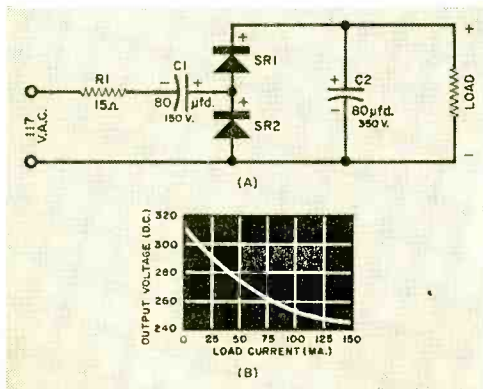


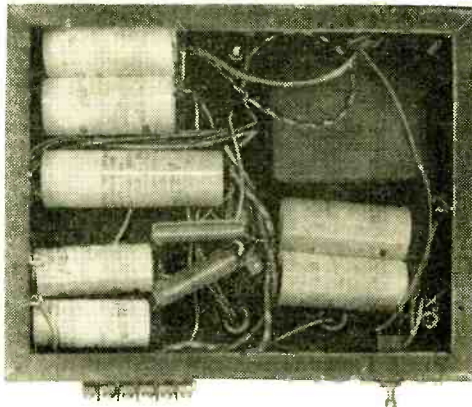
Fig. 1. Simple half-wave circuit as used in a.c./d.c. radios.

Fig. 3. Voltage tripler is a doubler and a half-wave in series.

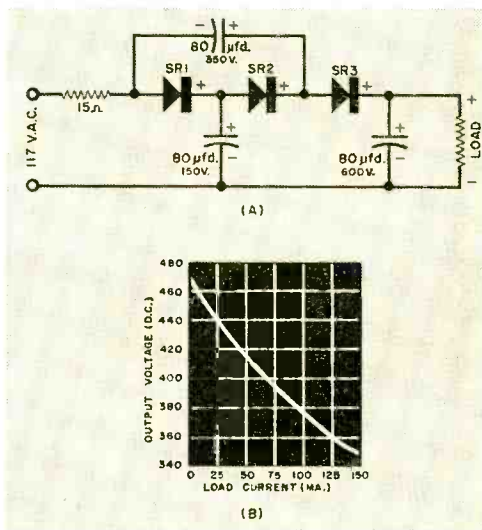
Fig. 2. Voltage doubler circuit. Note polarity of input capacitor.



rectifiers and will provide about 500 volts at a current drain of 200 ma. Unfortunately this circuit—if not isolated from the a.c. line by a transformer—has a high shock hazard. Depending upon which way the line plug is inserted, the high voltage output



Underchassis view of practical voltage quadrupler power supply.



might be 117 volts a.c. or even 230 volts d.c. above ground.

Transformer manufacturers, aware of the problem, and knowing that the voltage multiplier is well suited for TV use, have produced isolation transformers designed to be placed between the power line and the multiplier circuit. Such transformers effec-

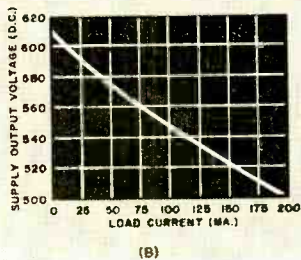
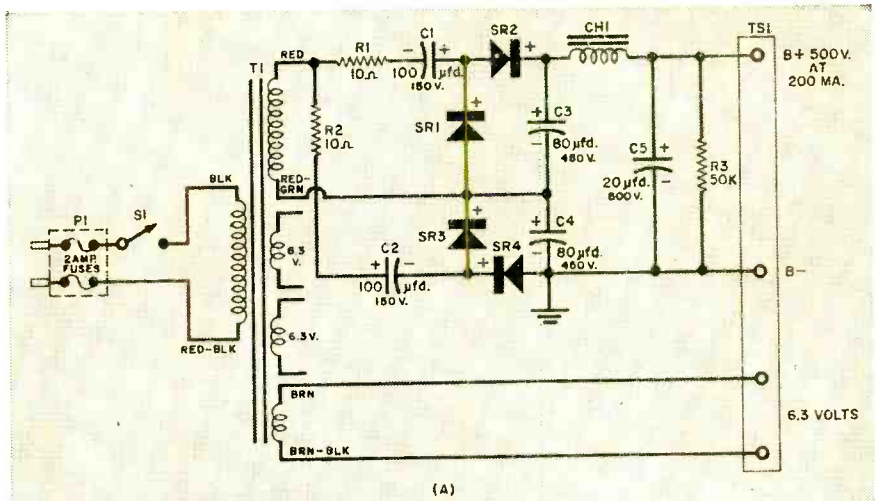


Fig. 4. Schematic and regulation graph of the voltage quadrupler. Make sure all polarities are correct before switching on a.c. line voltage.

tively isolate the line and, in addition, usually provide several filament windings for the operation of either 6- or 12-volt tubes.

The practical power supply circuit given in Fig. 4(A) is a simple voltage quadrupler, employing four selenium rectifiers. A choke and filter capacitor are included to reduce the ripple content to a low value. A IV-type isolation transformer *T1* is used so that the negative return of the supply can be grounded without shock hazard. The supply is built on a 9" x 7" x 2" aluminum chassis, as is shown in the photo at the top of page 57.

Each selenium rectifier can be mounted to the chassis by a long bolt, or they can be "strung" on a threaded rod and attached to mounting posts. Leads from the rectifiers pass through rubber grommets mounted in the chassis deck. The rectifiers should *not* be mounted beneath the deck as ample air circulation around the

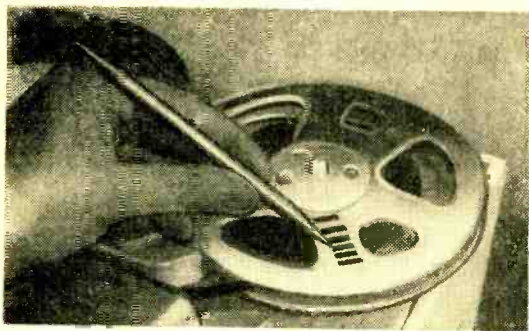
- ### PARTS LIST
- C1, C2*—100- μ fd., 150-volt electrolytic capacitor
 - C3, C4*—80- μ fd., 450-volt electrolytic capacitor
 - C5*—20- μ fd., 600-volt electrolytic capacitor
 - CH1*—9.5-henry, 200-ma. choke
 - P1*—Fused power plug, with 2-ampere fuses
 - R1, R2*—10-ohm, 10-watt wire-wound resistor
 - R3*—50,000-ohm, 10-watt resistor
 - S1*—S. p. s. t. toggle switch
 - SR1, SR2, SR3, SR4*—130-volt, 250-ma. selenium rectifier
 - T1*—Power transformer, 117-volt secondary at 280 ma., three 6.3-volt filament windings (Stancor P-8336)
 - TS1*—Screw-type terminal strip

rectifiers' square cooling fins is required.

For best voltage regulation, input capacitors *C1* and *C2* should be about 100 μ fd. Output capacitors *C3* and *C4* should each be 80- μ fd., 450-volt units. As a substitute, two 40- μ fd., 450-volt electrolytics can be wired in *parallel* for both *C3* and *C4*. Be sure that correct polarity is observed for each capacitor.

Now connect a 0-1000 volt d.c. meter across the terminals and turn on the supply. A regulation curve showing different load conditions appears in Fig. 4(B). Intermittent loads of 250 ma. can be drawn over a short period of time without damage.

Don't touch the plates of the rectifiers when the supply is running, and don't let the plates touch the chassis of the supply. The plates are insulated with enamel, but it is risky to depend upon that for protection against the high voltage applied to the rectifiers. And, as with any high-voltage supply, reasonable care in operation should be observed. The rectifiers will normally heat up after operating for a time. —50—

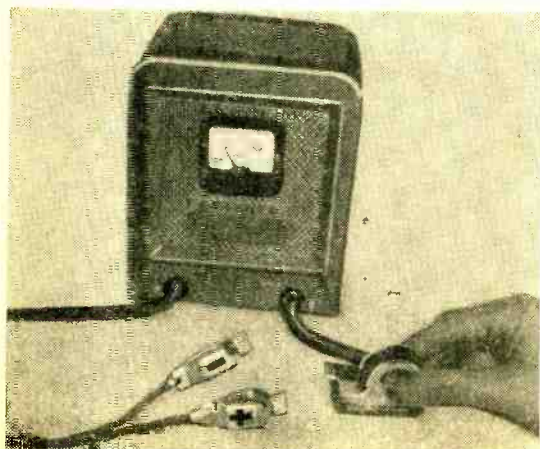


To show playing time on a reel of tape, mark it with strips of colored (Scotch) plastic tape. Determine correct spacing between strips by running tape at normal speed through the recorder and timing it at five-minute intervals. Place a narrow strip of plastic tape on the spoke in alignment with the amount of recording tape on the reel. The markers will serve as indicators and give a close approximation of tape on reel.



Drilling a hole in a radio or TV chassis usually calls for a center-punched indentation to keep the drill from "walking" about on the hard metal surface. The shock that the chassis receives when the punch is struck is liable to cause damage to delicate components. This can't happen if you place two crossed strips of masking tape over the area before drilling. The drill will enter the work precisely without attempting to walk away.

TRICKS with TAPE



Test clips of battery chargers and other electrical apparatus can be easily and quickly identified for polarity with signs cut from colored plastic tape. The tape is durable, available in several colors, and easier to see than the tiny plus-and-minus signs stamped into the metal of some test clips. It's a good idea to use a color combination such as red for plus and green for minus to avoid the possibility of mistaking signs.

By
JOHN A. COMSTOCK

THE TRANSISTOR has been on the electronic scene just a few short years but it has already proved itself superior to vacuum tubes in many applications. For hi-fi fans, it's a boon, because good quality can frequently be achieved with much less effort than is required with vacuum tubes. There is no hum or noise mixed with the music and no power supply problems.

The equalizer-preamp to be described will meet with the approval of the most critical hi-fi listener, and the cost of construction is amazingly low. Three RCA transistors are used. As the noise level of the unit is mostly dependent on *TR1*, an RCA 2N175 was chosen because of its low-noise characteristics. The second and output stages use the RCA 2N109.

First prepare the aluminum box which houses the circuit board. It is a 5" x 10" x 3" aluminum chassis. After the chassis has been drilled, you can letter the control panel using a lettering guide or decals.

The circuit is wired on a 7½" x 2¾" perforated phenolic board. Parts placement is not of great importance. However, because of the very high gain of the circuit, it's wise not to run the signal output wires too close to those handling input voltages.

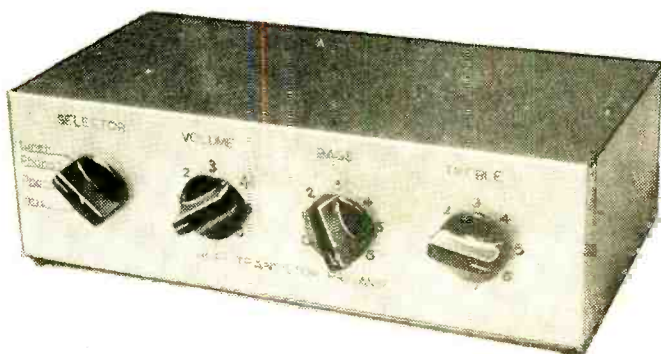
Components are mounted as shown on both sides of the phenolic board. Flea clips are used as tie points and terminal connections. No attempt has been made to miniaturize this unit, and to extend battery life, the largest 22.5-volt unit available is employed.

Use sockets for the transistors and place

them in a position where they can be reached easily when the phenolic board is mounted in the chassis box. A small right-angle bracket should be bolted to each end of the board for use during mounting.

When the wiring of the component board is completed, place it in the chassis as close to the controls as possible. Mark the chassis where the angle brackets line up, and drill

TRANSISTORIZED



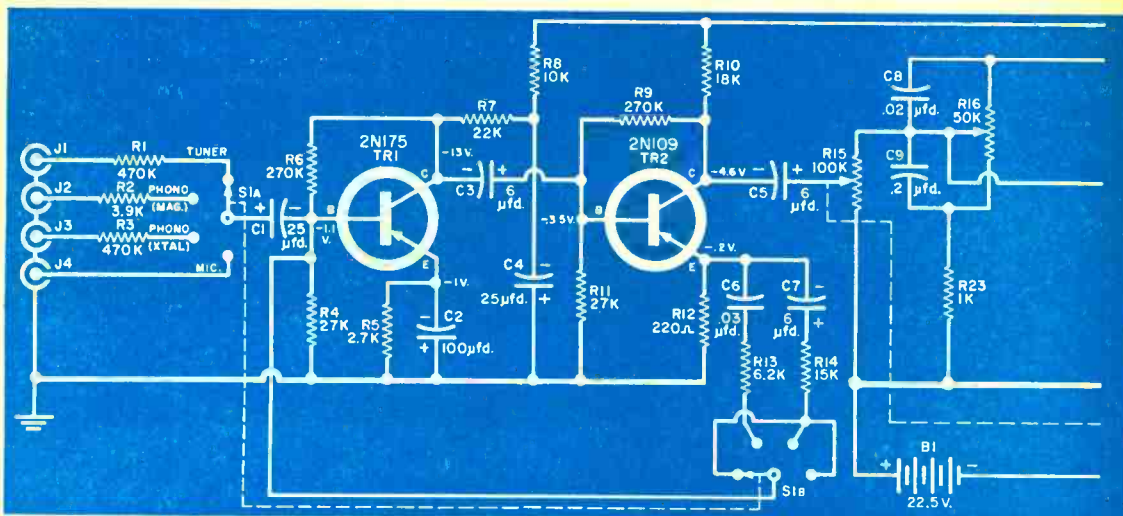
PREAMP and CONTROL UNIT

Avoid hum and noise with an all-transistor hi-fi preamplifier

By TRACY DIERS

two screw holes for mounting the board brackets. Now connect flexible leads from appropriate flea clips on the board to the front panel controls.

Check with the schematic often, as you can easily make a mistake here, especially at the selector switch (*S1*). Wires which run the length and width of the chassis should be tucked under the chassis lip for



PARTS LIST

B1—22½-volt battery (Burgess 4156 or equivalent)

C1, C4—25-µfd., 25-volt electrolytic capacitor

C2, C14—100-µfd., 15-volt electrolytic capacitor

C3, C5, C7, C12—6-µfd., 25-volt electrolytic capacitor

C6—0.03 µfd.

C8—0.02 µfd.

C9—0.2 µfd.

C10—0.008 µfd.

C11—0.08 µfd.

C13—0.1 µfd.

J1, J2, J3, J4, J5—RCA type phono jack

R1, R3—470,000 ohms

R2—3900 ohms

R4, R11, R18—27,000 ohms

R5—2700 ohms

R6, R9—270,000 ohms

R7—22,000 ohms

R8, R22—10,000 ohms

R10, R19—18,000 ohms

R12—220 ohms

R13—6200 ohms

R14—15,000 ohms

R15—100,000-ohm potentiometer with switch S2 (volume)

R16—50,000-ohm potentiometer (bass)

R17—50,000-ohm potentiometer (treble)

R20—220,000 ohms

R21—470 ohms

R23—1000 ohms

S1—2-pole, 4-position rotary switch (selector)

S2—On-off switch on R15

TR1—2N175 transistor (RCA)

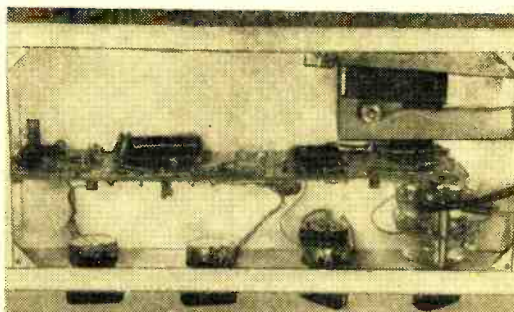
TR2, TR3—2N109 transistor (RCA)

1—Perforated board (Lafayette MS-306)

12—Flea clip terminations (Lafayette MS 263)

All capacitors, unless otherwise noted, are ceramic types, 25-volt or higher rating.

All resistors
½ watt



Beneath the chassis, the preamp looks like this. The battery is mounted at top, right, and held in place by an aluminum bracket insulated with electrical tape.

If no reading is obtained, check for an open circuit. If 1 ma. or more is read, check for incorrect transistor connection. If you remove all transistors and find that the reading is still excessive, there is a circuit error somewhere.

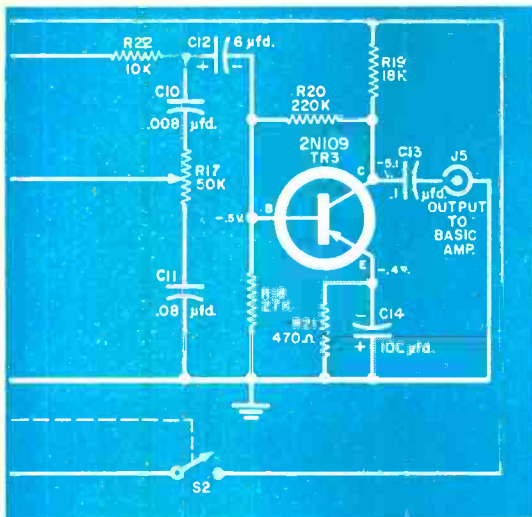
When you obtain the correct current flow (100-300 µa.), hook up the 22½-volt battery. The current which the preamp takes with the 22.5-volt battery will be about 2.4 ma.

Connect the output of the preamp to the input of the basic amplifier and plug your tuner into the proper jack. Turn the volume up about half way and adjust the tone controls to your taste.

Try your pickup cartridge next. If you

neatness. Use shielded wire to connect the input jacks to S1.

Test for the proper current drain with low voltage before applying the full 22.5 volts. Connect a three-volt battery (two size D cells) to the battery input wires with a milliammeter in series. Observe the correct polarity and you should get a meter reading of 300 µa. (0.3 ma.) or less.



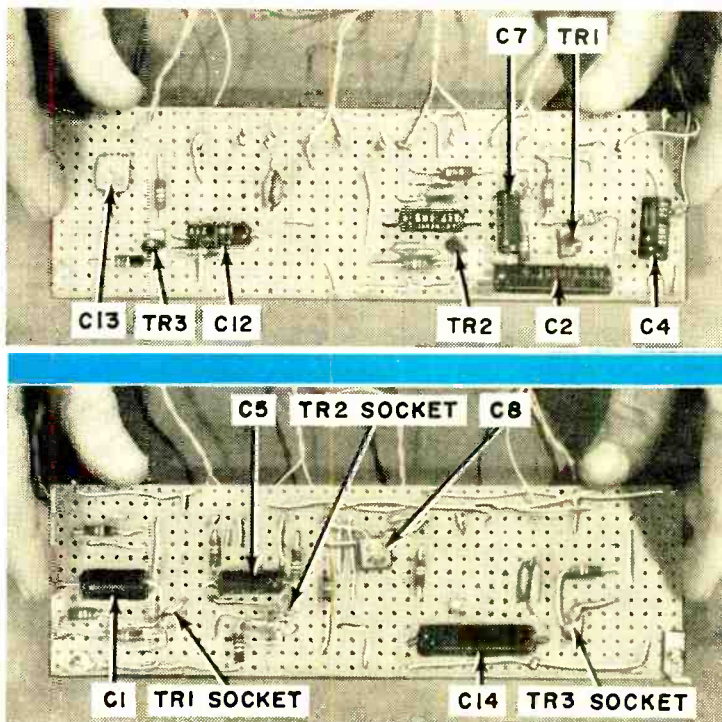
HOW IT WORKS

A feedback circuit comprising $R13$ and $C6$ or $R14$ and $C7$ —depending on the setting of selector switch $S1$, Section B —is connected from the emitter of $TR2$ to the base of $TR1$. This circuit reduces distortion and smooths the frequency response.

When $S1$ is set in the *Phono 1 (Mag.)* position, Section B automatically connects $R13$ and $C6$ into the feedback loop and the preamp circuit provides the correct playback compensation (RIAA) for modern LP records. Section A of $S1$ selects the proper cartridge load when $S1$ is in the *Phono 1 (Mag.)* position. In other positions, Section A determines the degree of attenuation necessary to prevent overload of $TR1$.

When a crystal or ceramic cartridge is used and $S1$ is set in the *Phono 2 (Xtal.)* position, record compensation will *not* be automatic and the tone controls may need adjustment to provide the correct tonal balance. The tone control portion of the preamp has a range of ± 15 db on both the bass and treble and should be able to match most crystal cartridge frequency characteristics.

Following this stage, the signal is passed into $TR3$. The low output impedance of $TR3$, about 18,000 ohms, limits the high-frequency loss which may occur due to a long output cable.



Both sides of the phenolic wiring board are shown at right. The components are "threaded" onto the board and held in place by their leads. Any capacitor value not available may be made up by wiring two capacitors in parallel whose values total the desired capacitance.

have a magnetic cartridge of the type which requires considerable amplification, you will get that amplification—and without hum!

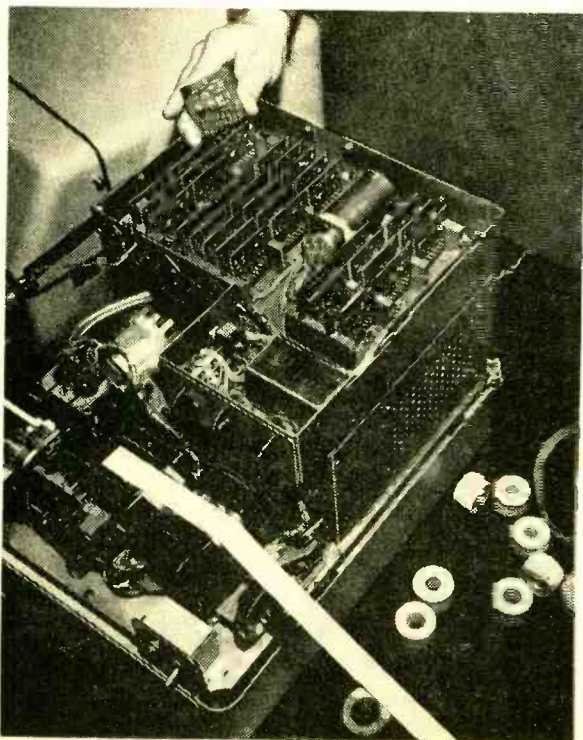
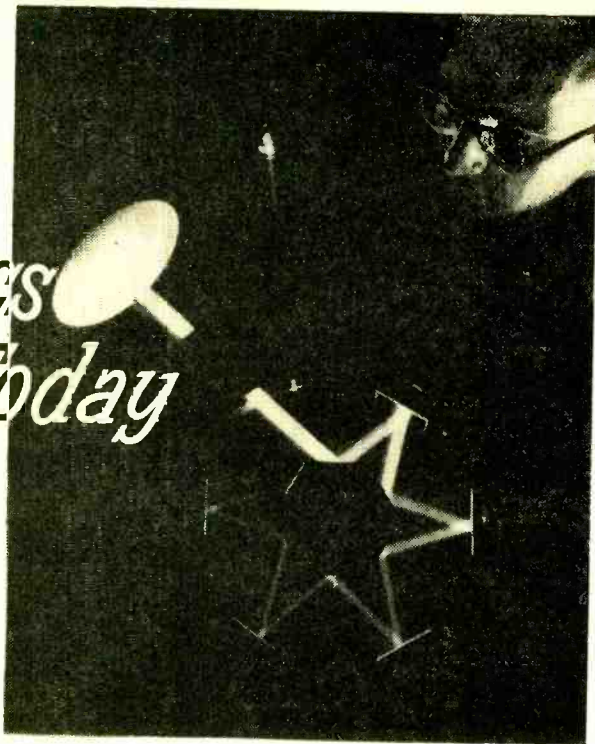
On the author's unit, the "flat" response settings for the tone controls are approximately at the 12 o'clock position. You can determine the *exact* flat position for your preamp very easily but you will need an audio signal generator and a VTVM and/or

a scope. "Square Waves Check Tone Controls," in the March 1958 issue of P.E. gives instructions for the exact technique.

The 22.5-volt battery should last a long time since the current drain is small. Should you wish to be completely independent of batteries, a transistorized power supply can be built which will deliver the necessary voltage from the a.c. lines. —30—

Electronics Today

Pulses of light only a few billionths of an inch in length are produced by the Westinghouse "light chopper," a super-speed six-sided mirror. The pulses are used to test reaction time of electronic devices.

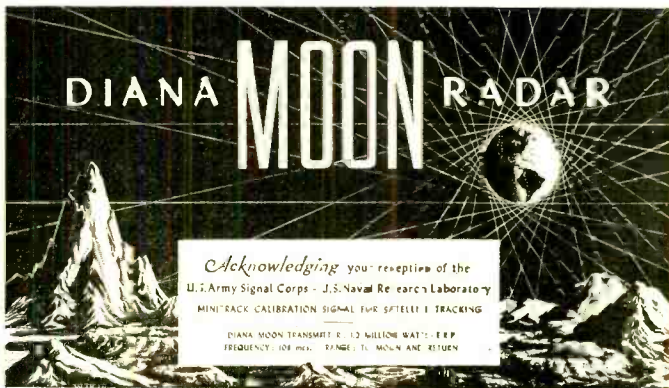


SWL's who pick up signals from space can obtain a QSL card for their trouble. Before launching a satellite, the Signal Corps bounces a signal off the Moon to help calibrate the Minitrack stations. Those receiving such a reflected signal may contact the Signal Corps at Fort Monmouth, N. J., and will be sent the card shown at right.

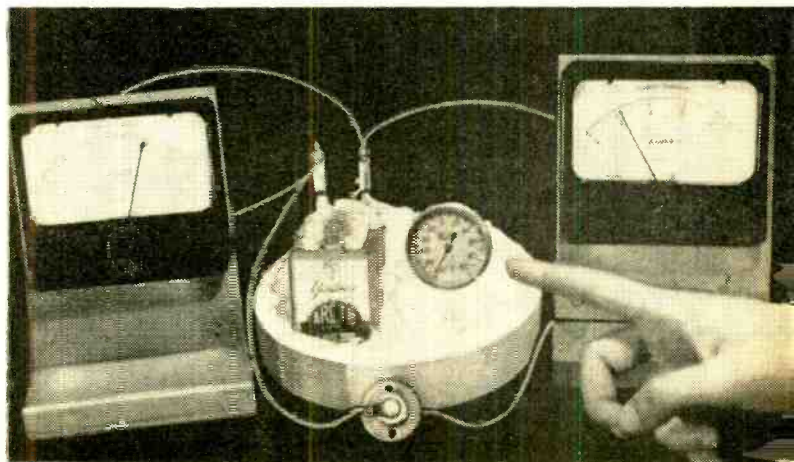
The world's fastest message printer and code puncher—750 words a minute—has been developed for the Signal Corps by Kleinschmidt Labs. The message is printed by a wheel whirling at 3750 rpm, as fast as the wheels of a car that is speeding at 500 miles an hour.

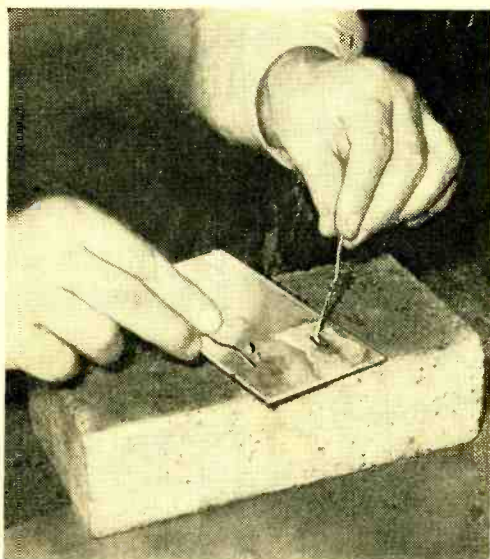


There's no fly on the nose of this infant. No sir, he's concentrating on the world's smallest precision electrical switch. Minneapolis-Honeywell engineers developed the device, which weighs 1/28th of an ounce and has a 5-amp rating—enough to control the motor of a refrigerator. It is used in missiles.



A battery that operates at -100° F is slated for use in low-temperature and high-altitude electronic equipment. Developed by Yardney Electric, it will operate over a 300° range. This is said to be the first time appreciable current below -65° has been available in any type of battery.



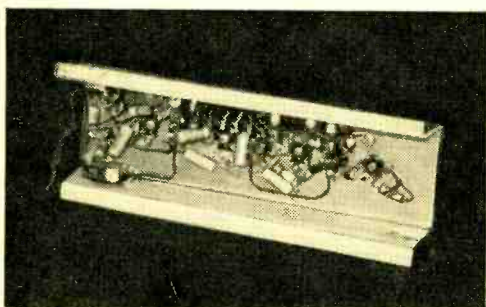


Note the difference in results when the Chemalloy fluxless aluminum soldering rod is used as compared to ordinary solder. Without Chemalloy, solder balls and forms globules without holding (left), while with it, solder adheres perfectly (right).

Fluxless Soldering and Welding of Aluminum

Made Easy

By WALTER WHITE, Jr., W4UEK



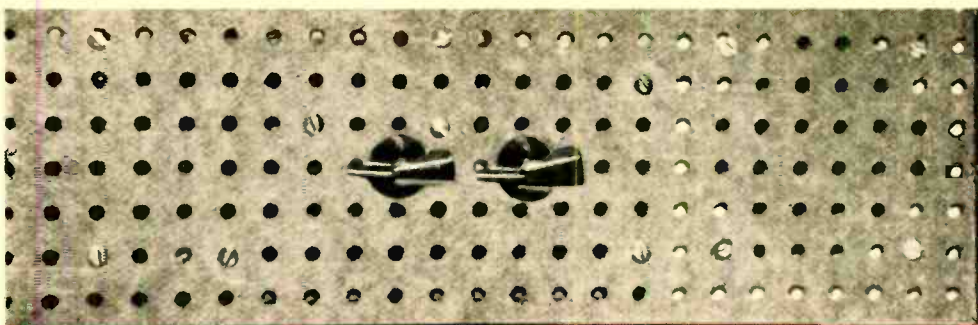
Aluminum chassis on which the new fluxless aluminum solder has been used to ground components, instead of employing the usual ground lugs. This speeds up work and insures positive grounding.

SOLDERING AND WELDING of aluminum is now made easy for the experimenter by an improved fluxless aluminum solder and welding rod known as "Chemalloy." This product is derived primarily from zinc blended with other metals which have been cleansed and homogenized with muriatic acid while in the molten state. Three types are available in 14" triangular

rods: a very low temperature type (500° F); a low temperature type (600° F); and a medium temperature type (800° F). It is used as a tinning agent or a solder.

Sheet aluminum and other aluminum stock is widely used by experimenters, craftsmen and radio amateurs for home-made wave guides, horn antennas, chassis, and "black boxes" due to the ease with which aluminum can be worked. One drawback, however, is that ordinary solders do not hold because a surface film or oxide forms on aluminum when it is exposed to air. This surface film, oddly enough, keeps aluminum bright and free from corrosion, but no weld or solder will hold if it is not removed or cracked to permit fusion between the parent metal and the welding or soldering metal. The film won't disintegrate at ordinary welding or soldering temperatures.

The photo at the top of this page shows a piece of aluminum the right half of which was coated with Chemalloy. The left half was not treated, and the soft solder rolled off due to the surface oxide. On the treated half, the solder adhered.



Monoceiver Pulls in DX

*Miniature one-tube receiver
for the short-wave listener*

By FORREST H. FRANTZ, Sr.

HERE'S a "Tom-Thumb" receiver that speaks loud and clear—and uses only *one tube!* It's a real radio with "pull" and selectivity enough for broadcast station separation, even in metropolitan areas. And its simple circuit and ease of assembly make it an excellent first project for the beginner—it *could* be completed in one evening.

First, cut a 4" x 12" perforated Masonite panel. Ream out two $\frac{3}{8}$ " holes at the points shown above. Mount the speaker against the right side of the front panel, aligning it with a row of perforations. Then mark the speaker mounting holes to coincide with the panel perforations, and file or drill for proper installation of the mounting screws.

A 4" x 4" piece of cardboard is used as a small speaker baffle. Center the speaker over it and punch the mounting holes. A 3" circle should be cut out of the center of the cardboard for the speaker cone opening.

Mount the loudspeaker, baffle, and other

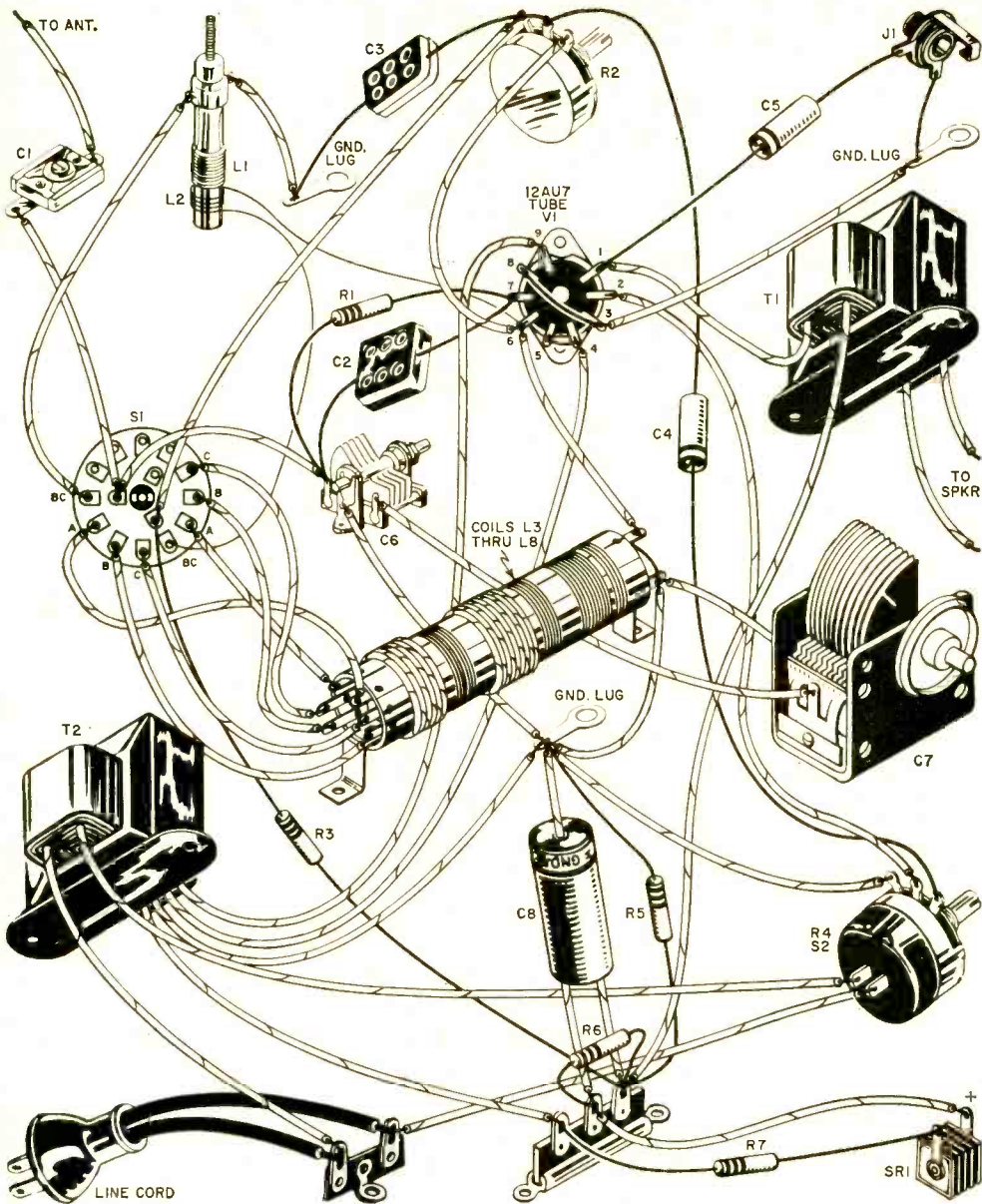
components. The tube socket is mounted with a small bracket or by means of $1\frac{1}{4}$ "-long 6-32 screws inserted through the panel.

The wiring sequence is: first the power supply, then the ground circuit, then the output transformer, and the remainder. Loopstick antenna coil *L1* must be provided with four turns of wire to serve as a tickler (*L2*). Use insulated wire, between No. 22 and No. 30, and leave $2\frac{1}{2}$ " of lead on each end.

After winding the tickler, hold your soldering iron near (but not against) the coil till the wax flows slightly. This will hold the turns in place. The coil itself (*L1*, *L2*) can be mounted by soldering its slug screw retainer on the tube socket frame or bracket. The tickler connections should be made last. Solder them lightly because they may have to be interchanged.

Now install the tube, use a 3' to 5' length of wire for the antenna, and plug in the line cord.

With the volume control on full, rotate



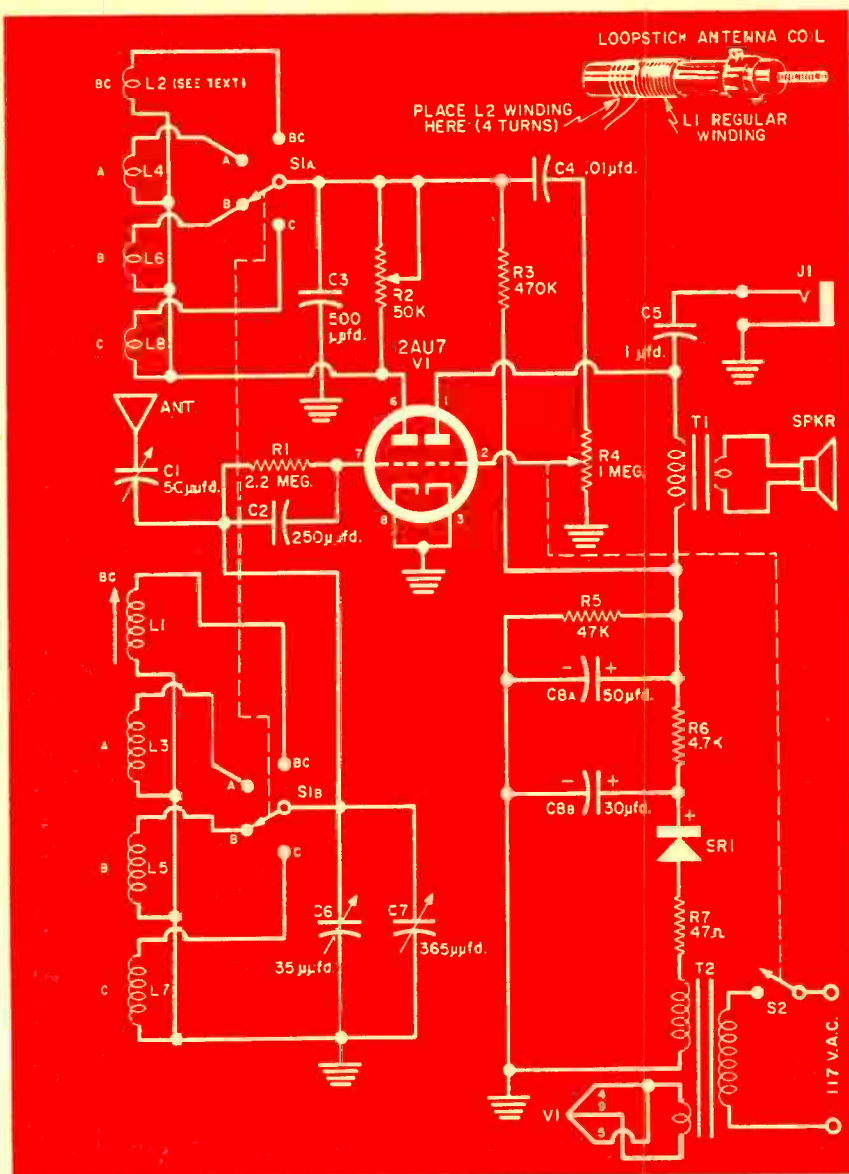
Pictorial of the complete short-wave receiver. See page 70 for coil connection details.

the tuning capacitor till a station or an oscillation squeal is heard. If there's no signal, or a weak one, connect a longer antenna and try again. If the set is still dead, place your finger on the center lead of the volume control (without making any other contact with your body). A loud hum should be heard. If it is not heard, check the audio stage. If you do get the hum, the difficulty is in the detector. In that case, try reversing the tickler coil connections to insure that they are wired

correctly with relation to the primary.

Broadcast band coverage should be complete. If your set doesn't cover the entire broadcast range, adjust the screw slug in the Loopstick coil until it does.

If your radio played, but didn't oscillate, reverse the tickler coil connections (if you haven't already done so). Leave the tickler connections fixed for loudest reception or oscillation. A squeal indicates that regeneration is excessive for the signal being received. Reducing the volume

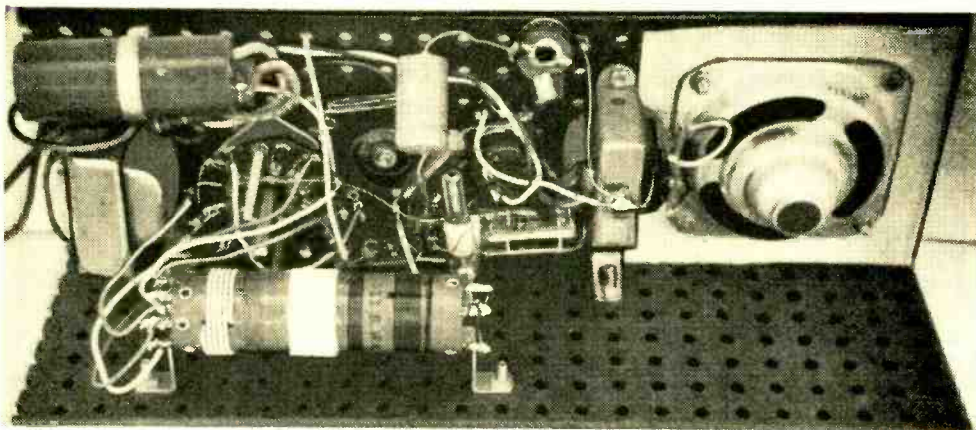


Schematic of Monociever with short-wave reception features included. The three-band antenna coil is available at your local distributor or from J. W. Miller Co., 5917 S. Main St., Los Angeles, Calif.

PARTS LIST

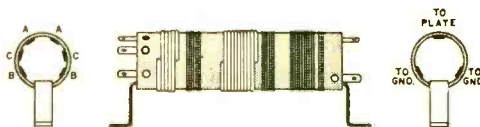
C1—50- μ fd. trimmer capacitor
 C2—250 μ fd. mica capacitor
 C3—500 μ fd. ceramic capacitor
 C4—0.01- μ fd., 200-volt capacitor
 C5—1- μ fd., 200 volt paper capacitor
 C6—35- μ fd. variable capacitor (Bud 1852)
 C7—365 μ fd. tuning capacitor
 C8a/C8t—30-50 μ fd., 150-volt electrolytic capacitor
 J1—Phone jack
 L1—Loopstick antenna coil (Lafayette MS11)
 L2—Four turns of wire below L1 (see text)
 L3, L4, L5, L6, L7, L8—Short-wave three-band antenna coil (Miller 511-SW-A)
 R1—2.2-megohm, $\frac{1}{2}$ -watt resistor
 R2—50,000-ohm potentiometer

R3—470,000-ohm, $\frac{1}{2}$ -watt resistor
 R4—1-megohm volume control (with switch S2)
 R5—47,000-ohm, 1-watt resistor
 R6—4700-ohm, 1-watt resistor
 R7—47-ohm, $\frac{1}{2}$ -watt resistor
 S1—2-pole, 4-throw bandswitch (Mallory 3234)
 —one section not used
 S2—S.p.s.t. switch (on R4)
 SPKR.—3" loudspeaker
 SR1—30-ma. selenium rectifier
 T1—25,000- to 3.2-ohm output transformer
 T2—Power transformer, 125-volt and 6.3-volt secondary (Stancor PS 8415)
 V1—12AU7 tube
 1—4" x 12" piece of perforated Masonite
 Misc. knobs, terminal strips, line cord



HOW IT WORKS

The 12AU7 (V1) has two triode sections, one of which is used as a *regenerative* detector; the sensitivity and selectivity of this type of detector are obtained by feeding back a portion of the detector's output signal to the detector's input by way of tickler coil L2. Tube V1's second triode serves as an audio amplifier-output stage—its job is to amplify the audio signal which the preceding triode has separated from the radio-frequency signal. The power supply is a standard selenium rectifier type with RC filtering.



Parts placement is shown in rear view of Monoceiver at top of page. The multi-winding short-wave coil may be seen at left of center in photo. Connection details of this coil appear in diagram above.

slightly or using a different length of antenna is the solution.

If you are close to stations, a very short antenna will pick them up, without causing a squeal, but you'll have a difficult time receiving weaker stations. A compromise can be achieved by the use of an adjustable antenna trimmer capacitor.

The trimmer capacitor is a variable type of about 50- μfd . maximum capacitance. For strong stations that might cause oscillation, decrease the antenna coupling; for weaker stations, increase it.

Short-wave coverage and other features can be added to your receiver in about 30 minutes. With five turns of insulated antenna lead wrapped around the

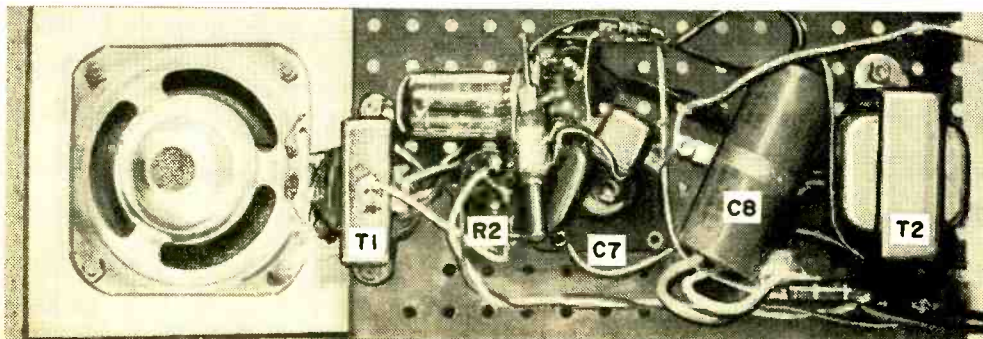
handle of a metal filing cabinet, the "Voice of the Andes" comes in at loudspeaker volume. With headphones, London and U. S. commercial short-wave and hams blast in loud and clear. And for the code-conscious, there's plenty of c.w.

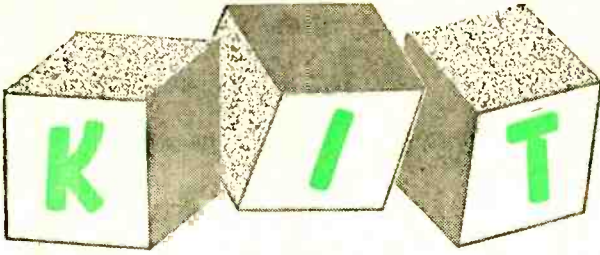
The bandswitch knob is installed on the front panel next to the tuning capacitor. The three-band short-wave coil primary winding is used as a tickler coil. Fasten 4" color-coded leads to each of the terminals before you mount the coil.

Since regeneration is more critical for short-wave operation than it is for broadcast-band operation, a regeneration control should be added. A 50,000-ohm linear taper

(Continued on page 129)

Layout of Monoceiver as straight broadcast receiver; placement of parts varies from s.w. model.





BUILDER'S KORNER

THANKS TO PRINTED CIRCUITS and other modern techniques, the enjoyment of high-performance radio reception is no longer limited to those whose pockets are bulging, or who are willing to mortgage off the old homestead to make a down payment. For just over \$100, plus some pleas-

it is virtually impossible to select a wrong resistor due to misinterpretation of color codes. All resistors are mounted in clearly marked cards bearing their *R* numbers, which agree with markings on the printed-circuit boards as well as on the schematic diagrams and photographs.



Knight 83YZ726 De luxe All-Band Amateur Receiver

ant and instructive hours, the beginner or veteran can acquire a general-coverage communications receiver with sensitivity and selectivity comparable to or greater than many which cost several times more.

The Knight Model 83YZ726 de luxe all-band amateur receiver (Allied Radio, 100 N. Western Ave., Chicago 80, Ill.) should appeal both to amateurs and short-wave listeners. The kit was designed and engineered for simplicity of assembly, without sacrificing performance. Anyone who can read directions should be picking up stations from all parts of the world within 24 working hours.

You Can't Go Wrong. As a typical example of Allied's "convenience engineering,"

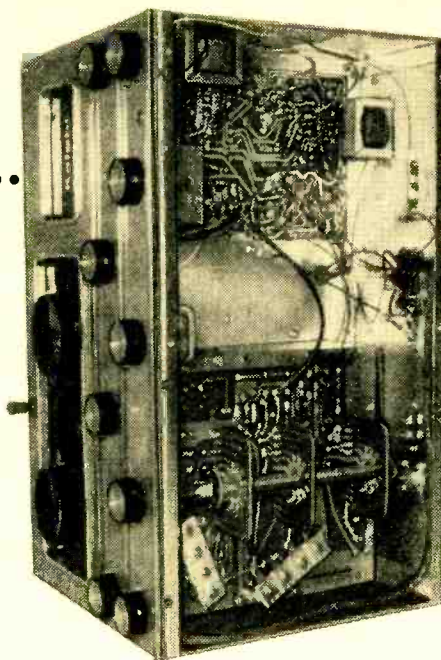
All other parts are marked with similar clarity. In cases where polarities are important, or where more than one method of mounting might be possible, parts are color-keyed to prevent mistakes.

The printed-circuit boards not only simplify wiring, but also provide lead dress uniformity which makes possible the high performance with minimum difficulty due to differences in wiring. The high-gain circuits are recessed and shielded to prevent interaction between stages. Leads are, in general, so short that they are almost nonexistent.

The Knight receiver has 1.5-microvolt sensitivity (for 10-db quieting), placing it in a class with much more expensive re-

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Wiring of Knight receiver is greatly eased by the use of printed circuit boards and switches. In this view, note board at top and multiple-gang switch at bottom.



ceivers. The Q-multiplier provides razor-sharp selectivity for single-signal reception of c.w. signals and reduces interference to single-sideband and amplitude-modulated phone signals.

Bands covered are: Band A, 540 to 1650 kc. (broadcast); Band B, 1.6 to 4.6 mc. (ship-to-shore, amateur, etc.); Band C, 4.4 to 12.4 mc. (foreign broadcast, amateur, etc.); and Band D, 12 to 30 mc. (including three amateur bands, plus Sputnik frequencies).

The kit comes less speaker, but has an output stage with a transformer designed to match 3- to 8-ohm loudspeakers. Small speakers are available for less than \$2, or almost any discarded radio will yield a suitable speaker. Just add a simple baffle or enclosure.

Some Features. In these days of double conversion, one might wonder about image interference. The Knight uses only one i.f. frequency (two stages) at 455 kc., offering reasonably good selectivity (made better by the built-in Q-multiplier) and good image reduction. In preliminary tests, the "front end" of the set seems to be adequately selective to minimize images to a negligible point.

One unique feature is the printed-circuit bandswitch. This not only simplifies construction, but improves stability by providing added rigidity and uniformity. Use of multipurpose tubes produces 11-tube performance with only nine "bottles."

The average kit builder or the beginner

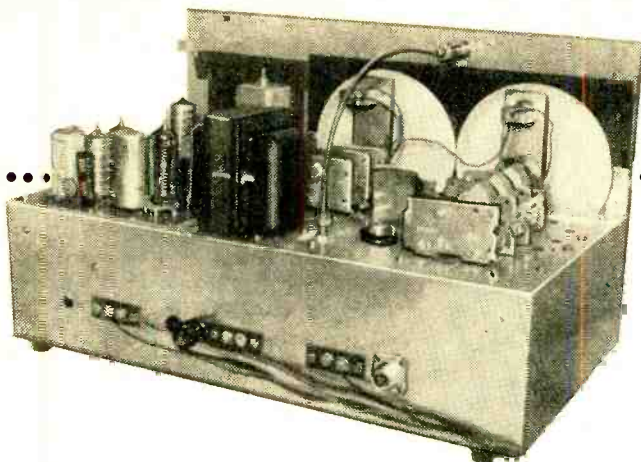
may be somewhat dismayed by the number of small parts furnished with the kit. One convenient method of segregating them into groups, without complicating the search process, is to use cake pans for each category.

Preparation of shielded wire can be a tedious job, but it cannot be hurried. Shielding often means the difference between a piece of electronic equipment doing what it's intended to do or something undesirable. The frayed ends of a poorly prepared braid can cause not only faulty operation of the receiver but permanent damage.

The almost overpowering temptation to get the receiver finished and on the air must be subdued. The trimmer strips must be connected firmly and in exactly the right positions for best results. Follow the diagrams carefully.

The latter suggestion applies even more critically to the assembly steps that follow. Be sure that the pre-tuned coils are mounted exactly vertical to permit easy access for tuning.

Important Steps. One of the most important groups of steps consists of those which involve the positioning and alignment of the tuning shafts and knobs of the main tuning capacitor and bandspread capacitor. Unless aligned carefully and checked and



Completed assembly rear view (above) shows the two types of antenna input available—coax and screw terminal connection. View at right shows receiver ready for action in the ham shack.



rechecked frequently during the mounting of the corresponding dials, the receiver will not have the right "feel" and inaccuracies in calibration and difficulty in interpretation of dial readings will result.

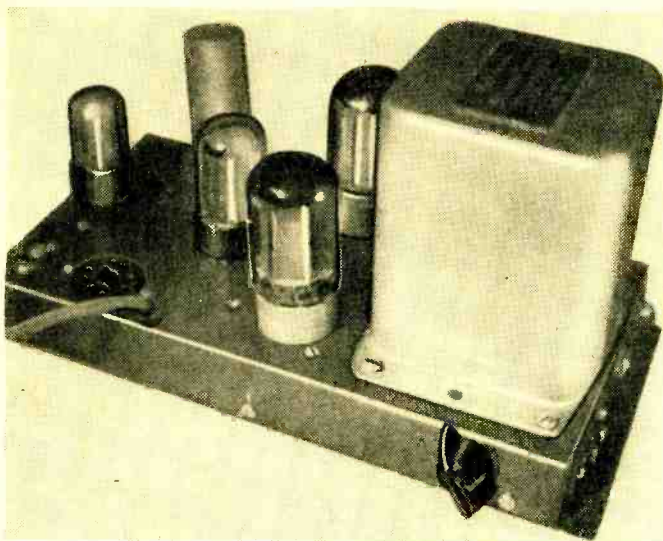
Under normal conditions, the receiver will pick up strong signals from all parts of the world, even without further alignment. Alignment by ear can greatly improve performance, and if the builder is familiar with the spectrum, he can find enough check points to calibrate the receiver with reasonable accuracy—without any other instruments. For optimum performance, however, there is no substitute for the signal generator and VTVM.

Several antennas were tried. Although improvement was noticeable when the set was connected to a properly terminated and tuned antenna for the frequency being used, excellent performance can be achieved with a short piece of hookup wire as antenna. The manufacturer has anticipated a variety of approaches to the antenna problem

and provided both coax and screw terminal connectors.

Some Accessories. The receiver is available with or without an S-meter kit and a 100-ke. crystal calibrator kit. For the casual listener, the S-meter may not be important. But to the ham or would-be ham, and as an aid in alignment, the extra investment is worth while. The crystal calibrator is extremely useful in spotting special short-wave broadcasts, and in locating band edges for ham work.

Although the Knight 83YZ726 lacks the massiveness of more expensive receivers, it performs well and should provide many pleasant hours of listening. The ham who has a high-priced ham-band-only receiver will find the Knight receiver invaluable for listening to Sputniks and other signals, including broadcast, that fall outside the amateur bands. For the beginning ham or the short-wave listener, there is probably no better way of getting in on the listening end quickly and inexpensively.

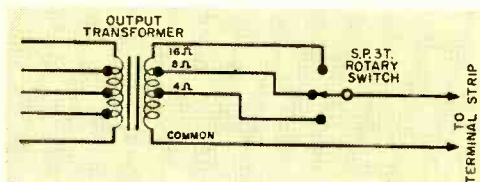


SWITCHING OUTPUT IMPEDANCES

A Heathkit dual-chassis Williamson-type amplifier can be modified for a more flexible output arrangement. A single-pole, three-position rotary switch can be easily installed which, when properly wired, will switch the various speaker impedances. Install it on the side of the chassis at right angles to the output terminal strip as shown in the photo. Make sure to wire the three

output leads to the switch with the correct color code. Wire the common contact on the switch to the output terminal. A pointer knob and the appropriate decals complete the job.

—John L. Weber



IMPROVISED TUNING INDICATOR

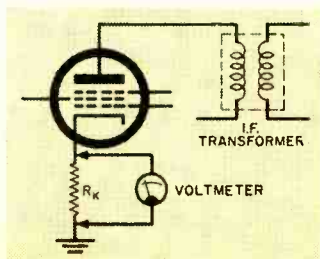
Many Novice amateurs and short-wave listeners using low-cost receivers have often felt the need for a tuning indicator such as an S-meter. An improvised tuning meter can be made using the 1½- to 5-volt range

of any standard test bench multimeter.

The tuning indicator is connected across the cathode resistor of the i.f. tube to chassis ground. A better arrangement in which the meter could be adjusted to read full scale would be to replace the voltmeter with an 0-1 ma. d.c. meter and connect a 1000-ohm resistor and a 3000-4000 ohm potentiometer in series with it. This circuit will work only in receivers in which the cathode of the i.f. tube runs through a resistor to ground. Do not remove the cathode bypass capacitor.

Note that the meter will read backwards and that the best tuning will show the lowest deflection.

—B. J. Desind



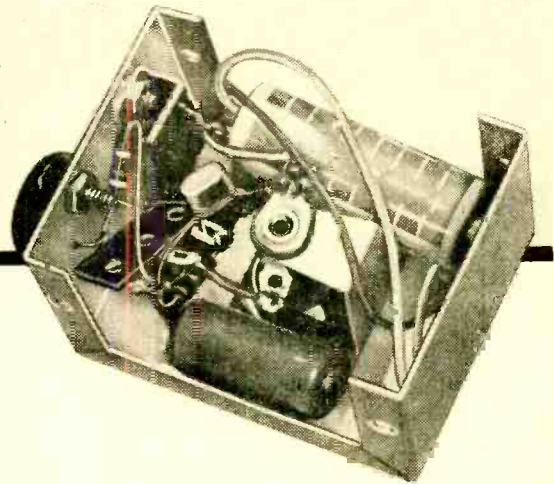
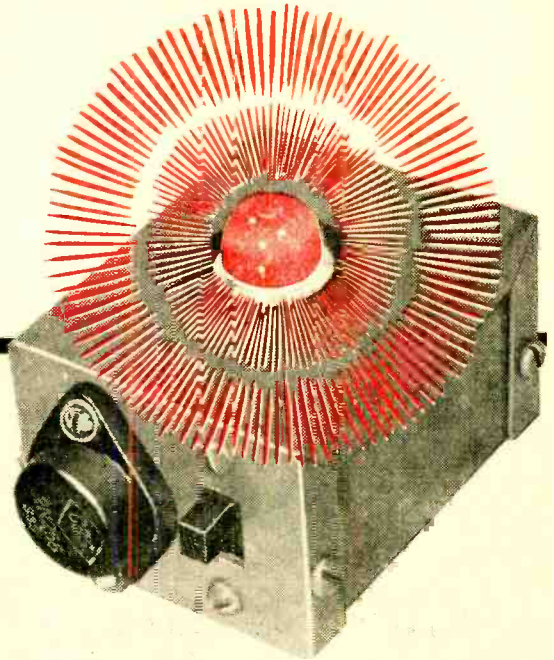
Flash Light with Transistors

Use low-current

blinker for warning

or signaling

By R. L. WINKLEPLECK



THERE are many excellent circuits for flashing a light but they require relatively high voltages or currents or both. Neon relaxation oscillators, heated bimetallic strips and various electromechanical systems are commonplace examples. Situations arise, however, when a small flashing light is needed which must operate dependably and economically from a small battery. Here is a good electronic solution for such a problem.

Two transistors, four resistors and a ca-

capacitor provide the pulse which flashes a small incandescent bulb. The power source is a small transistor battery, and the complete flasher assembly can be housed in a 2¼"x2½"x1½" Minibox. Variations in value

terminated by $R1$, and $R2$ determines the length of the "on" period. These all interact, however, and the desired flashing pattern can best be established by trial and error.

Since less than 0.5 ma. is drawn during the "off" period and nearly 150 ma. while the lamp is lit, battery economy is achieved by decreasing the frequency and shortening the "on" period as much as the particular use for which the unit is designed permits.

The 2N35 *n-p-n* transistor, $TR1$, was selected on the basis of its price and availability. Many others would work as well. The same is true for $TR2$, although a medium-power type is needed to handle the current drain through the 6.3-volt pilot lamp $PL1$.

A larger lamp can be used if the need for more light outweighs the disadvantage of increased current consumption. Many other batteries can be employed, ranging from six volts up to the full rating of the bulb, transistors and capacitor.

This flasher circuit offers high efficiency—which means long battery life; its operation is subject to no mechanical limitations; temperature influences its operation only moderately; and it's small and inexpensive.

When you go boating after dark these days, do you need some method of finding your way back to your home dock? This unit on the dock will guide you back. If your neighbor builds one, too, you can avoid confusion by changing bulb color or the flashing pattern.

If you park your car overnight on the street, a small pilot light assembly in one fender and this circuit is the answer. The flashing light is a far more effective warning than one which burns steadily, and it uses less current.

If you replace $R1$ with a high-value potentiometer, the unit is converted into an adjustable interval timer or metronome. It can be changed from visual to aural by replacing the bulb with a small speaker.

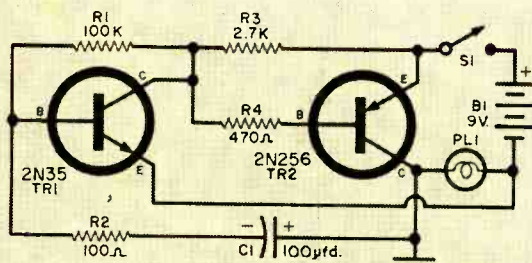
Maybe you're planning to build an electric fence charger. Connect the primary of the pulse transformer in place of the bulb and eliminate all mechanical gadgets usually needed to pulse the circuit.

There are hundreds of other applications where this circuit can really shine. You probably have some in mind already. —30—

PARTS LIST

$B1$ —9-volt battery (Eveready #216)
 $C1$ —100- μ d., 12-volt electrolytic capacitor
 $PL1$ —6.3-volt, 150-ma. #40 pilot light
 $R1$ —100,000 ohms
 $R2$ —100 ohms
 $R3$ —2700 ohms
 $R4$ —470 ohms
 $S1$ —S.p.s.t. slide switch
 $TR1$ —2N35 transistor
 $TR2$ —2N256 power transistor
 I —Minibox (CU-3000)

All resistors
 ½ watt



HOW IT WORKS

When the flasher is first turned on, some time will elapse while a reverse charge is built up in capacitor $C1$ because of leakage. While this current flows, the voltage drop across resistor $R1$ holds the base of $TR1$ biased to cutoff. When the flow slows sufficiently, the base of $TR1$ becomes more positive and it conducts.

The resultant flow of current through the emitter-collector circuit of $TR1$ biases the base of $TR2$ (which all this while has been cut off), into conduction. With $TR2$ conducting, the pilot lamp lights. Simultaneously, the capacitor receives a forward charge, at a rate determined by resistor $R2$, which continues until the base of $TR1$ is sufficiently negative to cut it off. This in turn cuts off $TR2$, the light goes out, and the charge on the capacitor is dissipated at a rate determined primarily by the largest resistor in the discharge path ($R2$).

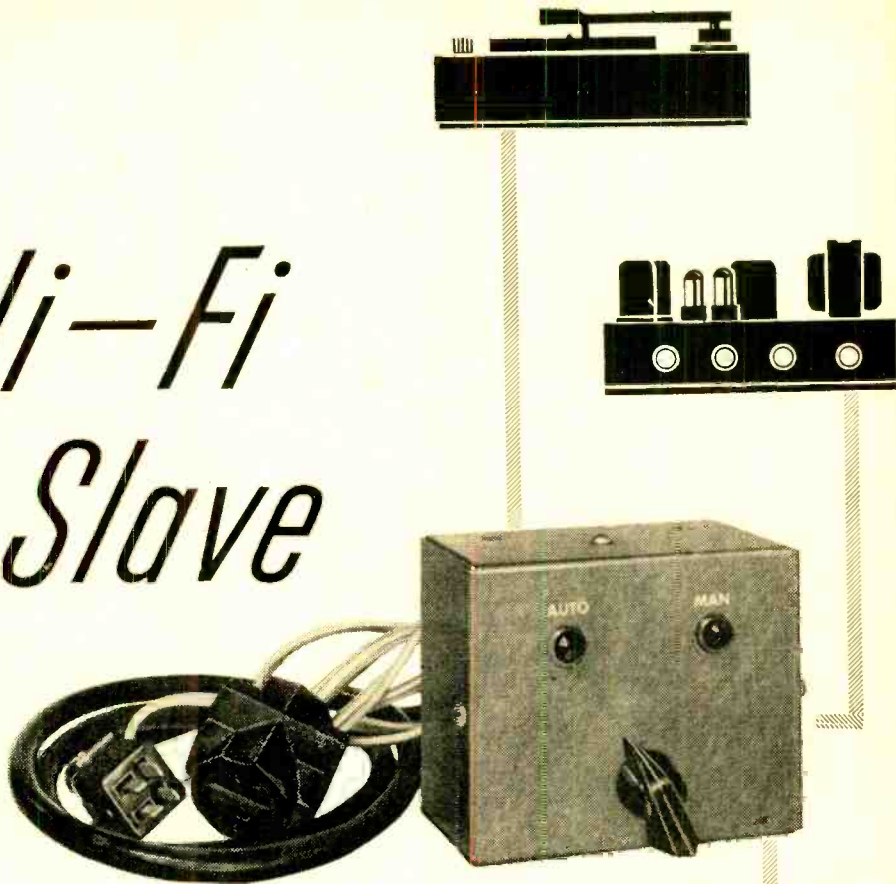
As the cycle is repeated, the initial leakage of $C1$ —which slowed the beginning of the sequence—is no longer a factor, and a stable on-off frequency is established and will be maintained.

of the capacitor and resistors will change the frequency of the flashes and the duration of the "on" and "off" periods.

The circuit and values shown produce approximately 85 flashes per minute with the "on" period long enough to bring the filament of the bulb to full brilliance. Frequency can be slowed to only a couple of flashes a minute by increasing the capacitance of $C1$.

Length of the "off" period is largely de-

Hi-Fi Slave



This genie in a box turns off your complete record playing system after the last disc has been played **By ROBERT M. DUFF**

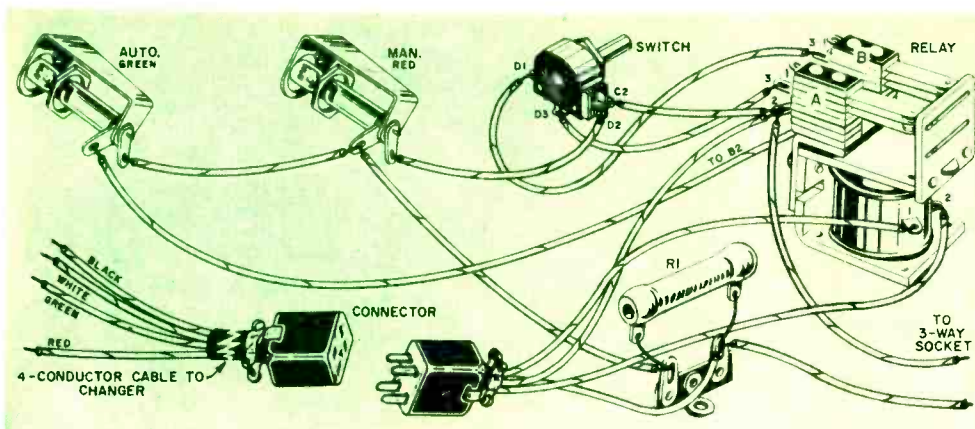
DID YOU EVER get up in the morning and find your hi-fi amplifier still on? Build this slave unit! Once set, it will play the selected program and then turn off *all* the equipment, including itself, or leave it on, depending on the setting.

The slave costs less than \$6, and can be mounted in its own case or on a control panel. It must be used with a changer that has an automatic cutoff.

There are no tubes or high-priced parts. The most expensive item is a double-pole, double-throw, 117-volt relay. Cost can be reduced by eliminating the indicator lamps.

Construction. If your record changer has a four-pole motor, its *built-in* automatic shutoff switch may





Wire from connector plug shown in pictorial above attached to relay contact A2 should connect to A3. Note optional holes for grommets used as feet.

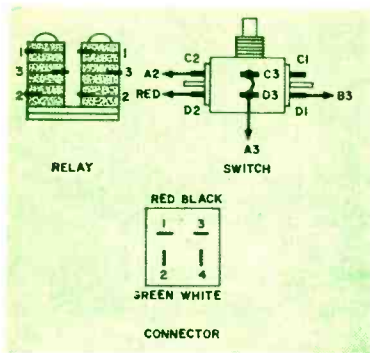
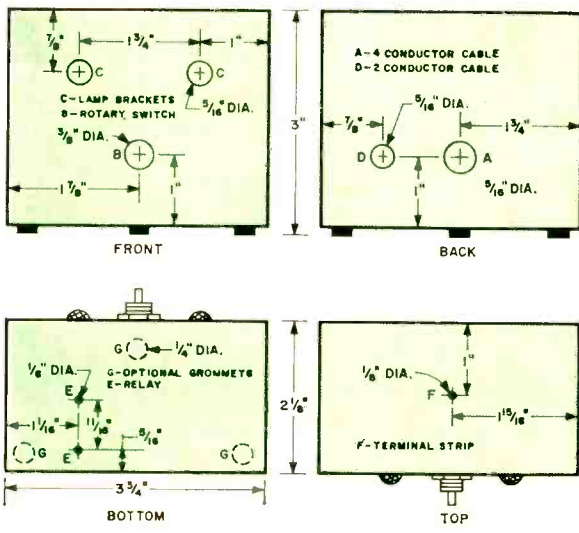
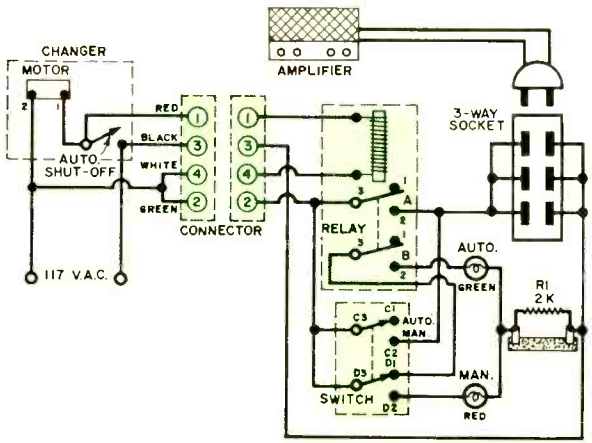
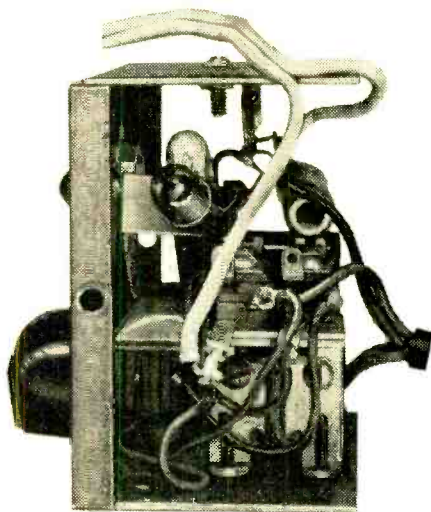
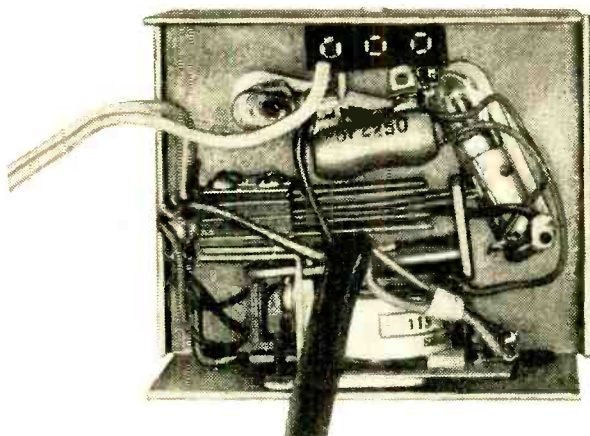


Diagram above contains terminal identification for relay, switch and connector. Underside of switch is shown. When mounted, C1 and D1 will be on red lamp side. Schematic at right shows how to wire the "Genie in the Box."



PARTS LIST

- R1—2000-ohm, 5-watt resistor
- 1—117-volt, 60-cycle relay, with d.p.d.t. contact assembly (Guardian Universal Series 200 Coil and 200-4 Contact Assembly)
- 1—Male and female connector pair, four-pin type with cable clamp (Cinch-Jones Type P-304-CCT and S-304-CCT)
- 1—D.p.d.t. rotary switch (Hart and Hegeman Type 81727)
- 2—Pilot light assemblies (Dialco Series 710)
- 2—28-volt a.c. bayonet-type lamps (GE #1819)
- 1—Length of four-conductor cable
- 1—Length of two-conductor cable and extension-cord cube-tap a.c. socket
- 1—3 x 3 3/4 x 2 1/8" aluminum case (ICA channel-lock type)
- Misc. rubber grommets, bolts and nuts, tie lug strip, lock washers, etc.



Two views of components in case. Switch is behind relay coil in rear view at left. Lamp brackets must not interfere with relay leaves. In side view, note how almost all available space is utilized.

be located in the lead connecting the two field coils. If so, disconnect the two wires from the shutoff switch and solder them together. Disconnect the line cord. Then connect a lead from the first motor terminal to the shutoff switch.

If the shutoff switch is *not* wired between the coils in your unit, make the conversion connections as shown in the schematic on page 78.

Solder the red conductor from the four-conductor cable to the same point. Connect one side of the line cord to the *other* terminal of the shutoff switch. Solder the black conductor to this same switch terminal. Now connect the white and green conductors and the other leg of the line cord to the second motor terminal.

When installing the back panel of the slave unit case, make certain that wiring from the four-conductor cable does not cause interference with relay operation.

Operation. Plug the slave unit into the changer connector, and plug the amplifier

or other units to be controlled into a triple socket. Set the selector knob to *Man.* The red lamp should light, and the amplifier or other equipment should turn on. (Don't forget to plug in the changer and set the amplifier on-off switch to "on.")

Now set the selector knob to *Auto.* If the tone arm is at rest and the turntable off, the amplifier and green lamp will turn off. With the selector knob at *Auto,* lift the tone arm and set it on the record, causing the turntable to start. A sharp click should

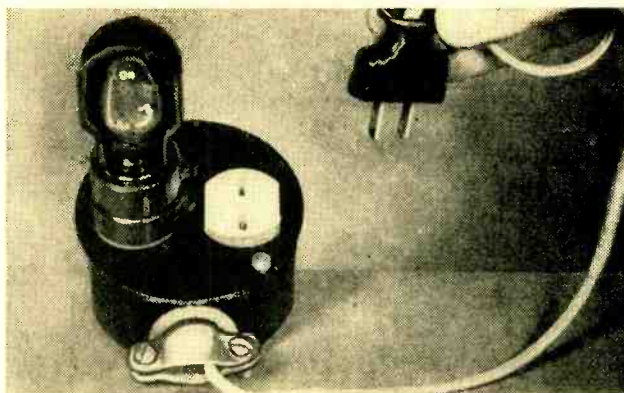
be heard as the relay is energized, the green lamp will flash on, and the amplifier will begin to warm up.

Push the changer reject button to simulate the end of the last record. When the change cycle is completed and the tone arm comes to rest, another click will be heard as the relay releases; the green lamp and the amplifier will turn off.

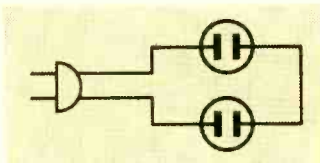
If, during the playing of a record, the selector knob is turned to *Man,* the green lamp will go off and the red lamp will go on (the amplifier will remain on). At the end of the record, a click will be heard when the relay releases, but the amplifier will *not* turn off.

(Continued on page 125)

**EASILY ASSEMBLED
TESTER
IS SAFE,
ECONOMICAL**



A small 7½-watt plug-in lamp, combined with a duplex outlet box, can be hooked up to provide a safe, quick and inexpensive means of checking electronic equipment and



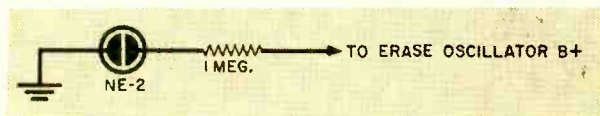
appliances. The small lamp will not pass enough current to operate most devices, but its glow (or non-glow) will indicate the condition of the circuit of the radio or other appliance attached to the lamp outlet.

Make sure that the outlet used is a duplex

type, with the two receptacles *not* connected together. One terminal from each of the two outlets is connected to the other with an insulated wire. The line cord is then attached to the other two terminals. This results in the two receptacles being wired in series so that the same current will pass through both receptacles with lamp and device connected.

Quick checks of small radios, test hook-ups, or cords of almost any appliance can be made. You can plug in a cord and pull or twist it to detect shorts—which will be indicated by the glowing of the lamp. With this type of tester, the operator is not required to touch any test probes, and so is not subject to shock. Heavy-duty appliances require a larger bulb. —H. Leeper

**ERASE WARNING LIGHT
FOR YOUR TAPE RECORDER**



Have you ever had the sorrowful experience of accidentally erasing one of your prize tapes or “recording” a program and finding later that you had forgotten to set the controls in record position? This little indicator will solve the problem.

Simple to build and inexpensive to install, it consists of an NE-2 neon bulb and a 1-megohm, ½-watt resistor connected in

series. One side of the circuit is grounded while the other is connected to the bias erase oscillator's B+ supply at the “Play/Record” switch. You can locate this point by consulting the schematic diagram that comes with your recorder.

The neon bulb is wired to light only when the tape recorder is switched to the record position. —Glenn A. Towill



Transistor Topics

By LOU GARNER

A NEW TYPE of transistor amplifier uses a single hexagonal rod-like crystal of extremely pure zinc oxide immersed in a highly conductive electrolyte instead of a pair of semiconductor junctions. It was developed by J. F. Dewald, a scientist at Bell Telephone Laboratories. Although the device is still in the experimental stage and may not be available commercially for several years, in test circuits it has provided gains in excess of 15 db at 1 kc.

Fabrication of the transistor-like device is a delicate operation. The two ends of the zinc oxide crystal are first indium-plated

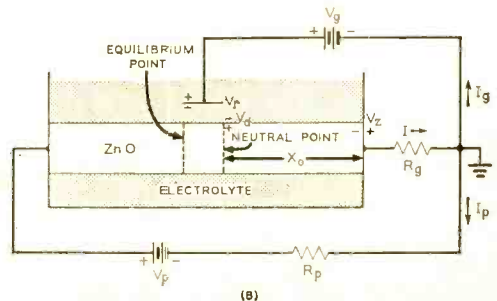
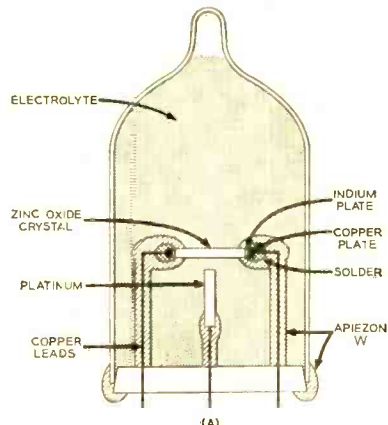
Laboratory model of new transistor amplifier with its inventor, J. F. Dewald, of Bell Telephone Laboratories.



Fig. 1. Cross section (A) of liquid-filled transistor and schematic (B) showing its use in experimental circuit.

to assure good ohmic contact. Afterwards, copper is plated on top of the indium to permit copper wire leads to be soldered to the ends of the rod. A platinum electrode, which serves as a grid, is mounted to one side and near the center of the zinc oxide crystal. Next, all wire leads and connections, except the grid and crystal, are insulated and the assembly is immersed in an electrolyte made up of a 5% sodium tetraborate and boric acid solution. The completed unit is then hermetically sealed in a small glass tube to prevent electrolyte evaporation.

The crystals may have any of a variety of shapes and sizes. In general, the available power output increases as the crystal area is made larger but the unit's frequency response drops at the same time. The smallest units assembled thus far use crystals about 0.3 mm. long and 0.15 mm. in diameter. Figure 1 (A) is a cross-section view of the device and Fig. 1 (B) is a schematic



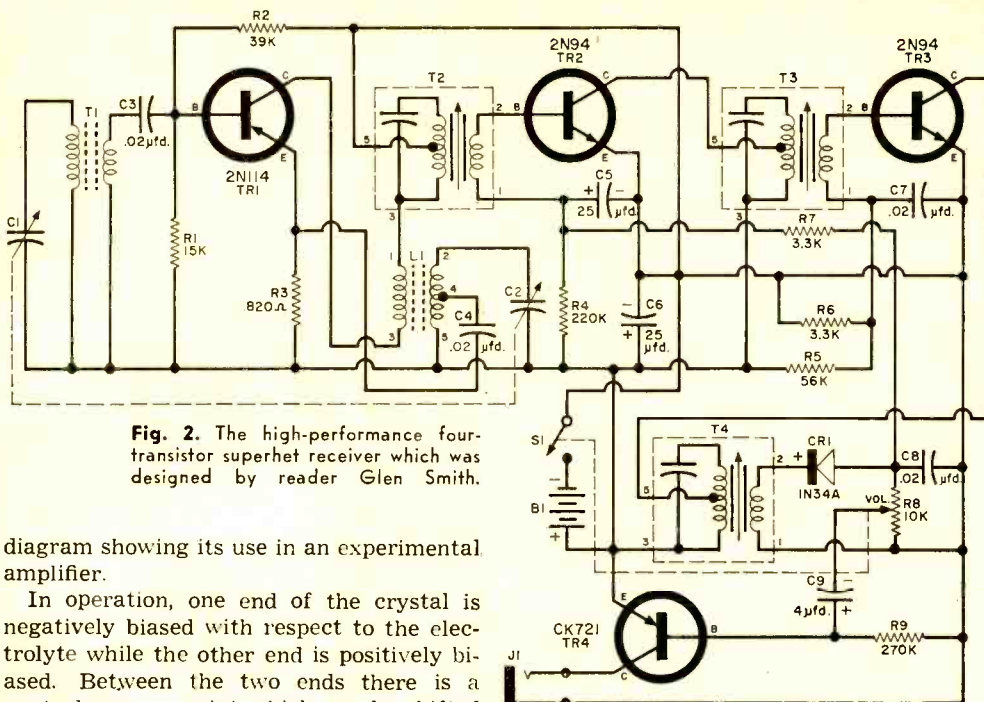


Fig. 2. The high-performance four-transistor superhet receiver which was designed by reader Glen Smith.

diagram showing its use in an experimental amplifier.

In operation, one end of the crystal is negatively biased with respect to the electrolyte while the other end is positively biased. Between the two ends there is a neutral area or point which can be shifted back and forth under the influence of an electrical field produced by the platinum grid electrode. As these shifts in the neutral point occur, there is a corresponding shift in the resistance of the crystal, varying the current through the load in accordance with the signal applied to the grid.

Reader's Circuit. The "pocket" radio receiver is one of the most popular projects with home experimenters. Unfortunately,

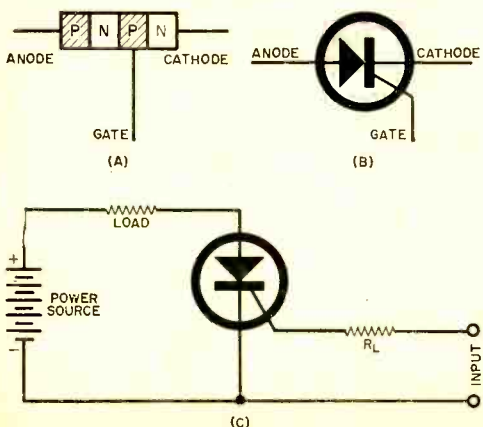
most small sets have limited sensitivity and rather poor selectivity, thus limiting their usefulness except when they are close to strong local stations. Some time ago, reader Glen Smith (Box 4111, North Carolina State College, Raleigh, N. C.) set out to design a high-performance receiver. After many, many experiments and considerable study, he finally settled on the circuit given in Fig. 2.

According to Glen, his four-transistor receiver has excellent selectivity and sufficient sensitivity to "pull-in" broadcast stations as far as 50 to 60 miles away, with only its built-in antenna. He indicates that he has used the receiver in steel-framed buildings as well as out-of-doors with good results.

Referring to Fig. 2, we see that Glen has used a conventional superhet circuit. R.f. signals are picked up and selected by antenna coil T1, tuned by variable capacitor C1. The selected incoming signal is combined with the signal produced by a local oscillator in the converter stage, a 2N114 p-n-p transistor. The resulting i.f. signal—the 455-kc. difference frequency between the incoming and locally generated r.f. signals—is selected by i.f. transformer T2 and coupled to a two-stage transformer-coupled i.f. amplifier, a pair of 2N94 n-p-n r.f. tran-

(Continued on page 118)

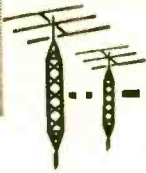
Fig. 3. Basic construction (A) of General Electric's new silicon-controlled rectifier, its schematic symbol (B), and its use (C) in a power switching circuit. See page 121.





Among the Novice Hams

By HERB S. BRIER, W9EGQ



TO ANSWER many of the questions in all amateur license examinations, except for the Novice exam, some knowledge of how vacuum tubes work is necessary. So let's start acquiring it.

By placing a thin filament of resistance wire—such as tungsten—and a metal plate inside of a vacuum, a *diode* or two-element vacuum tube is formed. If we connect the diode in the circuit of Fig. 1, we can study

just where does the current come from?

We know from fundamental electron theory that an electric current consists of electrons in motion. Also, we know that a vacuum is an extremely poor conductor of electric current, because there are no electrons in a perfect vacuum and very few in a near vacuum. But the meter shows current; therefore, electrons must be scooting across the vacuum.

The secret is the heated filament. Electrons are "boiled" off its surface and hover in an invisible cloud around it. As electrons are negative particles of electricity, when a battery is connected between the diode plate and filament as shown in Fig. 1, the positive plate attracts the electrons to it in a steady stream, through the meter and battery, and back to the filament.

The amount of plate current varies directly with the plate voltage until most of the electrons emitted by the filament are

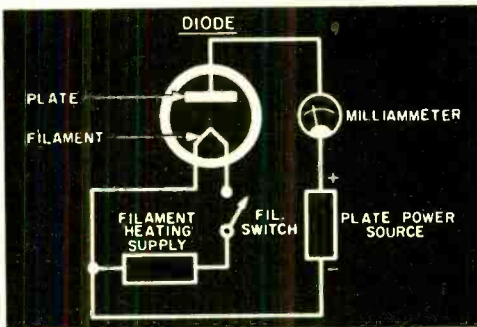


Fig. 1. Theoretical circuit used to illustrate the discussion of how a diode vacuum tube works.

Bob, KN3CMC, shares this equipment with his father, **KN3DDH**. See News and Views for details.



some of the fundamental properties of vacuum tubes which took early investigators years to discover.

Vacuum Tube Fundamentals. In this circuit, when the filament switch is closed, the filament becomes hot, and the milliammeter connected between the diode plate and the plate battery will indicate the passage of current through the tube. But

drawn to the plate. Beyond this point, an increase in plate voltage results in little increase of plate current, unless the filament temperature is increased. However, the filament cannot be made too hot, or it will burn out.

If we reverse the plate battery, so that its negative pole is connected to the plate, no current will flow through the tube, be-

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, W9EGG, c/o 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.

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John Sing, 722 W. 16th St., Davenport, Iowa. (Code and theory)
Richard Sommer, 6025 Madison, Lincoln 4, Nebr. (Code, theory and regulations)
David Menges, 833 N. Union, Colorado Springs, Colo. (Code and selection of equipment)
Bob Koch, Jr., 304 W. Washington, Marengo, Iowa. (Theory)
Tom McMahan, 1118 Pamela Dr., Jefferson City, Mo. (Theory and regulations)
George Donaldson Fisher, 13401 McGinty Rd., W., Minneapolis 26, Minn. (Code, theory and selection of equipment)
Clarence R. Johnston, 411 E. Jackson, Arkansas City, Kan. (Code and theory)
Richard Lagerstrom, Marine-on-St.-Croix, Minn. (Code and selection of equipment)
Harry L. Danner, 840 S. 29th St., Omaha 5, Nebr. Phone: HA 5229. (Code)
William Diamond, 4410 Manchester, St. Louis 10, Mo. (Code)
James Warden (14), 514 S. 12th, St. Joseph, Mo. Phone: 2-2905. (Code and theory)
Jim Dzewior (13), 422 30th Ave. N., Minneapolis 11, Minn. (Code)
Robert Cronberg (14), 3124 19th Ave. S., Minneapolis, Minn. Phone: PA 9-3273. (Code and theory)

VE AND OTHERS

Paul MacAulay, 6 Joyce Ave., Spryfield, Halifax, N.S., Canada. Phone: 5-5736. (Code)
Paul Costello, 378 Brock St., Winnipeg 9, Manitoba, Canada. (Code and theory)
Bob Thompson (14), Wien Airlines, Nome, Alaska. (Code and theory)
Artin Margossian, The Iraq Times, Baghdad, Iraq. (Code, theory and regulations)
Einar Beckman (15), Smyrlisveg 22, Reykjavik, Iceland. (Code and theory)

cause the negative plate will repel the electrons emitted by the filament. And the cold plate emits no electrons to travel to the filament. Therefore, current flows through a vacuum tube in only one direction.

An alternating-current source connected in place of the plate battery will result in pulses of current flowing through the tube during the half cycles that the plate is positive with respect to the filament and no current through it on the negative half cycles.

Thus, a diode may be used to convert a.c. to pulsating d.c., which can then be passed through a filter and smoothed into pure d.c.



Mike, KN6KZD, runs 75 watts to his new Heathkit DX-40 on 80, 40 and 15 meters. His receiver is a Hallicrafters S-53A. Mike QSL's 100%.

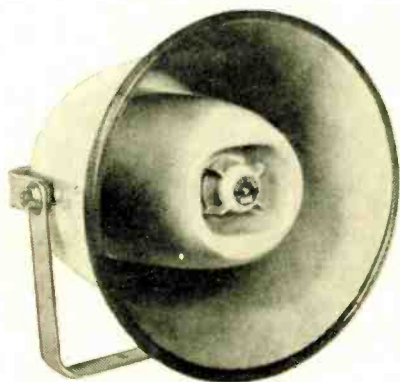
and used to power equipment, such as a receiver or a transmitter, that requires a source of direct current for its operation. Diodes used in power supplies to convert a.c. to d.c. are called *rectifiers*.

"Names" of Elements. The scientific name for the element in vacuum tubes and related devices that emits electrons is the *cathode*. If the filament itself emits electrons, its correct and full name is *filament-cathode*, which describes both its shape and function. The distinction is required because not all cathodes are filaments. In many tubes, the cathode is a metal sleeve or thimble that is specially treated to emit copious quantities of electrons at moderately low temperatures. It is placed over and insulated from the filament which heats it to operating temperature. The filament is then called the *heater*.

One advantage of an *indirectly heated* (Continued on page 129)

Hi-Fi Highlights

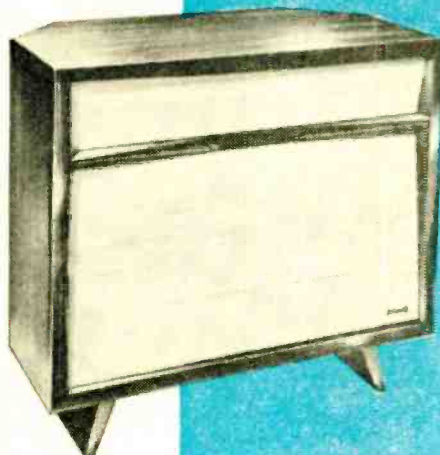
MANY READERS have been writing in to inquire about new and novel developments in high-fidelity equipment that they have heard about. To help supply such information quickly, POPULAR ELECTRONICS presents a roundup of the most interesting high-fidelity accessories crossing our desks in recent weeks. Each brief description is numbered and a box appears on page 127 along with additional items. Just circle the numbers in the box pertaining to the items that interest you and send the box in to the address given. You'll receive complete information on those items. —30—



29

29 Weatherproof outdoor speaker is comprised of two individual driver-horn assemblies mounted coaxially with built-in crossover. Power capacity is 15 watts. Atlas "Coax-Projector" WT-6.

30 Designed as second speaker in stereo system, this unit reproduces range above 300 cps, includes mid-bass, tweeter and super-tweeter. With space for bass not needed, enclosure is only 25" x 17 1/2" x 7 1/2". Electro-Voice Stereon.

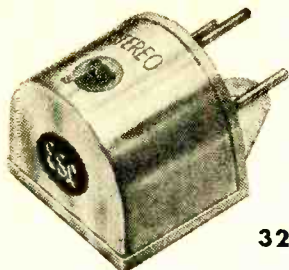


31

31 Rear-loaded folded horn with baffle angled for optimum coverage. In lowboy design, cornerless horn construction allows it to be placed in corner, flat against wall or under bay window. It takes 12", 15" wide-range speaker or multiple systems. University Troubadour.

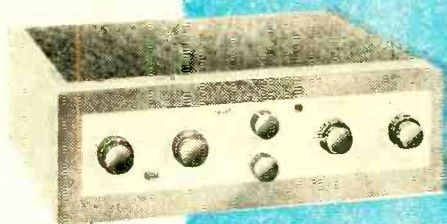


30



32

32 Electrodynamic stereo cartridge with two subminiature D'Arsonval movements pivoting on four jewels for low-friction coupling. Response: ± 3 db, 30-15,000 cps; channel separation, 20-25 db. Vertical stylus force, 2 to 4 grams. Electro-Sonic Stereo.



33

33 Stereo amplifier-preamplifier. Two complete channels. Output: 14 watts each channel, or 28 watts monophonic. Eight inputs each channel; ganged level, separate balance controls. Independent bass and treble controls for each section. Kit or wired. Eico HF81.



34

34 Stereo record kit for converting monophonic tape recorder to half-track, two-channel or quarter-track, four-channel stereo use. Playback and recording amplifiers also available. Nortronics.



35

35 Stereo two-channel basic amplifier, rated at 18 watts per channel or 36 watts when in parallel, may be used as two separate 18-watt monaural amplifiers. Inputs have individual level controls. Output impedances available: 4, 8, 16 and 32 ohms each channel. Kit form only. Lafayette KT-310.



36

36 AM-FM tuner plus 15-watt amplifier on one chassis features split bar of light which comes together to show proper tuning. FM section has a.f.c. Pre-amp section has loudness and rumble controls, 3-pos. speaker switch. Bell 2521.

More hi-fi items on page 127

By
FRANK WOODS, Jr.



Transiprobe for Signal Tracing

THE "TRANSIPROBE" is an audio amplifier, a signal tracer, an audio voltmeter "front end," and an audio signal generator—all in one compact package. It is only $2\frac{3}{4}$ " long by $\frac{1}{16}$ " in diameter, and you can count its component parts on the fingers of one hand.

The secret of the Transiprobe's compact size and simple construction lies in the use of Centralab's printed-circuit transistor amplifiers—the TA-6 voltage amplifier stage and the TA-7 output stage. Each of these assemblies complete with transistor and circuit is smaller than a CK722 transistor!

Complete circuit details and the actual wiring of the Transiprobe are shown in Figs. 1 and 2. Be sure to observe the usual precautions for soldering small electronic components. It is especially important to interpose a pair of needlenose pliers between the point at which you're soldering and the transistor amplifier.

Assembly. The case of the Transiprobe is a small plastic "bottle" which you can probably obtain at the prescription counter of your drug store. You can make the hole for the probe tip (a 6-32 machine screw) with a heated ice pick.

Wire the TA units together with #28 wire and bring out the leads for connection to the other parts. After the probe tip and the battery are wired, tape the leads for the volume control, earphone, and common

(ground) clip against the battery, and push the assembly into the bottle.

Make two small holes in the plastic bottle top with a hot ice pick for mounting the volume control (*R1*). Attach and solder the leads of *R1* and make and attach switch *S1* (see Fig. 3). Then force the volume control into the small holes on the bottle top. It will stay put with a pressure fit.

The top can be placed on the bottle and wiring completed by soldering the ground clip and the earphone leads to the leads you've brought out under the bottle top. A piece of tape around the bottle will hold the earphone tips and common lead in place. To turn the probe on, you simply rotate the top till the contacts of *S1* close.

Applications. For audio signal tracing, the probe ground clip is connected to the common or ground of the equipment under test. Use the probe tip to pick up the audio signal.

For r.f. or i.f. signal tracing, an auxiliary demodulator probe must be used. A simple diode circuit which can be connected to the Transiprobe input is shown in Fig. 4.

To make the Transiprobe function as an audio oscillator, connect a lead from the TA-7 collector to the input probe tip. The volume control will vary the output signal frequency at the probe tip. Output voltage ranges from about 0.5 volt at 100 cycles to 0.1 volt at 1000 cycles and 0.02 volt at 5000 cycles.

Pill-bottle
signal tracer
uses thumbnail
printed circuits

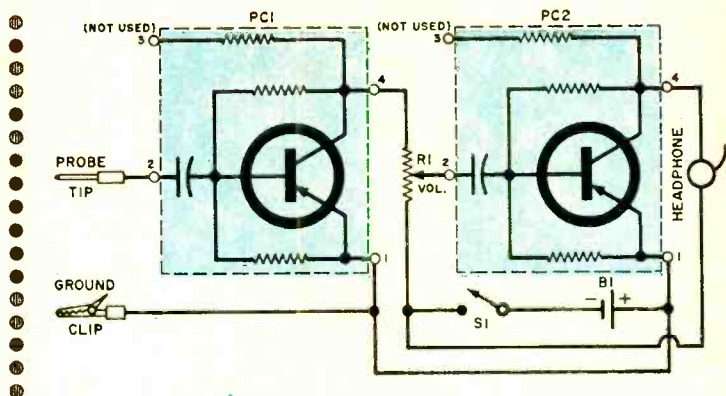


Fig. 1. Complete schematic of Transprobe. Components in color are part of printed circuits.

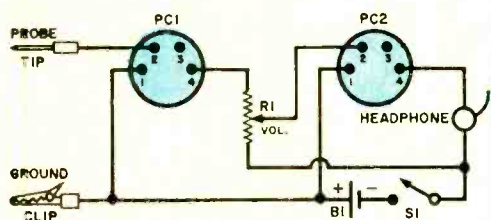


Fig. 2. Actual wiring of the terminals of the thumbnail TA units.

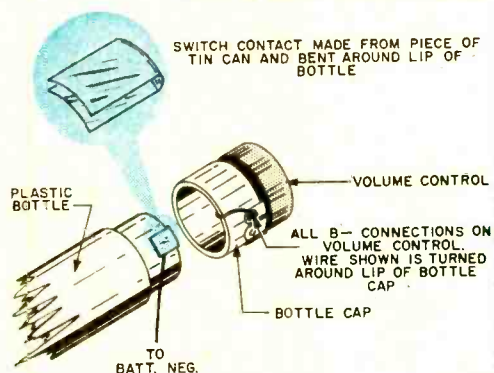


Fig. 3. Details of mechanical assembly of pill-bottle probe shell.

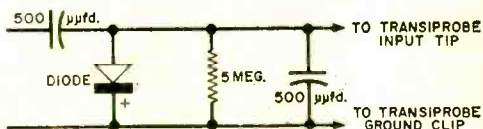
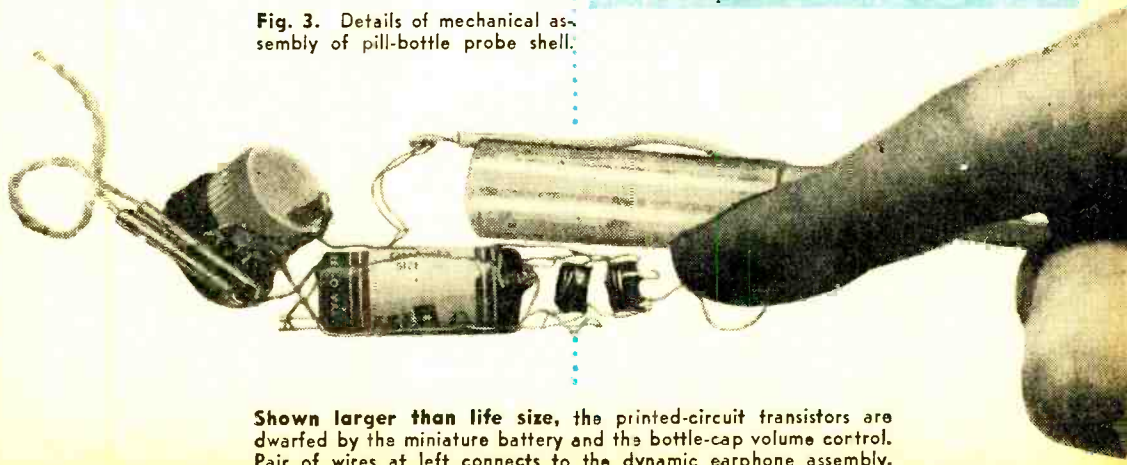


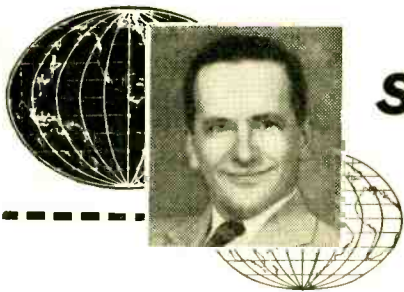
Fig. 4. Demodulator probe allows tracing of the r.f. signal.

PARTS LIST

- B1—Battery (Ray-O-Vac 716)
- PC1—Printed-circuit transistor amplifier (Centralab TA-6)
- PC2—Printed-circuit transistor amplifier (Centralab TA-7)
- R1—Volume control (Centralab B16-117)
- S1—Switch (see Fig. 3)
- l—Headphone, 2000-ohms (Latayette MS-367)
- l—Small plastic bottle



Shown larger than life size, the printed-circuit transistors are dwarfed by the miniature battery and the bottle-cap volume control. Pair of wires at left connects to the dynamic earphone assembly.



Short-Wave Report

By HANK BENNETT

INSTEAD of presenting the usual listing of stations currently heard and reported, this month we will cover the verification policies of many of the short-wave stations and give you their latest addresses—some of which may be quite different from the addresses which appear in the *World Radio Handbook*.

First, however, we would like to call your attention to a few points which may enable

include enough information of use to the station. Nor is the information contained in his report definite proof that he has heard a particular station. All reports should contain as much precise information as possible.

Make note of any unusual announcements and signal peculiarities that you hear. If names of people are given during a broadcast, you will do well to include those names in your report. Titles of recordings also help to convince a station that it was *not* another station you heard.

Be sure that your times are exact and, if you do not use Greenwich Mean Time, be sure to show your time zone. Do not rely on printed schedules as your basis of information as to what a certain station is broadcasting at any specific time.

A leaflet entitled "Verifications," which explains the proper method of making and sending reports, is available from your Editor at no charge.

In addressing your report, it will often be to your advantage to send it in care of a known person at the station. In the following list, we are including names of verification signers as a help to you. Names of key personnel at nearly all of the short-wave stations in the world can be found in the *World Radio Handbook*, which is available from Gilfer Associates, P. O. Box 239,

Grand Central Station, New York 17, N. Y., for \$2.20.

We are deeply indebted to William Flynn (7), Pittsburg, Calif., Bob Knowles (28), San Diego, Calif., and to our anonymous Middle Eastern Correspondent (*MEC*) for their valuable assistance in the compilation of this list of stations.

(Continued on page 139)



Three colorful verification cards from different parts of the world: Radio Norway, Oslo (top); Hungarian Broadcasting Station, Budapest (above); and medium-wave station JOUR, Nagasaki, Japan.

you to receive a better percentage of replies to your own reports.

One of the chief reasons for the lack of reply to a report is that the DX'er does not

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6. Plans for shop arrangement.
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8. Continuous consultation and help.
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NORTH AMERICAN PHILIPS CO., INC.
High Fidelity Products Division, Dept. 1F9
230 Duffy Avenue, Hicksville, L. I., N. Y.

Tips and Techniques

(Continued from page 36)

portable handles over the sharp edges. You'll find them handy also as chassis "pontoons" to float the chassis and keep it from marring the bench top. —J. A. C.

PROTECT PORTABLE SPEAKER

Portable amplifier-speaker units for use with tape recorders and record players are not generally provided with cases to protect them while traveling. To keep a unit looking new and free of scratches, secure a corrugated carton in which it will fit loosely. Remove the bottom, cutting the carton down if necessary to give it the same height as the speaker. Cut a slot in the top for the carrying handle, and drop the carton over the unit. —K. M.

GOSMETIC CASE FOR SMALL PARTS

Ladies' plastic zippered cosmetic cases selling in the five & dime stores for 20 cents



make ideal shirt-pocket cases for small test equipment, Allen wrenches, test leads, hardware, etc. —C. C.

PHONES DETECT SPEAKER TROUBLE

When you suspect that a defective speaker is the source of distortion emerging from your hi-fi system, radio or TV, here's a simple method that can be used to verify or eliminate your suspicions. Disconnect the primary of the speaker's output transformer, connect a sensitive pair of headphones across the primary and, while wearing the phones, carefully press your fingers on the speaker cone and move it in and out. A loud rasping sound indicates that the voice-coil is rubbing the pole piece. If no rasping is heard, check elsewhere in

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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—up to 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, modulators, test equipment. You will learn 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.

A useful and necessary 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 more than 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 worthwhile investment.

Many thousands of individuals of all

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

PROGRESSIVE TEACHING METHOD

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

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

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "breadboard" hardware, but genuine radio circuits, constructed by means of professional wiring experiments, 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, hook-up wire, solder, etc. hardware, tungsten, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, a 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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The Progressive Radio "Edu-Kit" has been sold to many thousands of individuals, school and organizations, public and private, throughout the world. It is recognized internationally as the ideal radio course.

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It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc. for any reason whatsoever, the purchase price will be refunded in full, without quibble or question, and without delay.

The high recognition which Progressive "Edu-Kits" Inc. has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, and 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

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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. Stataxis, 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

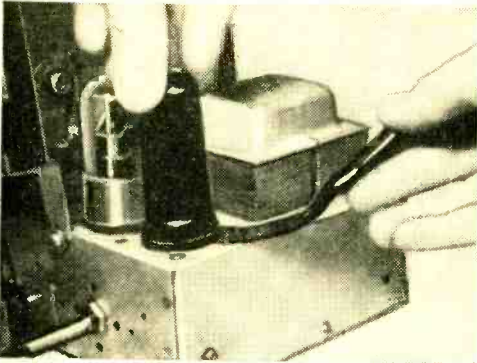
Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for these. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the 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."

the system for the trouble. Perhaps there's a defective tube or capacitor. —J. A. C.

TOOTHBRUSH SERVICING TOOL

A handy radio servicing tool can be made from a discarded toothbrush. Pull out the bristles with pliers, and file or grind the

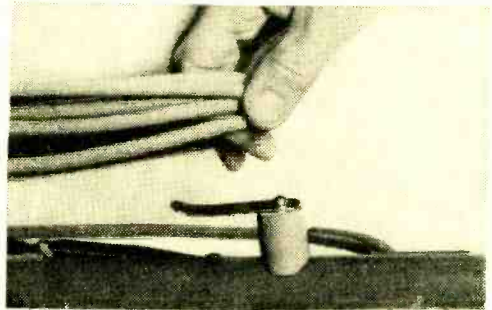


tip so that it is tapered like the blade of a screwdriver. Heat the handle in hot water, make about a 30° bend at the neck, and you have a tube lifter for stubborn tubes. Saw in from one side to the hole in the handle and use the resulting "hook" for stringing dial cords or as a prod for

poking about in a chassis looking for loose connections. Wires can be wiggled while the set is operating, as the plastic handle is non-conductive. —J. A. C.

APPLIANCE CORD RELEASE

Much time and effort is spent unwinding coiled-up appliance cords on vacuum sweepers, floor polishers, floor sanders, etc., but if you replace the top cord hook on an appliance with the simple swivel-hook shown, you can remove a coiled-up cord instantly. You simply turn the lever



around one-half turn, slip the coiled cord off the hook, and the coil unwinds as you walk to the wall outlet. —A. T.

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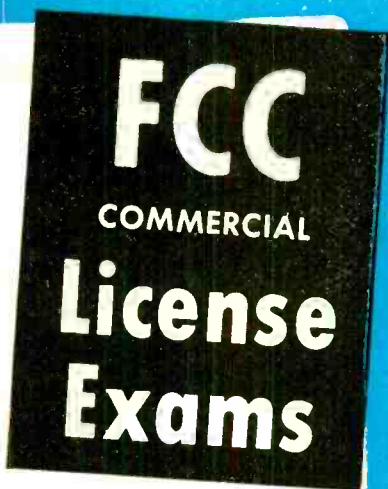
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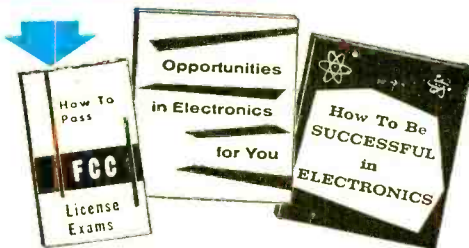
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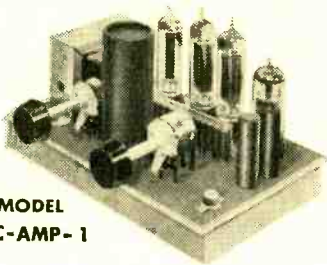
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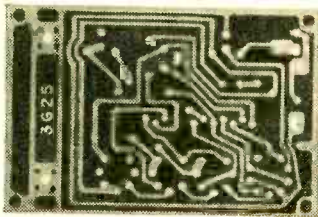
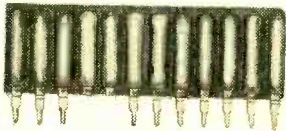
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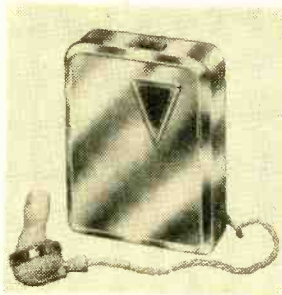
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(Continued from page 38)

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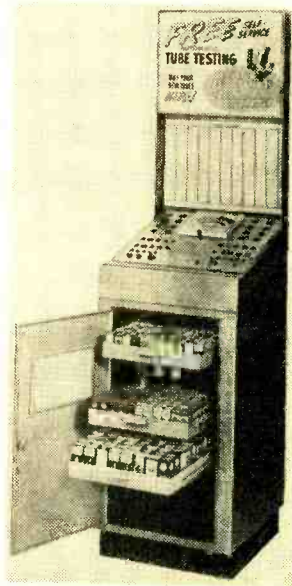
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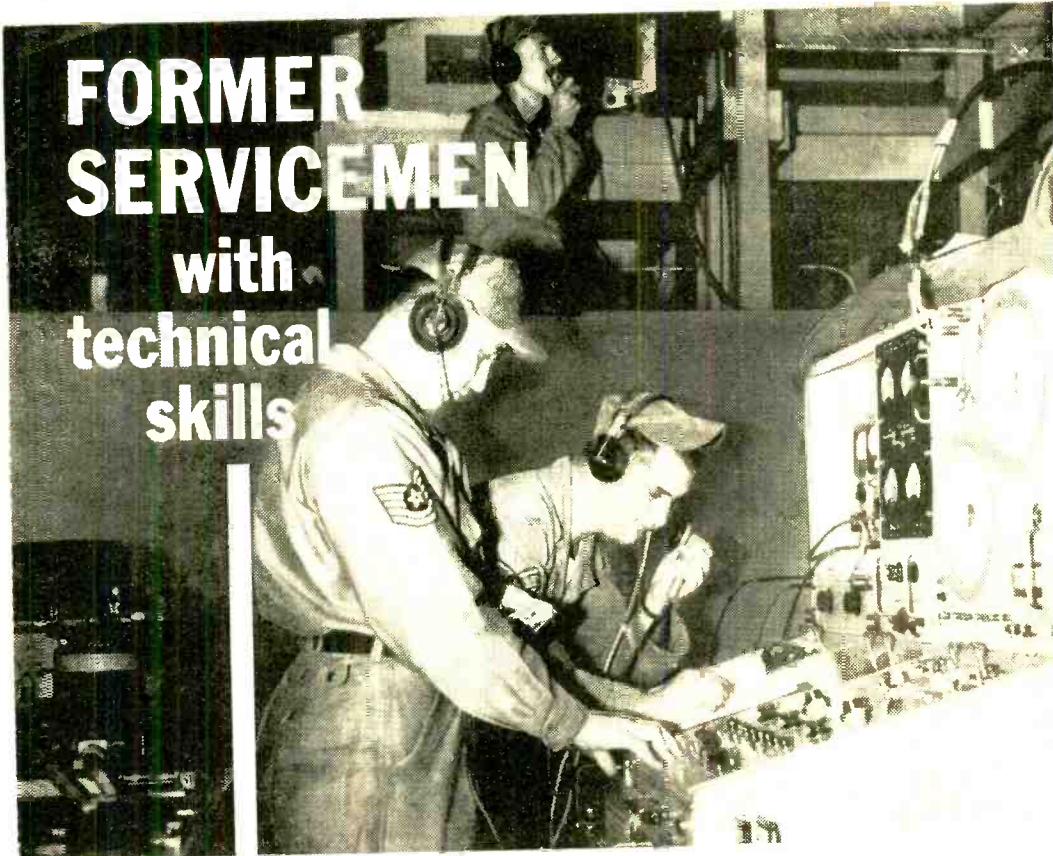
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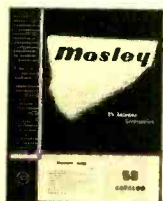
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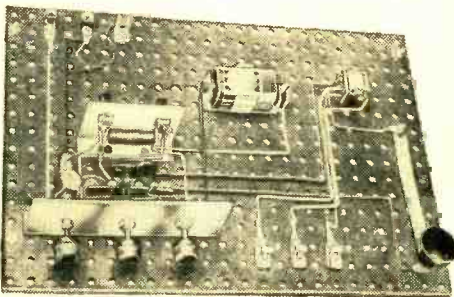


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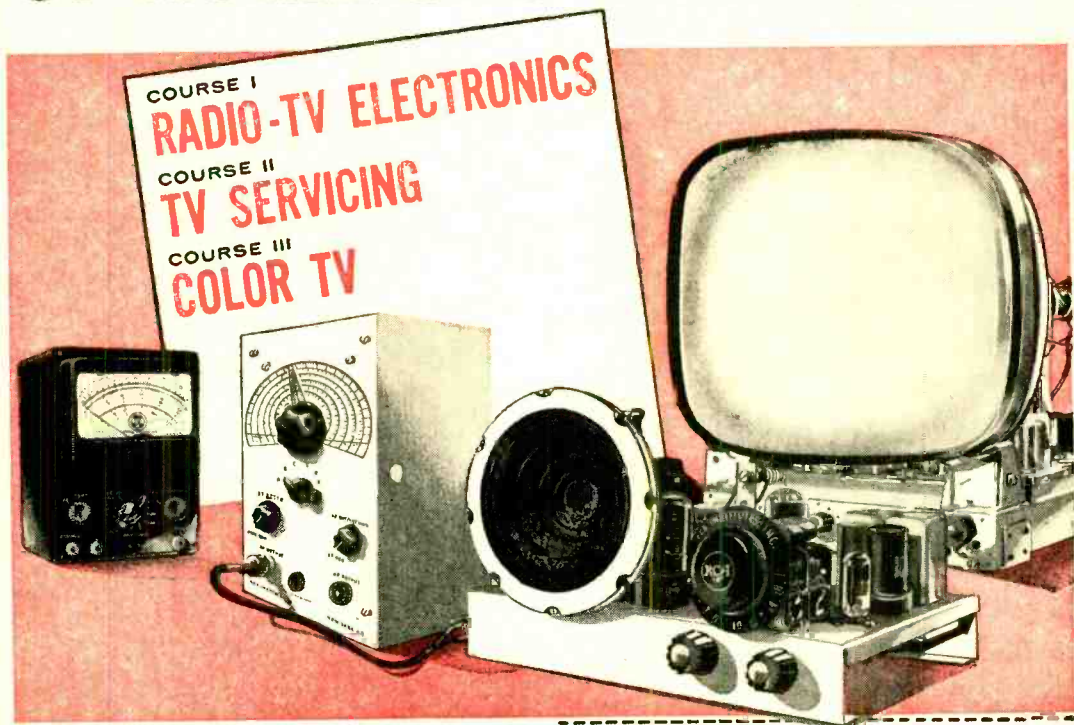
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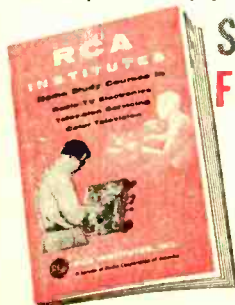
which is shown in the photo) are provided in Lafayette's KT-134 kit. A detailed in-

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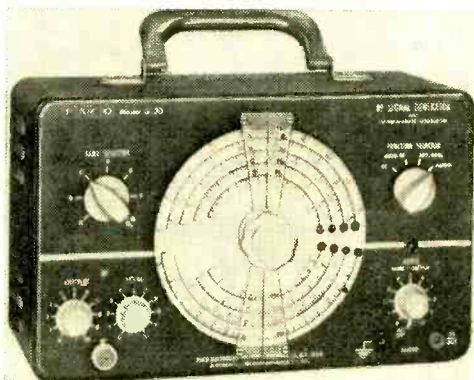
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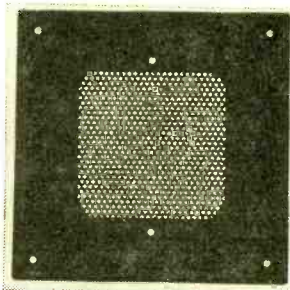


a 400-cycle audio output is available up to approximately 15 volts. Net price, \$28.50, complete with parts and instruction manual. Net price of Model G-30-PC, which has front end precalibrated, \$35.50. (PACO Electronics Co., Inc., 70-31 84th St., Glendale 27, L. I., N. Y.)

struction manual explains the operation of each circuit, and shows how to mount the parts and make the necessary connections for building such devices as an electronic timer, burglar alarm, two-stage audio amplifier, two-stage broadcast receiver, and many others. It is battery-powered, shock-proof and safe. Price, \$14.95. (Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.)

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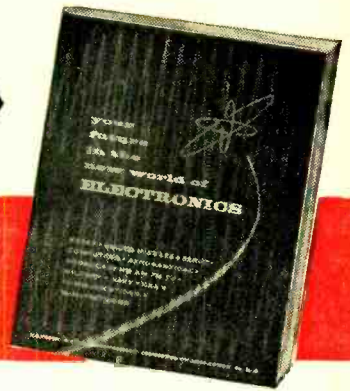


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Interplanetary Communication

(Continued from page 45)

Q. You said something about a "tight" beam. What do you mean by that?

A. The "tighter" a radio beam, the narrower the angle of transmission, or the more concentrated the signal. Obviously, the narrower or tighter the radio beam, the better we concentrate the available radio energy in the direction we wish to transmit, and the smaller the area covered by the beam at any given distance. A fairly tight beam may cover only part of our Moon, but may cover an entire planet at a greater distance, as shown in Fig. 1.

Q. And what do you mean by "tracking"?

A. To demonstrate this principle, you'll need a toy auto, which will represent a space ship or another planet, and your flashlight, which will represent our communication center on Earth. Place the flashlight on a block or similar object so that you can hold it steady in one plane, but so that you can rotate it horizontally.

Now, start the toy auto moving across the floor. As it moves, turn on the flashlight, keeping the light beam centered on the moving car. You'll have to rotate the flashlight at a speed which depends on the speed of the auto and its relative angle of movement with respect to the light beam. If the car moves at right angles to the beam, you'll have to turn the light more rapidly than if the car is coming toward, or moving away from, the light.

When you keep the moving toy auto centered in the flashlight beam, you are "tracking" it. In the same way, radio antennas will have to move continuously to track the movements of a space ship, satellite or another planet. Remember that all planets and satellites in our solar system rotate around the Sun and that many rotate on their own axes as well. And the satellites rotate around their respective planets.

Tracking a space ship moving between planets is much more difficult, of course, than tracking a toy auto. A space ship moves in three dimensions while your auto, for practical purposes, moves only in a two-dimensional plane. In addition, you can keep the flashlight in a fixed position. If a station on Earth were communicating with a space ship, the Earth antenna position also would be moving constantly with the rotation of the planet.

Q. I think I understand, but you said something about a "time lag" a little earlier. Just what is that?

A. As you know, radio signals travel
(Continued on page 112)

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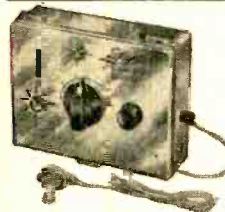
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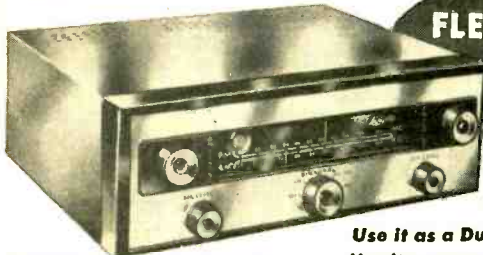
Zone _____ State _____

CUT OUT AND PASTE ON POSTCARD

New!
YEARS AHEAD!

Lafayette STEREO TUNER KIT

**THE MOST
FLEXIBLE TUNER
EVER
DESIGNED**



**Use it as a Binaural-
Stereophonic FM-AM tuner**

Use it as a Dual-Monaural FM-AM tuner

Use it as a straight Monaural FM or AM tuner

- Multiflex Output for New Stereo FM
- 11 Tubes (including 4 dual-purpose) + Tuning Eye + Selenium rectifier Provide 17 Tube Performance
- 10KC Whistle Filter
- Pre-aligned IF's
- Tuned Cascade FM
- Separately Tuned FM and AM Sections
- Armstrong Circuit with FM/AFC and AFC Defeat
- 12 Tuned Circuits
- Dual Cathode Follower Output
- Dual Double-Tuned Transformer Coupled Limiters.

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.

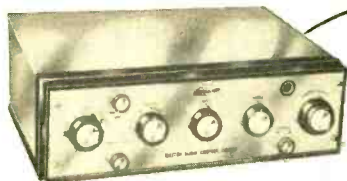
The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. 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 13 1/4" W x 10 5/8" D x 4 1/2" 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

KT-500 IN KIT FORM
74.50
ONLY 7.45 DOWN
7.00 MONTHLY

LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.



KT-300
39.50
IN KIT FORM

- Self-Powered ● DC On All Filaments
- 24 Positions of Equalization
- Tape Head Input, High Impedance
- Dual Cathode Follower Output Stages

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12 3/4" x 9 1/2" x 3 3/4". Shpg. wt., 10 1/2 lbs.

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

DELUXE 70 WATT BASIC AMPLIFIER



KT-400
69.50
IN KIT FORM
ONLY 6.95 DOWN
7.00 MONTHLY

- Conservatively Rated At 70 Watts
- Metered Balance And Bias Adjust Controls
- Inverse Feedback ● Variable Damping
- Available In Kit And Wired Form

Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT 88's and wide range linear Chicago output transformer, variable damping control, meter for bias and balance and gold finish chassis. Frequency response 10-100,000 cps \pm 1db. Hum and noise 90db below full output. IM distortion less than 1 1/2% at 70 watts, less than 0.3% below 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000 cps \pm 1db. Output impedance 4, 8 and 16 ohms. Handsome decorative cage perforated for proper ventilation. Size 14 1/2" x 10 x 7 3/4" including cage and knobs. Shpg. wt., 40 lbs.

KT-400—Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions.Net 69.50

LA-70—Same as above completely wired and tested with cage and instruction manual.Net 94.50

Lafayette Radio
DEPT 11

165-08 Liberty Ave.
JAMAICA 33, N. Y.

NEW YORK 13, N.Y. 100 6th Ave.
BRONX 58, N.Y. 542 E. Fordham Rd. BOSTON 10, Mass. 110 Federal St.
PLAINFIELD, N.J. 139 W. 2nd St. NEWARK 2, N.J. 24 Central Ave.
PLEASE INCLUDE POSTAGE WITH ORDER

NEW! 6 TRANSISTOR SUPERHET RECEIVER with LATEST NPN-PNP TRANSISTORS



29.95
Less Case
and Battery

- GE 2N188A AUDIO OUTPUT TRANSISTORS • 100% SUBMINIATURE PARTS - NO COMPROMISES!
- CLASS B PUSH-PULL AMPLIFICATION-PLENTY OF POWER. • FOR GROUP AND PRIVATE LISTENING
- LABORATORY DESIGNED - SENSITIVE, SELECTIVE, STABLE!

Superb Performance! Incomparable Value!

Transistor-wise Lafayette proudly presents its newly revised 6 Transistor Superhet Receiver Kit KT-119A. This improved model uses the latest GE NPN-PNP Transistors in an ingeniously engineered, laboratory tested circuit providing superb performance and an amazing superior commercial quality. The circuit features a specially matched set of 3 IF transformers, Oscillator Coil, High-Q Loop, Class B Push-Pull Audio-Amplification and optimum Transformer Coupling in audio and output stages. Has efficient 2 3/4" speaker for exemplary reproduction and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, but less battery and leather case. New 28 page easy-to-follow step-by-step instruction book. Size 6 x 3 1/2 x 1 1/2. Shpg. wt., 3 lbs.

- KT-119A — Complete Kit-Less Case and Battery.....Net **29.95**
 BATTERY 9V BURGESS 2N6.....Net **1.30**
 MS-339A — Sturdy attractive brown leather case with carrying strap for KT-119A. 6 x 3 1/2 x 1 1/2". Shpg. wt., 1 lb.....Net **2.95**
 MS-366 — Sensitive matching earphone.....Net **1.29**

3 TRANSISTOR SUPERHET POCKET RADIO KIT

A TRUE POCKET SUPERHET RECEIVER-NO EXTERNAL ANTENNA. • NO EXTERNAL GROUND



A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case.

The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors, battery, case, dial and easy to follow step-by-step instructions. 4 1/2" x 2 1/4" x 1-1/16". Shpg. wt., 1 lb. KT-116—Complete Kit, less earphone...Net **16.95**
 MS-260—Super Power Dynamic Earphone.....Net **3.95**

NEW!

CODE PRACTICE SET

Economical and practical code practice key and buzzer unit for learning code.

Telegraph key chrome and nickel plated with both adjustable spring tension and contact clearance. The high frequency buzzer has frequency adjustment with locknut to keep tone constant. Screw type pin jack terminals for headphone connection. Works with inexpensive 1 1/2 volt battery. Heavy black molded phenolic base and buzzer housing. Base 6 3/4" x 2 3/4" x 1 3/8", overall length 8 1/2". Shpg. wt., 2 lbs. MS-438 Code Practice Set (less battery). **1.95**

- BATTERY Burgess 2.....**.13**
 MS-369 Stethoscope Headset.....**1.69**

NEW MINIATURE HIGH SENSITIVITY MULTITESTER

20,000 OHMS PER VOLT DC — 10,000 OHMS PER VOLT AC
 CLEAR PLASTIC FACE COVER



A terrific buy in a hand-held, compact, light, accurate, completely wired instrument. Has a 36 μ A movement, 1% precision resistors and simple selector switch with calibration markings protected against wear. Scales: Volts DC and AC; 0-5.25, 100, 500, 1000; Ohms: 0-6K-600K-6 Megs; DC Current; 0-50 μ A- 5-50-500 MA; Decibels—20 to +64 in 5 ranges. Size 4 3/4" x 2 7/8" x 1 1/4". Shpg. wt., 1 lb. Complete with batteries and test leads. Imported to save you money.

AR-660 Miniature Meter.....Net **22.50**

NEW! AUDIO LEVEL INDICATOR



Precision loudness meter. Calibrated in Volume Units and percent, with 20 db variable attenuator. Ideal for setting output level in paging and music systems; removes guesswork when used as record-level indicator with tape recorders. Highly damped meter; responds to average level of voice and music. Impedance 10,000 ohms; sensitivity 1.4 volts for 0 VU. With capacitor for blocking DC to prevent burnout, 4" w x 2-3/16" h x 1-3/8" d. Shpg. wt., 1 lb.

LAFAYETTE TM-20 Audio Level Meter.....Net **5.95**

NEW! STEREO BALANCE METER



Removes guesswork in providing perfect balance of the 2 amplifier or preamplifier channels in any stereo system. Can be used as record-level indicator with stereo tape recorders, and for balancing stereo tuners. Impedance 10,000 ohms; calibrated 20 db attenuators, capacitors for blocking DC. Calibrated in Volume Units and percent; highly damped, reads average voltage of voice or music signals. Sensitivity 1.4 volts for 0 VU. Shpg. wt., 1 lb.

LAFAYETTE TM-40 Stereo Balance Meter.....Net **8.95**

Lafayette's Radio-Control Specialties

LAFAYETTE SPECIAL R/C TRANSMITTER

New crystal controlled 27.255 MC R/C transmitter, completely assembled, tested and guaranteed. Includes tube, crystal and 6 section telescoping antenna. Approx. 1 mile range. Size 8 1/2" x 2 1/4" x 1 1/4". Shpg. wt., 2 1/2 lbs. Less batteries. F-249 R/C TRANSMITTER (Less Batteries) Net **14.95**

LAFAYETTE SPECIAL R/C RECEIVER

New factory wired and tested RC receiver. Completely enclosed — for use around water — case may be removed. Ready to operate on exam-free 27.255 MC band. Has fine tuning control, antenna lead, and connector plug. Requires one 1.5V and one 45V battery. Complete with 354 tube, less batteries. Size 3 x 2 1/4" x 1 1/2". Ideal companion for F-249 Transmitter. Shpg. wt., 8 oz. F-208 R/C RECEIVER (Less Batteries) Net **8.95**

SPECIAL COMBINATION OFFER

Consists of R/C Transmitter (F-249) and R/C Receiver (F-208)
 F-259 Combination Net **22.90**

LAFAYETTE SIGNAL GENERATOR

COMPLETELY WIRED AND TESTED!
 ACCURACY AND QUALITY
 GUARANTEED!

22.50

- FREQUENCY 120KC TO 260MCI
- 120KC TO 120MC ON FUNDAMENTALS
- 30 DAY TRIAL PERIOD! FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON

Completely wired and tested instrument. Do not confuse with kits sold in the same price range. Has the quality and accuracy of instruments selling for 3 to 4 times as much. Six overlapping ranges — 120KC to 320KC, 320KC to 1000KC, 1MC to 3.2MC, 3.2MC to 11MC, 11MC to 38MC, 37MC to 130MC — all on fundamentals — calibrated harmonics from 120MC to 260MC. Switch between internal modulation at 400 cps or any external source at other frequencies. 400 cps signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 cps audio. RF output is in excess of 100,000 micro volts. Jacks are provided for high or low RF output.

Highly stable special circuit design. Fine adjust RF control. AF output 2-3 volts, input 4 volts, across 1 megohm. 5 inch etched dial plate — protected by clear plastic bezel. Common AF terminals for EXT-MOD input and INT-AF output eliminates need for special connectors. Gray metal case — carrying handle — complete with leads, line cord and plug. For 105-125V, 60-60 cycle A.C. Shpg. wt., 8 lbs.

LSG-10 — Signal Generator.....Net **22.50**

Lafayette Radio 165-08 Liberty Ave.
 DEPT. II JAMAICA 33, N. Y.

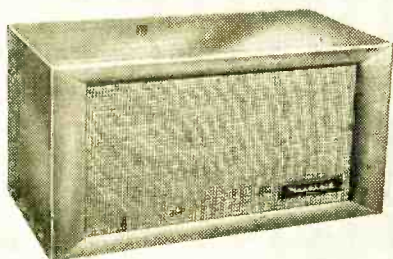
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build your own  *for fun!*



Don't let a lack of experience keep you from enjoying the fun and savings of "Do-it-yourself" kit construction. The easy-to-follow diagrams that come with every Heathkit insure your success. Let our experience be your teacher—and you'll save one-half or more over the price of "built-up" equipment of equal quality.

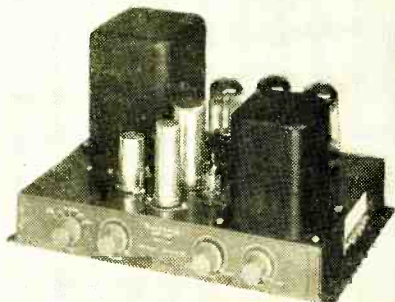
HEATH COMPANY A subsidiary of Daystrom, Inc. BENTON HARBOR 10, MICH.



"BASIC" SPEAKER SYSTEM



RANGE EXTENDER



A-9C 20-WATT AMPLIFIER

**HEATHKIT "BASIC RANGE"
HIGH FIDELITY SPEAKER SYSTEM KIT**

This amazing speaker system can fulfill your present needs and still provide for future expansion. Fine hi-fi performance the result of using high quality speakers in an enclosure especially designed for them. Features two Jensen speakers to cover 50 to 12,000 CPS within ± 5 db. Power rating is 25 watts, and impedance is 16 ohms. Enclosure constructed of veneer-surfaced plywood, $\frac{1}{2}$ " thick, and measures $11\frac{1}{2}$ " H x 23 " W x $11\frac{1}{4}$ " D. Precut and predrilled for quick assembly.

Model SS-2
\$39⁹⁵

Shpg. Wt. 26 lbs.

**HEATHKIT RANGE EXTENDING
HIGH FIDELITY SPEAKER SYSTEM KIT**

Designed especially for use with SS-2 "Basic" system. Contains 15" woofer and compression-type super tweeter. Extends basic unit to 35—16,000 CPS, ± 5 db. Impedance 16 ohms. Measures 29" H x 23" W x $17\frac{1}{2}$ " D, and is constructed of $\frac{3}{4}$ " veneer-surfaced plywood.

Model SS-1B
\$99⁹⁵

Shpg. Wt. 80 lbs.

**HEATHKIT A-9C HIGH FIDELITY
AMPLIFIER KIT**

This model incorporates its own power supply and preamplifier. Plenty of power with full 20 watt rating. Four separate inputs, selected by panel-mounted switch, and separate bass and treble controls. Ideal for home or PA applications. Output transformer tapped at 4, 8, 16 or 500 ohms. Response within ± 1 db from 20 to 20,000 CPS.

Model A-9C
\$35⁵⁰

Shpg. Wt. 23 lbs.

HEATHKIT HIGH FIDELITY FM TUNER KIT

Now you can have full-fidelity FM performance from 88 to 108 mc at reasonable cost. Features temperature-compensated oscillator—built in power supply, and beautiful cabinet. Components prealigned at factory!

Model FM-3A
\$25⁹⁵

Shpg. Wt. 8 lbs.

(with cabinet)

HEATHKIT BROADBAND AM TUNER KIT

Tunes standard AM band from 550 to 1600 kc with fine sensitivity and broadband characteristics. Features include built-in power supply and low-distortion detector. All RF circuits pre-aligned for simplified construction.

Model BC-1A
\$25⁹⁵

Shpg. Wt. 9 lbs.

(with cabinet)

**HEATHKIT "MASTER CONTROL"
HI-FI PREAMPLIFIER KIT**

Provides extra amplification, selection of inputs, volume and tone controls, and turnover and rolloff controls, for Williamson-type amplifiers. Beautiful satin-gold enamel cabinet. Derives operating power from amplifier.

Model WA-P2
\$19⁷⁵

Shpg. Wt. 7 lbs.

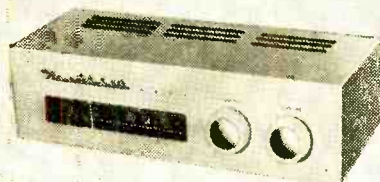
(with cabinet)

**HEATHKIT 25-WATT HIGH FIDELITY
AMPLIFIER KIT**

Outstanding 25-watt Williamson-type amplifier employs KT66 tubes and Peerless output transformer, tapped at 4, 8, 16 and 500 ohms. A fine amplifier for the "deluxe" system. WA-P2 preamplifier required for operation. Express only.

Model W-5M
\$59⁷⁵

Shpg. Wt. 31 lbs.



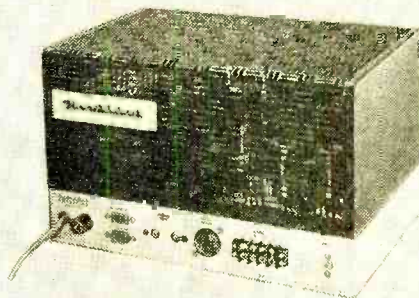
FM TUNER



AM TUNER



PREAMPLIFIER



W-5M 25-WATT AMPLIFIER

HEATHKITS

*World's finest
electronic equipment
in kit form...*



Choose your own "Do-it-yourself" project
from the world's largest kit manufacturer

HEATH COMPANY

A subsidiary of Daystrom, Inc.

BENTON HARBOR 10, MICHIGAN

Now you can have radio
wherever you go —
with the portable
that plays anywhere!

NEW LOW PRICE!

Model XR-1L
\$34⁹⁵

Model XR-1P
\$29⁹⁵

Note: Prices are with cabinet less batteries.

HEATHKIT MODEL XR-1P TRANSISTOR PORTABLE RADIO KIT

This easy to build transistor radio is designed for lifetime operation. Features 6 name-brand (Texas Instrument) transistors for extra good sensitivity and selectivity. A 4" x 6" speaker for "big set" tone, built-in rod-type antenna, and uses 6 standard size "D" flashlight cells for extremely long battery life (between 500 and 1,000 hours). Cabinet is two-tone blue molded plastic with pull-out carrying handle. Measures 9" L. x 7" H. x 3 $\frac{3}{4}$ " D. Transformers are prealigned eliminating special alignment equipment. Shpg. Wt. 6 lbs.

MODEL XR-1L: Identical to XR-1P except in leather case. Carrying strap included. Shpg. Wt. 7 lbs.

HEATHKIT BROADCAST BAND RADIO KIT

Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5 $\frac{1}{2}$ " 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
\$18⁹⁵

(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
\$7⁹⁵

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
\$11⁵⁰

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
\$35⁹⁵
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.

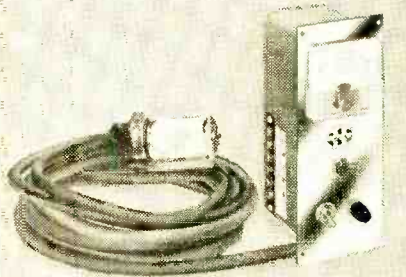
Model PM-1
\$14⁹⁵

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 5½" H x 5¼" 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
\$54⁹⁵

NEW! Heathkits for the boating enthusiast



FUEL VAPOR DETECTOR



POWER METER



RADIO DIRECTION-FINDER

HEATHKIT



DX-20 TRANSMITTER



RF SIGNAL GENERATOR



GRID DIP METER



HANDITESTER

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

\$35⁹⁵

Shpg. Wt. 19 lbs.

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

\$21⁹⁵

Shpg. Wt. 4 lbs.

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. Preadigned coils eliminate the need for calibration after completion.

Model SG-8

\$19⁵⁰

Shpg. Wt. 8 lbs.

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

\$17⁹⁵

Shpg. Wt. 3 lbs.

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

\$24⁵⁰

Shpg. Wt. 7 lbs.

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

\$29⁹⁵

Shpg. Wt. 12 lbs.

(less cabinet)

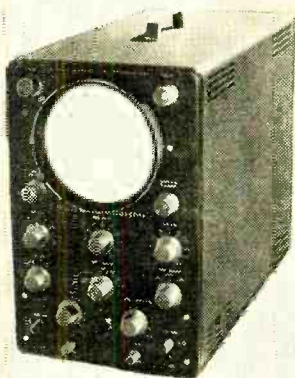
HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

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."

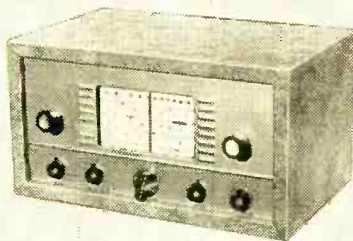
Model OM-2

\$39⁹⁵

Shpg. Wt. 22 lbs.



"GENERAL-PURPOSE" SCOPE



ALL-BAND RADIO



VACUUM TUBE VOLTMETER



FREE 1958 CATALOG

Write today for this FREE CATALOG listing more than 100 "do-it-yourself" kits.

HEATHKITS
*World's finest
 electronic equipment
 in kit form...*

*Pioneer in
 "do-it-yourself"
 electronics*

HOW TO ORDER . . .

Just identify the kit you desire by its model number and send check or money order to address below. Don't hesitate to ask about HEATH TIME PAYMENT PLAN.

ORDER BLANK		HEATH COMPANY	A subsidiary of Daystrom, Inc. Benton Harbor 10, Mich.	
Name _____		SHIP VIA		<input type="checkbox"/> Parcel Post
Address _____				<input type="checkbox"/> Express
City _____ Zone _____ State _____				<input type="checkbox"/> Freight
				<input type="checkbox"/> Best Way
Quantity	Item	Model No.	Price	
<input type="checkbox"/> SEND FREE Heathkit Catalog				
Enclosed find <input type="checkbox"/> check <input type="checkbox"/> money order for \$_____ Please ship C.O.D. postage enclosed for _____ lbs. On express orders do not include transportation charges—they will be collected by the ex-		press agency at time of delivery. On parcel post orders include postage for weight shown. Orders from APO's must include full remittance. NOTE: All prices are subject to change without notice and are F.O.B. Benton Harbor, Mich.		POSTAGE
				TOTAL

SENSITIVITY SELECTIVITY STABILITY

AND SSB



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at the speed of light, about 186,000 miles per second. Even at this great speed, it takes a definite length of time for a radio signal to travel from one point to another. This time interval is used to measure distances in radar systems.

Thus, on Earth our "instantaneous" radio communication is not instantaneous at all—it only seems so because of the short distances involved! But when we start communicating with space ships and other planets, the *time of transmission* will assume real importance.

If we were to send a radio message to the Moon, for example, the first part of our message would not arrive until more than *a second* after we started sending, and our Moon base would continue to receive the message for a little over a second after we ended transmission.

But the Moon is pretty close as far as interplanetary distances go! If we sent a radio message to Mars when it was on the same side of the Sun as the Earth (see Fig. 2), it would not start arriving until slightly *over four minutes* after we started transmitting, and would *continue to arrive* for the same length of time *after* we stopped sending.

From this, we can see that "two-way" radio conversations as we know them on Earth would be next to impossible. The time lag applies to *both* terminals of our communications network. There would be a delay of *eight minutes* between our sending and our receiving a message from Mars (four minutes out, four minutes back). And this is assuming that Earth and Mars are on the same side of the Sun! As the distance increases, so does the time lag.

Q. What frequencies will be used for interplanetary communication?

A. There are several factors which will help determine the frequency of an interplanetary radio link. We already have one clue in the type of transmitters used in the first Earth satellites. The first two Russian Sputniks had transmitters operating at 20 and 40 mc.; our satellites transmit at the higher frequency of 108 mc.

As we go to higher and higher frequencies, smaller antennas become much more efficient and we can get tighter and tighter beams. Thus, to obtain the maximum in efficiency from an antenna of given size, we would want to use the highest frequency we can. Chances are, therefore, that our interplanetary communication equipment will operate at microwave frequencies—between 1000 and 10,000 mc.

Q. I suppose we'll need pretty powerful transmitters. What factors determine how much power is needed?

A. With fairly tight radio beams and a

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1S5	59	6CS6	59
174	59	6CU6	1.19
1U4	59	6DE6	59
1U5	59	6DT5	59
1X2	79	6J5	49
3A4	69	6J6	69
3A5	49	6K5	57
3CB6	59	6S4	55
3DT6	69	6S7	59
3E4	69	6S7	75
3F4	59	6S7	77
3V4	69	6S7	69
4BZ7	99	6S7	79
5T4	1.39	6SN7	68
5U4	59	6S7	65
5U8	59	6T4	85
5L4	77	6T6	77
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6A4	69	6X5	79
6AC7	79	6W4	71
6AF4	99	6W6	71
6AC5	99	6X4	48
6AG	99	6X5	79
6AH4	85	6X8	79
6AH5	99	12AT6	69
6AK5	49	12AT7	79
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6AM5	43	12AV7	79
6AN8	1.00	12AX4	69
6AN8	89	12AX7	69
6AD5	59	12AY7	99
6AT6	49	12QZ7	69
6AU5	95	12B4	69
6AU6	59	12B4E	54
6AU8	59	12BE6	1.99
6AV5	99	12BH7	79
6AV6	45	12BY7	79
6AW5	95	12CA7	69
6AX4	75	12CK7	69
6BA6	57	12CN7	69
6BC5	59	12DZ7	69
6BE6	59	19BG6G	1.83
6BG6G	1.59	25AV5	1.10
6BH6	69	25B6	1.39
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good-sized receiving antenna, the power required will depend on: (a) the sensitivity of our receiver; (b) type of communication system chosen (whether code, radiotelephone, or television); and (c) the distance over which the message is to be transmitted.

The limiting factor on receiver sensitivity is the relative strength between the random noise generated within the receiver plus the noise level in space due to radiation from planets and stars compared to the strength of our picked-up signal. The noise we have to overcome with our signal, in turn, depends on the bandwidth of our communication system. Finally, the type of communication system we choose will determine our signal bandwidth and hence noise level. The greater the noise level, the stronger the signal we must deliver to our receiver, and hence the more powerful the transmitter.

The bandwidth required by a radio signal depends, among other things, upon the rate at which we transmit bits of information. A c.w. or radiotelegraph code system transmits at a rather slow rate and requires a relatively narrow bandwidth. Voice transmission (radiotelephone) conveys information more rapidly and needs greater bandwidth. Finally, television transfers information at a tremendous rate and requires a very large bandwidth.

From this, we can see that a communication system requiring a wide bandwidth, such as television, will need much more power than a system requiring a narrower bandwidth, such as radiotelephony. And a radiotelephone system will need considerably more power than a radiotelegraph or teletype system.

As far as distance is concerned, we've already demonstrated that strength varies inversely with the square of the distance between the transmitting and receiving antennas. If we need a given amount of power to transmit a specific distance, we'll need four times that power to send a message to twice the distance, nine times as much to send a signal to three times the distance, sixteen times our original power to send a signal four times the initial distance, and so on.

Q. No wonder radio hams and commercial communication services prefer "code" for long-distance communication! Do we know exactly how much power we'll need?

A. We'll have to make a few assumptions regarding receiver sensitivity and antenna efficiency to answer that question. We needn't go into the calculations here, but it can be demonstrated mathematically that if we use microwave signals, have a

(Continued on page 118)

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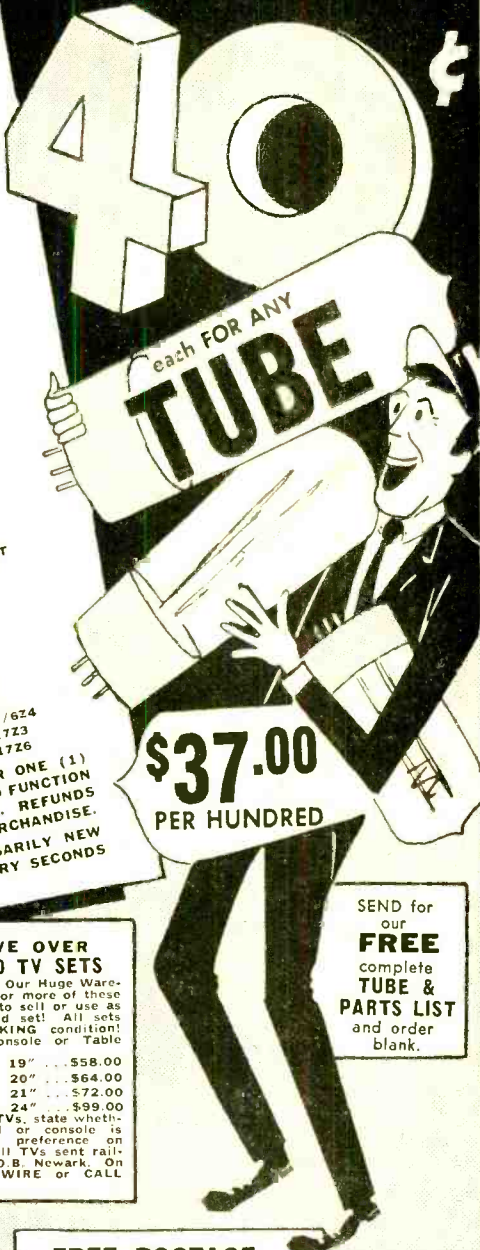
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| 1B3GT | 6A7 | 6BL7GT | 6SK7 | 12AT6 | 24A |
| 1H4G | 6AR | 6BN6 | 6SL7GT | 12AT7 | 25AV5 |
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| 1L6 | 6AF4 | 6R26 | 6T4 | 12AV6 | 25L6GT |
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| 1R5 | 6AH4GT | 6C5 | 6W4GT | 12AZ7 | 26 |
| 1S5 | 6AH6 | 6C6 | 6W6GT | 12R4 | 35A5 |
| 1T4 | 6AK5 | 6C7 | 6X4 | 12RA | 35B5 |
| 1U4 | 6AL5 | 6CB6 | 6X5 | 12RA6 | 35C5 |
| 1U5 | 6AL7 | 6CD6G | 6XA | 12R6 | 35L6GT |
| 1V2 | 6AMR | 6CF6 | 6Y6G | 12RF6 | 35W4 |
| 1X2 | 6ANA | 6C7 | 7A4 | 12RH7 | 35Z5GT |
| 2A3 | 6AQ5 | 6CL6 | 7A5 | 12BQ6 | 37 |
| 2AF4 | 6AQ6 | 6CM6 | 7A6 | 12BR7 | 39/44 |
| 3BC5 | 6AQ7GT | 6CN7 | 7A7 | 12CA5 | 42 |
| 3BN6 | 6AR5 | 6CS6 | 7A8 | 12J5 | 43 |
| 3BZ6 | 6AS5 | 6CU6 | 7B4 | 12K7 | 45 |
| 3CB6 | 6AT6 | 6DQ6 | 7B5 | 12L6 | 50A5 |
| 3CF6 | 6AT8 | 6F6 | 7B6 | 12Q7 | 50B5 |
| 3C56 | 6AU4GT | 6H6 | 7B7 | 12SA7 | 50C5 |
| 3LF4 | 6AU6 | 6J4 | 7B8 | 12S6GT | 50L6GT |
| 3Q4 | 6AUS | 6J5 | 7C4 | 12S7 | 50X6 |
| 3S4 | 6AV5GT | 6J7 | 7C5 | 12SK7 | 56 |
| 4BQ7A | 6AV6 | 6K6GT | 7C6 | 12SN7GT | 57 |
| 4BZ7 | 6AW8 | 6K7 | 7C7 | 12SQ7 | 58 |
| 5A58 | 6AX4GT | 6K8 | 7E6 | 12SV6GT | 71A |
| 5AT8 | 6AX5GT | 6L7 | 7E7 | 12W6GT | 75 |
| 5AV8 | 6B8 | 6N7 | 7F7 | 12X4 | 76 |
| 5AW4 | 6BA6 | 6Q7 | 7F8 | 12Z3 | 77 |
| 5BK7 | 6BC5 | 6S4 | 7H7 | 14A7 12B7 | 78 |
| 5L6 | 6BC8 | 6SA7 | 7Q7 | 14B6 | 80 |
| 5R8 | 6BD6 | 6S7 | 7X7/XXFM | 14Q7 | 84/624 |
| 5U4G | 6BF5 | 6SGT | 7Y4 | 19 | 11723 |
| 5UB | 6BF6 | 6SG7 | | 11726 | |
| 5V4G | 6BG6G | | | | |
| 5V6GT | | | | | |



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very sensitive receiver, and employ relatively large transmitting and receiving antennas, we should be able to transmit code messages to the Moon with less than 15 watts.

A kilowatt should be more than ample for Moon-to-Earth television and, as you know, many radio amateurs own kilowatt rigs. A kilowatt should also be quite ample for code transmission to Mars when the two planets are on the same side of the Sun.

Q. You've covered straight communication problems pretty well. But how about radio and TV broadcasts for entertainment?

A. Broadcasts for entertainment and general information purposes have one advantage over two-way communication: the time lag is relatively unimportant.

However, as we have seen, quite a bit more power is required for radiotelephone and TV transmission than for code communication. But TV broadcasts to and from the Moon and globe-circling artificial satellites will be quite practicable and, to some extent, easier to accomplish than long-distance television on Earth. The day may come when one of our manned Earth satellites will be a major relay station for coast-to-coast TV broadcasts!

-30-

Transistor Topics

(Continued from page 82)

sistors and i.f. transformers T_3 and T_4 .

The amplified i.f. signal obtained from T_4 's secondary winding is applied to a 1N34A diode detector. The d.c. component of the detected signal is coupled back through R_7 as a control on the base bias current of the first i.f. amplifier. The audio component, appearing across the diode load resistor, volume control R_8 , is coupled through C_9 to the audio output stage, a CK721 p-n-p common-emitter amplifier. Finally, the output signal drives magnetic earphones plugged into output jack J_1 .

Standard, readily available components are used throughout the circuit. Glen obtained his r.f. and i.f. components from Lafayette Radio. Their stock numbers for these parts are: T_1 —MS-329; oscillator coil L_1 —MS-265; tuning capacitor C_1 - C_2 —MS-270; T_2 - T_3 —MS-268; T_4 —MS-269.

All resistors are half-watt units. Capacitors C_3 , C_4 , C_7 and C_8 are low-voltage disc ceramic capacitors. The other fixed capacitors, C_5 , C_6 , and C_9 , are subminiature electrolytics with a rated working voltage of at least 6 volts d.c. Their actual capaci-

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082	3ALS	5V6GT	6BE6	654	7F7	12Q7	3217GT
024	3AU6	5W4GT	6BF5	65BGT	7F8	12SA7	35/51
1A5GT	3AV6	5X4G	6BG6G	65A7	7G7	12SG7	35A5
1A7GT	3BA4	5X8	6BH6	65B7Y	7M7	12SJ7	35B5
1B3GT	3BC2	5Y3GT	6BH8	65C7	7T7	12N7	35C5
1C5GT	3BE6	5Y4G	6B16	65F5	7K7	12N7GT	35L6GT
1C6	3BN4	5Z3	6BK5	65F765G7	7L7	12SQ7	35W4
1C7	3BU8	5Z4	6BK7	65H7	7M7	12SR7	35Y4
1M4G	3BY6	6A8	6BL7GT	65J7	7Q7	12V6GT	35Z4GT
1MSGT	3BZ6	6AB4	6BN6	65K7	7F7	12W6GT	35Z5GT
1L6	3C7	6AC7	6B06GT	65L7GT	757	12X4	= 37
1L4A	3CB6	6AF4	6B27	65N7GT	797	12Z3	= 39/44
1L6	3CF6	6AG5	6BR8	65O7	7M7	1A47	# 41
1L8	3C56	6AG7	6B58	65R7	726	1A4F7	# 42
1L5	3D16	6AM4GT	6B75G	614	7J7	1A86	# 43
1L6	3D4	6AM6	6B26	618	774	1A7	# 45
1LH4	3D5GT	6AK5	6B27	6U4GT	724	1A78	# 47
1LNS	354	6AK6	6C4	6U5	8A8B	1A97	5D45
1MSGT	3V4	6ALS	6C5	6UB	12A8	1A97	5D85
1PSGT	48C2	6A17GT	6CR5	6V3	12A85	1A07	5D55
1QS7	48O7A	6AM8	6C6	6V4GT	12AQ5	1A57	5D66G
1RS	4858	6AN8	6CD6G	6W4GT	12AT6	17AX4GT	50L6GT
1S5	48UR	6AQ5	6CF6	6W6GT	12AT7	17DQ6	50Y6
1T4	48Z7	6A06	6CG7	6X4	12AU6	19AU4	50Y7
1T5GT	4CB6	6A07GT	6CG8	6X5GT	12AU7	19B0G	# 57
1U4	5AM8	6AR5	6CB8	6X8	12AV6	19C8	# 58
1U5	5AN8	6AS5	6C16	6Y6G	12AV7	19J6	# 80
1V	5AG5	6AS8	6CM6	7A4	12AX4GT	1918	# 81
1V2	5A51	6AT6	6CM7	7A5	12AX7	19X8	1171GT
1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AV8	6AUSGT	6C06	7A7	12B4	25AV5GT	117P7GT
2A5	5AV4	6AU6	6DQ6	7A8	12B4G	25AX4GT	117Z3
2A7	5AZ4	6AJ8	6DQ6	7A4	12BE6	25BK5	117Z4GT
2AF4A	5BK7	6AV5GT	6D16	7B5	12BF6	25S06	117Z6GT
2B7	5BR8	6AV6	6E5	7B6	12BH7	25CD6G	807
2BN4	5BQ7	6AW8	6H6	7B7	12BK5	25C06	9002
2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25L6GT	9003
2E5	5CG8	6AX5GT	6J5	7C4	12BR7	25W4GT	9006
2Z2A	5J6	6AZ8	6J6	7C5	12CA5	25Z5	
3A3	5J8	6BA6	6KAGT	7C6	12C06	25Z6	
3A7	5J8	6BC5	6K7	7C7	12D06	# 27	
3A4	5U4G	6BC9	6L6	7E6	12J5	# 30	
3A5	5V4G	6BD6	6L7	7E7	12L6GT	# 31	

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tance values are not too critical. For example, *C5* may have values of from 8 to 25 μ d., *C9* from 4 to 25 μ d., and *C6* from 16 to 50 μ d. *R8* is a subminiature potentiometer having an audio taper, and is equipped with a s.p.s.t. switch *S1*. *B1* is a four-volt mercury battery (Mallory Type TR-133R).

Glen managed to assemble his entire receiver in a plastic box no larger than a typical "flip-top" package of cigarettes. Actual case measurements were $3\frac{7}{16}$ " x $2\frac{1}{4}$ " x $\frac{7}{8}$ ". He admits, however, that it's difficult to squeeze all the components into a package this size and suggests that the i.f. transformers be laid on their side along one edge of a $2\frac{1}{4}$ " x 2" x $\frac{1}{16}$ " wiring board, with the 2N94 i.f. transistors and associated resistors on end between them. He suggests, further, that the tinned lugs be cut to about $\frac{1}{16}$ " and that connections be made to the terminals with stranded piano wire; each connection should be soldered as *quickly as possible* using a clean, hot, well-tinned soldering iron. All transistors except the CK721 are mounted in subminiature sockets. It may be necessary to provide small slots in the case to allow the antenna rod to project slightly.

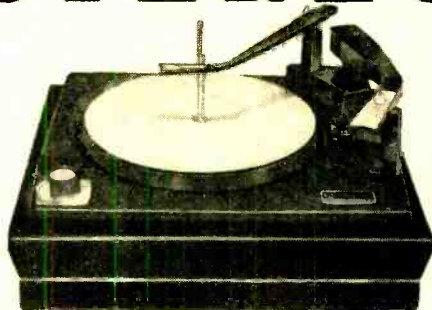
The receiver's current requirements are small. Glen estimates that a typical battery should provide about 400 hours operation.

If you decide to duplicate this receiver, take time to work out a clean layout and follow the general rules of good wiring practice. Make all leads as short and direct as possible, keep input and output signal leads well separated, and insulate bare leads with spaghetti tubing.

Since this is a superhet circuit, you'll have to align the completed receiver. Use magnetic earphones with an impedance of from 1000 to 4000 ohms. Applying a modulated r.f. signal at 455 kc. peak the i.f. transformers (*T2*, *T3*, and *T4*) for maximum output. The r.f. trimmer capacitor (on *C1*) is peaked for maximum output near the upper end of the broadcast band (about 1400 to 1500 kc.), while the oscillator trimmer (on *C2*) is adjusted for correct dial tracking.

Controlled Rectifier. Combining the features of both a transistor and a semiconductor rectifier, G.E.'s new "controlled rectifier" is one of the most recent additions to the growing family of special-purpose semiconductor devices. Basically a three-junction device, it consists of alternate re-

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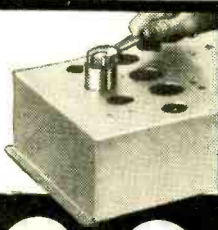
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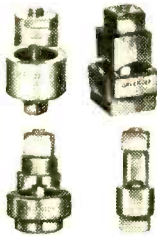
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gions of "p" and "n" type semiconductor materials, as shown in Fig. 3(A). Its schematic symbol is given in Fig. 3(B).

In operation, the unit offers a high resistance to the flow of current between its anode and cathode until an appropriate signal is applied to its third electrode, called a "gate." When this is done, the unit's internal resistance suddenly drops to quite a low value. Thus, the user can control a relatively large anode-to-cathode current with an extremely small amount of power applied to the gate.

In many respects, the controlled rectifier's operation is like that of the grid-controlled thyatron tube, and it can be used in similar applications. A power switching circuit is shown in Fig. 3(C). Here, the d.c. power source is connected in series with the controlled rectifier and its load. Under normal conditions, little or no current can flow through the load due to the controlled rectifier's high internal resistance. When a control signal is applied to the gate electrode through current limiting resistance R_b , the rectifier switches from a high resistance to a low resistance mode, permitting power to be delivered to the load.

Possible future applications include the replacement of relays, thyatrons, magnetic amplifiers, power transistors, and many types of conventional rectifiers. The controlled rectifier may be used for static switching, for d.c. motor speed control, in regulated d.c. power supplies, d.c.-to-d.c. converters, and in dynamic braking circuits.

New Products. Supplying sufficient current at 6 volts to operate a typical six-transistor radio receiver, the AR-300 is a new multicell solar battery just introduced by the Argonne Manufacturing Company (165-11 South Rd., Jamaica 33, N. Y.). This unit measures approximately 7½" x 5¼" x ¾" over-all. It will be available through all of the 600-odd Argonne distributors. Selling price, to the experimenter, will be approximately \$13.50 net.

Argonne has also announced a companion line of hermetically sealed rechargeable flashlight and penlight cells selling for a fraction of the cost of nickel-cadmium cells. These may be used in conjunction with the new solar battery to assemble light-operated power packs for operating transistor radios, amplifiers, transmitters, and phonographs.

Both General Transistor (Jamaica, N. Y.) and RCA (Somerville, N. J.) have an-

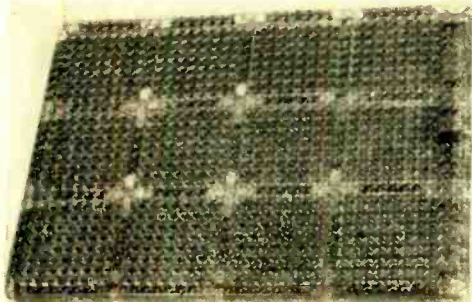
nounced new types of transistors. The GT types include five bilateral units, Types 2N592 through 2N596, and ten general-purpose transistors, Types 2N563 through 2N572.

RCA types include the 2N373 and 2N374, both of which are *p-n-p* "drift" transistors designed specifically for use as i.f. amplifiers and r.f. converters in entertainment-type battery-operated radio receivers operating in the AM broadcast band. Another RCA type, the 2N586, is a *p-n-p* alloy-junction unit for low-speed switching applications in industrial and military equipment, and is particularly useful as a relay-actuating device and in voltage regulator, multivibrator, d.c.-to-d.c. converters, and power supply circuits. The 2N586 is also suitable for use as an audio oscillator and as a large-signal class A or class B push-pull amplifier in audio circuits.

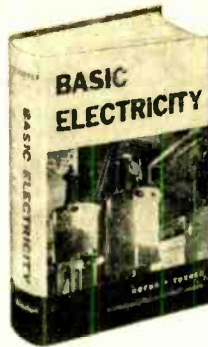
Designed for large-scale class A audio driver stages in automobile receivers, the 2N591, another new RCA transistor, is a *p-n-p* germanium alloy-junction unit capable of providing a power gain of 41 db with a total harmonic distortion of only 3% at a power output of 5 milliwatts.

Philco's new "Transac," a fully transistorized computer employing 10,000 surface barrier transistors in 332 printed circuit cards, is now being delivered to its first customers after almost three years of development and field tests.

Westclox (LaSalle, Ill.) has announced the production of an electric clock which has an operating voltage compatible with the low voltages used in transistor radios, thus making possible—for the first time—a portable transistorized clock-radio. The new clock operates from a 1½-volt battery and has a single three-position control switch which may be used to turn a radio on or off or can be set to start the radio



The AR-300, Argonne's new 6-volt solar battery. September, 1958



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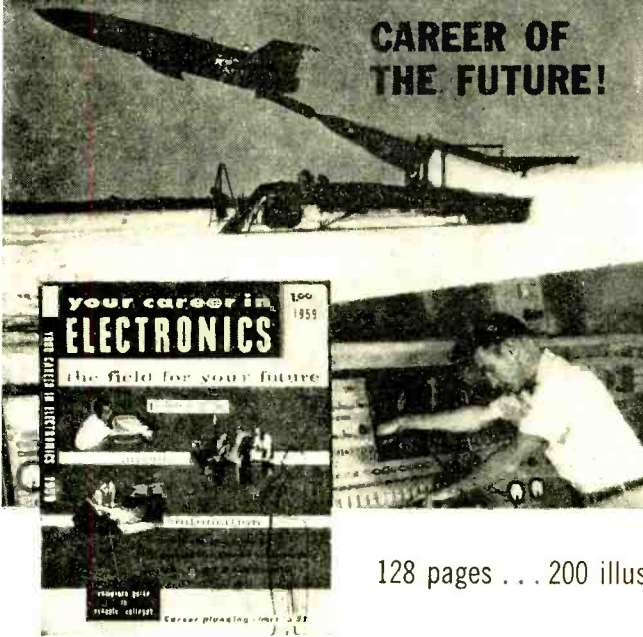
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automatically at a preset alarm time. A "sleeper switch" will be made available to turn the radio off after an interval up to 60 minutes.

That's the story for now, fellows. See you next month . . .

Lou

Hi-Fi Slave

(Continued from page 79)

If a tape machine is used as the program source, a microswitch will do the same job as the changer's automatic shutoff switch. Many tape machines have a microswitch which stops the machine when the tape runs off the supply reel. If the tape machine does not have such a microswitch, one can be installed in the tape transport path very inexpensively.

—30—

HOW IT WORKS

Since a record changer is the most common program source, one is shown in the schematic on page 78. However, a tape machine can also be used.

Most record changers have an automatic shutoff switch which turns off the turntable when the tone arm has come to rest at the end of the last record. This operates the control relay. When the relay is energized, contact *A2* completes a circuit to the equipment plugged into the triple socket. Contact *B2* completes a circuit to the green lamp if the selector switch is set at *Auto.*, so that contact *D1* supplies power to contact *B3*.

If the selector switch is set at *Man.*, the equipment is supplied power through switch contact *C2*, and the red lamp is supplied power through contact *D2*, whether or not the relay is energized. With the selector switch at *Man.*, the green lamp cannot be lit even if the relay is energized, because relay contact *B3* is not receiving power through switch contact *D1*.

One side of each lamp goes to *B2* and *D2*, and the other side goes to a common resistor, *R1*, which is used to drop the line voltage to about 28 volts—the value of the lamps. One resistor is sufficient, since only one lamp will be operating at a time.

This circuit permits either automatic or manual operation. On *Auto.*, the changer cutoff switch operates the relay which supplies power to the equipment and the green lamp. On *Man.*, power is supplied to the equipment and the red lamp through the selector switch alone. This allows all on-off switches in the various pieces of equipment to remain in the "on" position.

To turn the equipment on, set the selector switch to *Man.* When it is warmed up, program material can be played. When it is finished, the switch in the changer will turn off, and the relay will de-energize, but the hi-fi equipment will remain on.

However, when the equipment is warmed up and the turntable started, the selector switch can be turned to *Auto.* This places control on the relay. When the changer switch turns off the relay, the contacts open, turning off the power to the equipment, including the power to the green lamp.

The relay provides foolproof operation, and mechanical independence from the changer. It also allows a current up to 12.5 amp. to be drawn through the relay contacts instead of through the changer switch contacts, which are not rated for this current.

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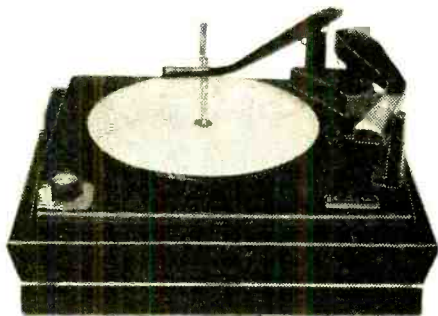


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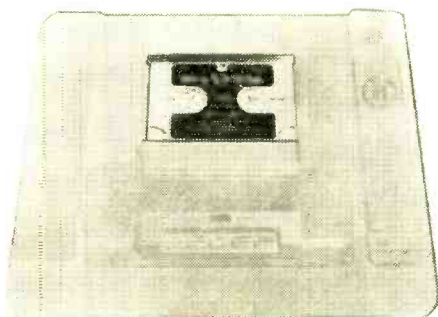
Hi-Fi Highlights

(Continued from page 87)



37 Four-speed stereo changer has stereo-monophonic switch to allow stereo cartridge use with mono-LP's. It features a double-channel muting switch, quick-change cartridge holder for change-over to monophonic cartridge. Furnished less cartridge. Glaser-Steers GS-77 Stereo.

38 Pre-recorded stereo 4-track tape cartridge holds one hour of program material at $3\frac{3}{4}$ ips. Cartridge fits only RCA players or others designed to take it. Controlled by buttons, it eliminates handthreading or rewinding. RCA.



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Monoceiver Pulls In DX

(Continued from page 70)

miniature potentiometer connected across the tickler winding does the job nicely.

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-50-

Among the Novice Hams

(Continued from page 85)

cathode is that it permits operating any number of tubes from the same heater supply while keeping the cathodes electrically independent of each other. When the heater supply is alternating current, the isolated cathodes make it less difficult to keep hum modulation from the heater

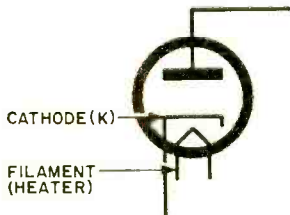


Fig. 2. Schematic symbol for an indirectly heated cathode.

circuit from getting in the output signal than when directly heated cathodes are used.

Figure 2 shows the schematic symbol for an indirectly heated cathode. In "working" diagrams, the complete heater-cathode circuit is usually shown. But for simplicity in "theoretical" diagrams the cathode symbol often represents the entire cathode-heater circuit. Both methods are used in the schematic diagrams appearing in the License Manual.

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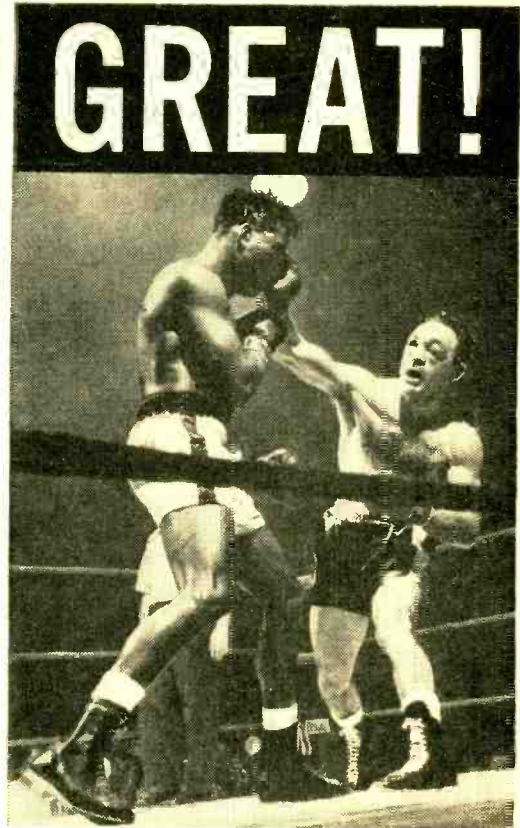


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both, as you may get a question or two in the examination where *anode* is mentioned instead of *plate*.

Triode Vacuum Tubes. By placing another element, called the *control grid*, between the cathode and plate of a diode, a three-element or *triode* vacuum tube is formed. The control grid consists of a number of fine wires parallel to each other and

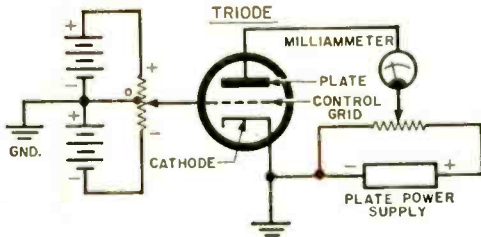


Fig. 3. Theoretical circuit used to illustrate the manner in which a triode vacuum tube operates.

connected together at their ends. The space between adjacent wires is fairly wide.

Referring to Fig. 3, when the grid voltage is zero, varying the plate voltage will vary the plate current as in the diode circuit of Fig. 1. If the plate voltage is held constant and the grid voltage is varied, the plate current will still vary.

The important thing about this demonstration is that a small change in grid voltage has as much effect on the plate current as a large change in plate voltage. The reason is simple. The grid is close to the cathode; consequently, a small change in grid voltage must have more effect on the electrons emitted by the cathode than an equal change in voltage on the more distant plate.

When the grid is positive, most of the electrons it pulls away from the cathode whiz through the spaces between the grid wires to the plate. When the grid is negative, it repels the electrons from the cathode, while the plate attracts them. As a result, the plate current is reduced. If the grid is made sufficiently negative, the plate current will be *cut off* completely, no matter how high the plate voltage may be.

Of course, when the grid is positive, some electrons strike the grid wires and some grid current flows. However, the grid can be operated so that it draws no current and still controls the plate current of the vacuum tube.

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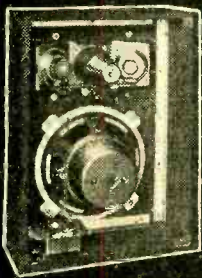
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say 250 volts—and zero grid voltage initially, the plate current is 20 milliamperes. While the grid is made more and more negative, the plate current gradually decreases until at 10 volts, negative, the plate current is reduced to zero. Over this range the grid draws no current, because it is always negative; yet it produces a 20-ma. change in plate current.

Now, let us connect a fixed negative bias voltage of five volts (halfway between zero bias and cutoff bias) to the grid and apply an a.c. signal to the grid. During each positive half cycle, the applied signal will cancel part of the fixed negative bias; and during the negative half cycles, it will add to the fixed bias. As a result, the plate current will vary in exact step with the signal applied to the grid.

Class A Amplifiers. A tube operated in this manner is called a *class A amplifier*. Its main feature is that its output signal is a replica of its input signal. A class A amplifier is used whenever it is necessary to amplify a signal with a minimum of distortion.

In a normal class A amplifier, the grid never draws current, because its input sig-

nal never exceeds its fixed negative bias voltage. Also, its d.c. plate current remains constant, as it swings equally above and below its no-signal value. Consequently, its average value is unchanged.

However, if the fixed bias is too low or the input signal is too great, the grid will draw current on positive signal peaks, and the plate current will "kick" with signal. Then the waveform of the output signal will be a distorted version of the input signal.

News and Views

"Mutch," **KNØMIK**, feeds his Heathkit DX-40 transmitter into three antennas—one at a time, an 80-meter doublet, a 40-meter doublet, and a 15-meter "Demi-Quad" tacked to the side of the house. He receives with a Hallcrafters SX-71 receiver, to which he has added a Heathkit QF-1 Q-multiplier. Fifteen meters is his favorite band, with 80 next. Forty-three states worked and 40 confirmed in four-and-a-half months is his record. . . . **Mike, KN6KZD**, runs 75 watts to his new DX-40 on 80, 40, and 15 meters. His two antennas are a 120' "long wire" and a 40-meter dipole. His receiver is a Hallicrafters S-53A. Mike's 135 contacts have been spread over 12 states. He QSL's 100% and takes a dim view of the QSL promisers who send invisible cards.

Mike, KN7CLO, must want to get lots of

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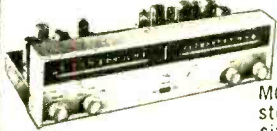
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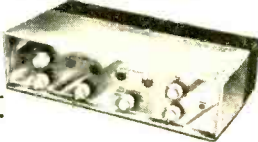
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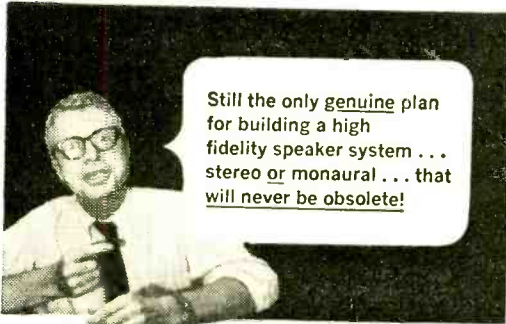
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mail. He is in *Utah* and offers to sked anyone needing a *Utah* contact. In four months on the air, his Heathkit AT-1 transmitter, 33' vertical antenna, and "surplus" BC-348 receiver have worked Hawaii twice and the east coast a couple of times in racking up a 30-state total. . . . **Richard Randall** is on 40 meters from Burlington, Vermont, with an AT-1 transmitter and a Hallicrafters SX-42 receiver. Alas, he forgot to give his call letters when he wrote to us.

Adding to his report in the August column, **Bill, KN5MUS/Maritime-Mobile**, reports that he needs just Nevada and Idaho to complete his WAS on 15 meters. Bill gets lots of requests to make skeds, but conditions change so fast, because he is always moving, that they never work out. Also, FCC regulations prevent him from operating in port while the ship is loading and unloading cargo. Therefore, all contacts are catch-as-catch-can. Bill has a Heathkit reflected power meter in his antenna lead, and whenever the reflected power goes up too high, he knows that it is time to let down the antenna and wash the dirt and encrusted salt spray from the center connector and end insulators.

Doc, KN2LBK, operates on 80, 40, and 15 meters with a DX-35, a Hallicrafters S-38A, and two antennas. However, his main reason for writing was to offer to help prospective Novices in the Beacon—Cold Spring—Poughkeepsie area. . . . **Doc, K4MIH**, worked 42 states as a Novice on 40 meters with a Johnson Adventurer transmitter and a Hallicrafters S-40B with an external Q-multiplier. Now, as a "General," he has tried 20 meters and has worked a "blue million" 1's and 2's and has pushed his DX total up to 44 states and seven countries. . . . **Sanford, KN5QHS**, has worked 10 states in two weeks on 40 meters with his Heathkit DX-20 transmitter and RCA AR-77 receiver. He uses a coaxial-fed doublet antenna and discovered, after his first few contacts, that it worked a good deal better when he hooked it up to his transmitter correctly.

Bobby, KN3CMC, and his dad, **KN3DDH**, operate on 40 and 15 meters, using the Harvey-Wells TBS-50 transmitter Bobby received for his 14th birthday and the Hallicrafters SX-99 receiver he received for Christmas. (Moral: get your Dad interested in amateur radio.) Their 15-meter antenna is the "D-Q" described in *POPULAR ELECTRONICS*, January 1958. It is quite a wind catcher, but it works the DX; so they have no complaints. **KN3CMC** has 29 states and Canada, and **KN3DDH** has 22. Bobby credits the fact that his name was in the February 1958 *News and Views* for confirmation of at least two of the states worked, and he still gets letters as a result of his name appearing in "Help Wanted" last September. Some ask for help. Others offer it. He answers all letters.

Cal, WN6GZK, should have his General now. His Novice record was 38 states and seven countries. He rates LU1, Buenos Aires, as his best DX, although most west coast hams would pick his Northern Ireland contact as better. **WN6GZK's** Adventurer transmitter, Hallicrafters SX-100 receiver and other equipment are located in a closet off his den for two reasons: lack of room and to keep them

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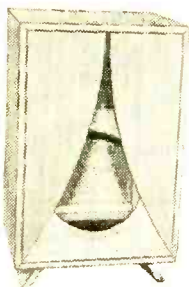
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away from his three children. He works 80 and 40 meters, but his favorite band is 15 meters, for which he has a motor-driven, 3-element rotary beam.

Ken, KN2KOT, has pushed 65 watts into his Heathkit DX-35 and out of a 120' "long wire" antenna into 40 states—all confirmed—and 13 foreign countries in 3½ months on the air. KN2KOT reminds all Novices—and Generals—who work DX to keep a stamped, business-size envelope with their address in the usual place and their call letters in the upper, left-hand corner on file with their Call-Area QSL Bureau. Its address is at the head of each call-area list in the Radio Amateurs' Call Book.

Bob, KN4OZC, uses an 11-year old Hallcrafters S-38 receiver, a DX-40 transmitter and an 85' antenna, 35' high. In two months, he has worked 24 states, several Puerto Ricans and Canadians, plus G3BTA, who gave him an RST-589X report. . . . A special word of thanks to **Lester Sade**, 632 Second St., San Bruno, Calif., for the encouraging cards and letters he has written to those whose names have appeared under "Help Us Obtain Our Ham Licenses."

Lynn, KN6OAP, operates on the 7-mc. Novice band using a "home-brew" 807 transmitter to feed a Windom antenna and receives on her Dad's (K6AYO) Hammarlund Super-Pro receiver. Lynn is only eight years old and too young to know that there is no DX to work in the 40-meter Novice band; so she has worked JA1EF (Japan), KX6AF (Marshall Islands), and VK3XB (twice) and VK3KS (Australia). But she was too sleepy to get up the night DL9TE (Germany) was coming through. . . . Via KN6OAP, **Ivor, VK3XB**,

lists the Novices he has heard in the 40-meter Novice band: KN6LIU, KN8HJC, KN3CEO, KN6KMB, KN6LPK, KN6LAK, WN6HJX, KN4YZZ, KN4SWJ, WH6CRP, KN7COS, KN6KCV, WH6CJG, WH6CNK, KN6OLB, KN0OXN, WN2HCR, KN5OND, KN6ZHT, KN0ODO, WP4ANH, KN9LSC, KN0KXW. He has called them, too, on 7150 kc., without response! VK3XB is on 7150 kc. most weekday nights. Listen for him.

Contributors to News and Views: **Steve "Mutch" Mutchler, KN0MIK**, Aneta, N. D.; **Mike Jones, KN6KZD**, (14) 1984 Ensenada St., Lemon Grove, Calif.; **Mike Gilmore, KN7CLO**, 528 Daley Ave., Layton, Utah; **Richard W. Randall, KN7???**, 43A University Hts., Burlington, Vt.; **Bill Riley, KN5MUS/MM**, 162-13 Teichman, Galveston, Texas; **Howard "Doc" Nichols, KN2LBK**, East Mountain Road South, Cold Spring, N. Y.; **Doc Shellhorse, K4MIH**, (13) 113 East Carter St., Cartersville, Ga.; **Sanford Hutson, KN5QHS**, Box 27, Stuttgart, Ark.; **Bob A. Copella, KN3CMC** (son), and **Rob F. Copella, KN3DDH** (father), Box 25, Byrnedale, Pa.; **Cal Andrews, WN6GZK**, (33) 927 Nutwood St., Anaheim, Calif.; **Bob Simkins, KN4OZC**, 202 Pleasant Ridge Avenue, Greenville, S. C.; **Lynn Stillwell, KN6OAP**, (8) 518 Eleanor Ave., North Sacramento 15, Calif.

Send us that report of your experiences as a ham for use in *News and Views*. Include a sharp picture, if you have one available. Until next month, 73,

Herb, W9EGQ

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Short-Wave Report

(Continued from page 90)

NORTH AMERICA

Bermuda—Bermuda Broadcasting Co., Ltd., a medium-wave station, sends a plain card. Total time for verification was one year, after one follow-up letter.

Cuba—*Circuito Nacional Cubano* (11,750 kc.) should be addressed: Calle "O", Num. 216, Apartado 3540, Vedado, Havana. A long wait noted for their card.

Mexico—XECMT (6090 kc.) verified by postcard. QTH: P. O. Box 79, Ciudad El Mante.

Netherland West Indies—*Radio Hoyer 1 and 2* (medium-wave) sent a QSL letter in English, signed by H. E. Hoyer. They also reply to letters requesting information.

Panama—*Corp. Panamena de Radiodifusion, S.A. (Circuito R.P.C./Onda Popular)*, HOH7, 9685 kc., verified promptly with a hectographed letter in Spanish signed by Lloyd B. O'Meally, Director, Dept. Tecnico.

SOUTH AMERICA

Bolivia—CP25, *R. Libertad*, Casilla 302, Sucre, 9200 kc., sent a QSL letter in Spanish and English signed by Jose Moscoso (Owner) and Julio Penaranda Quintana. No luck with a later report.

Chile—CE1196, *R. Soc. Nac. de Minería*, 11,960A kc., Santiago, verifies by letter.

Colombia—HJDJ, *R. Quibdo, La Voz del Choco*, Apartado Aereo 31-63 or Apartado 21-41, Medellin, verifies by letter for the 5040-kc. outlet.

Ecuador—HC3RM, *R. Cultura Machala*, Casilla 695, Machala, sends a letter signed by Servero S. Garcia Conzalez. *Ondas del Volante*, 6140 kc., Casilla 726, Asoguez, sends a letter which is signed by Director Reinaldo Palacios P.

Peru—OAX8E, *R. Loreto*, Emisora Castellanos, Apartado 555, Iquitos (testing on 9590 kc.), is anxious for reports. They QSL with a pennant.

Surinam (Dutch Guiana)—A.V.R.O.S. verifies with a letter signed by Miss Lydia Emmanuel, Announcer. No luck with reports to her.

Venezuela—YVQN, *Ondas Portenas*, Edificio Anzoategui, Apartado Correos 4123, sent a letter in Spanish signed by Rafael Bellorin Malaver. A letter was also received from YVQA, *R. Sucre*, Apartado 26, Edo., Sucre, Cumana.

EUROPE

Andorra—The QSL was a photo-card with message on reverse signed by "Caminal," the listed Sec. General.

Bulgaria—The new lithographed cards are not as attractive as the former printed cards.

Germany—DMR20, *Westdeutscher Rundfunk*, 3970 kc., sent a large photo with message on the back signed by Curt Weber. Armed Forces Network (AFN), 5470 kc., now has only a mimeographed form letter, signed by F. K. Tourtellotte, Lt. Col., Signal Corps.

September 1958

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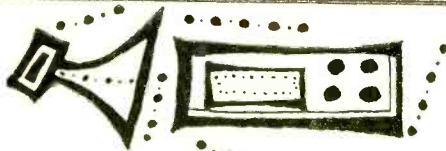
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QTH: U. S. Army Element, A.F.N., Europe, APO 757, New York.

Ireland—*R. Eireann* (medium-wave) sends a mimeographed form letter signed by M. High de Lindhe, for Dir. of Broadcasting.

Italy—*Radio Roma* now has multi-colored QSL cards.

Poland—A lithographed multi-colored card shows natives in costumes.

Spain—The QSL card is the same photograph that has been used for some time but they have a new message on the reverse.

AFRICA

Angola—CR6AA sent a card in 1952. CR6RD and CR6RE took a prepared card for a verification. CR6RM also sent a card. CR6RQ has a card containing a photo of natives; the message on the reverse side is signed by Jose L. Nunes.

Bechuanaland—ZNB (no longer active on 8230 kc.) sent a card from the Dept. of Public Works. This one took two years to come through.

Belgian Congo—*R. Congo Belge*, Stanleyville, "acknowledged" with a photo of the station personnel. OQ2AA, *R. Leo*, % AFRI-CONGO, B.P. 345, Leopoldville, sent a two-page letter with the note: "Sorry, no QSL cards." The signer was Monsieur Machael Van Damme. Included with the letter was a program-schedule booklet.

Canary Islands—EA8AB, *R. Clube Tenerife*, Apartado 225, Santa Cruz de Tenerife, sends a card, printed in blue, with a red-yellow-red stripe in left-hand corner. In Spanish, this

verification arrived within three weeks.

Ethiopia—Their QSL card took five months to arrive.

Fed. of Rhodesia and Nyasaland—N. Rhodesia B/C Service has used the same card for eight years. The latest is signed by A. Davis, Ass't. B/C Engineer. Fed. B/C Corp. of R. & N. has two addresses: Head Office, Travlos House, Stanley Avenue, P.O. Box 8212, Causeway, Salisbury; and Broadcasting House, P. O. Box 8008, Causeway, Salisbury. They send a letter signed by T. V. Pile, Studio Manager.

French Cameroons—*R. Douala* (6115 kc.) sent a card for a report in French.

French Equatorial Africa—*Radio AEF* verifies erratically, acknowledges with Brazzaville's folder without completing the verification statement.

French West Africa—

Dahomey—*R. Cotonou*, Boite Postale 366, provided only acknowledgments until a prepared-form card was sent for a definite verification.

French Guinea—*R. Conakry* sends a QSL letter signed by P. Conrath, Le Chef du Service de L'Inform. et de la Radiodiffusion.

French Sudan—*R. Soudan*, Boite Postale 171, Bamako, sends only acknowledgments, signed by J. Chabanel, Le Directeur.

French Somaliland—*R. Djibouti* (4780 or 6000 kc.) sends only acknowledgments. After six tries, a prepared card finally did the trick.

French Togo—*R. Lome* sends a letter in French by registered airmail in 13 days.

Kenya—African B/C Service, Dept. of In-

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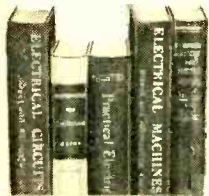
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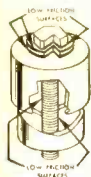


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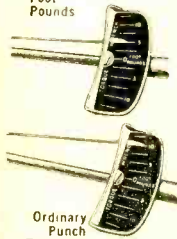
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formation, P. O. Box 30035, Nairobi, sent a letter signed by P. Tieffey for A. M. Dean, Broadcast Officer.

Morocco (French Morocco, Spanish Morocco, Tangier Zone now consolidated into one)—*R. Dersa*, Tetuan, sent an acknowledgment folder with photos of studio and area; this one also has the official station stamp. *R. Africa Maghreb* sends a large 4" x 8½" card. *Norea Radio* (located in Tangier but the address is Grensen 19, Oslo, Norway) sends a blue and grey card with *Voice of Tangier* in red.

Reunion—A letter was received but the name of the signer is not legible.

Sierra Leone—They verify by letter but be sure to give them a reference number! The letter is signed by W. A. Yoke, for Director of Broadcasting.

Somaliland Protectorate—*R. Somali* sends a mimeographed letter of confirmation, plus a photo of the transmitter house with confirmation on the back. They are asking for more reports and state that cards are being printed. The signer is Lionel S. Williams, Radio Mechanic.

Spanish Guinea—*Emissora de Radiodifusion Santa Isabel* sends a photo of natives on a home-built *bake* with the verification statement in Spanish signed by Margallo; they are also anxious for reports. *R. Equatorial*, Apartado 57, Bata (7850 kc., 400 watts), sent a card. Reports to *R. Calatrava* addressed to Calatrava, Spain, have been returned marked "Unknown"; a "Calatrava" exists in Spanish Guinea and this may be the proper location.

Tunisia—No QSL's although replies that took five weeks in transit have been received. No short-wave outlets as yet but due shortly.

Union of South Africa—Signers of all cards are R. Morris, H. W. Acheston, for the Chief Engineer. They reply readily with cards and personal letters.

Zanzibar—A QSL has been received by our Middle East Correspondent.

ASIA

Afghanistan—A letter has been received by some European DX'ers and possibly a few in North America.

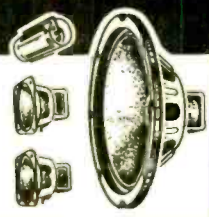
Bahrein Island (medium wave)—This one sent a QSL letter plus a second letter confirming the first!

Burma—They acknowledge with a card that was received after six months and a "tough" follow-up letter. The statement says merely "Thanks for report." This is reportedly the same card that the Burma station has used for years.

Ceylon—Considerable mail gets lost since the address for the Commercial Service and the National Service are *not* as given in the 1958 *World Radio Handbook*. Reports to the Commercial Service should go to: P. O. Box 1575, Torrington Square, Colombo. They formerly sent a mimeographed letter although cards are now being received by some DX'ers. One DX'er received a "non-descript" letter. Follow-up letters netted no replies. The cards are being signed by the Ass't. Chief Engineer for N. S. Wickremasingme, Chief Engineer.

Goa—Ninety percent of the mail to Goa

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154	.78	GAG7	.97	654	.59	12SK7	.69
155	.88	6AH4	.89	65A7	.79	12SN7	.69
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954	10.51	6AU6	.89	678	.98	35W4	.59
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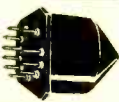
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does not get through due to a reported dispute with India. All correct reports which do arrive are acknowledged. Send your report to this Portuguese Colony via registered mail.

Hong Kong—They acknowledge correct reports with a card—the same card that has been used for ten years. You had better send reports here via registered mail, too, as a lot of mail to this country also gets lost.

Japan—JJY (standard frequency station) acknowledges with a multi-colored lithographed card, similar to the Japanese medium-wave station cards.

Jordan (now federation of Iraq and Jordan)—They send a mimeographed form letter signed by Jawad Joudeh, Engineer-In-Chief.

Kashmir—Send reports to *Azad Kashmir Radio*, Tararkhel, via *Radio Pakistan*, Rawalpindi, Pakistan.

Korea—Korean B/C Service, Seoul, seems to QSL irregularly with much delay, which suggests that many reports may get lost. *R. Pyongyang*, North Korea, verifies by letter but reports have to go via Hong Kong or Peking for forwarding, or via a European communist satellite.

Laos—A QSL card and a New Year's card were received after two months. The card was in French with the message in English; it was signed by Thong Sing, Director.

Macao (medium-wave)—CR9XL (1005 kc.) sent a letter in English after a long delay. The signer was Jose da Conceicao Norena, Program Director.

Saudi-Arabia—A verification letter was received.

Taiwan (Formosa)—BEC38 sent a large card with red border, yellow background, blue print. The signer, C. Y. Tuan, asked for more reports. BEC32 sent a large card showing Chinese characters which the Director signed with a rubber stamp.

Thailand—In 1952 all stations verified with a folder. Now the National Service is erratic; after 3 1/2 years and 6 reports, one DX'er received a schedule that became effective in 1953. The Overseas Service verifies promptly with the signer being Nai Witt Siwasariyanon, Chief of Foreign Affairs Division.

Vietnam—Radio VTVN sent a large card promptly with a confirmation statement that was unsigned. *R. Hanoi* sends a mimeographed letter of acknowledgment. Reports to Hanoi from the U.S.A. must go to Hong Kong, then to Peking for forwarding.

Yemen—Chances for a QSL are extremely poor. A cablegram to the Director of *Radio Sanaa* (while he was in Cairo) resulted in no reply.

OCEANIA

British North Borneo—*R. Sabah*, P. O. Box 222, Jesselton, sends a card via airmail. They have statements for confirming or "not confirmed, insufficient details" with the inappropriate statement crossed out. They also send a photo. The card is signed by V. Raagh. Earlier verifications were by letter.

Philippine Islands—Far East B/C Co. now has separate cards for each call-sign and the signer is Miss Dale Golding, Shortwave Secretary.

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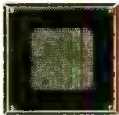


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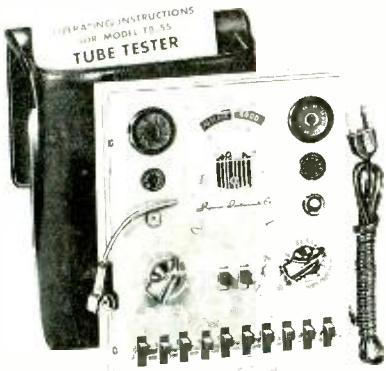
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