POPULAR ELECTRONICS

MAY 1957

35 CENTS

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(see p. 35)

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D	14.0 —40 mc	14.0—14.35 mc (20 meters)
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POPULAR ELECTRONICS

CONTENTS

(Also see page 6 for DEPARTMENTS)

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MAY 1957

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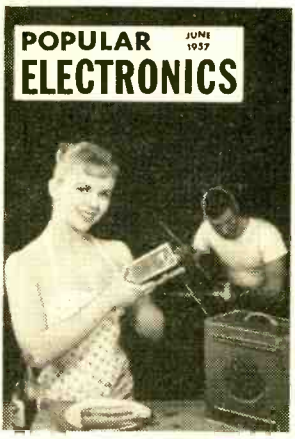
DEPARTMENTS

COMING NEXT MONTH (JUNE)



(ON SALE MAY 21)

An epic event is scheduled for our June issue—construction details on the first household application using the brand-new CBS-Hytron 2N255 power transistor. You can get "room-filling" volume from your portable radio with this power amplifier. Other how-to-build-it items include: a signal tracer with but eight components; a pocket receiver which requires only a short (less than 3') wire antenna; and a transistorized calibrator for the SWL.

Computers are now doing ordinary, everyday jobs—would you like to learn to run one? If clicks, hisses and pops are a part of your hi-fi, they shouldn't be, so we'll tell you what to do about getting rid of them. Do you know how to make GOOD tape recordings? You can find out in the June issue of POP'tronics.

IN THIS MONTH'S

RADIO & TV NEWS

(MAY)

Research at the Threshold of Space
All About Audio and Hi-Fi (Part 1)
Electronics at Redstone Arsenal
Transistorized Ultrasonic Generator
Transistor Mike Preamps
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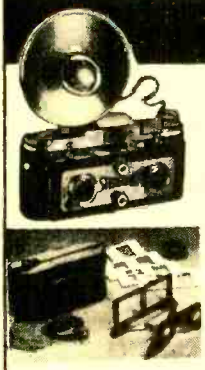

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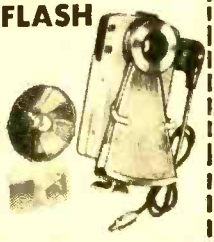

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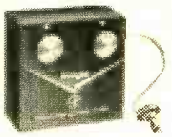

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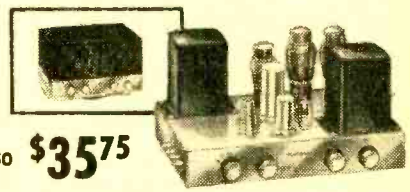

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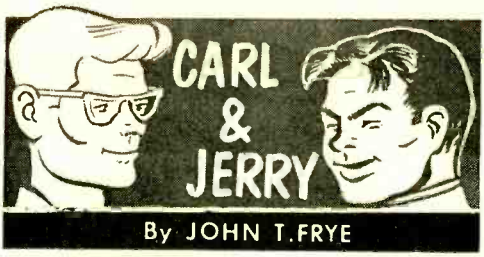

By JOHN T. FRYE

"Holes" to the Rescue

IT WAS A PERFECT spring morning for their fishing trip, thought Carl, as he stepped out of his back door and started across the yard to the basement entrance of Jerry's home. While electronics was unquestionably the boys' chief interest, they also engaged in many other activities that took them out-of-doors.

Carl clumped down the basement steps in his hip boots and opened the door to find his fishing partner all dressed for the occasion, even to the battered black felt hat with flys stuck in the band—but the objects on the bench before him looked a lot more like electronic gadgets than fishing tackle. True, Jerry's casting rod *was* leaning against the wall at the back of the bench, but a wire clipped to the bottom of the rod ran into the back of a little gray, crackle-finished box about 3" x 4" x 5". There were five black knobs on the front of this little cabinet, and a slide rule dial was housed in a bulge at the top. Another coaxial lead came out the rear of the cabinet and went to the back of an a.c.-d.c. broadcast receiver on the bench.

"I thought we were going fishing," Carl said sarcastically.

"I *am* fishing—for DX," Jerry answered with a teasing grin. "Take a listen."

He turned the large center knob a bit, and a soft Oklahoma drawl came from the speaker of the broadcast set, but the voice was signing a "DL" amateur call that indicated he was operating a G.I. station in Germany.

"How's that for 10-meter reception on an improvised basement whip antenna?" Jerry demanded.

"Slightly terrific, but where's the receiver?"

"Let's see how good your memory is: do you recall the cover picture on the September, 1956, issue of POPULAR ELECTRONICS?"

"Certainly. She had blue eyes, brown hair, was wearing a black, off-the-shoulder dress, and her name was Diane," Carl recited promptly.

"Sometimes I wonder about you," Jerry said darkly. "I wanted you to recall that she was holding one of these Regency ATC-1 transistor ham-band converters and

Carl & Jerry (*Continued from page* 10)

that there was a story about it inside the magazine."

"I remember the article, but how did you get hold of one?"

"Dad got it for my birthday. I'll admit I had to do a little selling job on him. I explained that it was a 'natural' to permit me to operate mobile without tearing the car receiver apart to bring out filament and plate leads. You see, this little transistor converter is powered by three penlite cells here at the back.

"But I think what really won Dad over was the fact that having such a converter would make it unnecessary to lug my heavy communications receiver up to our lake cottage this year. He really griped about that last summer. Now, when we get up there, I'll just slip this little thirty-ounce job out of the car, take it into the cottage, and run it into this a.c.-d.c. set we always take along, just as I'm doing right now. Then I'll be able to hear every ham band from 80 through 10 in fine style."

"All very interesting," Carl said, "but it's not putting any fish in the skillet. Mom's waiting in the station wagon to haul us to the river."

"Let's go!" Jerry said, as he unfastened the little converter, wrapped it in heavy cloth, and placed it in his tackle box. "I'll just take this along, and if the fish don't bite too voraciously, I'll slip it out of the case and show you how much electronic equipment can be put in a small space these days without crowding."

IT WAS ONLY a short drive to the river; and before long the boys had transferred their gear to a sturdy boat, clamped Carl's powerful little outboard motor to the stern, and were heading upstream. They had a long ride ahead of them—they always went up the river until they could no longer see the little forked sticks that were placed at the edge of the bank for use as fishing-pole rests. Carl contended that as long as you saw these sticks you could be pretty sure the river was "fished out." That meant they had to go nearly eight miles up the river to a section hard to reach by any means other than a boat. There was an old abandoned logging road along one bank, but it was too rugged for modern low-slung cars; so this section of river was free of Carl's despised little forked sticks.

To while away the time on the way up the river, Carl got out his little portable transistorized broadcast receiver and set it on the seat cushion beside him. The outboard was well muffled, and the boys enjoyed the music delivered by the powerful

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Occupation_____

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Carl & Jerry (*Continued from page 12*)

little set. A stiff breeze was blowing, and the boat jarred rhythmically as it slapped the waves. Jerry snuggled down in the prow of the boat with his hat pulled over his eyes to keep out the sun. Carl sat erect at the stern and guided the boat.

Suddenly, as he felt Carl throttle back the motor, Jerry sat up and pushed his hat to the back of his head.

"Look over there on the bank, Jer!" Carl said, swinging the bow of the boat in the direction he was pointing. "A car's slipped off the old road and crashed against that big sycamore."

Sure enough, a recent model car had its hood jammed and wrinkled against the trunk of a huge sycamore growing right at the edge of the water. The windshield on the driver's side was shattered.

Carl let the front of the boat run up on the shelving sandbar that jutted out from the bank, and both boys leaped out and ran toward the car.

"OH, OH!" Carl exclaimed with a white face as he stopped abruptly near the back of the car. On the ground beside the open door of the car was a crumpled figure in an Air Force uniform. His eyes were closed, and his face was blood-smeared.

"Is—is—is he dead?" Jerry whispered.

As if in answer, a low moan came from the injured young man. Quickly the boys determined that no one else was in the car. Almost subconsciously, they noted the ten-meter whip on the rear bumper of the car and the converter fastened beneath the dash; so they knew the poor guy on the ground was a fellow ham.

"What are we going to do," Carl asked. "Shall we load him into the boat and take him back to town?"

"I'm afraid to try that," Jerry said. "You know what we learned in that first aid course about not trying to move a badly injured person. He almost certainly has some broken bones. Did you see how his knee smashed that car radio? I'll bet every tube in it is broken. And by the looks of that steering wheel he may have some bad chest injuries. I'm afraid to risk a rough boat ride."

"Well, do you want to stay here while I go back for help in the boat?"

"Guess that's about all we can do, although it'll take a long time; and this fellow may not *have* too much time. If we just had some way to call for help—"

"How about using his mobile rig?"

"That's no go. You saw the receiver—

Carl & Jerry (*Continued from page* 14)

it's entirely smashed. Even if the transmitter would still work—which is doubtful—we couldn't rely on sending out a blind call and not know whether it was received or not. Guess you had better get started—Hey! Wait a minute! Let's see if that transmitter *will* work."

JERRY SLID GINGERLY into the driver's seat and turned on the transmitter filament switch. In a few seconds he picked up the microphone and pressed the push-to-talk switch. As he did so, the whir of a dynamotor came from the closed trunk, and he saw the pointer of a little field strength meter mounted over the rear-view mirror swing up-scale.

"That proves the transmitter works—but we still don't have a receiver," Carl said.

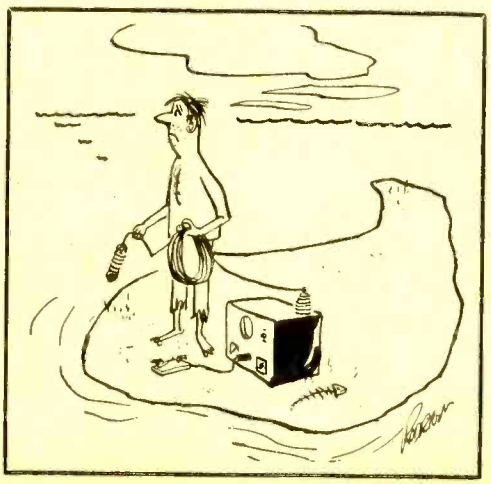
"Bring your transistor receiver up here by the car while I get my transistor converter out of the tackle box," Jerry ordered.

In a few minutes he had taken a short length of copper wire from his tackle box and fashioned it into a crude four-turn coil a couple of inches in diameter. The ends of this coil were fastened to the tip and shell of the plug on the end of the coaxial lead coming from the output of the converter.

"Now let's tape this coil on the outside of the case of your set near the cold end of the loopstick antenna on the inside," Jerry said, pulling a roll of friction tape from his tackle box.

In a matter of seconds the coil was fastened into place so that the output of the converter would be induced into the receiver's antenna; the receiver was tuned to 1230 kilocycles; and both it and the converter were turned on. The boys were bit-

(*Continued on page* 18)



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Carl & Jerry (*Continued from page* 16)

terly disappointed when nothing but a rushing noise was heard.

"Hey! We were so excited we forgot the antenna," Carl pointed out.

Only a few more seconds were needed to connect a short piece of wire from the bottom of Jerry's steel casting rod to the antenna input jack of the receiver, and immediately several strong 'phone signals were heard.

"You get into the car and work the transmitter while I work the receiver," Jerry said. "First, just hold the carrier on for a second while I spot your frequency. Okay, I've got it. Now blast loose with a distress call. Let's not fool around with 'S O S,' 'May Day,' or anything like that. Just use the good old c.w. emergency call of 'QRRR.' Every ham should recognize that."

Obediently, Carl pushed the button on the mike and began to call: "QRRR, QRRR, QRRR! This is W9EGV calling. QRRR, QRRR, QRRR! This is W Nine Easy George Victor calling QRRR and tuning around this frequency."

As the transmitter snapped off, the loudspeaker of the little transistor receiver burst forth with: "W9EGV, W9EGV, W9EGV; this is W7XXX of Tucson, Arizona, returning. What's wrong, OM?"

QUICKLY Carl explained the situation and asked the Arizona ham to put in an emergency long-distance call to the police department of the boys' home town. This the W7 did while the boys stood by. In a surprisingly short time, he was back with a report that the message had been delivered and that help would soon be on the way. The boys signed with him after promising to let him know how things turned out. Then they got some water from the river and washed some of the blood from the face of the young man, who was still moaning faintly.

"It will take an ambulance a long time to get up that road," Carl remarked. "I don't see how this fellow ever got up here at all. He must be from the air base south of town or he would have known—"

He broke off speaking as he heard an odd sound. Looking up, the boys saw a helicopter hovering directly above them. As they watched in fascination, it settled gently on the sand spit that ran out into the stream. A couple of corpsmen bearing a stretcher leaped out and ran toward them.

"The police called us and said one of our men was hurt up here," one of the corpsmen explained, as they gently and expertly slid the injured youth onto the stretcher. "The chopper was the quickest way to get

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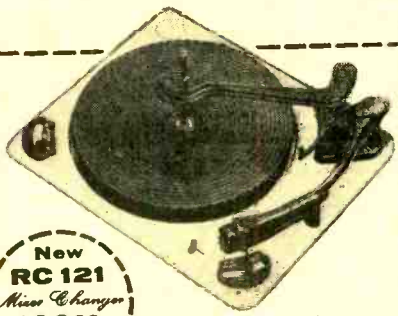

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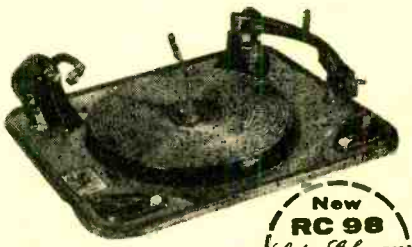

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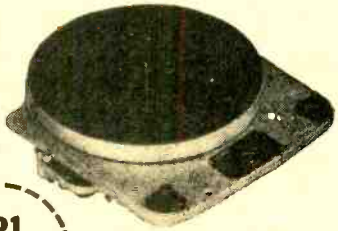

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Carl & Jerry (*Continued from page* 18)

him out. You kids certainly used your noodles in not trying to move him. With the injuries he has, trying to move him without a stretcher would almost certainly have meant his death."

After the whirlybird rose vertically into the air and took off down river, Carl and Jerry called the W7 in Tucson and reported the success of the operation. Then they began to disassemble their improvised receiver.

"JER," Carl said slowly, "this experience really has convinced me that transistors are here to stay. I was just thinking that we were receiving that station from Tucson without the aid of a single tube. All we had to snag his voice out of the air was a bunch of negative electrons and positive 'holes' moving through some semiconductors. A year or so ago, I remember, it was considered quite a feat to make a transistor work clear across the broadcast band, but we were receiving that station on twenty-nine megacycles! We've sure come a long way."

"Yes," Jerry agreed; "it certainly makes you think. After the way that hay-wire combination worked, I can see no reason at all why we shouldn't have excellent transistor communications receivers in a very short time. They should be lightweight, rugged, and about one-tenth the size of present communications receivers. Being powered with a few flashlight batteries, they'll be entirely independent of the light line, and a.c. hum will be no problem."

"If this trend keeps on, a fellow is going to be able to pack a whole ham station into a shoe box!" Carl exclaimed. —30—

. . . After the whirlybird rose into the air and took off down river, Carl and Jerry called the W7 in Tucson and reported the success of the operation . . .

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Here is an excerpt from a letter that we received from Loren DePriest, 1496 4th St., Mansfield, Ohio: "I have spent many pleasant hours in constructing the radios from the schematics in your book, and have learned a great deal from them. Being as I am interested in Radio, I consider the money spent for your course as a wise investment. I have learned more from your course by actually doing than I did from an expensive course."

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

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SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of 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 in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

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

FROM OUR MAIL BAG

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

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

CONSULTATION SERVICE

One of the most important aspects of the "Edu-Kit" is the Free Consultation Service which we provide. Our staff of experts carries on an extensive correspondence with students in all parts of the world, concerning all phases of electronics. We welcome and encourage students to send us their problems, whether related to any of the material covered in the "Edu-Kit" course, or encountered in other experiences in the field of electronics.

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LETTERS FROM OUR READERS

Covering Comments

■ Movies may be getting better than ever, but so are the POP'tronics covers! How could anyone resist buying your February issue? But, one question; if I buy the Hammarlund receiver, do I get that particular model?

FRANK MARIANI
Buffalo, N. Y.

■ Please send complete picture of the girl on the February cover.

D— B———
Oakland, Calif.

Okay men, take it easy. Our February cover gal has been doing some further modeling (she was originally on the Jackie Gleason show) and you should be seeing some photos of her in other magazines.

Citizens Band in Canada

■ As far as I have been able to find out from the Department of Transport (the Canadian FCC), there are no channels here for private citizens. This is in response to the query from Roy Smyth, (March issue, page 28).

I am engaged in the Lake Ontario Air-Sea Rescue Service and would like to see reasonably priced equipment made available to Canadians. The establishment of a Citizens Band in Canada would benefit all concerned.

J. BRICHENDEN
Toronto, Canada

Oscilloscope Techniques

■ As a suggestion, how about some articles on how to detect, recognize, and distinguish separate harmonics and patterns with moderately priced oscilloscopes. I am thinking of identifying traces so that we would know what they mean.

WILLIAM A. SANDER
Redondo Beach, Calif.

Your idea sounds swell, Bill, and the author of our recent article on Lissajous figures (March 1957 issue, page 63) has consented to a new series on servicing and fault-finding by oscilloscope tracing. It is shaping up into a fine series (scheduled to start soon) which will be of value to numerous readers.

Glad We Could Help

■ I want to thank you for the series of articles on becoming a radio amateur. This was just the nudge I needed to get started in the right direction toward a ham "ticket." I am now the proud owner of station KN2UWW, using a Heath AT1 and Hallicrafters SX-99.

BILL ADDISON, KN2UWW
Niagara Falls, N. Y.

■ Guess I misjudged your magazine. I am an SWL and figured you might be letting us down,

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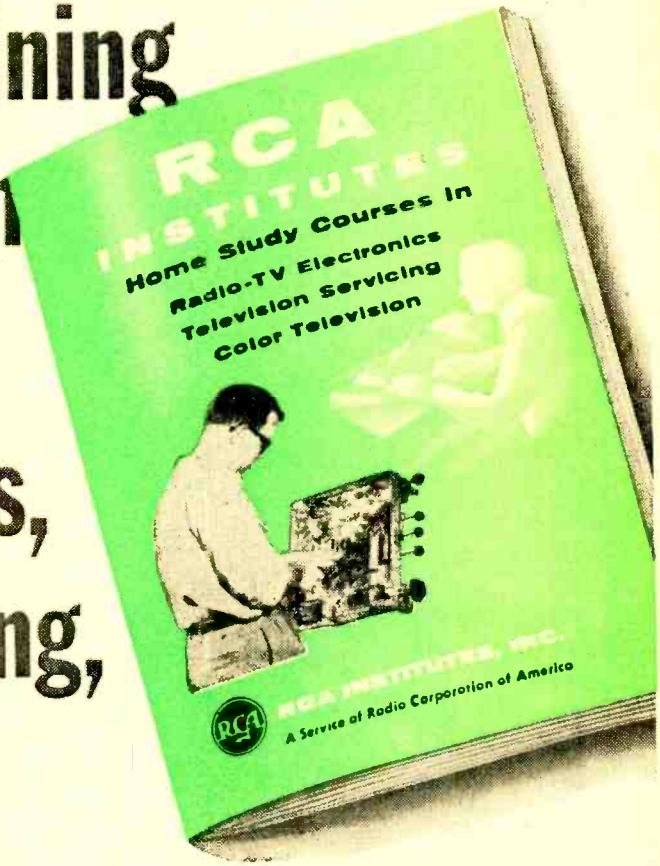

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Letters

(*Continued from page 22*)

but then the February issue and the article by Stew West changed things. I'll stick around and here's my three bucks for a subscription—that's what really counts.

G. KILLAM
Reading, Mass.

Kit Builder's Korner

■ I read the "Kit Builder's Korner" item on the Packard-Bell receiver. I was a little hesitant before reading the article, but now I feel like an old hand and will soon be getting the kit.

MIKE GREEN, JR.
Montclair, N. J.

■ I think "Kit Builder's Korner" is great. I would like to see the Heathkit Model AR-3 reviewed in this column.

KEVIN HURLEY
Berkeley, Calif.

■ In regard to "Kit Builder's Korner," I would like to see the Precise tube checker, Model 3111, reviewed as soon as possible.

G. R. WIGGINS
St. Catherines, Ont.

Duplicates of Our Projects

■ I finally got around to building the "Economy Signal Chaser" (November 1956 issue, page 63) and found that it works satisfactorily. I built it into an old electrolytic capacitor can about 1½" in diameter and 4½" long, and used a bolt mounted in one end of the can for a test prod.

EDWIN PRUSINOWSKI
Winnipeg, Manitoba

■ The TV tube rejuvenator (February, page 61) works well and only cost me $7.00 to build.

ROBERT ROAM
Fowler, Calif.

What Happened?

■ Why did you discontinue "What's The PE Answer?" I think it was an outstanding feature giving information that everyone could use.

DAVID JUNCHEN
Sherrard, Ill.

We were sorry to drop the "Answer" column temporarily, Dave. However, it's back in this issue on page 96, so we hope that you will continue to enjoy it.

Earth Satellite

■ How are the chances that you will have articles on the earth satellite? Our newly formed science club has elected the IGY program as its first project, and I'm sure there are other experimenters interested in the satellite program.

RON BAIRD
Jackson, Mich.

Ron, we've been keeping it under wraps, but if our present plans work out, we will have a red-hot item for you in the July issue. Keep your eyes pealed for a flashy cover announcement—should it work out! —30—

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"THE RADIO AMATEUR'S HANDBOOK" by the Headquarters Staff of the A.R.R.L. Published by the A.R.R.L., 38 La Salle Road, West Hartford 7, Conn. 576 pages, plus tube tables and catalog sections. $3.50 in the U.S.A., $4.00 in Canada, and $4.50 elsewhere.

There is not a lot that can be said about the 34th edition of the *Handbook* that has not been said time and time again. It is complete, authoritative, and up-to-date. It has a place on the bookshelf of everyone interested in ham radio, and practically everyone else working in radio theory or circuit design. The ideas and presentations are the cream of the best articles from QST, and from the laboratories of the A.R.R.L.

Recommended: to all POP'tronics readers.

"REPAIRING TELEVISION RECEIVERS" by Cyrus Glickstein. Published by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N. Y. 212 pages. Soft cover. $4.40.

Logical trouble-shooting techniques and servicing short-cuts based on actual experience are described in this book. The various sections of a modern TV receiver are examined, with their typical troubles pinpointed. Remedies are suggested. Theory is kept to a minimum, as it is assumed that the user of this book has had previous training and experience in video circuits. A "quick key check system" is described in the first six chapters in connection with specific trouble-shooting procedures. The use of test equipment is covered. Excellent diagrams and photos enhance the text.

Recommended: as a practical aid to the technician.

"HI-FI HANDBOOK" by William F. Boyce. Published by Howard W. Sams & Co., Inc., 2201 E. 46 St., Indianapolis 5, Ind. 224 pages. Soft cover. $3.00.

Aside from the more-or-less "personal" aspects of hi-fi, such as listening tastes and psycho-acoustics, there are many objective, technical points whose understanding can aid the enthusiast in choosing and using his equipment wisely. These points are

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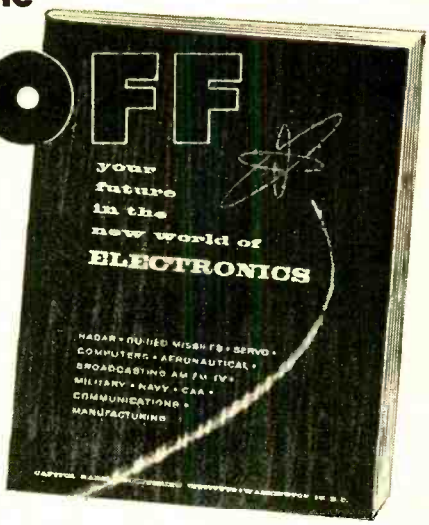

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treated clearly and concisely in this volume, but due regard is also given to the "intangibles" of sound systems. Where it is a matter of individual taste, or experimenting for best results, the author says so.

Generally, the ground covered includes a simplified explanation of audio theory, considerations regarding the selection of equipment, and hints on arranging the system in the home. In discussing components, the author works "back" from the speaker, through amplifiers to program sources. The text is always to the point, and mathematical formulas are kept to a minimum. Photos, charts, and diagrams help explain many knotty points. The diagrams are especially clear and logical, typifying the kind of big and "open" presentations for which this publishing house has been noted in their larger manuals.

Recommended: to all interested in hi-fi.

"RAPID TV REPAIR" by G. Warren Heath. Published by Gernsback Library, Inc., 154 W. 14 St., New York 11, N. Y. 224 pages. Soft cover. $2.90.

The majority of common troubles encountered in TV receivers, and suggestions for remedying them on-the-spot, are included in this volume. The author acknowledges that not all problems are discussed, however, and counsels the reader: "If the trouble cannot be eliminated, then the set should be pulled and the job completed in the shop."

Symptoms of trouble are arranged alphabetically. Hints for curing them are based on a minimum use of test instruments, and involve the usual tools, tubes, accessories, and a VTVM. Numerous photos, schematic diagrams and a subject index round out the contents.

Recommended: as a reference guide to technicians for rapid servicing of TV sets.

Free Literature Roundup

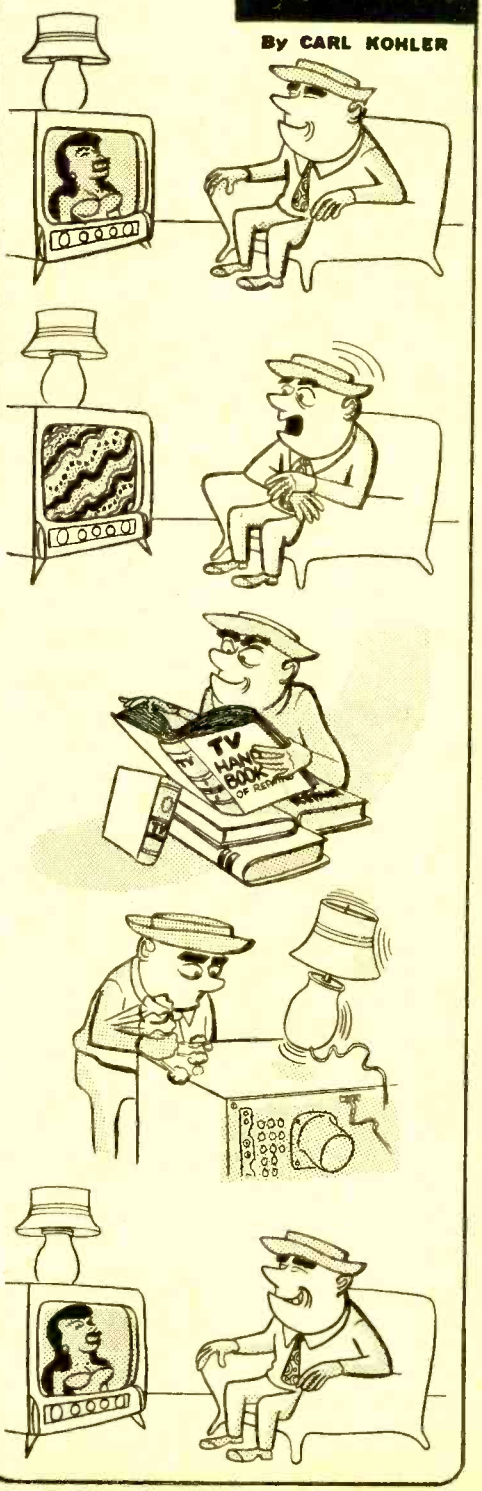
An attractive color booklet contains some well-taken points on the question of using a turntable or a record changer in a hi-fi system. Write to Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City 1, N. Y., for your copy.

Humorous and informative is a 32-page booklet entitled "Seven Villains of Tape Recording." Copies are available from ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala.

Reprints of magazine articles dealing with the Goodmans' Acoustical Resistance Unit (ARU) are available from Rockbar Corp., 650 Halstead Ave., Mamaroneck, N. Y. —30—

McWatts

By CARL KOHLER



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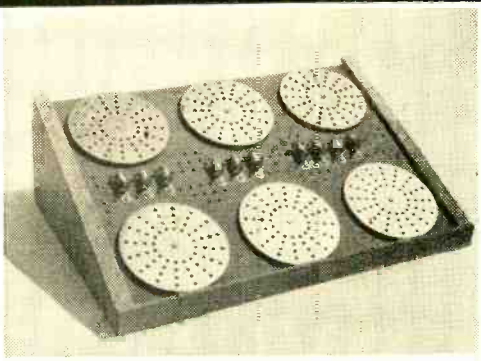

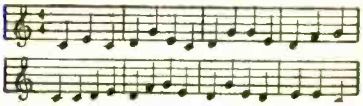

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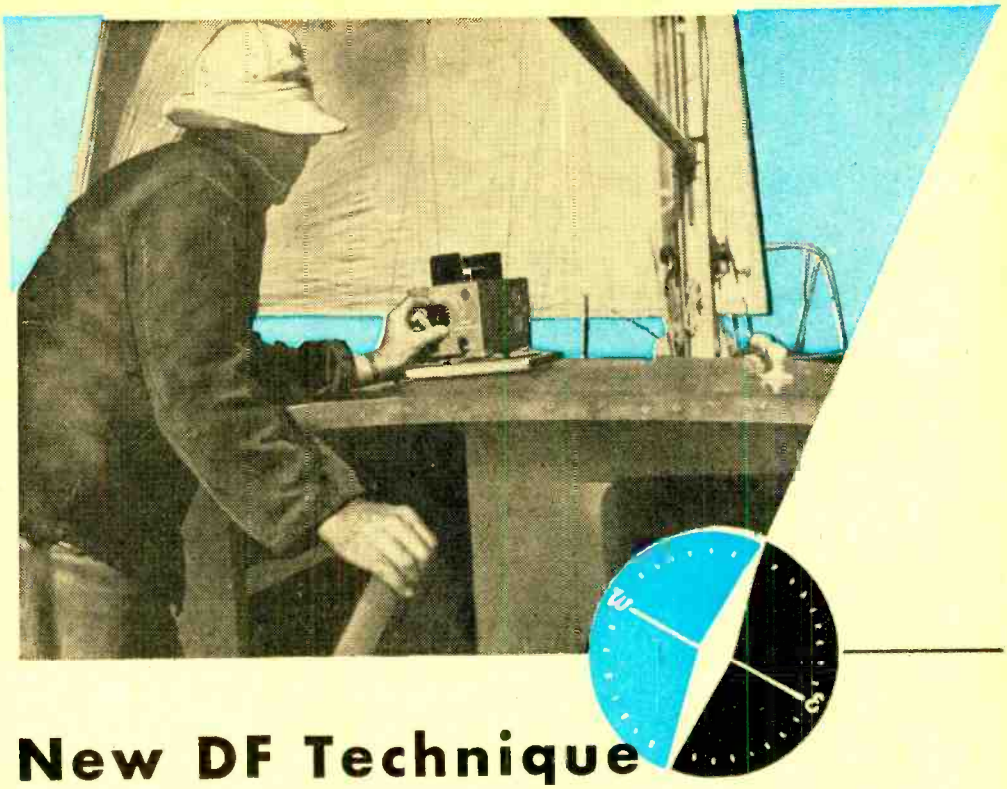


New DF Technique For Small Boats

By ELIOT DRAKE

Aeronautical beacons aid seafarers with or without a DF loop antenna

THIS COMING SUMMER more people than ever will be spending their weekends and holidays in boats. For many, it will be their first venture into unfamiliar surroundings. It follows that, after getting out on the water, numerous beginners will wonder how to find their way back.

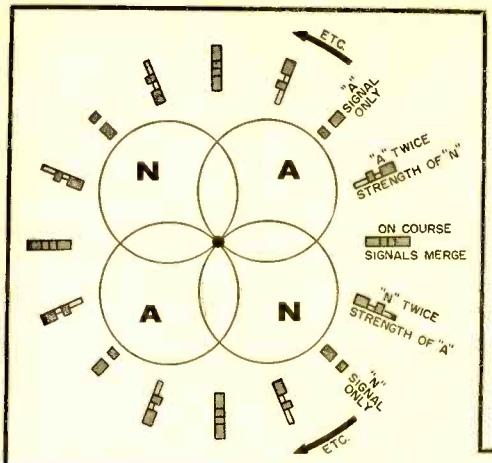
The older mariners depended entirely on the magnetic compass. Within the past few decades, and particularly within the past five years, the use of radio direction finding (DF) equipment has become standard procedure. The novice boatsman, however, may not want to spend the money for a DF loop antenna. This article tells how you may approximate your position on the water by simply listening to aeronautical radio range stations.

Although radio range stations operating between 200 and 400 kc. are not generally used by navigators afloat, they are the simplest source of sea-going signposts to be found. No skill is required for observing radio range signals, and they are accurate even if you are in a small bouncing boat—something that cannot be said for the usual kind of radio bearings taken with DF equipment.

To use the aeronautical radio ranges for navigation, all you need is a receiver covering the band of frequencies from 200 to 400 kc. Radio range stations are generally on the air continuously, and the signal that you receive from any one of them depends upon the compass bearing between you and the station.

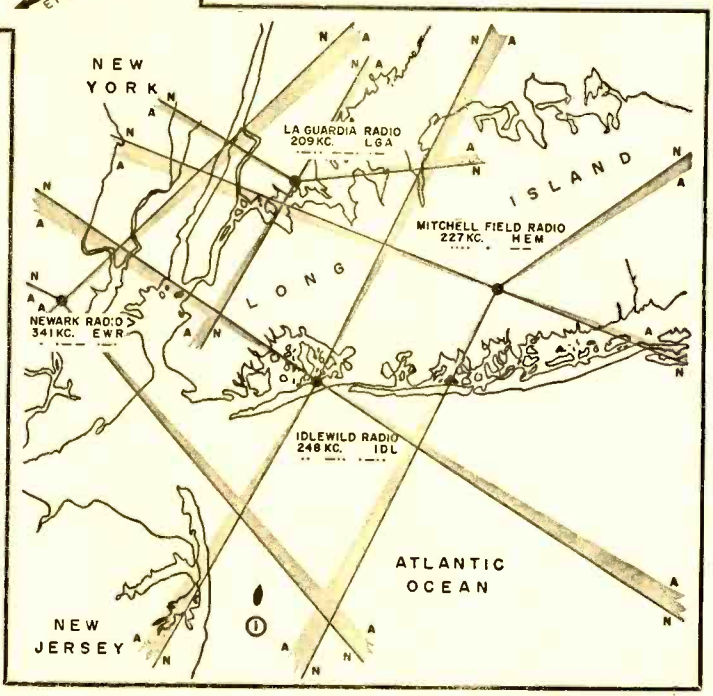
The range transmits two signals in the pattern of a four-leaf clover. As shown in the drawing, page 36, you will find that, if you are in the center of the upper left or lower right quadrant, you will only hear the code signal N (dash-dot). In the other two quadrants, you will hear the letter A (dot-dash). But when you are located on the lines that bisect the overlapping A and N patterns, you will hear a steady tone. Thus, you know that you are on the beam. The airlines pilot "rides" this tone to find his base through clouds and darkness.

Actually, 16 different sectors are indi-



Drawing above shows division of antenna pattern from a radio range station into 16 parts, represented by intensity of the "A" and "N" signals. In actual practice, the beams are "warped" as shown in the map at right.

If your boat is suddenly surrounded by fog in position ① on the map, you should first tune to 227 kc. to find station HEM, Mitchell Field, L. I. In this position, the A signal will be heard about twice as strong as the N signal. By then tuning to 248 kc. and identifying IDL, Idlewild Radio, the N signal will be heard with approximately twice the strength as the A signal. To verify the position further, tune to 341 kc. and identify EWR, Newark Radio; you should hear the N signal about twice as strong as the A signal.



cated by a single range. This is also shown in the drawing above. However, you cannot find your position from observing a single radio range. By tuning in two or three radio range stations and determining in which sector of each range station pattern your boat lies, a fairly accurate position may be obtained. Then, at the very least, you can pilot the boat home by compass or direct it towards the nearest radio range course (steady tone) that will bring you safely to your destination.

Radio range patterns are identified in sectional aeronautical charts published by the United States Coast and Geodetic Survey. The price of a chart is only 25 cents, and since few changes are made each year, a small investment will probably last at least one or two boating seasons.

Radio range stations have a positive means of identification. They are each assigned call letters which they periodically transmit in Morse code. These dot-and-dash call signs are transmitted very slowly and may be easily read and identified by a rank novice.

Representative patterns are shown in the map of the Sandy Hook and lower Long Island area. The caption accompanying this map further explains the use of the aeronautical radio range stations.

Once you've learned to poke your way around in poor visibility by using aeronautical range signals, the next logical step is to try loop-receiver direction finding. The new National NC66 receiver shown on our cover provides for such "growth" by permitting the purchase of a loop antenna and null meter as a separate unit. This will enable the boat owner to take more bearing lines by using marine beacons and shoreline AM broadcast stations.

If you take your boat out on a lake, where you don't need to bother with radio navigation, learn to do it for the experience anyway. Then when you hit open water some day, you'll know the ropes. No matter how adept you eventually become with DF equipment, you'll always find the invisible patterns of the airway radio ranges one of the easiest check points to use for your maritime navigation. —30—

Midwife to Dwarf Diodes

THE BIRTH of a semiconductor diode or transistor is a very delicate operation requiring utter cleanliness and skilled precision reminiscent of surgery. The whole new field of electronically active solids employs such delicate techniques that women, accustomed to the painstaking labor of needlepoint, are often their ablest practitioners.

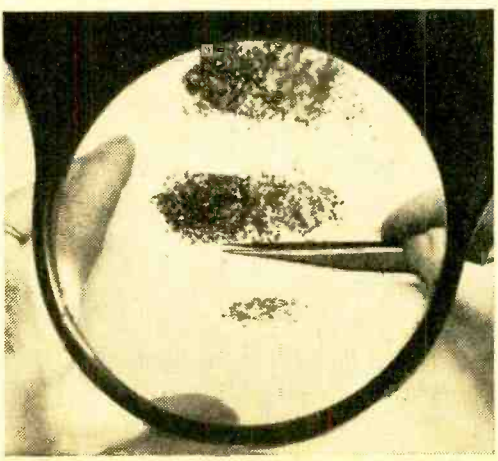
Our pictures show tasks performed by these girls in the making of tiny silicon diodes, no bigger than a grain of rice. These midget diodes, manufactured at the Electronics Division of Hughes Aircraft Company, use silicon in place of germanium to gain greater heat resistance. This makes them suitable for many new applications in the field of industrial process control. —30—

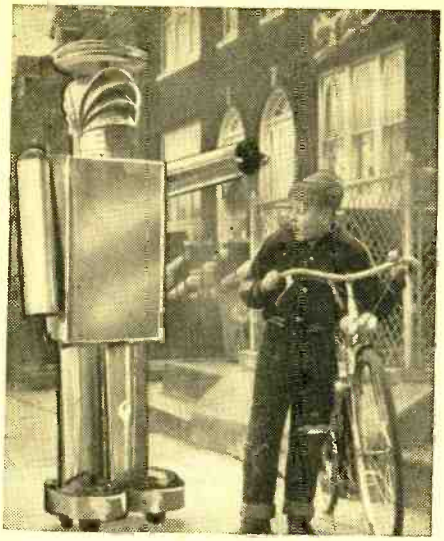
Silicon furnace (above) converts coarse nuggets into silicon ingots as the first step in diode-making. A controlled amount of impurity (1%) is added to the melt at 2640° F to provide conductor electrons within the solid structure.

Paper thin wafers, sliced from ingot individually by an automatic machine, are examined for uniform thickness, shape and surface texture in photo at left.

Completed diodes are checked at right—both by eye and ear. An audio signal in the test device indicates the crystal orientation.

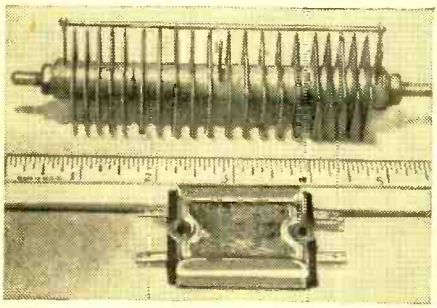
Crystals shown below under magnifier are sorted out for proper shape. Because they are "diced" from semi-circular wafers, some of them have rounded edges and must be rejected.





Horror in Brooklyn

In this age of imminent space travel and flying saucers, no one need be surprised on encountering a space monster on the quiet Brooklyn street pictured above. This department fails to understand the evident horror on the boy's face at this friendly meeting.



Rectifier Goes Flat

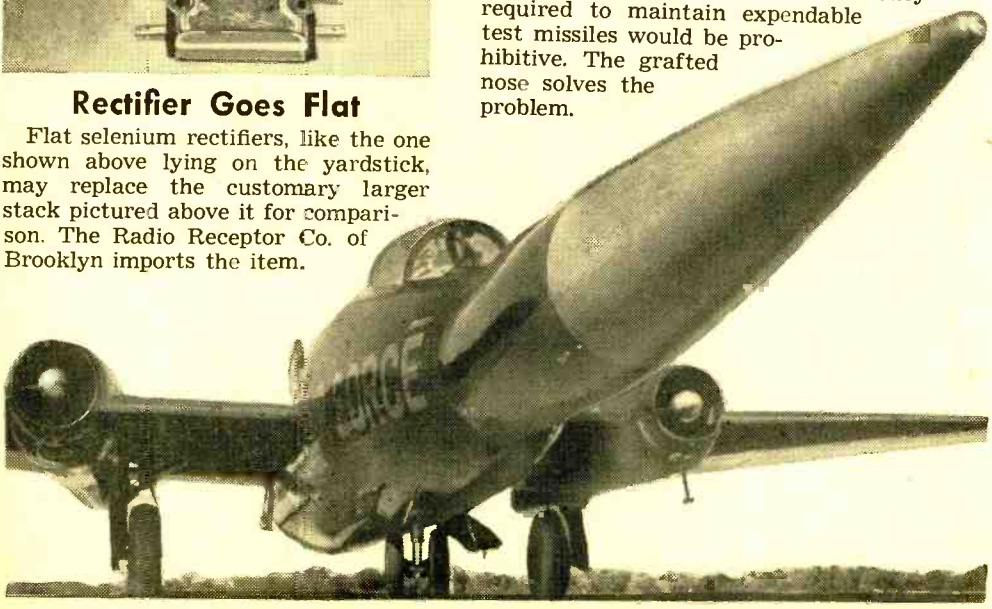
Flat selenium rectifiers, like the one shown above lying on the yardstick, may replace the customary larger stack pictured above it for comparison. The Radio Receptor Co. of Brooklyn imports the item.

Space Message Expected

Provisions are now being made to receive the messages from space to be sent earthward from the artificial moon that will be launched later this year. Dr. John P. Hagen, Director of Project Vanguard, is shown below with a model of the satellite designed by scientists working under his direction at the Naval Research Laboratory in Washington, D. C. The instruments shown inside include telemetering equipment which will transmit radio signals to earth while the satellite courses through its orbit.

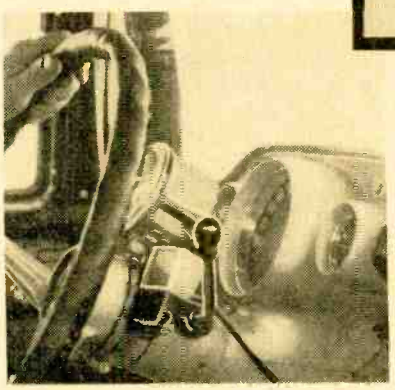
Nosing Its Way 'Round

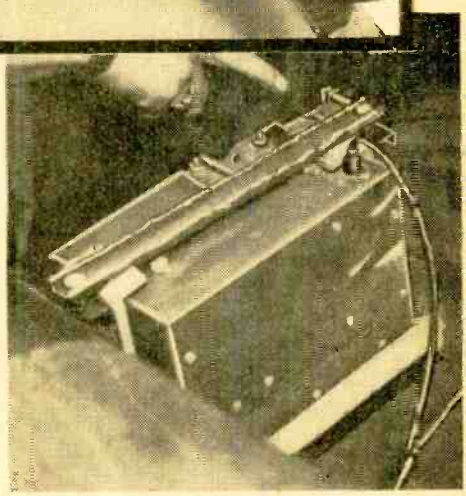
Grafting a 17-foot nose, simulating the front end of a Bomarc missile, onto a B-57 bomber (below) is a novel way of testing the guidance systems intended for eventual installation in the missiles. Testing under these simulated conditions saves not only money but also the most important element of research and development: time. Since test missiles seldom can be recovered, the time and money required to maintain expendable test missiles would be prohibitive. The grafted nose solves the problem.



Racing Radio

New use for Citizens Band transceiver demonstrated at Daytona Beach track





Microphone (above) is taped on gear-shift lever. Photo at right shows transceiver mounted on car's transmission hump. Above right, driver checks car antenna.

"PIT STOP! Make a pit stop! Your left rear tire is almost done."

"Okay," radios the tired driver of speeding car No. 44 as he slows to broadslide a turn and jams his car through racing traffic. "I'm coming in."

In the past, race drivers have always been plagued with the problem of how to secure accurate communication with their pit crew. Now, through the use of Citizens Band 465-mc. transceivers, both driver and crew can participate in exciting races with complete mutual understanding. No longer does a driver have to wear his tires to shreds before realizing it is time for a change. His crew chief in the pit can quickly spot such troubles through binoculars and radio a warning of potential danger.

On the other hand, drivers flying past the pit area at 110 miles an hour are in no position to advise their crews of impending needs—such as a pit stop in the next lap for gasoline. Radio enables the driver to alert his crew in plenty of time. An advance warning of action to come reduces the possibility of an excited crewman pouring *water* in the *gas* tank—a mistake which caused one car to lose a race last year.

The 4.1-mile track at Daytona Beach,

(*Continued on page* 114)

Hams in Service Help Their Hobby

Military Affiliate Radio System boosts the morale of U. S. servicemen

Typical of the many MARS installations throughout the world is this one in Wiesbaden, West Germany. Airman First Class Ann Moody, center, is speaking to her mother in Kezar Falls, Maine. T/Sgt Rialto Cardinale operates station controls while Theresa Iannone waits to talk to her parents.

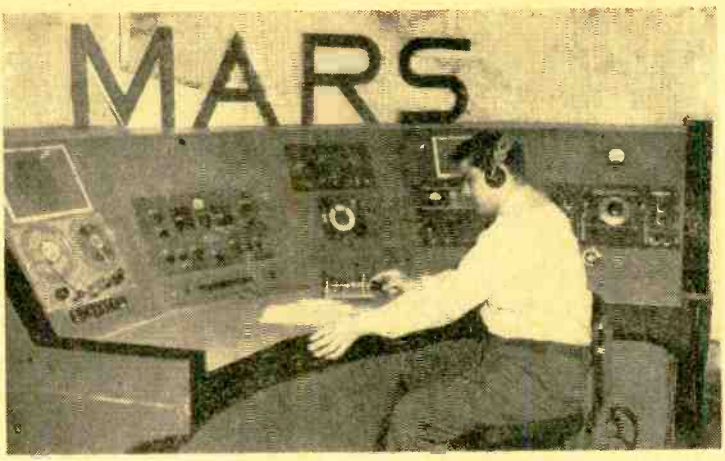
SCATTERED throughout the world are many friends and relatives of POP'tronics readers. They are members of the Armed Forces serving to protect our democracy. Although most of our contact with these airmen and soldiers must be through the mails, there is another method that has proven to be immensely valuable. It is the Military Affiliate Radio System, commonly referred to as MARS.

MARS is comprised of radio stations that operate in or near the usual radio amateur bands. They are mostly staffed by licensed radio hams who receive further training in message-handling procedures, equipment operation, etc., through these activities.

Two MARS networks are in existence. One of them is operated by U. S. Army personnel. The other is operated by men and women of the U. S. Air Force. Both have their headquarters in Washington, D. C. Although, as illustrated on these pages, the major portion of their messages concerns the morale and welfare of our troops, the military also believes that these networks can provide an additional number of traffic channels should they ever be needed.

The history of MARS is an impressive legend of cooperation between U. S. radio hams and the military. Reports indicate that MARS will soon expend considerable effort in teaching—or providing the facilities to teach—Novice ham radio. Follow our pages for more information. —30—

Airman Harold Banks (at the right) requested the MARS station in Tokyo to relay an important message to his mother concerning the welfare of the entire family. MARS sent the message to Hawaii, then to the west coast, on to New Orleans, and finally delivered it less than 36 hours later. Personal messages are always handled with the greatest possible degree of discretion by MARS personnel.



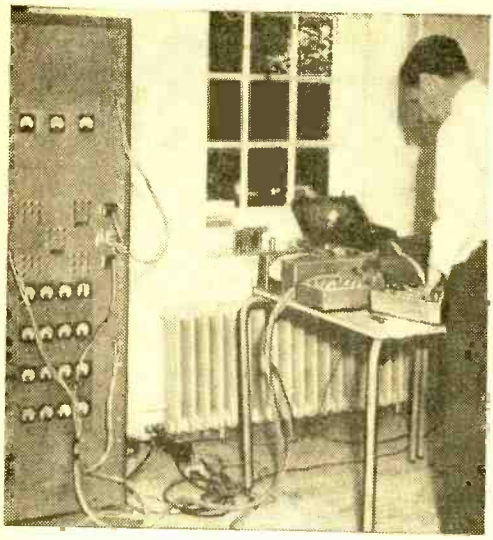
Located in the New Kaijo building in Tokyo is the net control station for the Far East Air Force (FEAF). At the left, A/1C Leo Gonzalez, Jr., is checking net reports. Some messages of the MARS stations go by c.w., some by radiotelephone; and others by a system of radioteletype.

U. S. Air Force Photos

MARS Station AIIBL is located at Tachikawa City, Japan, and is one of the foremost traffic-handling stations in the Far East. T/Sgt G. F. Doran is supervisor of this station, which is known as KA2FC in the radio amateur bands. On one occasion, by setting up a phone patch with a large hospital in San Francisco, AIIBL was responsible for securing special serum for a stricken airman within 48 hours.

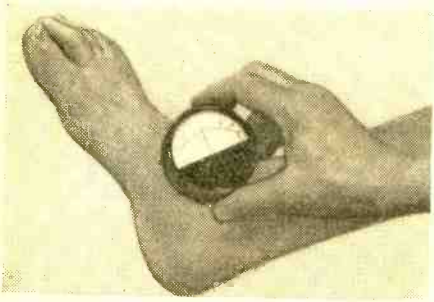
T/Sgt Cardinale (above), manager of the MARS station at Wiesbaden, Germany, adjusts one of the many transmitters at AJ3AIR. These transmitting units are powerful enough to reach any part of the world.

Station AJ3AAA (right), the net control station of the 12th Air Force Network, handles 2000 to 3000 messages each month while phone patches to relatives run around 120 a month. As in other stations shown, nearly all of the equipment is either surplus military or salvaged and repaired by station personnel.



Electronic Brain—Neurotic?

British scientists have designed the electronic brain above to include unusual human traits—forgetfulness, neuroticism and panic. Nicknamed Eucrates I, the "brain" learns from an electronic instructing computer. Continual successful accomplishments make Eucrates careless and then neurotic as it becomes unable to catch up. Finally it panics —until the electronic instructor comes to the rescue and smooths its muddled thinking. Eucrates will be used to study "neurotic" traits that might plague electronic computers.



Skin Thermometer

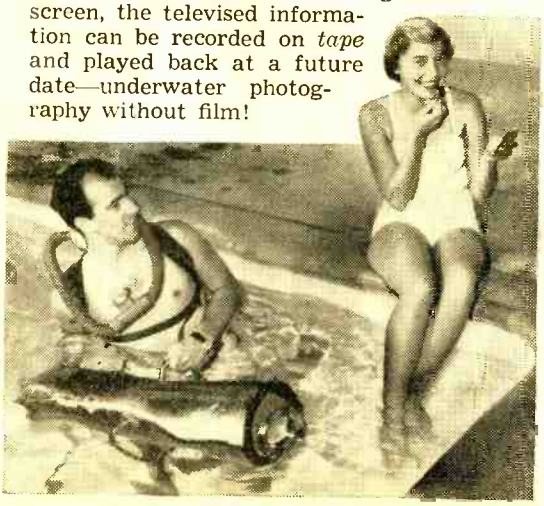
A new skin thermometer (above), working on the principle of a temperature perceiving magnet in a constant magnetic field, is now being used for clinical diagnoses in Austria. The magnetic indicator, mounted on a thin silver plate, becomes more magnetic when subjected to rising temperatures. Placed on the skin, the thermometer immediately assumes its temperature, enabling quick, accurate readings.

What Is It?

Spotted on Lexington Avenue, in midtown New York, was this unusual antenna. There was no visible indication of what the driver expected to capture and the antenna itself gave no clue to its possible purpose. Aside from the incidental opinion that it looks something like a halo, we've been unable to figure out anything about it. Several photographs were taken by our staff to save this epic scene for posterity. Nevertheless our curiosity is still bothering us. We can't help wondering —what is this antenna and what is it supposed to do?

TV Keeps Dry Under Water

Businessmen can now conduct underwater salvage and offshore oil drilling operations, inspect spillways, dams, canals, irrigation systems, etc., without going near the water. A closed-circuit demonstration of the new underwater TV camera that makes all this possible was recently held in Hillsborough, Calif. (see photo below). The camera, designed by the engineering staff of HEC Corp., Redwood City, Calif., is housed in a watertight stainless steel cylinder. The lens looks out through a small window in one end of the cylinder. In addition to immediate viewing on the TV screen, the televised information can be recorded on *tape* and played back at a future date—underwater photography without film!



Building the Big Ear

Sound detector in action. All you'll need are a few parts—and maybe a cardboard horn for greater sensitivity.

You can pick up voices a block away or even a jet in the next county—

By ELBERT ROBBERSON

THE FELLOW across the street was raking leaves. In my earphones the rake sounded like a road-scraper race in an echo chamber.

"Whisper something," I yelled at him, first turning down the gain on my black box for a second.

"You're nuts," he whispered, continuing his raking.

Then he looked up. *"What kind of gadget you got there?"* he blasted, putting down the rake. *"What time did the saucer land?"*

I'll admit I might have looked extra-terrestrial, standing there wearing a pair of earphones, holding a little black box, and aiming a blown-up take-off of a Gramophone horn. So I had to tell him about my "sound detector."

The first thing, I warned him, is that you don't yell at this device—you talk low. Dogs a quarter-mile away sound like they're in your own yard; voices that are just a murmur shape up into conversation; and the birds sound as if they're singing right in your ear. When you listen with the detector, sounds are picked up which otherwise would have flown right by, and you can recognize speech that was just noise before. In fact, a little listening gives you the feeling of bathing in a sea of sound.

"But what's it good for?" asked the man with the rake, a solid practical character by nature.

"Well, if you wanted to," I told him, *"you could pick up a jet in the next county, or hear someone talking to you from a block away. Combine it with a megaphone, and you could talk with a person at a distance—like a swimmer, or somebody out in a canoe."*

The leaf-raker began to get ideas. *"You could listen for signals,"* he added, *"or make sure the kids are okay. Is there much to building one?"*

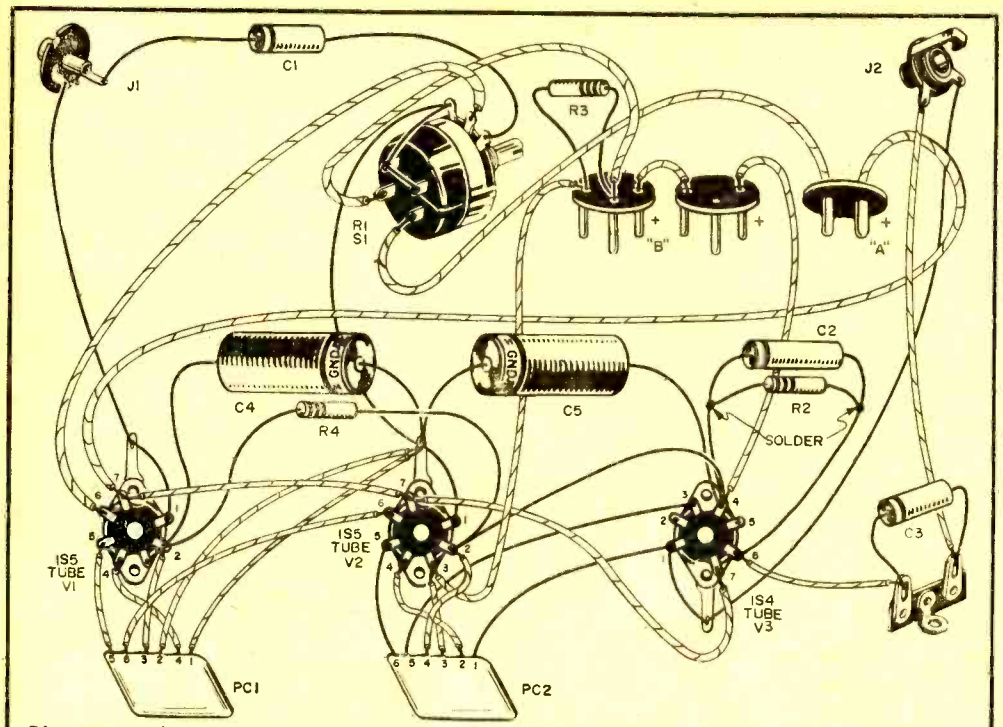
"Not much," I told him. *"I put this one together in an afternoon, making it out of leftovers."*

The parts of a sound detector are few—just a microphone, an amplifier (in a separate case), and a headset for listening.

To house the amplifier, use a 4"x5"x6" steel utility box. This may have a built-on chassis, or one can be added. Construction of the panel and chassis is shown in the photographs. Be sure that your cabinet is steel, not aluminum; steel provides shielding, which is always desirable in a high-gain amplifier.

The first step in wiring the unit is to install the "power," or d.c. wiring. Putting this wiring in first makes the subsequent insertion of components easier.

Then make up the battery cables and plugs, allowing about 10" scope on the wires. Note that one of the B battery plugs carries the resistor, *R3,* between the negative

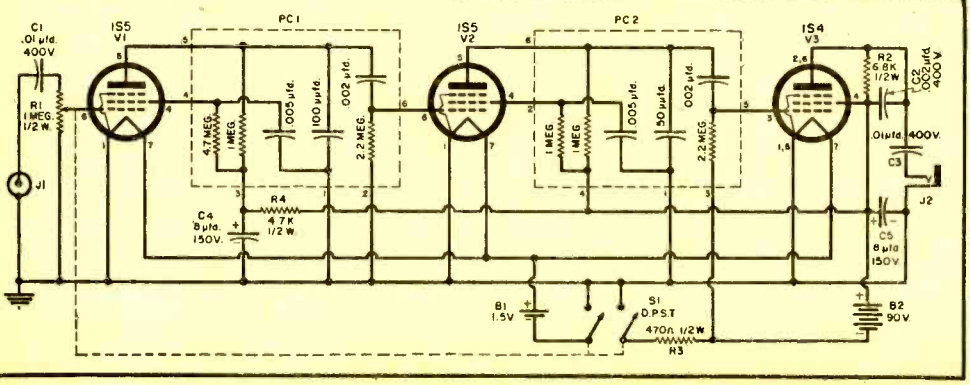


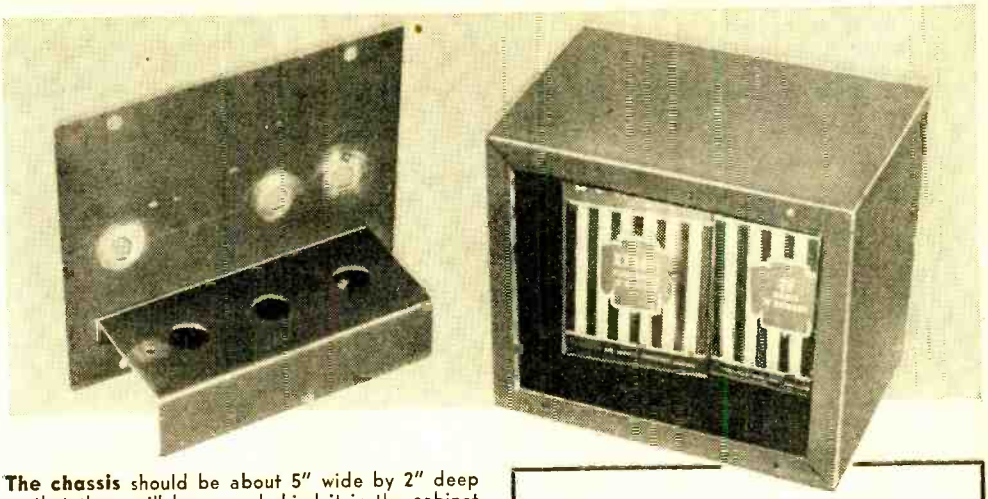
Diagrams and parts list for sound detector.

B1—1½-volt battery (Burgess 2F or equivalent)
B2—90-volt battery; two 45-volt units in series (Burgess XX30P1 or equivalent)
C1, C3—0.01-μfd., 400-volt tubular capacitor
C2—0.002-μfd., 400-volt tubular capacitor
C4, C5—8-μfd., 150-volt electrolytic capacitor
J1—Phono jack
J2—Headphone jack
PC1—Printed circuit (Centralab PC92)
PC2—Printed circuit (Erie 1407-01)
R1—1-megohm, ½-watt potentiometer
R2—6800-ohm, ½-watt resistor
R3—470-ohm, ½-watt resistor
R4—4700-ohm, ½-watt resistor
S1—D.p.s.t. switch, on R1
V1, V2—1S5 tube
V3—1S4 tube
1—5" x 6" x 4" utility case and chassis (Premier CA-1404 or equivalent)
3—Seven-pin miniature sockets
1—Two-terminal tie point
1—Crystal microphone replacement cartridge (Shure R7 or equivalent)
1—High-impedance headset

terminal and the "dead" center terminal which is employed as a tie point. Voltage drop across this resistor is used for bias on the output amplifier tube.

The diagrams show two different makes of printed circuit, Centralab and Erie. In the model equipment, these were used to test the interchangeability of parts. If desired, the same combination of coupling circuits may be employed, but the unit will work as well (and buying parts will be simpler) if you stick to one or the other (or any equivalent) line of products. Just be careful to check the schematic of the coupling unit to make sure the wires are connected properly. For example, note the difference between the numbering of the two printed circuits illustrated. With these two





The chassis should be about 5" wide by 2" deep so that there will be room behind it in the cabinet for the batteries when the unit is assembled. Before cutting any holes, make sure that the potentiometer and phone jack will clear the vacuum tubes.

units, the order in which the wires are arranged from left to right is the same, circuitwise, although the numbers are different.

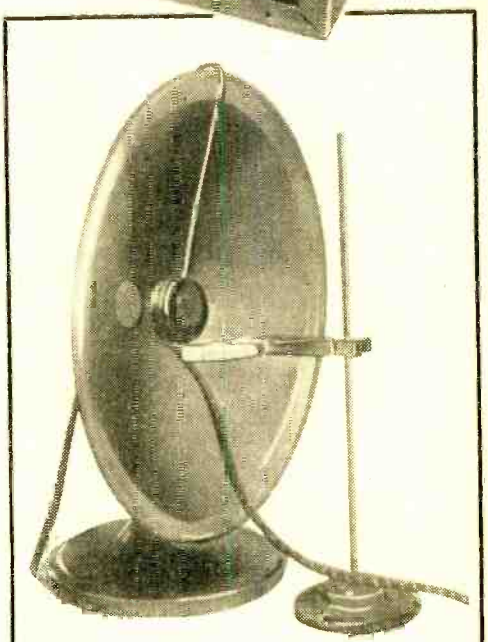
When the wiring is completed and checked, the tubes and batteries connected, and the headset plugged in *J2*, a rushing noise should be heard as *R1* is turned to maximum clockwise. Now plug in the microphone, and you should be able to hear yourself breathe.

Until you are acquainted with the unit, speak softly! You may note that any tendency of the potentiometer *R1* toward noise production will be amplified. Scratchy sounds produced when you operate this control do not necessarily indicate a defective potentiometer but rather are due to the high amplification.

Although the sound pickup with a "bare" microphone is very high, both loudness and intelligibility are greatly increased through the use of some means to concentrate available sound on the microphone.

An electric-heater bowl employed as a reflector will increase the response to sounds above a certain frequency, which depends upon the bowl diameter. "Highs" are greatly accented, and some directivity is obtained, which allows concentration on sound from the desired direction.

To use a heater as a reflector, remove the grill and screw out the heater element. The element has a left-hand thread, so turn it the opposite way that you would a light bulb to get it out. Remove the socket from the bowl, and cover the opening with a piece of cardboard or aluminum foil. Then move the microphone in toward the center of the bowl to find the point of maximum



Microphone pickup can be improved with a parabolic reflector, such as this heater bowl. Offering directivity and high gain, it will increase the response for high-pitched sounds.

pickup. The diaphragm of the microphone should face the reflector.

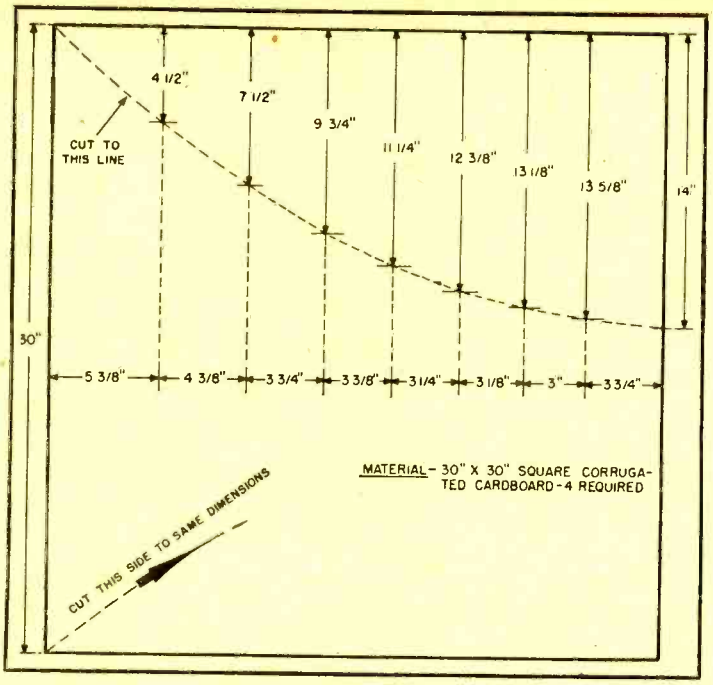
The usual heater bowl falls off in sensitivity on sounds of less than 1000-cycle frequency, and has the most effect on higher pitched sounds. For instance, bird calls, children's voices, or other sounds rich in high frequencies are quite improved with such a reflector.

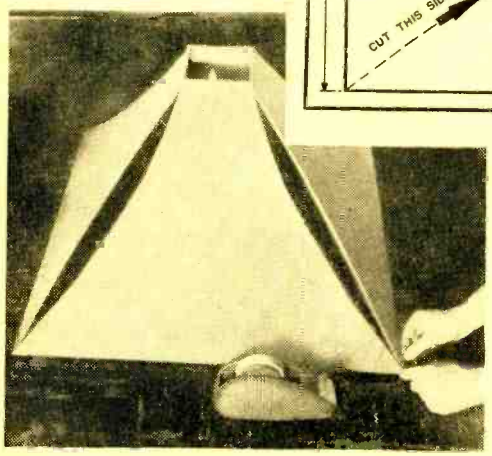
Best over-all response is obtained with an exponential horn. This device will gather in quite a volume of sound and cram it into the microphone, and will provide the best reproduction of low frequencies. The

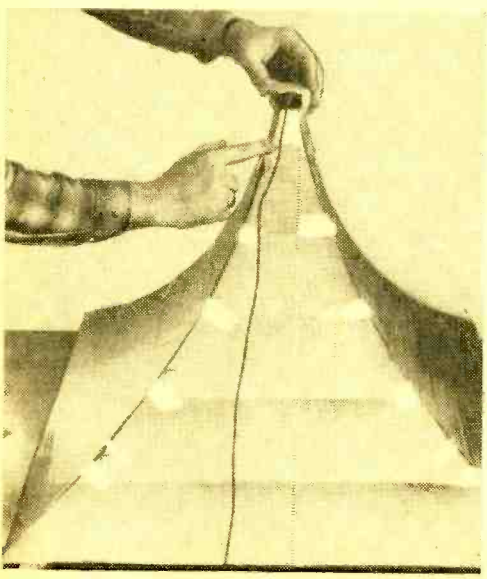
An exponential horn, simply made with corrugated cardboard according to the layout at right, will give the best reproduction of low frequencies.

Stand the sides of the horn on the floor and tape the corners together, as shown below. Then draw the edges together, tacking with tape as you go.

When the horn is fully shaped, tape the microphone into place at end (see bottom photo) and wrap securely, covering all cracks with tape.







exponential horn illustrated is very simply constructed out of packing-box corrugated cardboard. Four 30" squares are required.

First lay out each of the four sides and cut them to shape with a sharp knife. Stand the sides on the floor and tape the corners together with masking tape.

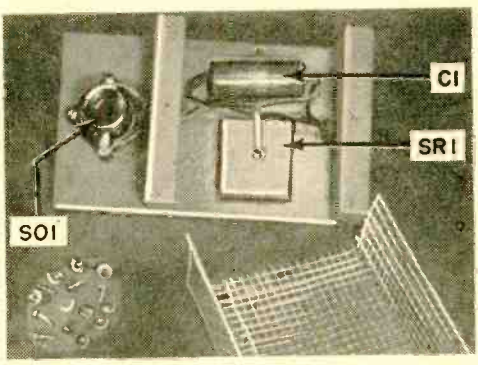
Then draw in the edges of the cardboard to meet, and spot-fasten with masking tape. When the sides are fully drawn in and secured, the horn will have the required exponential shape. Strips of tape can be run along the inside of the corner joints, and the outside fastenings augmented to make the horn rigid and secure.

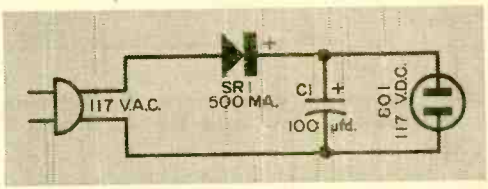
Shape the neck of the horn so it butts against the face of the microphone. Then tape the microphone in place, covering all cracks and building up over the assembly with tape until a fairly rugged mounting is obtained. Inside the horn, apply tape where necessary to make the path into the microphone diaphragm smooth and unbroken.

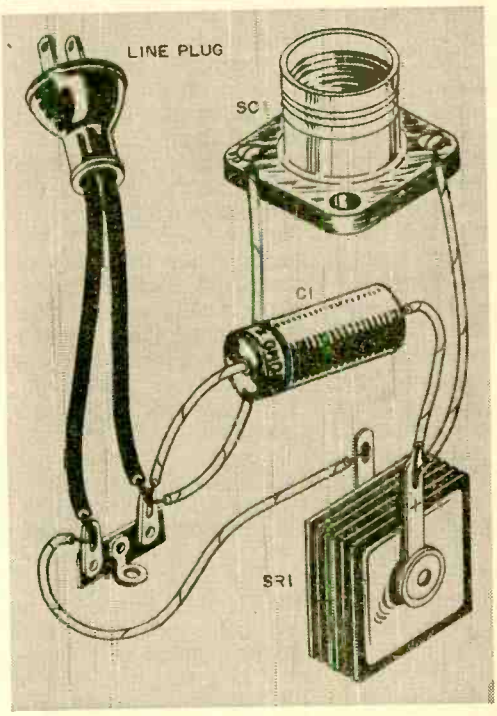
To aim the horn, prop it up to point as desired, or secure a metal strip to the bottom at the center of balance.

With this horn, the most important improvement over a bare microphone—in addition to increased directivity and sensitivity—will be an important increase in sound intelligibility. For example, a plain microphone could pick up and greatly amplify the sound of distant voices, but the result might be just a babel. The horn will give the quality of "presence," and turn jumbled sounds into recognizable words. —30—

D.C. Supply for Small A.C./D.C. Motors







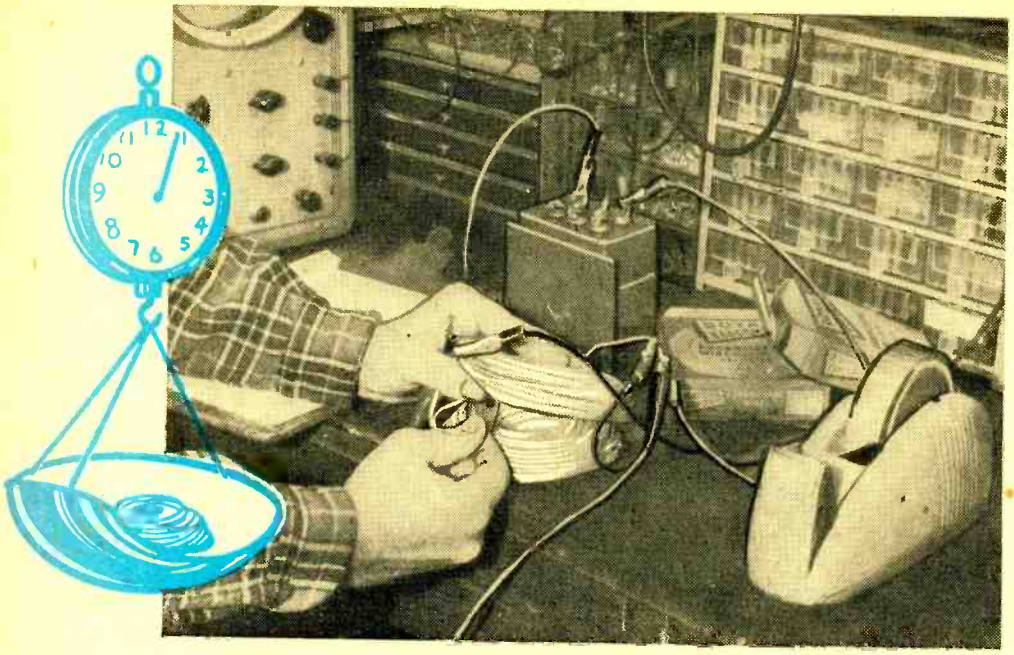
THIS POWER SUPPLY can be used to increase a motor's speed and prevent excessive heating. Very simple to construct, it is designed primarily for small high-speed motors used on a.c. or d.c., such as the carving motor shown at the top of this page.

Both the selenium rectifier (*SR1*) and the capacitor (*C1*) can be obtained from your local dealer in electronic parts. Construct the base and uprights from ¾" wood stock, and drill a ¼" hole in each of the upright pieces to pass the electric cord and wiring. The socket (*SO1*), capacitor and rectifier are then mounted and wired as shown in the diagrams.

Cut a protective shield from hardware cloth or wire screen (see photo above); then bend and fasten it with wood screws and washers. As an added safety measure, tape the exposed socket connections.

The d.c. supply must be used with motors drawing less than 0.5 ampere; those drawing more current will burn out the rectifier. It can only be employed with motors using d.c. or a.c./d.c.; motors using just a.c. will not work on the d.c. output of the rectifier.

For a faster, smoother shave, try your electric razor with this power supply. However, be sure that your razor has an a.c./d.c. motor. —*Carleton A. Phillips*



"Hardware Store" Hi-Fi Crossover

PRACTICALLY everyone knows the "why" of crossover networks in quality sound reproduction. A speaker cone that will sashay in and out along the distance necessary to pump a fat, low sound into the room just can't move fast enough for the highs; and the perky jobs that will trill out the highs just can't move far enough and push enough air to manufacture large low notes. And, even in "wide-range" speakers, there is danger of the high notes being squeezed out of shape by the cone's low-note excursions. Hence, it is desirable to have more than one speaker.

If you connect bass and treble speakers to your amplifier, each unit will try to do part of the other's job, resulting in loss and all-around confusion. The use of two speakers calls for a crossover network, which is simply an automatic tone-sifter to switch the various tones to the speaker that can handle them.

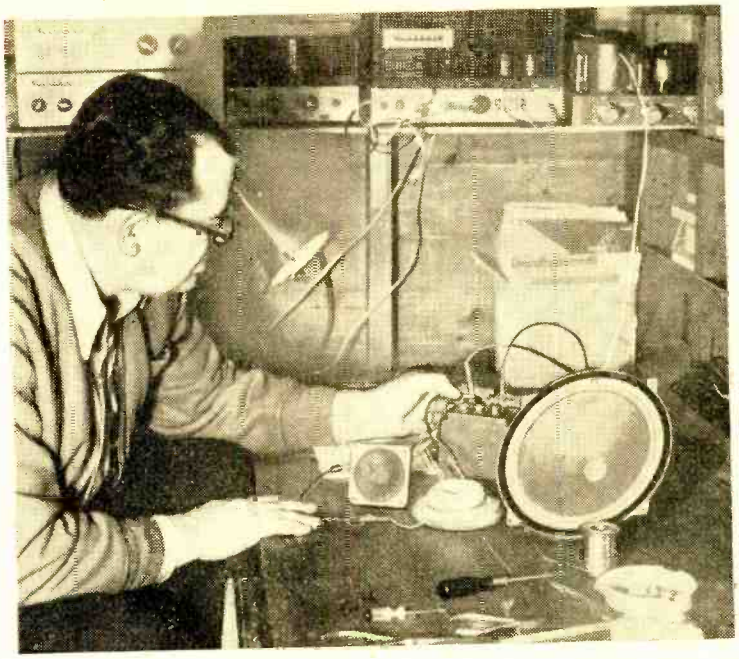
Unfortunately, the "how" is not so clear, since most designs require coils of special values which the hi-fi fan must wind himself. However, there is a way to build a crossover unit without any meticulous measuring or winding.

Figure 1 shows how the crossover works; Fig. 2 shows the circuit. At the crossover frequency, both speakers are fed equally. Below this point, the woofer receives more power and the tweeter less, and vice versa, at the rate of 6 decibels per octave.

The two speakers should have the same impedance rating. If the rated impedance of the two speakers does not happen to match, consider the combination to have an impedance half-way between the two values.

To build your network, first decide on the crossover frequency. This will depend upon the frequency range of each of the speakers, and how much of the load you want each to carry. The point chosen should be in a frequency region which both speakers are able to reproduce, although it may be close to their response limit.

In Table 1, follow the proper speaker impedance column down to its intersection with the horizontal line corresponding to the desired crossover frequency. The figure at the intersection is the value of capacitance required for the crossover network. This may be made up by connecting different-value capacitors in parallel to give the desired sum. These capacitors may be low-voltage units. (Surplus bins are an excellent source of capacitors for this use.) Paper capacitors are preferred because they retain their rated value indefinitely,



By
King Murdoch

To keep coils in shape, they are "spot wrapped" with Scotch tape (see facing page) after the correct weight of wire is chosen. At left, the author measures crossover frequency for various packages of ordinary bell wire.

while electrolytic capacitors tend to drop off or leak with age.

However, if it is necessary to use electrolytics, they will be perfectly satisfactory, as long as periodic tests are made to insure that they have not gone bad. With electrolytics, it is necessary to connect two sections, back-to-back (positive-to-positive or negative-to-negative). Otherwise, they would pass current in one direction. Because of the series connection, the capacitance of each section used must be twice the total value desired.

Stock rolls of plastic-insulated #18 bell wire, available in hardware stores, can be used for the coil. These rolls commonly come packaged in 1-lb. and ¼-lb. rolls, constituting a ready-made air-core coil with tolerably low loss. The characteristics of several such packages have been measured, and found to be quite suitable for our purpose. The coils illustrated in this article had the following dimensions: 1-lb. roll—5″ diameter, 1½″ hole, 1″ thickness; and ¼-lb. roll—3″ diameter, 1½″ hole, 1″ thickness. Try to get wire made up in packages as close to these dimensions as possible.

Now go into Table II, following the same speaker impedance column down to the line marked by the previously chosen crossover frequency. At the intersection, the amount of wire required in the coil is

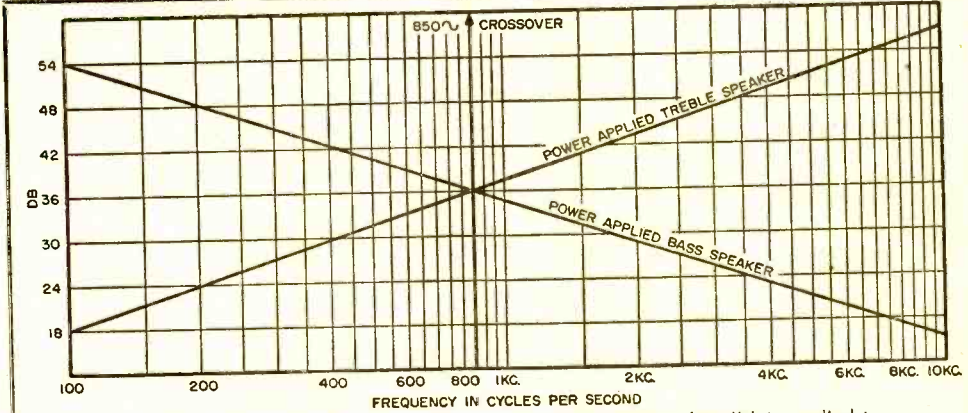


Fig. 1. Assuming 72 db of available sound energy, half of it (36 db) is applied to each speaker at the crossover point. At other frequencies the proportion varies, one speaker getting less while the other gets more, but the sum of 72 db is constant.

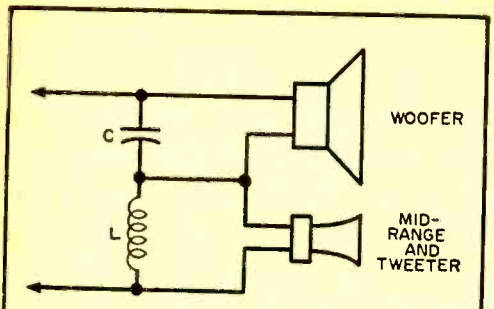


Fig. 2. Circuit for a two-way crossover network feeding separate woofer and tweeter.

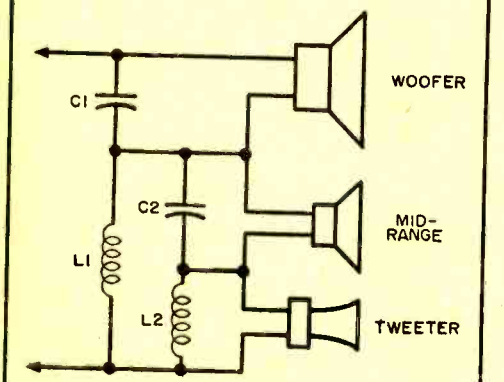


Fig. 3. Circuit for a three-way crossover network accommodating additional mid-range speaker.

shown in pounds. For example, a 1¼-lb. coil is required for a 4-ohm speaker to cross over at 500 cycles. This coil should consist of one 1-lb. coil, and a ¼-lb. coil stacked on top, the two then being connected in series.

Stack the coils so that the direction of winding is the same for both coils, and make the series connection by joining the inside end of one coil with the outside end of the other. Connect the rest of the circuit to the remaining two free wires.

To obtain any of the odd values of weight which may be needed, stack 1-lb. and ¼-lb. coils to arrive at the nearest quarter-pound in excess of the desired weight. Values of ⅛ lb. can then be obtained closely enough by simply removing half of a ¼-lb. coil.

Then connect the capacitor and the coil in series across the amplifier output. The treble speaker is connected across the coil, and the bass across the capacitor. The amplifier output impedance tap should be set to the rated value for a single speaker because, in the series-parallel connection, this is the load the amplifier "sees."

Judge the operation of the network by listening to any full-range music with which you are familiar. If the woofer seems to be loafing, peel a little more off the coil. On the other hand, response can be pushed the other way by adding several turns. Not much change will be evident after small alterations—it takes at least ⅛ lb. for the difference to show up to any noticeable degree.

Suppose you want to use three speakers, which ordinarily calls for a three-way network. You can get out of the woods very simply by using a network such as has just been described, with the crossover at the frequency desired to separate bass and mid-range speakers. Then, connect another similar network in place of the mid-range speaker across the first network coil. The second network should have the crossover frequency to separate the mid-range from the treble. The exact value in each case depends upon the speakers used. Connections are shown in Fig. 3.

Crossover Frequency (cycles)	Speaker Impedance			
	4 ohms	8 ohms	12 ohms	16 ohms
	Capacitance in Microfarads			
500	80	40	26	20
750	53	26	18	13
1000	40	20	13	10
1500	26	13	9	6.5
2000	20	10	7	5
2500	16	8	5	4
3000	13	6.5	4.4	3.3
4000	10	5	3.3	2.5

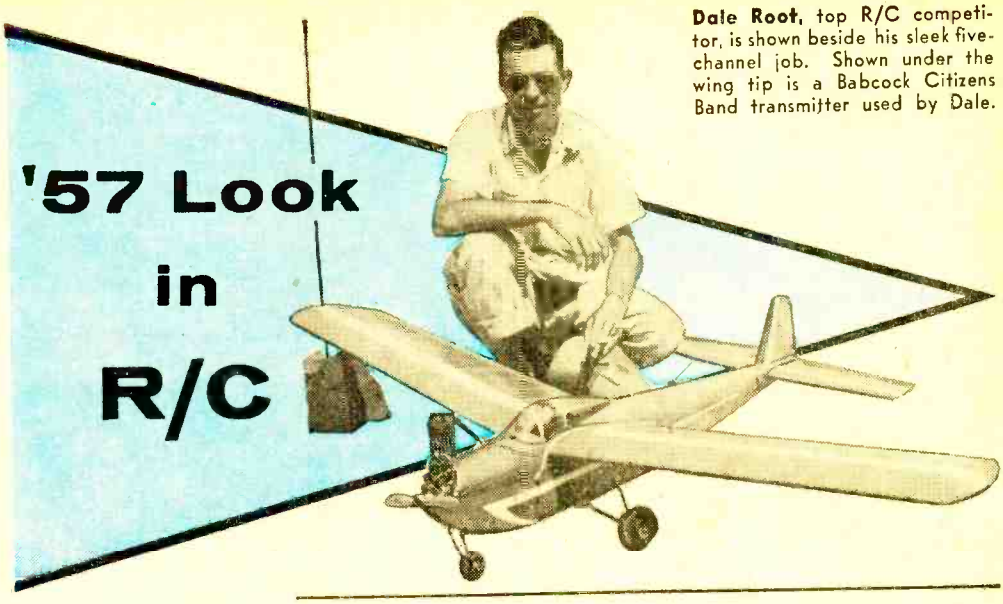
Table I.

Crossover Frequency (cycles)	Speaker Impedance			
	4 ohms	8 ohms	12 ohms	16 ohms
	Pounds of Wire			
500	1¼	1⅜	1½	1¾
750	⅝	¾	1	1¼
1000	½	¾	⅞	1¼
1500	⅜	⅝	¾	1
2000	¼	½	⅝	¾
2500	¼	½	⅝	⅝
3000	¼	⅜	½	⅝
4000	¼	¼	⅜	½

Table II.

Since the attenuation attained with these networks is smooth and gradual, a few cycles one way or the other make little difference—so don't bother splitting hairs. The main thing is to get the desired proportion of highs and lows into the appropriate speakers without humps or hollows. Your "hardware store" crossover network will do the job as well as many costing a great deal more money. —30—

'57 Look in R/C



Dale Root, top R/C competitor, is shown beside his sleek five-channel job. Shown under the wing tip is a Babcock Citizens Band transmitter used by Dale.

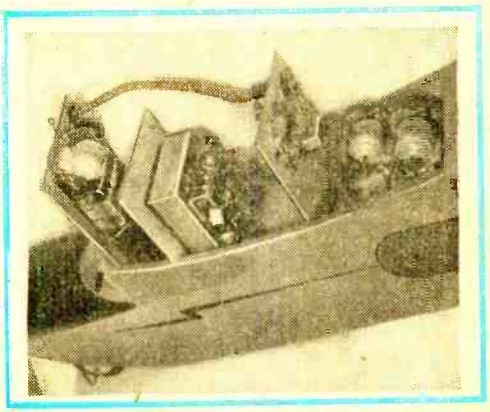
By **WILLIAM WINTER**
Editor, Model Airplane News

Eight-channel control a reality! All-transistor receivers and a transistorized power pack, too!

"IF YOU CAN'T do three consecutive outside loops, you don't stand a chance in multi-control events," say the R/C model fliers. Inverted flight, true spins, snap rolls, and exotic stuff like "Cuban Eights" aren't too tough with standard radio equipment now on the market, but the outside loops separate the men from the boys. To old-timers, it must sound like the ultimate lie that one need know nothing about electronics to do these things. But the amazing truth is that the super multiple-channel R/C gear now used for these maneuvers is not complex and is easy to operate and maintain.

The R/C breakthrough came in 1956, brought about by the competitive interest of firms whose main line of business was electronics for the military, from target drones to guided missiles. Transistors made it possible, with a big assist from printed circuitry and lightweight components and relays.

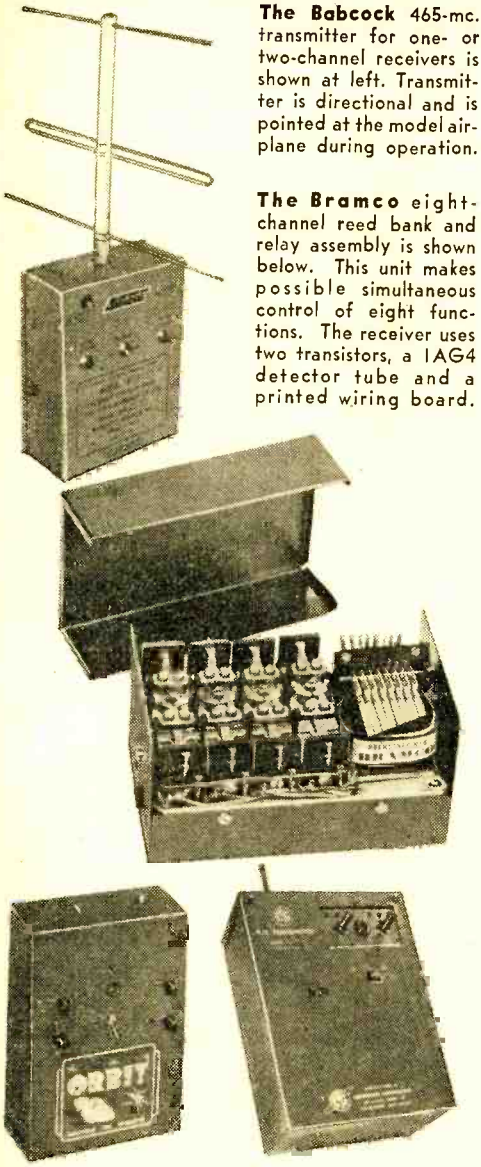
Eight-Channel R/C. As this goes to press, at least two firms make eight-channel equipment, costing in the neighborhood of $200 for transmitter and receiver. Planes are being flown with radio-controlled ailerons, wheel brakes, wing flaps, full-scale type trimmable tails, and so on. CG Electronics,



All components are easily removable in this five-channel installation in a model airplane. At far left is the engine control servo, next to it is the receiver, then the socket panel, servo for rudder control and servo for elevator.

who took the lead in 1956 when its five-channel models won the Nationals, now has an eight-channel job almost ready for production. Orbit and Bramco have "eights" on the market.

The Bramco "Regent," for example, weighs only seven ounces (less than 10 with batteries) and measures only 3½" x 2½", including eight relays! It idles at ½ ma. and has a filament drain of only 10 ma. The single tube is a 1AG4 subminiature type with transistor amplification. This set operates on one subminiature penlite cell battery, and a 45-volt Mallory B battery that weighs 2¾ ounces. As on all "eights," several channels may be used simultaneously—so the problem is figuring out how to use all those controls. With



Hand-held transmitter on left, made by Orbit, gives eight-channel control. A CG Electronics Corp. five-channel transmitter is on right.

The Babcock 465-mc. transmitter for one- or two-channel receivers is shown at left. Transmitter is directional and is pointed at the model airplane during operation.

The Bramco eight-channel reed bank and relay assembly is shown below. This unit makes possible simultaneous control of eight functions. The receiver uses two transistors, a 1AG4 detector tube and a printed wiring board.

simultaneous control, the flier can operate the rudder while holding down the elevator, or controlling the ailerons.

Basically similar is the Orbit eight-channel receiver. This job weighs 9 ounces, has a filament drain of 1¾ ma., operates on one penlite cell and one 30-volt hearing-aid battery. The Orbit transmitter stresses stability—all modern tone transmitters must be stable to avoid drifting of tone which could cause one or more receiver reeds to be inoperative. With this transmitter, there is no scrambling for the screwdriver when battery voltage drops and tones start drifting—while the plane flies merrily on. Current drain of the hand-held Orbit transmitter is only 16 ma.

Equipment for 465 Mc. The sensation of the 1956 Trade Show was the single- and two-channel Babcock equipment on 465 mc. Revolutionary aspects of these radios compel their inclusion in any roundup of top achievements of the past year.

The Babcock 465-mc. receivers are fully transistorized. There are no tubes, not even a detector. One transmitter model serves both receivers—emitting one or two tones, depending on the receiver. Both tones can be sent simultaneously so that the flier can hold elevator and rudder at the same time. There is no reed bank; tones are filtered electronically to operate the proper relay. These relays are hermetically sealed.

The signal is picked up by two antennas, one a "J" antenna and the other a folded dipole, connected in series. The antenna base contains a crystal diode and capacitors which filter out the r.f. and pass on only the tone, or tones, to the receiver. Four stages of transistorized amplification are used, with an additional one or two transistors to operate the relay or relays.

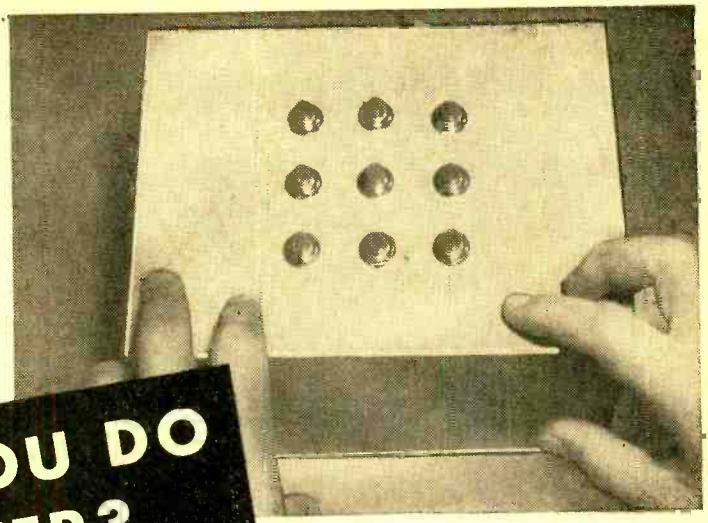
Since these receivers have no tubes, no filament batteries are needed. Operators on the 465-mc. band know the handicap of high filament drain with the tubes required for that frequency, so the elimination of filament batteries is a milestone in the R/C hobby. Range is guaranteed at 600 feet on the ground, probably the equivalent of 1800 feet in the air. Actually, this is a conservative estimate for the range is adequate for all normal flying.

Transistorized Power Supply. A tiny but mighty gimmick developed in 1956 is the transistorized power supply for receivers. That's right—for receivers. This power pack corresponds in function to the vibrator power supply used for transmitters, or to the vibrator power supply in the car radio.

The author has seen this amazing power supply, developed by the B and S Products Company, used with CG five-channel receivers. One penlite cell was the only source of current. The CG people have even been able to eliminate all radio batteries by using this power pack; the supply is taken from the actuator batteries which, of course, have to be carried anyway.

As this is written, other major suppliers are in the process of transistorizing their equipment. Names like Schmidt and Badaco are still to be heard from. Meanwhile, the cry is for nine and ten channels. Coast modeler Bob Bowen remarked: "Pretty soon we will be flying a couple of transistors, a tube, and an airplane built around an electric organ. Is there no end?" —30—

Challenge and test the "brain power" of people you know—family, friends and party groups—with this neat little push-button box. It takes less than one evening to complete and will provide many hours of interest and amusement.



CAN YOU DO BETTER?

An Intelligence Tester

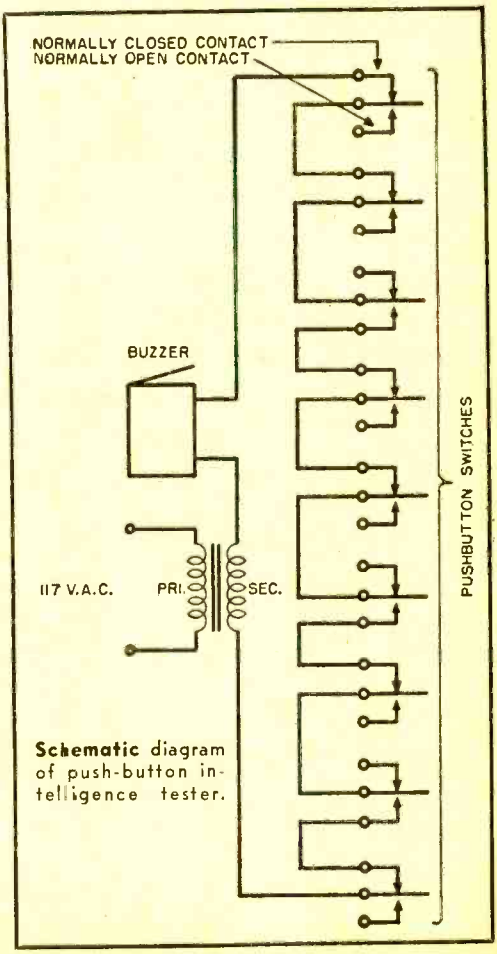
IT SEEMS AS THOUGH someone is always contriving to place a measure on our powers of reasoning. Most of us have been exposed to the pencil and paper variety of IQ tests, quizzes, etc. But here's a new way to challenge the IQ, electronically. You can build your own surprisingly accurate intelligence tester in just a few hours from a transformer, buzzer and nine push-button switches.

As shown in the photographs and drawing, the secondary of the bell-ringing transformer is connected in series with the buzzer and the nine push buttons. These push buttons have s.p.d.t. contacts, and are so connected that the buzzer will sound when three preselected buttons are pushed at the same time.

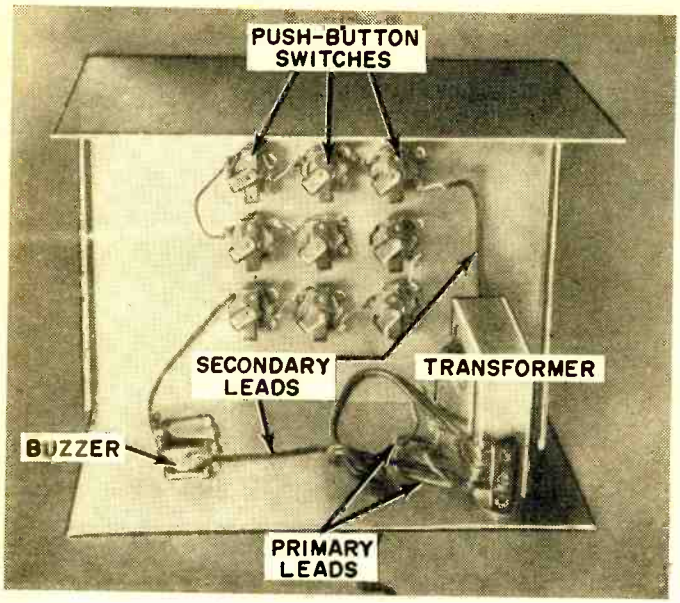
The person being tested must discover which three buttons to push. Since intelligence involves the ability to discover relationships, the length of time required to find the right combination of push buttons is an indication of the intelligence of the person being tested.

What's the Score? A "gifted" person will realize immediately that a certain number of possible combinations exist, and will proceed to try them in orderly sequence. A less gifted person will try a few combinations at random, will probably not realize the large number of possible combinations, and may forget and try the same combinations more than once. As a result, he will require much more time to locate the right buttons.

Standards for grading the test, according to the length of time required to ring the



Schematic diagram of push-button intelligence tester.



Metal cabinet, doorbell transformer and buzzer, a two-terminal tie-point strip, nine push-button switches, power cord and hookup wire make up the simple parts list for the intelligence tester. Push buttons with s.p.d.t. contacts are employed, and connection is made to normally closed contacts of all switches except the three that will be used to ring the buzzer.

buzzer, might range from less than one minute (Genius) to over four minutes (Dull).

With nine push buttons to choose from, there are 84 possible three-button combinations, and the mathematical probability for hitting the magic three by pure chance is almost nil. Push buttons with s.p.d.t. contacts are used so that the machine cannot be "fooled" by someone pushing more than three buttons at once.

Set the Combination. The model is constructed in a 4½" x 6" x 8" metal cabinet. When wiring the push buttons, connection should be made to the normally closed contacts of all push buttons except those which will activate the buzzer. On these three, normally open contacts should be used.

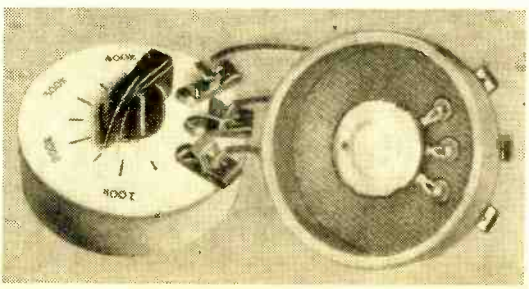
Any three buttons may be used for the "right combination." In the model, the three buttons are (viewed from the front panel), the right-hand button of the top row, the left-hand button of the middle row, and the center button on the bottom.

Once completed, this little "mental gauge" can be used to liven up a party, score your friends' IQ's, or even shed some light on the eternal question of male vs. female intelligence. At any rate, the next time the "little woman" starts proclaiming her superior mental prowess, bring out the push buttons and let her prove it. After all, you have the combination! *—Ed Bukstein*

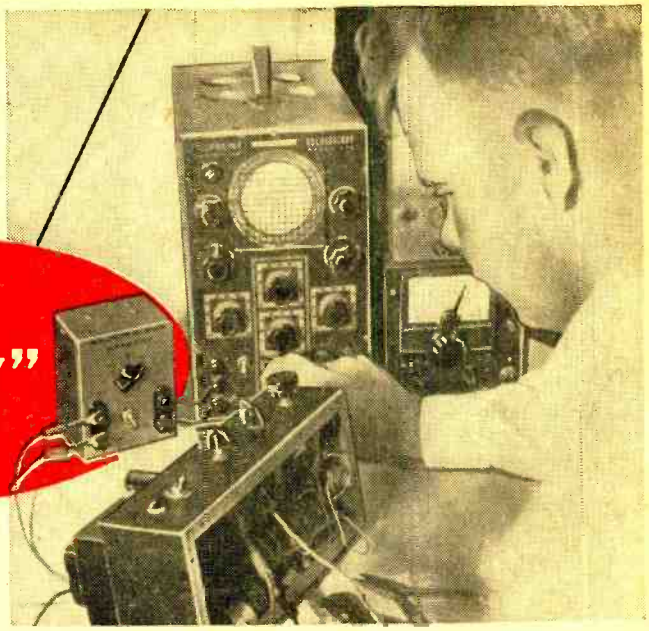
Mounted Variable Resistors for Experimenters

Potentiometers and volume controls in experimental "breadboard" setups present a mounting problem. However, it's a pleasure to experiment when your potentiometers are mounted as shown here (top and underside views respectively). You can make quick solderless connections to the terminal lugs; and you can calibrate the home-made dial plates to suit yourself and your needs.

The construction is very simple. Jigsaw a 2¾"-diameter disc from ⅛" composition board and glue it onto a ¾" section of 2¾"-O.D. cardboard tube; then cut a 2¾" disc from white drawing paper and glue it on top of the disc. Drill a hole through the center of the mount for the potentiometer. To mount the three medium-sized Fahnestock clips, drill three ⅛" holes through the top of the mount, directly in line with the ends of the lugs on the variable resistor, and mount the clips using *6-32* round-head brass screws. The ends of the resistor lugs are soldered directly to the ends of the screws to eliminate wiring. *—Carl Dunant*



Double the value of your oscilloscope with this simple, easy-to-build unit



"ECONOMY" OSCILLOSCOPE CALIBRATOR

By RICHARD GRAHAM

WE CAN ALL AGREE that the oscilloscope tells more about the operation of a piece of equipment than any other test instrument. But what do you do when you need more than just a picture? Suppose you want to know the actual peak voltage of the waveform under observation? The "Economy" oscilloscope calibrator can give you this information in a fraction of time, conveniently and accurately.

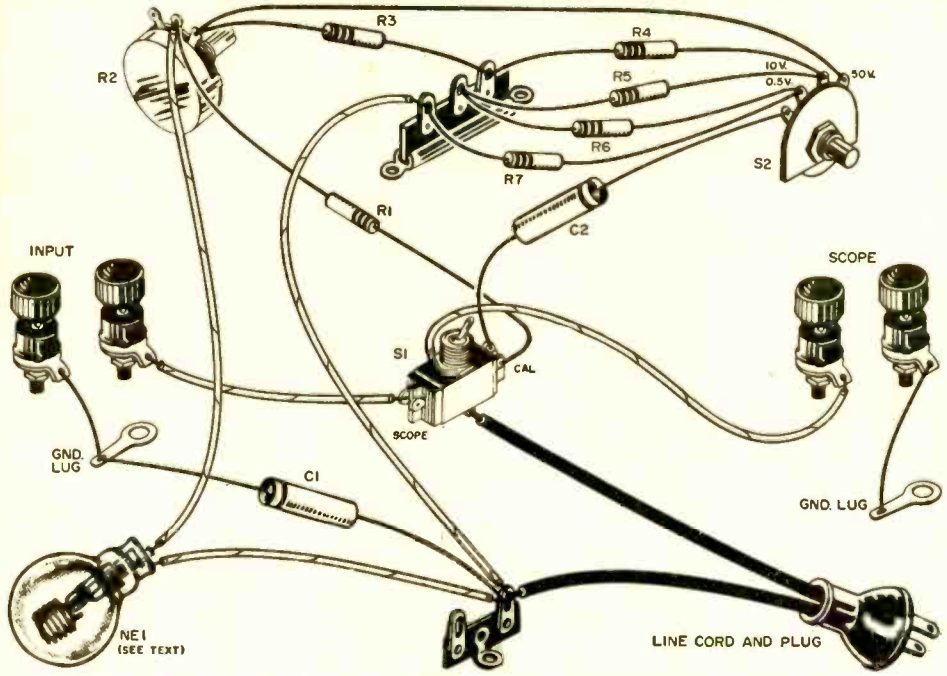
Price-wise, the construction cost of the calibrator shouldn't exceed $4.50 for the unit complete as shown. If you've invested in an oscilloscope, which probably cost upward of 10 times this amount, you're cheating yourself out of a large part of the utility and versatility inherent in the oscilloscope if you don't build the calibrator. Looking at it this way, you almost can't afford *not* to build it.

Basically, the calibrator is a device that will put out a standard a.c. voltage. This a.c. reference voltage is unaffected by variations in the 117-volt a.c. line voltage. Switching is provided in the calibrator to select either the waveform under observation or the standard voltage signal from the calibrator. Further provision is made so that any of three standard a.c. voltages can be obtained.

Construction. The oscilloscope calibrator is housed in a 5" x 4" x 3" aluminum utility box. Since nothing is critical in the layout or construction of the unit, any other size and shape box may be used. Preferably, the housing should be made of metal to act as shielding.

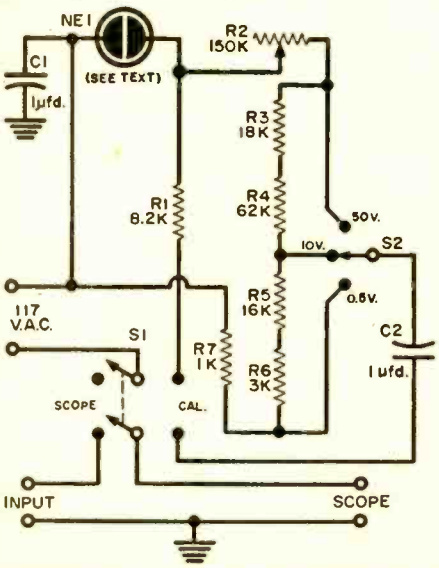
Close-up of the calibrator controls on the front panel. In the photograph at top of page, the calibrator is shown in action—being used to test an amplifier.

The heart of the calibrator is the one-watt neon lamp (*NE1*), the odd-shaped glass object you can see in the rear view photo. This is a standard one-watt type NE-30 neon lamp, which can be obtained at most electrical distributors, from which the screw base and internal resistor has



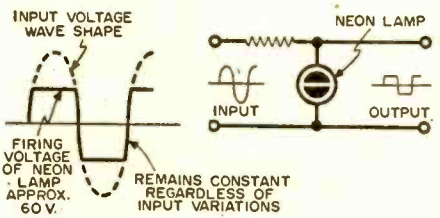
Follow the pictorial and schematic diagrams in putting the oscilloscope calibrator together. The parts list and a description of how the unit operates are given below.

C1—1.0-μfd., 200-volt paper capacitor
C2—0.1-μfd., 200-volt paper capacitor
NE1—Neon lamp (NE-30 or NE-32; see text)
R1—8200-ohm, 1-watt, 10% resistor
R2—150,000-ohm potentiometer
R3—18,000-ohm, ½-watt, 5% resistor
R4—62,000-ohm, ½-watt, 5% resistor
R5—16,000-ohm, ½-watt, 5% resistor
R6—3000-ohm, ½-watt, 5% resistor
R7—1000-ohm, ½-watt, 5% resistor
S1—D.p.d.t. toggle switch
S2—S.p. 3-pos. rotary switch



HOW IT WORKS

The calibrator is an a.c. voltage regulator capable of supplying a constant, known voltage to the oscilloscope. The regulator utilizes a one-watt neon lamp (*NE1*) that will conduct whenever the voltage across



the lamp exceeds its firing voltage, which is on the order of 60 volts. When the lamp "breaks down," it will start to conduct, but the voltage across the neon will remain constant. Thus, as the 60-cycle voltage waveform exceeds the firing voltage, the lamp begins to conduct, effectively clipping the voltage waveform to a maximum of 60 volts. It does this for both halves of the 60-cycle waveform, since the lamp will conduct equally well in either direction. The drawing above shows the regulating action.

To make the calibrator more versatile, a voltage divider is connected across the lamp. Potentiometer *R2* is used to adjust the voltage across resistors *R3* through *R7* to exactly 50 volts peak-to-peak. The divider drops this to 10 and 0.5 volts peak-to-peak. These three standard voltages are usually adequate. Switch *S2* selects the standard voltage to be fed to the oscilloscope, and switch *S1* is used to feed either the calibrator output or the signal to be observed and measured to the oscilloscope input. Capacitors *C1* and *C2* isolate the oscilloscope input from the power line.

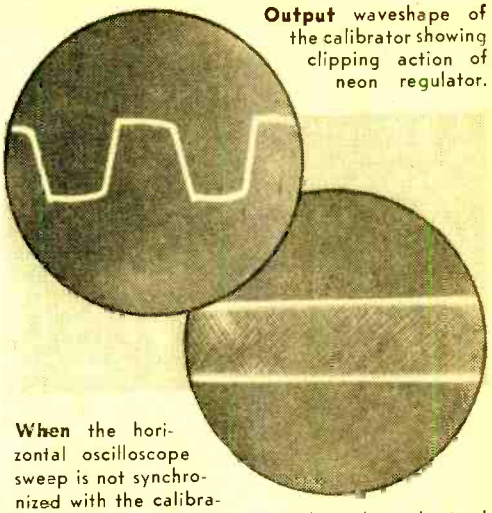
been removed and which has been mounted with the lead end up. Care must be used in removing the base from the lamp; since the brass screw base is very thin, however, only a pair of cutters is required.

If your radio parts distributor is well stocked, try and get a type NE-32 neon lamp. It has the same characteristics as the NE-30 except that the base is a double-contact bayonet base and does not include an internal resistor.

Mount the lamp in an electrolytic capacitor mounting clamp. To reduce the possibility of breaking the glass, first wrap the bulb with a few turns of tape. The clamp can then be tightened, remembering that it's a piece of glass we're clamping, not a piece of steel.

After the calibrator is completed and the wiring checked out, hook up the *scope* terminals on the calibrator to the vertical input terminals of your oscilloscope. Turn everything on, and place the calibrator switch in the *cal.* position of switch *S1*. The oscilloscope can be adjusted until a waveform similar to that shown in the photo above (the top one) is seen. This indicates that the calibrator is working properly. Now all that is needed is to perform the calibration of the calibrator.

Calibration. The setup is shown in the drawing on page 114. A reasonably accurate a.c. voltmeter is required. Since the full a.c. line voltage will be across the potentiometer, some caution should be exercised. A small ⅛-amp. fuse is in series with the incoming line to prevent any serious short circuits.



Output waveshape of the calibrator showing clipping action of neon regulator.

When the horizontal oscilloscope sweep is not synchronized with the calibrator, a waveform like the one at the right is obtained. This is easier to use in calibrating the calibrator.

Adjust the potentiometer until a reading of 17.7 volts is obtained on the a.c. voltmeter. This voltage reading corresponds to a peak-to-peak voltage of 50 volts used to calibrate the oscilloscope. Place switch *S1* in the *scope* position. Adjust the oscilloscope vertical gain for a specific number of boxes on the face of the oscilloscope. Let's use ten boxes for our example.

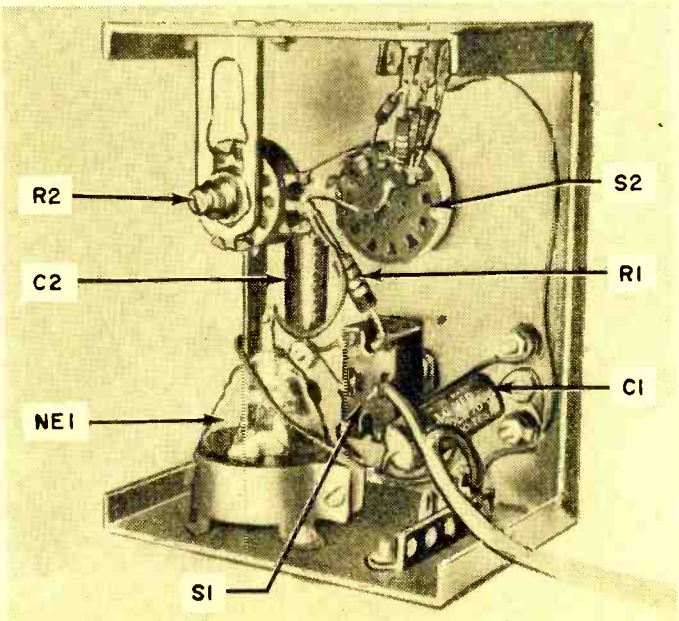
Once this is done, do not touch the vertical gain setting for the remainder of the calibration procedure. Now place switch *S1* in the *cal.* position and the volts peak-to-peak switch in the 50-volt position. Adjust potentiometer *R2* in the calibrator to produce the same ten boxes of deflection.

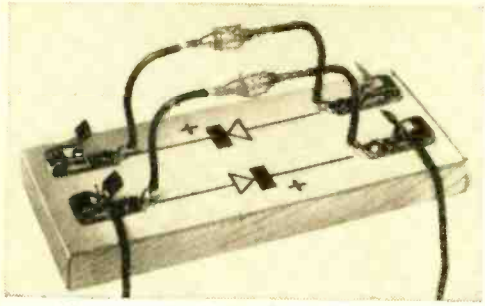
To check the accuracy of the voltage divider, set switch *S2* to 50 volts peak-to-peak. Adjust the oscilloscope vertical gain to produce a deflection of ten boxes. Then set switch *S2* to the 10-volt peak position. The deflection on the screen should now equal two boxes.

Similarly, to check the 0.5-volt peak-to-peak position, first set the switch *S2* to the 10-volt peak-to-peak calibrating position and then adjust the os-

(*Continued on page* 114)

Rear view of the unit in which the major components are identified.





Crystal Diode Mount

This diagram mount for crystal diodes (above) allows all radio experimenters to make quick and correct connections to the diodes. The symbols ink-drawn on the mount show exactly how to connect to the diodes, and Fahnestock clips do away with continual bending and soldering of the leads.

The wood base in the photo measures about 3½" x 1½" x ⅜". A piece of drawing paper is glued to top of base and four Size 15 (or larger) Fahnestock clips are mounted, in the positions shown, using ⅜" round-head wood screws. Solder the leads of the diodes to the clips (being careful not to overheat the diode leads), and bend the leads as shown. —*Art Trauffer*

Make Tandem Transistors

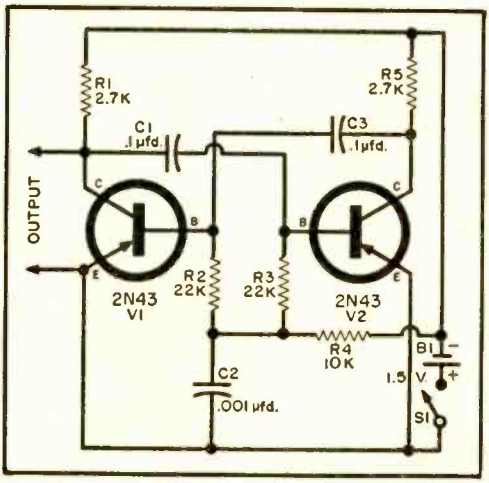
To simplify assembly and wiring in direct-coupled transistor amplifiers, pairs of your favorite transistors can be taped and wired together. Thus, you can make your own tandem transistors using the units of your choice. Just tape two *p-n-p* transistors together, using ½" cellophane tape. Then bend back the emitter lead of one unit and the base lead of the second unit and solder the two ends together. For circuits and data on typical direct-coupled transistor amplifiers, see page 87 in the September, 1956, issue of POPULAR ELECTRONICS.

—*Carl Dunant*

2500-Cycle Multivibrator

This multivibrator consists of two transistors driven by a single penlite cell (1.5 or 3 volts). Although 2N43 units are shown, almost any other *p-n-p* transistor may be substituted. If the component values specified are used, the audio square wave should be 2500 cycles. Coupling capacitors *C1* and *C3* control the audio frequency if another is desired. The current drain is about 0.6 ma., and a penlite cell will last about 250 hours in continuous operation.

An important feature of this multivibrator is the peak-to-peak output voltage. It will equal 1.5 volts when the circuit is used with a 1.5-volt battery and 3.0 volts when the circuit is used with a 3.0-volt battery. This makes it very handy for calibrating or testing hi-fi equipment, oscilloscopes, voltmeters, etc. —*William A. Scism*

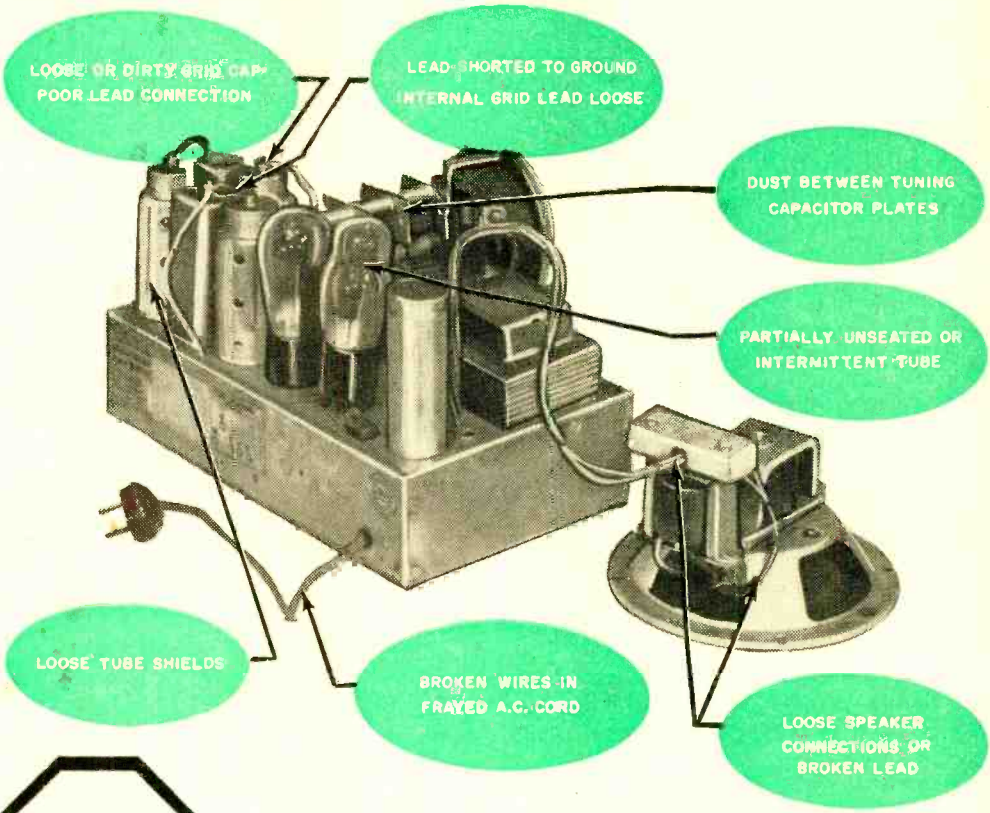


A "Talking" Mike

Have you ever wondered how some of those stage magicians can second-guess questions from the audience? Well, one method is to use a crystal microphone as a part of their p.a. system. As you experimenters know, there are also crystal headphones which are really nothing more than crystal microphones to start with.

The stage performer has his technicians arrange a switching circuit so that the mike can be put temporarily into the output of another low-power amplifier system from his "audience spotter." The latter speaks into his own mike when the stage microphone has been switched over to be an earphone, and in that way the stage performer knows what's going on.

The earphone can be heard within a range of two or three feet—not far enough for the audience to catch it, but plainly audible to the performer. —*Clyde D. Adams*



STOP—Those Intermittents—

By EUGENE F. CORIELL
Lt. Col., USAF

Many receiver defects can be readily cured by simple "above-the-chassis" checks

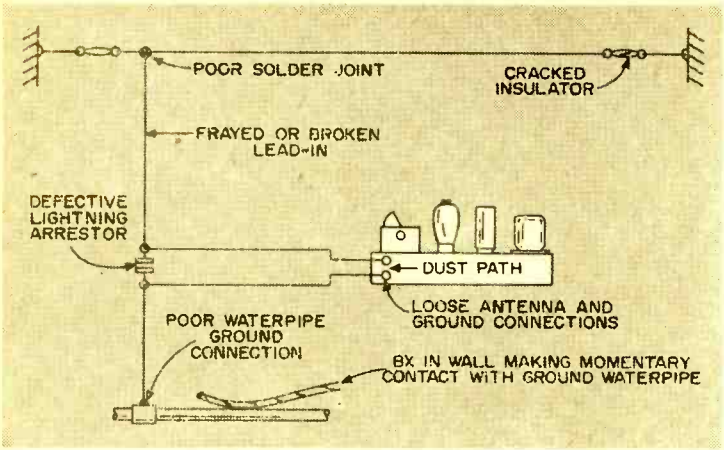
STOP-AND-START driving is a well-known nuisance to motorists, and stop-and-start playing is equally annoying to radio users. "Intermittent operation" is a rather fancy phrase to describe such performance, but often the trouble-shooting procedures needed to locate the defective intermittent are pretty fancy themselves. The cure, however, is usually fairly simple, like replacing a tube or wiping a ground connection clean.

Locating intermittents buried deep inside a crowded chassis may well be a job for an experienced—and patient—technician or advanced hobbyist. However, many intermittents are caused by defects *above and/or outside the chassis*. So, if your gear recurrently drops in volume, or emits noises, try these remedies before really rolling up your sleeves or calling the repair shop.

Line Cords and Grounds. Start with the a.c. line cord and other cables such as the turntable leads and speaker wires. Are the conductors loose on the plug terminals or broken inside the cable insulation? In the case of radios and tuners, the antenna or ground chassis connections may be loose or corroded. Cracked antenna insulators, poor lead-in soldered joints and defective connection to the ground water pipe are common troubles (see drawing on p. 60).

The lightning arrestor can cause intermittent operation by internal leakage between its terminals. A good arrestor should show a resistance of at least one megohm, when measured with the antenna lead-in disconnected so that possible antenna shorts to ground will not affect the ohmmeter reading.

Sometimes turning on a light or an ap-



Antenna-to-ground system has several points that can become trouble spots and cause interm'ttent operation of receiver. These points, together with the chassis items shown in photo on preceding page, should be checked for possible flaws.

pliance restores radio operation, in which case the trouble is likely to be in the antenna or ground circuits. The antenna may be shorting to ground through a dirt path between their respective chassis terminals. A perfectly good external ground to a water pipe may also contribute to this mysterious effect, due to the adventures that can befall the pipe. For example, building vibration may jar BX electrical cable in the walls or floor against the pipe, or the pipe may be serving as a ground for an appliance—or even a neighbor's radio. Try removing the ground altogether, or if a ground is necessary, run it to another pipe or to a long rod driven into the earth.

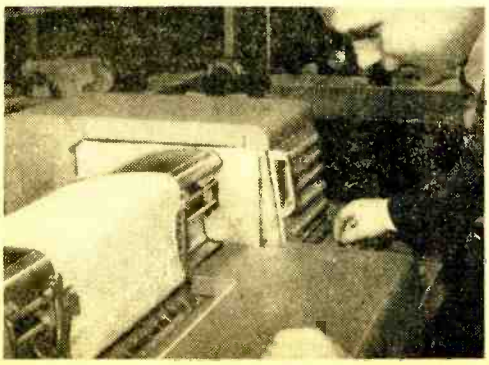
Chassis Components. The tuning capacitor of the radio or tuner sometimes causes intermittent crackling noises in the speaker. This is generally due to the accumulation of dust between the capacitor plates. To eliminate the noise, clean out the entire space between both sets of plates with a pipe cleaner. If the connection to the rotating plates is made by a wiper spring, make sure the wiper is clean and is bearing firmly against the shaft.

Tubes are a very common cause of intermittents. Checking them in a tube tester or tapping the tubes while they are in the set won't always show up the culprit, although checking them in the tester while they are still hot (wear a glove!) may show a "thermal" short or open. Look for glass tubes that are not lit, corroded tube pins, dirt between tube pins and between socket holes, dirty grid caps and loose cap connections, and partially seated tubes.

In a.c.-d.c. battery sets, a frequent cause of intermittent operation is low voltage due to weak batteries, or reduced line voltage resulting from heavy power demands when an air-conditioner or other large appliance is running or when the house lighting load is at a maximum. Low voltage causes the 1.4-volt oscillator tube to become unstable or inoperative. This tube type is very critical, especially as regards filament voltage.

Other causes of erratic operation or intermittent noise include defective speaker leads and connections; and loose tube shields, electrolytic capacitor cans, and transformers making poor contact with the chassis. Occasionally, a picture frame or a table ornament will vibrate audibly with a particular note from the speaker! —30—

High-Speed Printer Teams Up with Digital Computer



High-speed printer, shown at left, spells out results fast when it is hooked up to the output of a digital computer. Developed by Remington Rand, this device is capable of printing 600 lines and up to 78,000 characters per minute. What's more, it retains a record of the data fed to it by the computer. Typical uses of such a system would be furnishing quick weather forecasts, spotting market trends, providing inventories of supplies, estimating the financial status of a business, reckoning positions of stars, and furnishing stress analysis of moving parts.

Sound Impressions

HI-FI LISTENING usually runs strongly toward symphonic music. This doesn't mean that hi-fi fans are born music lovers. The reason is simply that a symphony orchestra is the richest source of varied sound—and sound is the substance of audio.

But beyond its mere sound, music has meaning. Of all types of music, the symphony has perhaps the greatest range of emotional expression and therefore offers the widest field of exploration by listening. For your symphonic safari, the following handful of records would form a kind of road map of the tonal territory as it spreads over the past 200 years.

The Starting Spark. Symphonic music as we know it today started about the time of the American Revolution. It was then that composers like Haydn and Mozart settled the ground rules for symphonic composition: four separate movements, each different in tempo, together forming a balanced whole. The orchestras of the time were small—no heavy brass and not much percussion . . . mostly strings and woodwinds. But their smallness gave them agility which bigger groups could not match. It's something like an MG besting a Cadillac on sharp turns.

That's just what Mozart's music is like: pointed angles, darting lines, with an occasional detour into a slow stretch. Sample Mozart's *Symphonies No. 39* and *No. 41* as played by the New York Philharmonic under Bruno Walter on Columbia ML 5014. The strength and sparkle of their playing is matched by Columbia's sharp but full sound.

More edgy in tone and concept, but beautifully clear and precise, is Antal Dorati's Mercury recording (MG 50121) of Mozart's *Linz Symphony* with the charming *Eine Kleine Nachtmusik* (A Little Night Music) on the other side.

Titan in Tone. Extending the automotive parallel, Beethoven could be likened to a ten-ton truck making way among a flock of flivvers. For one thing, his orchestra sounds bigger and *is* bigger. Horns, trombones and kettledrums are scored with telling force. More important: Beethoven's musical ideas are "bigger," too. Gone are the finely pointed darts of Mozart; Beetho-

(*Continued on page* 116)

PICK OF THE RECORD RACK

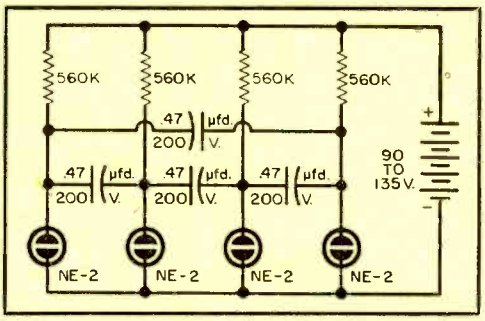
RECORD	PERFORMERS	COMMENT
España Capitol P-8357	Hollywood Bowl Symphony Orchestra Felix Slatkin, conductor	Spain inspired many composers to capture the passion and rhythmic fire of its mood and manner. This disc offers Ravel's famed *Bolero* and *Alborada del Gracioso*, Rimsky-Korsakov's *Capricio Espanol* and excerpts from Albeniz' *Iberia*. These varied evocations of Spain are given a supercharged performance and a recording that suggests the clarity and brilliance of the Spanish noonday sun.
De Falla: **El Amor Brujo, Nights in the Gardens of Spain** Epic LC 3305	L'Orchestre Lamoureux Jean Martinon, conductor Corinne Vozza, alto E. Del Pueyo, piano	More Spanish moods. De Falla weaves rich instrumental and vocal fabrics from folk rhythms and melodies. *El Amor Brujo* tells in exotic harmonies of a girl fearing the ghost of her dead lover until a new live one conquers the evil spirit. The *"Nights in the Gardens of Spain"* are apparently languorous and torpid, stirring with the undertone of excitement.
Les Baxter: **Skins** Capitol T-774	Les Baxter special percussion group	The art of music has always followed the medium through which it is expressed. Now that hi-fi is the main outlet for current musical invention, jazzman Baxter has devised an entertaining and ingenious arrangement of original compositions for a variety of drums to show off the musical and hi-fi possibilities of percussive sound. Fascinating—and technically superb.
Folk Songs, Vols. 1 and 2 Dyer-Bennet Records	Richard Dyer-Bennet, tenor and guitar	Possibly America's finest folk singer in a finely engineered and beautifully sung collection of folk songs from the U.S.A., England, France and Germany. Genuine folk melodies of immediate appeal, far removed from the brash corruptions of Tin Pan Alley.
Milhaud: **Suite Provencal, Saudades do Brasil** Capitol P-8358	Concert Arts Orchestra Milhaud, conductor	Engaging pieces by one of the foremost modern composers. *Suite Provencal* depicts the atmosphere of the composer's native southern France through arrangements of its old tunes. *Saudades do Brasil* does the same for South America, where Milhaud spent part of his life. In their sparkling orchestral guise, these simple folk tunes from two continents make highly rewarding hi-fi material, especially in Capitol's ultra-clean recording.

Sequential Neon Flasher Is Electronic Eye-Catcher

Attractive and inexpensive displays can be made from neon bulbs when they are connected as shown in the diagram at the right. The bulbs will go on and off in sequence.

As the first bulb fires, it charges the adjoining 0.47-μfd. capacitor to a level of about 60 volts. When the charging voltage to the second bulb is high enough to cause it to fire, it drops the voltage on the preceding bulb, thus turning it off. This procedure is repeated in sequence.

The cycling rate is determined by the values of the resistors, capacitors and battery voltage. Larger resistors and capacitors slow the rate. You'll find that power consumption for a four-bulb flasher (such as the one shown) is but a fraction of a milliampere.



—*William A. Scism*

Novel Microphone Utilizes Metal Faucet Connector

An inexpensive metal faucet connector for bath sprays provides the shield and housing for a handy, close-talking crystal microphone. The size and shape of this metal faucet connector is just right for the job, and you can buy it—or order it—from your hardware dealer or plumbing and heating dealer. Ask for a "Dumaco #A-4088 Bath Spray Bulb" (Durst Manufacturing Company, 409 Lafayette St., New York 3, N. Y.).

Force-fit an Amphenol 75-PC1M chassis unit into the small end (hose end) of the faucet connector. To do this, enlarge the opening slightly and twist the Amphenol chassis unit in as far as it will go. Then lay a block of wood on the chassis unit and drive the unit in further.

Now remove the cover on the large end of the faucet connector. Pull out the rubber interior using a pair of pliers and a small screwdriver.

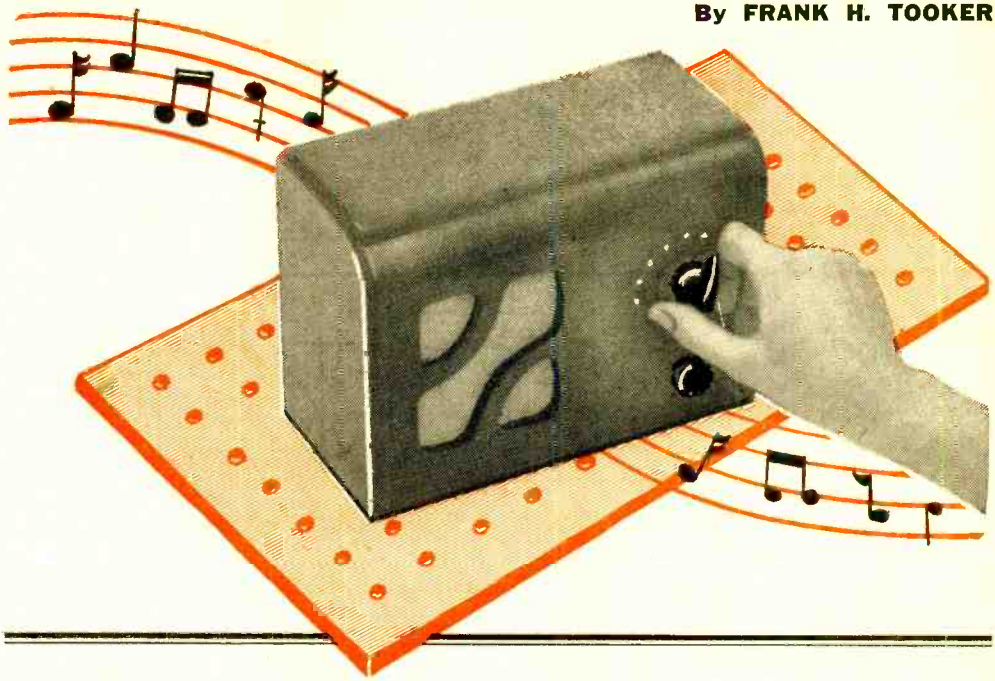
For the mike unit, the writer used a Primo R-200 crystal earphone (Lafayette Radio #MS-111, or Radio Shack Corp., Boston, #R-9021). These sensitive and economical crystal earphones make quite good microphones, but any other crystal or high-impedance magnetic earphone or mike unit can be used instead, provided that it fits into the housing.

Screw off the ear-insert of the crystal earphone and tape the mike unit to the rubber piece that you pulled out of the faucet connector. Be sure that the opening in the rubber piece fits around the opening in the mike unit. Clip off the mike unit leads to a length of about 3", and solder one lead directly to the interior of the metal housing near the chassis unit. Then solder the other lead into the center contact of the chassis unit.

Cut a 1½"-diameter disc from very-fine-mesh brass strainer screen and lay the screen inside the cover of the faucet connector. Now put the mike together and push the cover on the housing, using a little dab of solder here and there, if necessary, to hold the cover to the housing securely.

—*Art Trauffer*

By FRANK H. TOOKER



Building the "Vokar" Superhet

Special kit makes the construction of this transistor receiver simplicity itself

THIS HANDY LITTLE SUPERHET will find ready acceptance in every room of the home. Since it uses transistors and is powered by a self-contained battery of only four inexpensive flashlight cells, upkeep is very low—and there is no dangling power cord to confine it to the outlet. While this set was not designed specifically as a portable, it is small enough and light enough to go along with you on a picnic or a trip to the beach, or anywhere within the normal service area of a broadcast station—without an antenna.

No attempt has been made to miniaturize the setup. Instead, easily available parts were used throughout the receiver, and sufficient space was allowed to wire them into place without burning your fingers.

Construction. The entire receiver fits nicely into a midget table model radio cabinet. All components with the exception of the antenna coil, ganged tuning capacitor (*C1a/C1b*), and volume control (*R13*), are mounted on a 3½" x 6¾" x 1/16" perforated Bakelite board. A rectangular cutout measuring approximately 2¾" x 1" is made in one corner of the board to accept the frame of the speaker.

The dial consists of a series of shallow holes in a 180° arc, filled with white paint. This does away with the task of calibration and gives the cabinet front a modernistic appearance.

A simple bracket of rigid aluminum alloy holds the tuning capacitor and the volume control; the particular bracket used by the author was cut from the side of a discarded aluminum box. The antenna coil, *L1*, is permanently mounted in the plastic case in which it is purchased, and the case

HOW IT WORKS

This six-transistor receiver was designed around the Vokar 5000 i.f. kit, which supplies the tiny but efficient oscillator coil and miniature input, interstage, and output i.f. transformers. These transformers, plus one of Lafayette Radio's new flat ferrite antenna coils (MS-308), give the receiver adequate sensitivity for local reception without the use of an external antenna. Push-pull class-B CK-722's (*TR4* and *TR5*) feeding an efficient 4" speaker provide sufficient audio output.

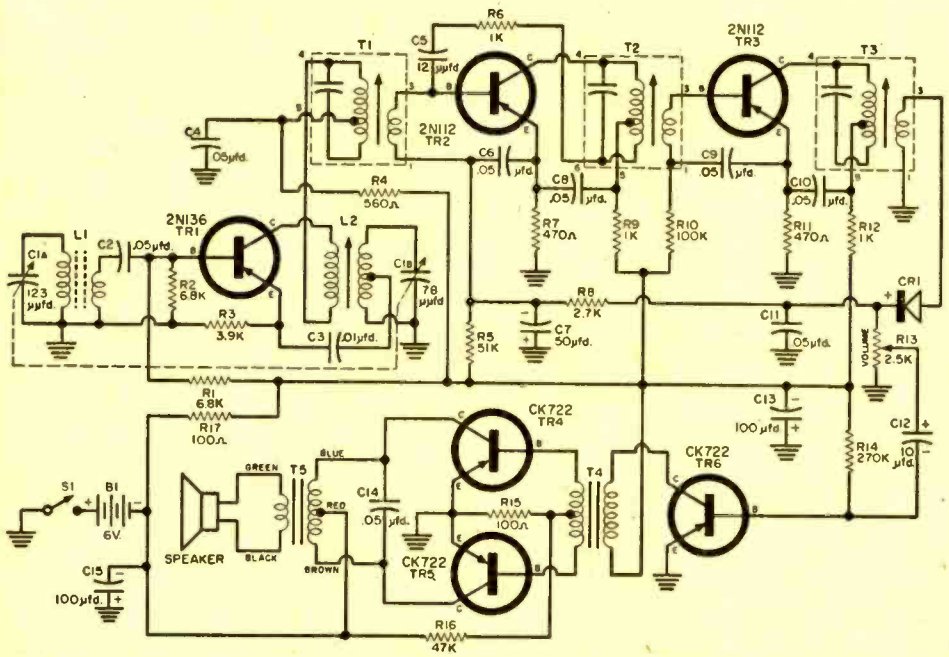
The remainder of the lineup features a 2N136 (*TR1*) as converter in the circuit specified by the manufacturer, a pair of 2N112's (*TR2* and *TR3*) as i.f. amplifiers, and a CK-722 (*TR6*) driver to push the output stage. A germanium crystal diode (*CR1*) occupies the detector position and, at the same time, develops the automatic gain control current which is applied to the first i.f. amplifier.

is then cemented to the inside top surface of the wooden cabinet.

Location of the majority of the parts can be easily seen in the photos. Layout is not especially critical, so no point-by-point wiring instructions are given. The rear portion of the specified ganged tuning capacitor is the oscillator section.

When wiring the receiver, leave as much space as possible under the speaker side of the board, so that there will be sufficient clearance for the four type "C" flashlight cells. These cells are held in place by a Bakelite strip and two vertical brass rods cut from *6-32* threaded stock.

Aligning I.F. Amplifier. Anyone familiar with aligning vacuum-tube superhets will find aligning a transistor set a little annoying. Three fundamentals must be kept in mind: (1) you should begin the align-



B1—6-volt battery (4 size "C" flashlight cells connected in series)
C1a/C1b—Dual, superhet-type, variable capacitor gang; 123-µµfd. r.f. section, 78-µµfd. osc. section (Lafayette MS-261)
C2, C4, C6, C8, C9, C10, C11, C14—0.05-µfd., 200-volt metallized paper capacitor
C3—0.01-µfd. ceramic capacitor
C5—12-µµfd. NPO ceramic capacitor
C7—50-µfd., 6-volt miniature electrolytic capacitor
C12—10-µfd., 15-volt miniature electrolytic capacitor
C13, C15—100-µfd., 15-volt miniature electrolytic capacitor
CR1—1N34 diode
L1—Flat ferrite antenna coil to match r.f. section C1a (Lafayette MS-308)
**L2—Oscillator coil to match osc. section C1b (Votron C-822)*
R1, R2—6800-ohm, ½-watt resistor
R3—3900-ohm, ½-watt resistor
R4—560-ohm, ½-watt resistor
R5—51,000-ohm, ½-watt resistor
R6, R9, R12—1000-ohm, ½-watt resistor
R7, R11—470-ohm, ½-watt resistor
R8—2700-ohm, ½-watt resistor
R10—100,000-ohm, ½-watt resistor
R13—2500-ohm potentiometer volume control, audio taper
R14—270,000-ohm, ½-watt resistor
R15, R17—100-ohm, ½-watt resistor
R16—47,000-ohm, ½-watt resistor
S1—S.p.s.t. switch, mounted on R13
SPKR—4" speaker with 1.47-oz. magnet (Quam 4A15)
**T1—455-kc. transistor i.f. input transformer (Votron T-5001)*
**T2—455-kc. transistor i.f. interstage transformer (Votron T-5002)*
**T3—455-kc. transistor i.f. output transformer (Votron T-5003)*
T4—Transistor audio driver transformer; primary 10,000 ohms, secondary 2000 ohms c.t. (Argonne AR-109)
T5—Transistor audio output transformer; primary 500 ohms c.t., secondary 3.2 ohms (Argonne AR-119)
TR1—2N136 transistor (General Electric)
TR2, TR3—2N112 transistor (Raytheon)
TR4, TR5, TR6—CK-722 transistor (Raytheon)
1—Perforated Bakelite circuit board
1—9⅜" x 6" x 4½" table radio cabinet (Allied Radio 98 S 932)
1—Length of 6-32 threaded brass rod
Misc. hardware, wire, solder, spaghetti tubing, etc.

**Included in Vokar 5000 i.f. kit, available from Vokar Corporation, Dexter, Mich.*

The schematic diagram will show you how to wire the superhet. Parts used are listed above.

ment at the detector (*T3*) and work back to the converter (*L1*); (2) if the two i.f. transistors (*TR2* and *TR3*) are removed from their sockets at any time, be sure to replace each of them in the particular socket it occupied at the time of the alignment (changing transistors, or replacing them with others of the same type, will generally call for a complete realignment); and (3) adjusting the tuning of the output circuit of a transistor will have an effect on the tuning of the input circuit.

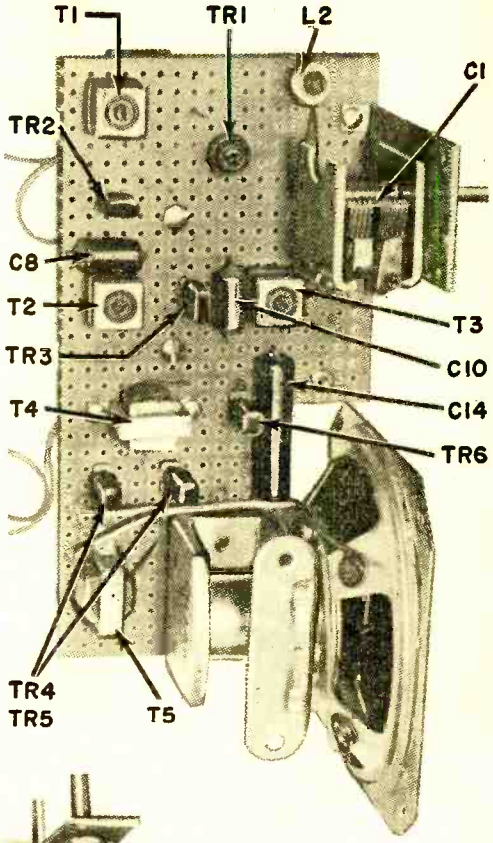
Using an r.f. signal generator with a very low output impedance such as the Heathkit LG-1, feed a modulated 455-kc. signal across the output winding (pins 1 and 3) of the last i.f. transformer, *T3*. The ground side of the signal generator should be clipped to the ground side of the receiver circuit. Feed the "hot" side of the signal generator through a good quality 0.001-μfd. mica capacitor to the junction of *CR1* and pin 3 of *T3*. Adjust the slug at the top of *T3* for maximum loudness of tone in the speaker.

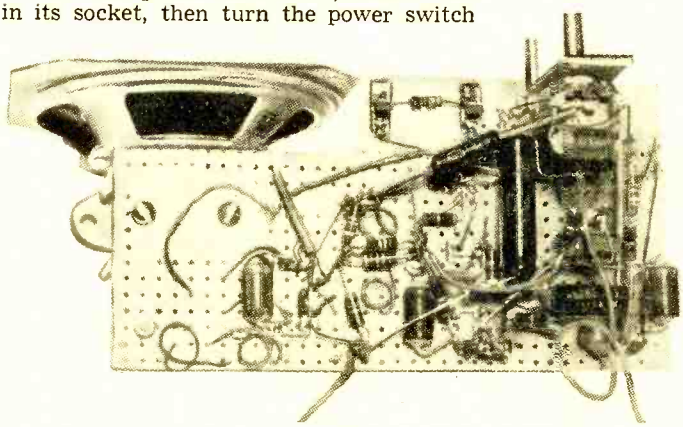
Now, apply the modulated signal to pin 3 of *T2*. Adjust the slug in *T2* for maximum loudness of tone in the speaker. Adjusting *T2* will detune *T3*, so juggle *T2* and *T3* for maximum loudness.*

Turn the power switch off, insert *TR2* in its socket, then turn the power switch on again. Now, apply the modulated 455-kc. signal through the 0.001-μfd. capacitor to the base of *TR2*. Adjust *T1* and then touch up *T2* and *T3*.

Turn off the power switch and insert *TR1* in its socket. Momentarily disconnect *C2* from the secondary winding of *L1*, and short-circuit the plates of *C1b* to disable the oscillator. Turn the power on, and apply a very weak (5 to 10 μv.) modulated 455-kc. signal through the 0.001-μfd. capacitor to the base of *TR1*. With this signal applied, go over the adjustments of *T1*, *T2* and *T3* at least once or twice to make sure all three are in alignment. Then reconnect *C2* to the secondary of *L1* and remove the short circuit from *C1b*.

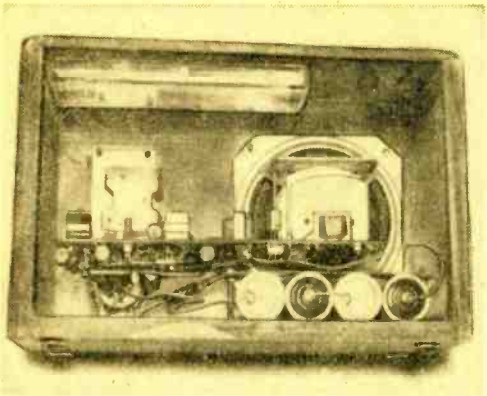
Aligning the Oscillator. Since the receiver is to be tuned over the broadcast band, the oscillator must tune from 1005





Two views of the chassis. Top of chassis, above, clearly shows how the parts are placed on the perforated board. In the bottom view, at left, the superhet is completely wired. No attempt has been made to miniaturize this receiver.

* Check *TR3* at this point to make sure it isn't oscillating. To do this, disconnect *R8* momentarily from *CR1* and connect a VTVM (set at its lowest range) across the volume control. With no signal applied to the base of *TR3*, the meter reading should be zero, and varying the tuning slug in *T2* or *T3* should have no effect whatsoever on the reading. In the event that *TR3* oscillates, or if the adjustment of *T2* and *T3* is critical in your setup, neutralize *TR3* by using a small capacitor and a resistor in series between pin 6 of *T3* and the base of *TR3*. Vokar recommends a 6.8-μμfd. capacitor and a 4700-ohm resistor for this purpose. When check is completed, reconnect *R8* to *CR1*, and realign *T2* and *T3* in the manner previously described.



Loop antenna is mounted in a plastic box attached to top of wooden cabinet on the inside. Batteries are taped together and soldered in series to provide a 6-volt power supply; they are visible in the lower right-hand corner of the cabinet.

to 2055 kc. Turn the power off, and turn the plates of the ganged tuning capacitor (*C1a*/*C1b*) to where they are fully meshed. Using a grid-dipper, adjust the slug in the oscillator coil, *L2*, for a dip at 1000 kc. Change grid-dipper coils, turn the plates of the tuning capacitor full out, and adjust the trimmer on *C1b* for a dip at approximately 2055 kc. Go back and readjust the slug in *L2* at 1000 kc. with the tuning capacitor plates fully meshed. Then touch up the trimmer on *C1b* at 2055 kc. with the tuning capacitor plates fully unmeshed.

Final adjustment of the oscillator range should be made with the receiver turned on. To do this, lay a wire from the "hot" output side of a modulated signal generator at approximately an inch or so from the "hot" side of antenna coil *L1*. Set the signal generator at 550 kc., and, with the plates of *C1* turned full in, adjust the slug in *L2* until the signal generator tone is heard in the speaker. Now, turn the plates of the receiver tuning capacitor full out, set the signal generator at 1600 kc., and adjust the trimmer on *C1b* until the tone is heard in the speaker. Then adjust the trimmer on *C1a* for maximum loudness of tone at about 1400 kc. Set the signal generator at 1400 kc., turn the receiver tuning knob until the tone is heard in the speaker, and adjust *C1a*.

You should now be able to pick up the local broadcast stations on your receiver. Tune in a moderately weak one near the center of the band, and go over the adjustment of the slugs in *T1*, *T2* and *T3*, for maximum loudness of reception from the speaker. -30-

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Vokar now has two more kits available using this circuit. Kit No. TC-6 contains not only the i.f. transformers, but tuning capacitor and bypass capacitors as well. Kit No. TC-6T has all of the above plus the transistors needed to make the receiver work.

The Editors

POSSIBLE TROUBLES—and CURES

No Reception. If you have this kind of trouble, turn off the receiver at once. Make sure all transistors are in the proper sockets—it's easy to forget and insert them in their sockets in the wrong direction. The red dot on the transistor identifies the collector lead. Check all wiring and alignment of the i.f. amplifier. Then check the tuning capacitor to make sure one of the rotor plates is not bent and rubbing against a stator. Make sure the battery is wired in with the proper polarity. If the polarity has been accidentally reversed, you may need a whole new set of transistors.

Motorboating. If low-frequency oscillation or motorboating occurs, check C13 and C15 to make sure that they are wired in with the proper polarity. If they are, check the capacitance of these two units, or replace each in turn with a spare capacitor of the same ratings. Do the same for C7. Also check the condition of the battery. Make sure the two audio transformers, T4 and T5, are wired in the circuit according to the color code.

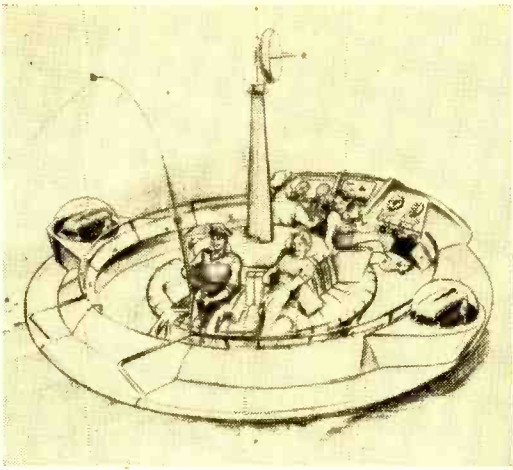
Squealing. First make the checks given under "Motorboating." Squealing may have at least two other causes, however: (1) oscillation in the i.f. amplifier; or (2) superregeneration in the oscillator portion of the converter. In the latter case, squealing will probably be noticeable only near the high-frequency end of the broadcast band. The second i.f. stage may require neutralization, or a slightly different value of C5 or R6 may be needed in the first i.f. amplifier stage. However, don't alter the value of these components until after you are positive that this stage is oscillating.

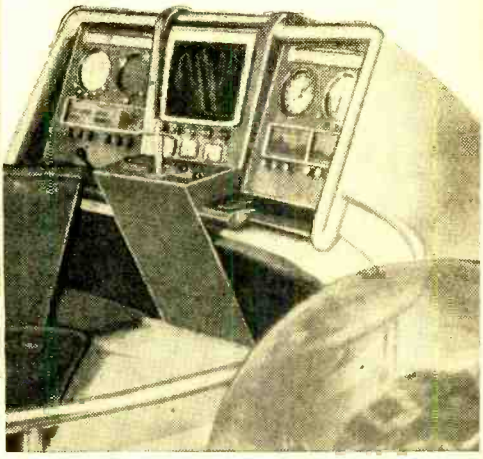
If squealing develops only near the high end of the broadcast band, it is probably due to excessive feedback in the converter. If you have a second 2N136, try it at TR1. A 2N113 may also be used here if you happen to have one at hand. As a last resort, try various values of capacitance across pins 4 and 6 of the oscillator coil. Alternatively, try various values of capacitance across R3. Either of these two expedients will shift the tuning range of the oscillator.

Distortion. If you obtain distorted reception, check all possible combinations of the three CK-722 transistors in the output stage. Actually, the two output transistors should be as closely matched as possible for minimum distortion. Try increasing or decreasing the value of R15 slightly.

Distortion which is developed in the detector stage may be due to a poor diode, CR1, or to a defective coupling capacitor at C12. Also, make sure that C12 is wired in the circuit with its positive lead connected to the center terminal of the volume control.

"Subsea Control" for Boat of Tomorrow





Sea-going computers, color television, and other advanced electronic devices for providing and recording information form "Subsea Control," a futuristic nerve center for the "Fisherman," a boat projected by the Evinrude Motors Div., Outboard Marine Corp., Milwaukee, Wis.

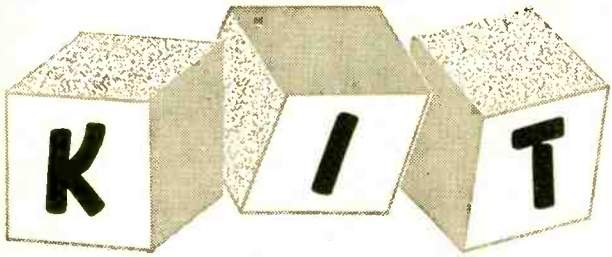
The Subsea Control was conceived and designed by Oliver Read, Publisher of POPULAR ELECTRONICS and RADIO & TV NEWS, and by Norman Eisenberg, Feature Editor of POPULAR ELECTRONICS. The model—installed in the striking circular Evinrude boat—has been seen by thousands at boat shows across the nation.

Subsea Control would present a continuous flow of valuable audio and visual information that could remove much of the guesswork from fishing, navigation, and underwater studies. As shown in the photo (above, right), the operator would have before him radar and sonar indicators, color television screen, compass rose, depth-sounding recorders, glow-type graph indicators, loudspeaker, a 16-segment navigation-direction channel indicator, and test meters. The data provided by this array would furnish, in effect, a complete "sound-movie" of the world beneath the waves, supplemented by valuable statistical data.

The boat itself (above, left) designed by Brooks Stevens, Milwaukee industrial designer, features twin engines, powered steering comparable to that of a twin-screw ocean liner, complete maneuverability, and a parasol-type canopy that can be folded—when not in use—against the radar mast projecting from the center.

Twenty-Year Battery

The tiny device held by the girl at left is actually a 95-volt battery with a projected shelf life of 20 years. Developed by G.E., it is designed for high voltage-to-volume requirements and long storage or standby service. It employs a solid electrolyte, is cylindrical, axial-leaded, measures $31/32$" long by 0.335" in diameter, and weighs 0.15 ounce. Uses include: charging capacitors for "one-shot" or intermittent applications; bias supply for high-impedance circuits such as those utilizing neon lamps or photomultiplier tubes; and furnishing low currents to circuits employing electrometer tubes or ionization devices. Price is $12.50. Further details are available from the Specialty Electronic Components Department, General Electric Company, West Genesee St., Auburn, N. Y.



BUILDER'S KORNER

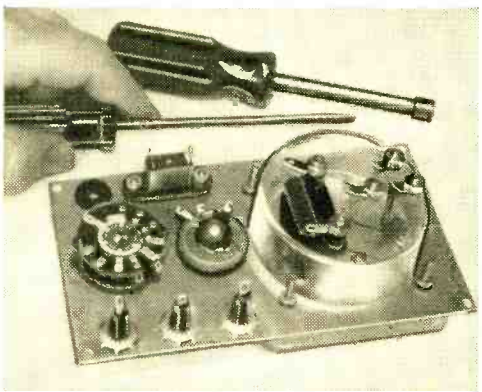
EICO 540 Kit "Redi-Tester"

WHAT DO YOU DO when one of your household appliances goes "haywire"? If you're an oriental potentate, you simply clap your hands and nod in the direction of the offending item. If you're a billionaire, you probably tell your secretary . . . who tells your business manager . . . who informs your chief maintenance engineer . . . who either (a) sends an electrician to fix it or (b) calls an outside repair firm to pick up the item. But if you're neither of these, chances are you'll try to fix it yourself. And, if you do, you'll find the Eico Model 540 REDI-TESTER a useful aid.

THE MODEL 540

Like most of the instruments manufactured by the Electronic Instrument Company (Eico, 84 Withers St., Brooklyn 11, N. Y.), the Model 540 REDI-TESTER is available either as a "do-it-yourself" kit ($12.95) or as a factory-wired unit ($15.95). You can use it to check line voltages, circuits for leakage, resistance, currents, and battery voltages.

The Model 540 is a multi-range instrument with voltage ranges of 0-7.5, 0-15, 0-150 and 0-300 volts, a current range of 0-15 amperes, and a 0-1000 ohm direct-reading resistance range. Using a 3½" meter, it has a deep-etched brushed aluminum panel and is fitted into a black Bakelite case measuring 3¾" x 6½" x 3½". Total weight of the instrument, including its batteries (used for ohmmeter checks) is only 3½ lbs. A pair of test leads is included.

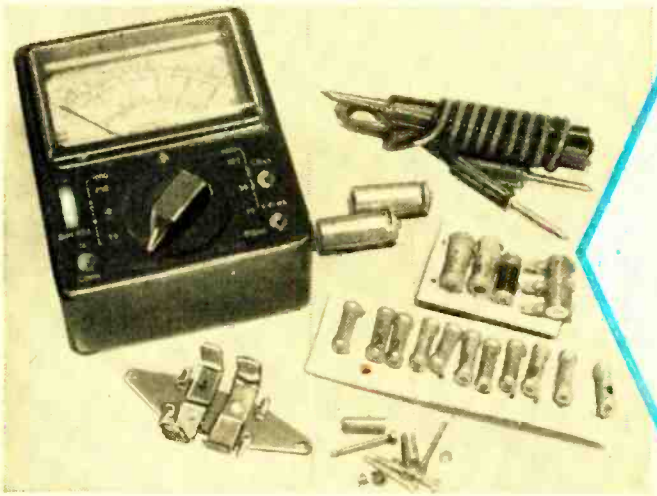


Mount all parts of the Model 540 before wiring.

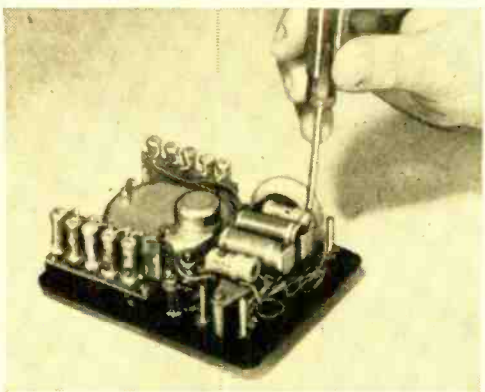
Putting It Together. One of the first things you'll notice when you open the kit is that two instruction manuals are provided. One is a conventional instruction booklet, as is often furnished with any test instrument . . . it gives the basic specifications of the instrument and tells how to use it in typical applications. The other is a large "fold-out" instruction sheet which

gives step-by-step assembly instructions and includes pictorial diagrams.

Take special pains when soldering around the meter . . . its clear plastic case can be damaged by excessive heat . . . and meters are expensive! You'll also find it good practice to check each wiring step twice. Check *before* you install a wire or part to make sure you understand the step and that you are using the right part. Check *after* each step to make sure you haven't erred . . . it's easier to correct a mistake during wiring than after all work is done.



Lafayette KT-20 "Semi-Kit" Multitester



Final assembly of the Model KT-20 multitester.

Special Features. The Model 540 REDI-TESTER is designed especially for home appliance and auto servicing. It is *not* a general-purpose multitester for electronics work. However, in its intended application, it is hard to beat. For one thing, all voltage and current ranges are a.c./d.c.—not a.c. *or* d.c.; it measures both alternating and direct voltages (and currents) with the same range selector setting, the same test leads, and using the same jacks. So you don't have to worry about the *type* of voltage you're measuring or, if it's d.c., about its polarity.

The instrument permits direct reading of power line voltages in two ranges, 0-150 and 0-300 volts, by means of an attached line cord and plug. When plugged into a power receptacle, up to 15 amperes may be drawn from a built-in, panel-mounted outlet, with power consumption indicated on a 0-1.5 kw. scale. "Good-Bad" scale indications are provided for checking 6-volt and 12-volt auto batteries, and there is an additional scale marking for checking the individual cells of the batteries.

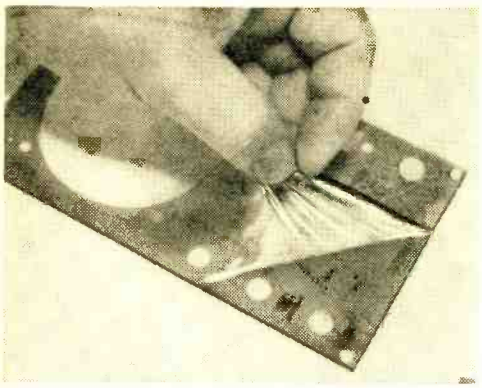
A neon lamp a.c. leakage test circuit permits continuity checks of resistors between 1000 and 2,000,000 ohms and capacitors above 0.005 μfd. The "leakage test" circuit is also useful for checking filament continuity and interelectrode leakage in radio receiving tubes.

Comment. If you're an auto mechanic, electrician, building maintenance man, or appliance repairman, you'll be able to use the Model 540 REDI-TESTER in all your work. And even if you're none of these—just an ordinary householder with a small touch of the "do-it-yourself" attitude, you'll find it pleasant to have around.

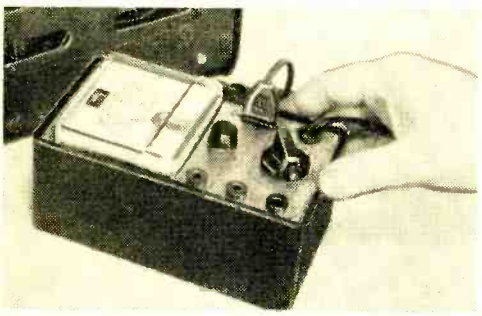
There is only one criticism we could make . . . replacing the batteries might be a chore, since the cells are individually wired in series. If care isn't taken to avoid overheating during this operation, battery life could be shortened considerably. We would prefer "clip" type mounting.

THE KT-20 "SEMI-KIT"

If you asked a dozen electronics technicians or radio-TV servicemen what they considered to be the *second* most important test instrument in their laboratories,



The front panel of the Model 540 is protected by a thin sheet of plastic film. This prevents damage to the engraving and lettering in shipment. It is peeled off as one of the last assembly steps. Below, the completed unit is being used to check the power requirement of a small radio.



chances are that you'd get at least two—and perhaps as many as a dozen—different answers. Some would feel that the signal generator was the second most important . . . others would favor the oscilloscope . . . and still others might lean towards the tube tester. But if you asked the same people what they considered to be the *most important* test instrument, there's a good chance that all twelve would agree on the volt-ohm-milliammeter—or *multitester*.

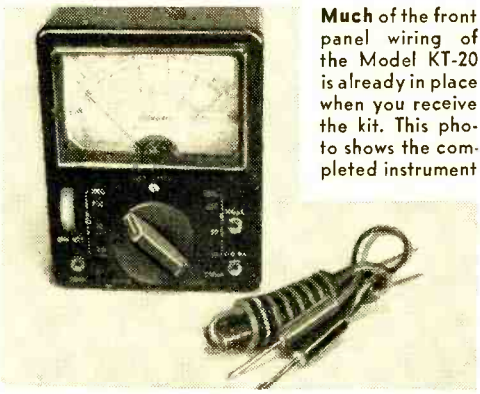
There are many good multitesters available to the electronics worker, both as kits and as factory-assembled and tested instruments. But this month we will review a unique approach to electronic kit design—the Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) Model KT-20 multitester "Semi-Kit." It assembles into a multirange volt-ohm-milliammeter with a d.c. sensitivity of 20,000 ohms per volt and an a.c. sensitivity of 5000 ohms per volt.

You may wonder what we mean by the expression "ohms per volt." This is a measure of the sensitivity of a multimeter or voltmeter and indicates the number of ohms of input resistance for each volt in each range. For example, with a rating of 20,000 ohms/volt, the instrument has an input resistance of 20,000 × 10 or 200,000 ohms on the 10-volt range. Similarly, on the 50-volt range, it has an input resistance of 20,000 × 50 or 1,000,000 ohms.

Putting It Together. There seems to be a surprising scarcity of parts when you first open the KT-20 kit. Actually, this multitester has just as many components as any multirange test instrument. The apparent lack of parts is due to the fact that the kit is *partially pre-assembled* . . . hence the name "Semi-Kit."

The meter movement, ohmmeter rheostat and knob, selector switch and knob, tip jacks, a.c. rectifier, and resistor terminal boards are already in place on the instrument's front panel. Part of the wiring, including the majority of the connections to the selector switch, is already completed. And the test leads are already assembled! Your job, then, is to mount the meter multiplier and shunt resistors, and to assemble and install the battery mounting board.* Finally, you connect a few short leads.

If you've wired compact radios, hearing aids, or other miniature equipment, you



Much of the front panel wiring of the Model KT-20 is already in place when you receive the kit. This photo shows the completed instrument

shouldn't have any trouble assembling the KT-20 multitester in a single evening. On the other hand, if your assembly experience has been confined to larger equipment . . . or if you're a beginner . . . you may find it best to spread out the work over several evenings, or even to devote an entire weekend to the project. Wiring in "tight places" can be tedious unless you've had some experience.

Special Features. The assembled KT-20 multitester provides a.c. and d.c. voltage ranges of 0-10, 0-50, 0-250, and 0-1000 volts.

(*Continued on page* 119)

* There is an optional construction step. A small adjustable *calibration resistor* is furnished with the kit. As normally assembled, the instrument has an accuracy of ±3%. However, if you want greater accuracy, you can install and adjust this resistor to give an accuracy of ±2%. Since this increase in accuracy is negligible for most practical work, the resistor was omitted from the test model shown in the photographs.

Don't Dig Those Crazy Worms

Let electronics flush them out of the ground

YOU CAN SAVE your back as well as your buck and get fresh worm-bait with no digging and no great expense by using one of the electronic "Worm-Turners" described here. A worm-turner warms the worms—in fact it makes things so hot for them that they quit their earthy diggings and sidle right to the surface where you can snake out an eager hand and scoop 'em up at will. The ladies giggle, the worms wriggle—and you'll have all the fish-bait you'll need.

Before you conclude that your POP'tronics staff has blown its collective cork, take a look at the photos and diagrams shown here. You'll admit there's a new angle for an old angler, and if you'll pardon our puns, you'll see that it's more fun and a lot easier to dig these simple circuits than to break soil as a preface to summer fishing.

All you need is a lawn and a 115-volt a.c. power source. When current from this source passes through a ground probe, the worms in the area of the probe will crawl to the surface. It is assumed that the worms experience a mild shock caused by the IR (voltage) drop in the earth. Regardless of the reason, this method will bring worms to the surface in a jiffy.

CAUTION

Do not attempt to modify either of these circuits. If wired according to the schematics, they will provide adequate protection from the LETHAL 117-volt a.c. household line.

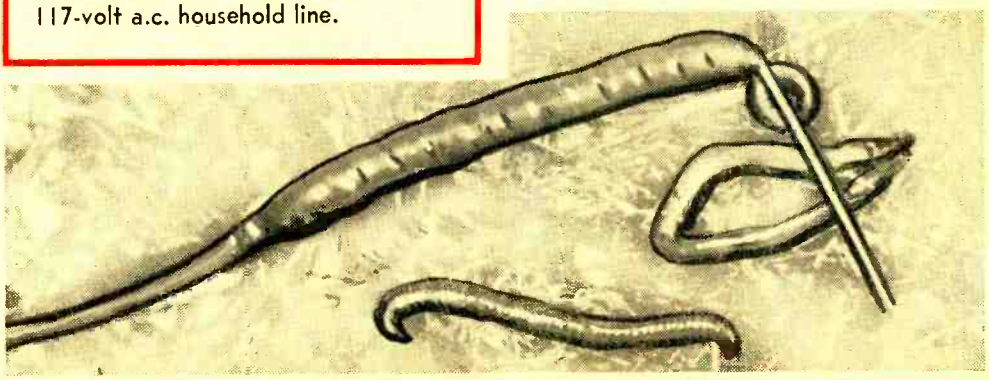
WORM-TURNER NO. 1

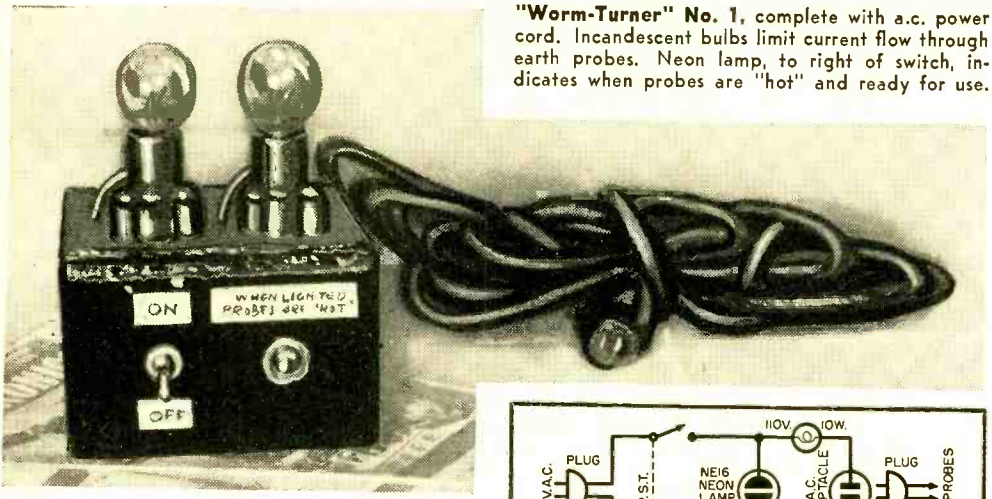
By R. Wayne Crawford

The safety factor is the biggest problem involved in the use of house current. One side of the a.c. line is "hot" to ground. Obviously, if this side of the line were grounded directly, the house fuses would blow. The circuit used here limits the current flow through the probes. The entire unit is built in a 3" x 3" x 5" wooden box; wood was used in this case because of its insulating properties.

When the d.p.s.t. switch is in the "off" position, both sides of the a.c. line are open. The purpose of the 10-watt lamp bulbs is to limit the current through the

"Worm-Turner" No. 1 in action. Probes (two are used) are inserted into the earth. The a.c. energy they shoot into the ground causes worms to rise.





"Worm-Turner" No. 1, complete with a.c. power cord. Incandescent bulbs limit current flow through earth probes. Neon lamp, to right of switch, indicates when probes are "hot" and ready for use.

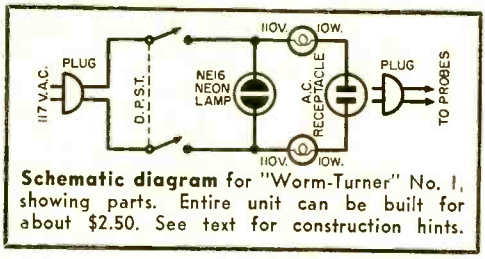
ground probes. The neon lamp lights when the switch is in the "on" position, indicating that the probes are "hot." Use of a lamp in series with each line eliminates the problem of trying to identify the "hot" line.

The probes can be constructed from any fairly stiff, thin, metal rod. The writer used two wire coat hangers with the enamel sanded off. Each probe should be about 15" long. One end of each probe should be filed to a point and a 10' or 12' length of rubber insulated wire soldered to the other end. About four inches from the soldered joint, make a 90° bend in the rod. Wrap this section well with rubber tape. It will serve as a handle for forcing the probe into the ground.

A standard a.c. plug and receptacle may be used to attach the wires from the probes to the unit. Connect the unit to the power source with a rubber-covered line cord. A long cord will give you greater freedom of movement about the lawn.

To use this worm-turner, push the probes into the ground to a depth of a foot with the two probes approximately three feet apart. Turn the switch to the "on" position. If the moisture content of the earth is about average, one of the lamps should light. Within a few minutes the worms will start crawling out of the ground in the area of the "hot" probe. When you find that no more worms are crawling to the surface, turn the unit off and move the probes to another location. *Don't take any chances by moving the probes when the unit is turned on.*

If the earth is exceptionally dry, water a section of the lawn before starting. The current flow will now be greater between the two probes and, since the lamps are in series, it may be necessary to use larger wattage lamps to obtain satisfactory results.



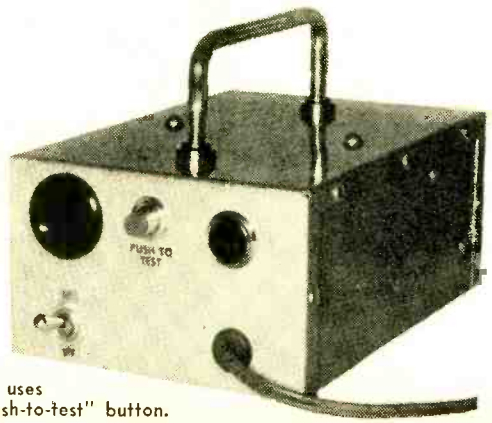
Schematic diagram for "Worm-Turner" No. 1, showing parts. Entire unit can be built for about $2.50. See text for construction hints.

WORM-TURNER NO. 2

By J. E. Pugh, Jr.

Worm-Turner No. 2 also depends on a surge of a.c. through the ground to jolt the worms to the surface. Details on its construction may be seen in the accompanying photos and diagram.

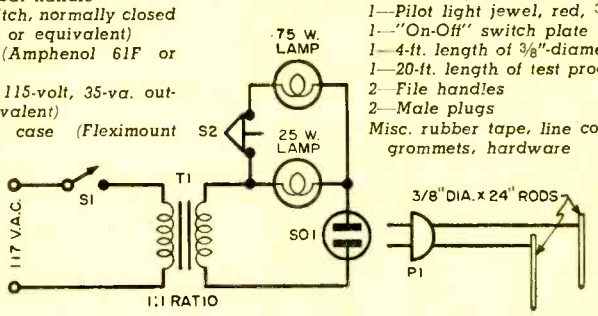
All parts fit nicely in a 3" x 5" x 7" aluminum box, but they should be located with care as they must be closely spaced. The transformer is centered in the box for good balance when the unit is carried. The lamp sockets should be made of Bakelite and



"Worm-Turner" No. 2 (at right) is more elaborate, uses isolation transformer. Note carrying handle and "push-to-test" button.

S1—S.p.s.t. toggle switch, bat handle
S2—S.p.s.t. push-button switch, normally closed contacts (Switchcraft 102 or equivalent)
SO1—Female receptacle (Amphenol 61F or equivalent)
T1—Isolation transformer, 115-volt, 35-va. output (Triad N-51X or equivalent)
1—3" x 5" x 7" aluminum case (Fleximount 29433 or equivalent)

1—Handle (USECO 1020 or equivalent)
1—Pilot light jewel, red, 3/4" diameter
1—"On-Off" switch plate
1—4-ft. length of 3/8"-diameter rod
1—20-ft. length of test prod wire
2—File handles
2—Male plugs
Misc. rubber tape, line cord, rubber grommets, hardware



Schematic diagram and parts list for "Worm-Turner" No. 2. Refer to photo, below, right, for hints on wiring this unit.

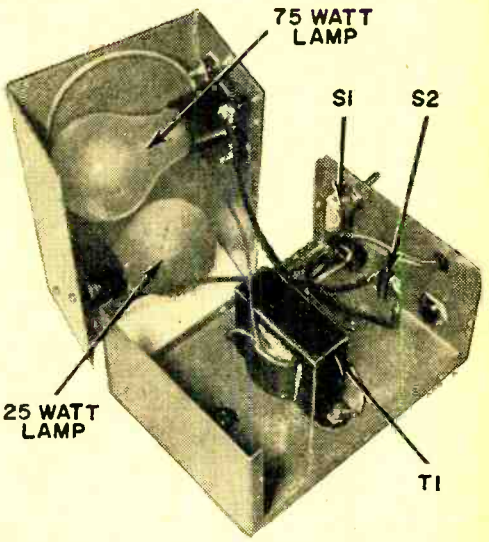
their mounting bases must be shortened to about 1/4" thick to provide space for shock mounting. Clip two rubber washers, 3/32" to 1/8" thick, on each mounting screw for this purpose. Use flexible wire such as test prod wire for connecting chassis parts between the two halves of the case. These wires should be long enough to permit the case to be opened if the lamps ever need to be replaced.

The probes are made of 3/8"-diameter rods about 2 feet long. Fit the upper end of each probe into an inexpensive file handle and then attach the wire (about 10' of test prod wire) near the handle. After this, tape the rod with rubber tape near the handle to lessen the chance of shock. The photo shows the probes both before and after being taped. The end opposite the handle is ground down to a point to make it easy to push into the earth.

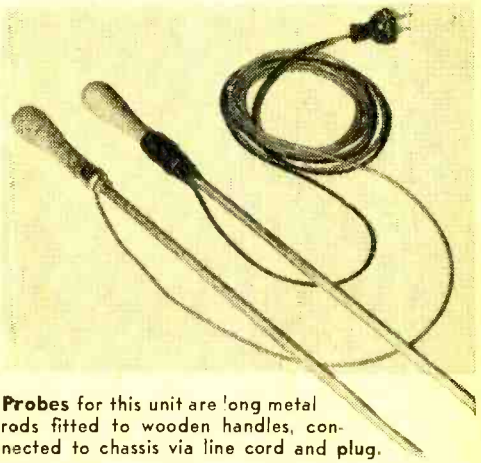
When *S1* is closed, line voltage (117 volts a.c.) is applied to isolation transformer *T1*, which in turn supplies 117 volts to output receptacle *SO1*. The two parallel lamps in series with the load will indicate if the probes become accidentally connected together, and under such conditions they place a limit on the maximum current through the transformer. This current is permitted to be somewhat above the transformer rating since excessive loading will ordinarily be only momentary.

In addition to the above, the smaller lamp is used to indicate that the probes are functioning properly. During normal operation, the load current is sufficient to cause the 25-watt lamp alone to glow with a medium brightness, but it is not great enough to light both lamps. Thus, switch *S2* is provided so that the 75-watt lamp can be switched out of the circuit for testing.

To use, push the probes into the earth 5' to 10' apart. Throw switch *S1* on and then press test switch *S2*. The 25-watt lamp should glow dimly, indicating that the system is working. Wait a few moments and then start picking up the worms. As with Worm-Turner No. 1, if the earth is very dry, it may help to spray it with water before inserting probes. —30—



Positions of parts in "Worm-Turner" No. 2. Note that carrying handle is mounted on obverse side of same chassis section which mounts the transformer.



Probes for this unit are long metal rods fitted to wooden handles, connected to chassis via line cord and plug.

Hellishcopter

By Carl Kohler

WHEN THE anguished tones of the Elvis Presley recording suddenly faded from the speaker in my workshack, I knew company was coming—most likely with the usual pot of coffee and a consuming curiosity. Calmly, I made a few last adjustments on my latest electronic triumph and awaited the judgment committee of one.

It took her exactly three minutes and twenty seconds to turn off the record player in the music room, stop in the kitchen

. . . Without warning, she all but threw the transmitter at me. I grabbed, missed, and the unit smashed to the ground. "Why did you do that?" I yelped . . .

for the coffee, walk from the house to my workshack and knock on the door.

"Couldn't stand any more of that male Banshee's adenoidal wailing, eh?" I said, admitting the wife into my private sanctum of scientific puttering. "Why you bought those absurd recordings is completely beyond—"

"It happens," she said coldly, "I *like* his singing."

"If that's singing, let's go down to the dog pound and hear some group stuff some time," I snickered. "I've heard better tonality from Air Alert Sirens and I—"

"What in the world is that?" She pointed to my newly built project on the floor.

"Oh, that happens to be the little marvel which is only going to walk off with all the awards when my R/C Plane Club holds its Competitive Meet next week," I said casually. "When they see *this* baby—"

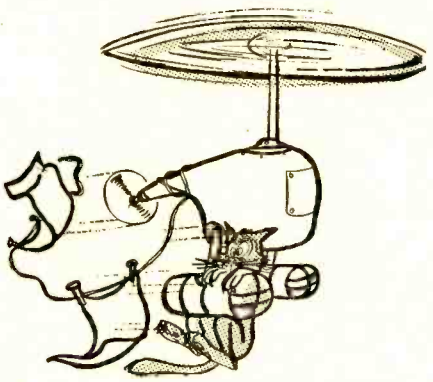
"First plane I ever saw without wings."

"It's a whirlybird type—you know, helicopter." I ran a fond hand over its smooth fusilage. "Whole thing only weighs twenty pounds, including the modified, aluminum-cast lawn-mower engine which powers it. It carries a quart tank of a special fuel, which I got from the kids who run the hot-rod strip on the edge of town, and it can stay airborne for almost an hour, according to my calculations."

"How do you steer it?" she asked.

"With R/C control of these adjustable blades on the larger rotor." I smiled into my coffee. "My tone control system modifications—somewhat along the line of what would be conventional elevator-control—are something a notch below sheer genius! According to my schematics, this baby'll—"

"You keep saying 'according to your plans,'" she said skeptically. "That means you haven't actually flown this misbegotten gizmo yet." An expression of mingled worry



. . . Suddenly the whirlybird appeared—a large and scrawny tomcat clinging to a pontoon . . .

and suspicion flooded her face. "How do you know it won't go berserk—like some of those other nutty R/C nightmares you turned loose?"

"Impossible!" I chuckled. "I've checked

(*Continued on page* 98)

By LEONARD FELDMAN

Playing a prized old record on today's wide-range hi-fi equipment can be fun, but—

Should it Hiss? Should it Rumble?

Photo courtesy Kierulff Sound Corp.

A FRIEND heard that we had a hi-fi system second to none, and decided to bring over some of his old, treasured 78-rpm records. He had been told that hi-fi could practically bring Caruso back to life. We started one of the ancient discs, and there followed a combination hiss-static effect that all but masked the great tenor's tones. "If that's hi-fi," said our friend, "I'm going back to my old model phonograph. I never heard any of that noise before!"

Those who have tried to play old records on new hi-fi systems have probably had a similar experience. The reason for it is simple. High fidelity, with its wide frequency response, does bring out the brilliance of high-pitched musical tones. But—at the same time—it reproduces record surface noise much more than a limited frequency range or "lo-fi" phono ever did. And there is plenty of noise on the older shellac recordings—caused by the manner in which they were made, the material of which they were made, and the type of heavy and often blunted pickups which were employed during playback when those records were new.

Still, many listeners own quite a collection of such discs. The question facing them is how to use their new hi-fi systems to hear the music on those records but not the accompanying noise.

What Is Scratch? What we call "scratch" is not a single tone, but a mixture of tones of varying intensity and pitch. The only sure thing about "scratch" is that it consists mostly of high frequencies. Hi-fi equipment, noted for its ability to reproduce musical overtones, will reproduce the high-frequency noise spectrum as well.

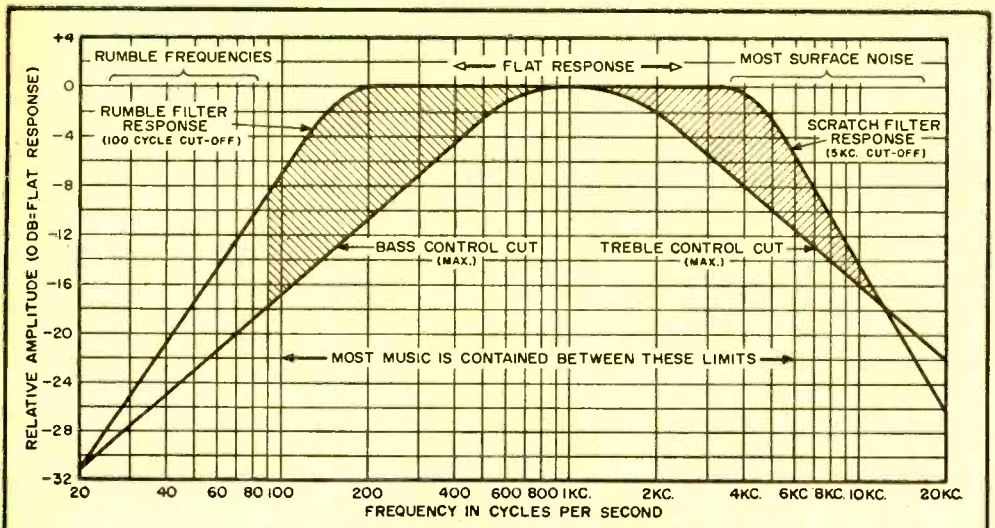
Now, at the other end of the frequency band are the low-frequency noises, caused chiefly by rumble from an imperfect record changer. In "lo-fi" systems using less expensive amplifiers, this rumble may go unnoticed because the amplifier and/or speaker is incapable of reproducing it. With better equipment, however, the rumble becomes a nuisance, especially during quieter passages of music.

Even when the rumble is so low-pitched that you can't hear it, it can still add distortion to the music. The speaker cone may vibrate very slowly, due to the rumble signal, while the regular program material is being superimposed on it. As a result, certain musical notes are reproduced by a distended speaker cone, causing subtle distortion which can give rise to "listener fatigue."

Tone Controls and Noise. Ideally, it would be nice if we could filter out the noises without filtering out any of the music along with them. Practically, this is not possible. Although we can design circuits to get rid of any frequency or group of frequencies, those circuits have no way of knowing whether they are blocking out musical tones or extraneous scratch and rumble.

The next best thing would be to eliminate as much of the objectionable noise and as little of the program content as possible. The graph on the next page shows why this cannot be done with conventional tone controls. It's true that rotating the treble tone control counterclockwise will get rid of the surface noise, but at the same time, it will cut down on the brilliance of musical overtones. Much of the color of the violins, triangles and flutes will disappear.

Nearly all tone controls have a slow rate of attenuation. In other words, to get a



Graph shows comparison between the action of tone controls and that of properly designed filters for reducing noise caused by scratch and rumble. Note how much useful program material (represented by shaded areas) is lost when using tone controls for this purpose.

substantial decrease in intensity of tones at around 10,000 cycles, the control is so arranged that some decrease of intensity is already taking place at frequencies as low as 1000 or 2000 cycles. This is an ideal arrangement where tone controls are being used to compensate for the differences in room furnishing, loudspeakers, etc., for anything other than a gradual change of response would sound artificial. But when surface noise is the problem, tone controls just don't act as "steeply" as they should.

The same situation applies to the bass tone control which might, at first glance, seem like the way to combat turntable rumble. Again, the rumble will be eliminated or reduced, but so will the sonorous tones of the bass fiddles and the thundering crash of the kettle drums.

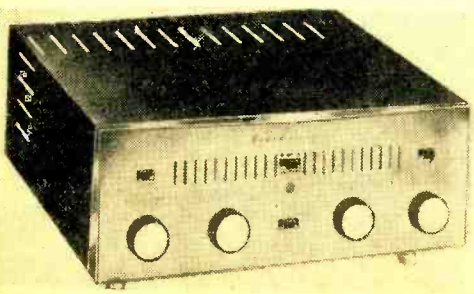
Filters Cut Sharply. There are two basic differences between filters and tone controls. The former circuits have relatively flat or uniform response up to a given frequency, known as the cutoff point in the case of low-frequency rumble filters. As a result, *most* of the program content (which occupies the middle frequencies primarily) is retained in its entirety, while the extremely high noise and low rumble frequencies are rapidly and substantially blocked out. The graph illustrates the expected action of a pair of filters and illustrates how much program content would be lost if the same thing were attempted using conventional tone controls.

Actually, in the case of old 78-rpm recordings, there was very little program content above 5000 cycles in the first place, so practically nothing is lost by introducing such filters except the scratch itself.

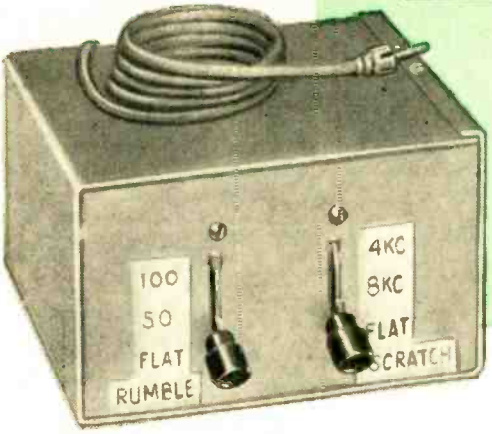
Commercial record scratch filters usually have three or more settings (including a "flat response" setting). This means that the new, better grade recordings can be played "wide open," while older discs can be reproduced with just a slight amount of filtering to remove that edge of hiss. The very old "collector's items" can be played with maximum filtering to cut out all the old scratch and noise.

Similarly, rumble filters have several settings to take care of different degrees of rumble. The idea is to use the least amount of filtering necessary for pleasant reproduction in both cases. Starting on page 77 you will find complete details on how to build a combination rumble-and-scratch filter which can be easily installed in your hi-fi system. —30—

Some amplifiers, like Bogen DB-115, incorporate switch-controlled filters. Details on building your own filter are given on the following pages.



Build Your Own Hi-Fi Filter



By LEONARD FELDMAN

Outboard unit adds finishing touch to hi-fi amplifier not equipped with switched filters

INCLUDING a combination record-scratch and turntable-rumble filter in your hi-fi system provides you with a double guarantee. It means that you can enjoy your old records with a minimum of noise. It also means that you'll be able to enjoy your present records when *they* reach old age, or when your record player begins to rumble and you're not yet ready to replace it with a new one.

Many commercially available preamplifier-control units have these filters already built in. But older or less costly equipment may not. Actually, it is a lot easier to include an "outboard" type of filter, such as the one to be described, than to try to design one into an existing circuit.

This unit can be used between any preamp and any power amplifier. The output of the preamp will be connected to the input of the filter, and the output of the filter plugs right into the input of the power amplifier. If you have an all-in-one preamp-amplifier combination, that's no problem either, as will be shown later.

How Much Filtering? Quite a bit of experimenting with old and new records was required to decide on the cutoff frequencies for the scratch filter portion of this circuit. We finally decided that two settings of filtering other than the normally flat response setting would do the trick. The first cutoff was set at 8000 cycles, and is intended for use with somewhat older microgroove recordings that are beginning to develop a definite "hiss." The second setting starts "cutting out" frequencies at about 4000 cycles and is intended for old 78-rpm recordings which have quite a bit of scratch and noise.

The rate of cut was designed to be 12 decibels per octave. This means that at the 4000-cycle setting of the scratch filter response will be relatively flat up to 4000 cycles, whereas 8000-cycle noise will be reduced by a ratio of 4 to 1, with even higher frequencies reduced still further. This "rate of cut" is about twice that possible with regular tone controls whose action is much more gradual.

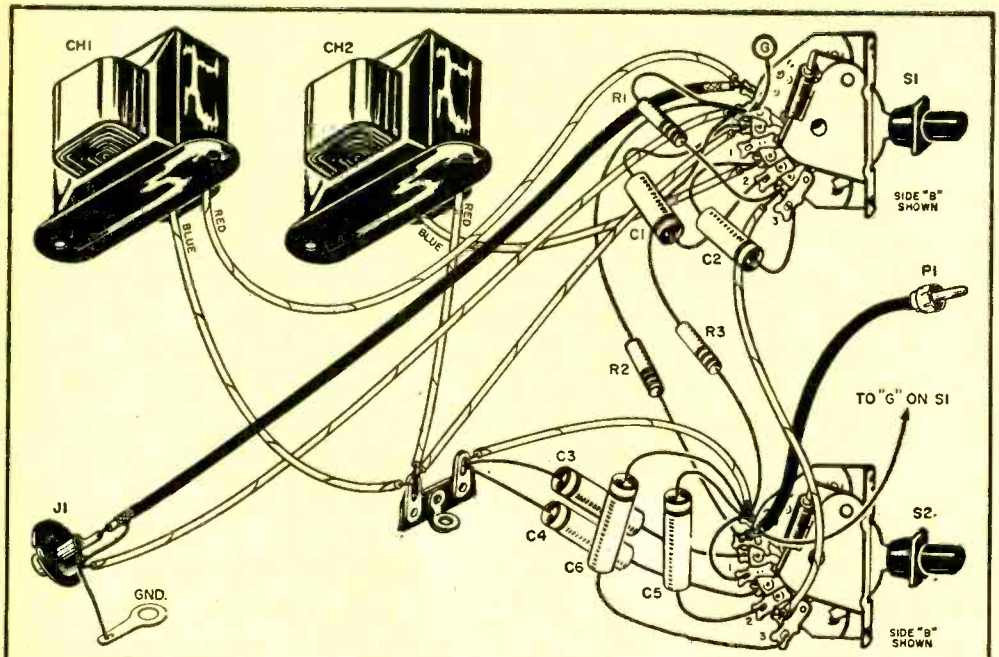
As for the rumble frequency filter, the two cutoff points selected are 50 cycles and 100 cycles, with the rate of cut about 10 db per octave. The first "cut" position is for very low frequency turntable rumble troubles, whereas the extreme 100-cycle setting will get rid of higher frequency rumble troubles *as well as* some 60-cycle power line hum which may possibly be present in your system.

Building the Filter. The entire unit is built into an aluminum two-piece case which, when completed, acts as a complete

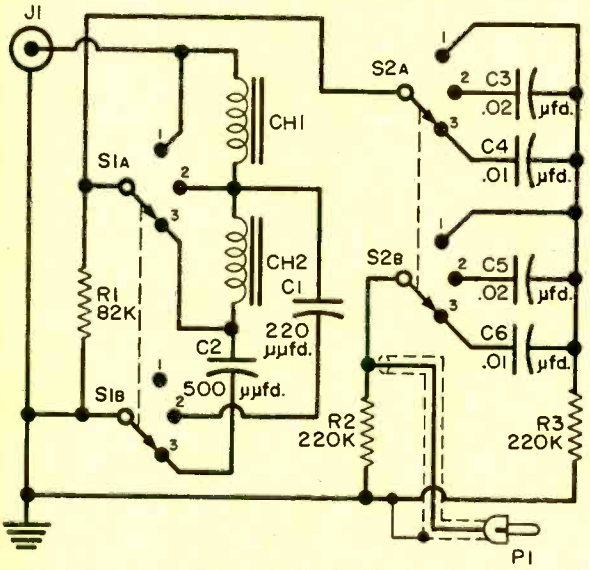
HOW IT WORKS

Scratch Filtering. At low frequencies, the chokes offer very low impedance as compared to the 82,000-ohm load resistor (*R1*). Conversely, the 500-$\mu\mu$fd. capacitor (*C2*) has very high impedance across the load, and consequently causes no shunting action. The result is that full input voltage is developed across the load resistor. At 10,000 cycles, the choke acts like a series impedance of about 200,000 ohms, and the combined parallel impedance of the 82,000-ohm resistor and the 500-$\mu\mu$fd. capacitor (whose impedance to high frequencies is low) is now reduced to about 20,000 ohms. By voltage divider action, then, only about 1/10th of the 10-kc. input signal is available at the output. This corresponds to a reduction of 20 db at this particular frequency.

Rumble Filtering. At high frequencies, the two 0.01-μfd. capacitors (*C4* and *C6*) act as a short circuit. The entire signal is developed across the 110,000-ohm effective load (two 220,000-ohm resistors in parallel). At 20 cycles, for example, each capacitor has a series impedance of about 800,000 ohms, and again—by voltage-divider action—the output voltage is about 1/25th of the total. It corresponds to a reduction of about 28 db at this particular frequency.



Pictorial diagram above details relationship of parts used in the filter. Note that leads on chokes CH1 and CH2 are colored, and must be wired according to instructions. Below are the schematic diagram, table of frequency cutoff action for different switch settings, and parts list. Switches are shown at 100-cps and 4000-cps cutoff positions. All ground points, including shield of output cable, should be returned to connection at ground on J1.



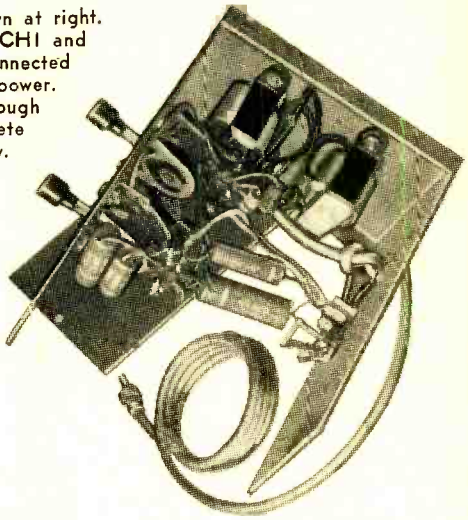
SWITCH POSITIONS		
	RUMBLE (S2)	SCRATCH (S1)
1	FLAT	FLAT
2	50∿	8000∿
3	100∿	4000∿

C1—220-μμfd. ceramic capacitor (Centralab BC220)
C2—500-μμfd. ceramic capacitor (Centralab BC501)
C3, C5—0.02 μfd. tubular capacitor (Cornell-Dubilier 2S2)
C4, C6—0.01-μfd. tubular capacitor (Cornell-Dubilier 4S1)
CH1, CH2—1.5-hy., 10-ma. choke (Merit C-2973)
J1—Phono jack (RETMA standard type, non-insulated)
P1—Phono tip plug (RETMA standard type)
R1—82,000-ohm, ½-watt resistor
R2, R3—220,000-ohm, ½-watt resistor
S1, S2—Double-pole, triple-throw lever switch (Centralab 1452)
1—3" x 4" x 5" aluminum chassis-case, (Insuline 29215)

shield for the circuit, preventing any hum pickup from power supply transformers located on nearby equipment.

Lever-type switches were selected because of their professional appearance and because the settings can be spotted easily from your armchair across the room. The orientation of these switches is such that flat response is achieved with both switch knobs all the way *down*. The rumble switch is mounted to the left of the scratch switch (since we normally think of low frequencies as being at the left of the audio scale and high frequencies at the right). Check the pictorial diagram for the exact position of the switch contacts, shown in the "flat" position, before mounting.

The only metal cutting necessary involves



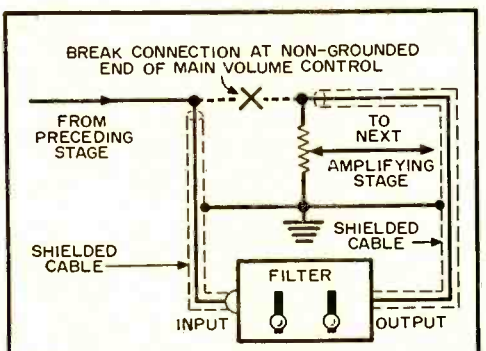
Inside view of filter, with wiring completed, is shown at right. Lever switches are mounted on front panel. Chokes CH1 and CH2 are mounted on left inside panel. Unit is to be connected between preamp and power amp. It requires no power. With both switches in "flat" positions, signal is fed through directly. For instructions on using filter with complete or "single-chassis" amplifier, see drawing and text below.

a few small round holes and narrow slots for the two lever switches. Each switch requires two round 3/16" holes spaced 1 11/16" apart with a 1⅛" x 3/16" slot centered vertically between the two mounting holes. As the aluminum of the chassis recommended in the parts list is quite soft, the slot was made by drilling a 3/16" starting hole at each end of the intended slot area and carefully cutting the slot between the end holes, using an ordinary coping saw.

The phone input jack requires two 3/16" holes spaced 11/16" apart and an 11/32" hole centered between them. A ¼" clearance hole for the output cable and four 3/16" holes for mounting *CH1* and *CH2* completes the metal work.

Wiring Tips. Capacitors *C1, C2, C5* and *C6* can all be pre-wired to their respective switches before assembly. One end of *C3, C4, R1, R2* and *R3* can also be wired to the switches before installation, reducing the number of wiring steps after all the parts are installed in the case.

You will note from the schematic diagram that *CH1* and *CH2* are actually wired in series. The chokes are color-coded and this coding should be strictly observed in order to get the full 3 henrys from a series combination. Start with the red lead of *CH1* wired to point 1 of *S1a*. The *blue* lead of *CH1* and the *red* lead of *CH2* are then joined together and wired to point 2 of *S1a*. Finally, the *blue* lead of *CH2* is wired to point 3 of *S1a*. Keep all unshielded leads as short as possible, and be certain that only a single chassis ground is made—using the "ground" side of the input jack *J1* for this purpose.



Filter may be used with "single-chassis" amplifier by tapping into amplifier's own circuit as shown in above schematic. Note use of shielded cable for carrying the audio signal.

Assemble the two parts of the case together using the self-tapping screws supplied. Mark the settings of the switch positions on the front panel. The markings for the rumble filter switch, reading from bottom to top, are "flat," "50 cps" and "100 cps." Scratch filter switch markings, reading from bottom up, are "flat," "8 kc." and "4 kc."

Installation and Use. Connect the output cable from your preamp to the input jack of the filter. The output cable of the filter is then connected to the input jack of your power amplifier. If you have a combination preamp-amplifier, the best place to "tap into" the circuit is at the ungrounded end of the main volume control, as shown in the partial schematic on this page.

On quality FM broadcast programs, you will want to leave both switches in the flat position; on weak signals, however, setting the scratch filter to 8 kc. will often dispense with some of the FM hiss normally associated with weak reception. For AM broadcasting, we found that the 4-kc. setting gets rid of a lot of static, and since this type of transmission is limited to a maximum range of about 5000 cycles, practically no program content is lost. As for your record collection, each record will require its own best setting, which can be determined by experimentation. A good idea might be a notation on the jacket or record album as to the most pleasing settings to be used.

The rumble filter setting will depend upon the quality of your turntable or record changer. Remember to set it back to "flat," however, when listening to radio, unless the radio station's turntable has some rumble, too—which has been known to happen! —30—

AFTER CLASS

Special Information on Radio, TV, Radar and Nucleonics

THE NEW MICRO-BATTERIES

IN JANUARY of this year, American newspapers carried a startling, almost incredible story: atomic energy had at last been tamed! The man in the street would soon be able to carry a tiny nuclear power plant in his pocket with absolute safety—a power plant which would operate his transistor radio, hearing aid, emergency receiver, and even his wrist-watch. Despite its cough-drop size and the absence of massive shielding, the danger from radiation would be less than from an ordinary radium-dial clock.

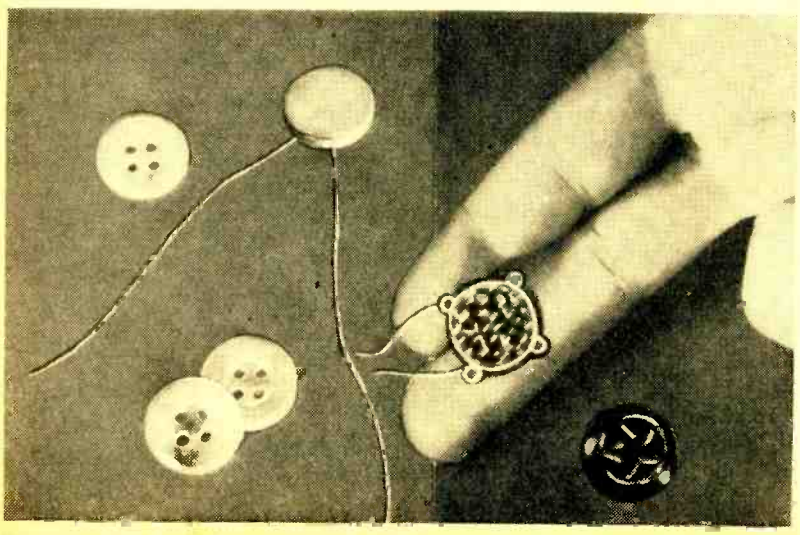
As so often occurs, public misinterpretation of the newspaper stories conjured up all kinds of fantastic visions—visions which are just as improbable today as they were fifty years ago. Let's try to clear up some of these foggy notions about the atomic battery and other microcells.

At this moment, a nuclear battery is producing usable electrical energy in the laboratories of a well-known American watch manufacturer, Elgin National Watch Co., Elgin, Ill. This cell is indeed no larger than a cough drop, is as safe as a house key to carry, has a life of about five years, and actually obtains its energy indirectly from atomic fission.

Atomic Energy. When most radioactive substances disintegrate, three types of emanations are given off: alpha particles which are heavy, positively charged bundles consisting of two protons and two neutrons; beta "rays" which are really free high-speed electrons; and gamma rays which are extremely high frequency electromagnetic waves. The chief danger to human tissue from atomic radiation lies in the latter.

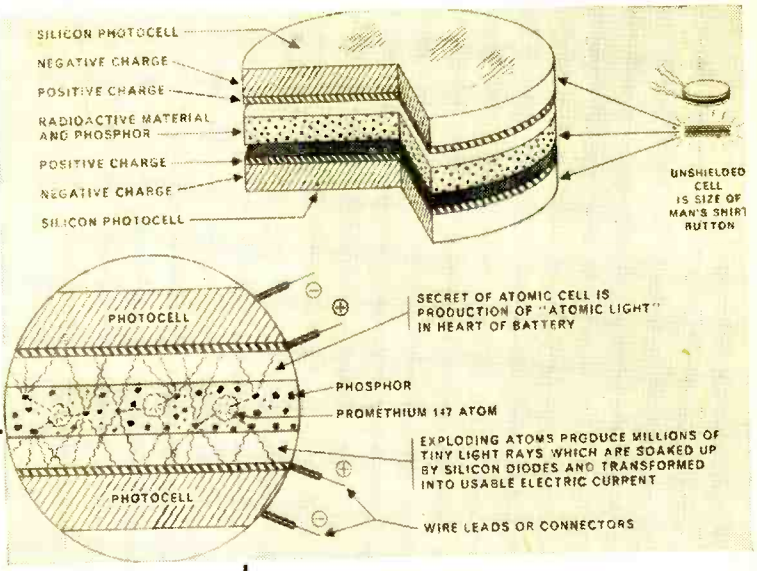
Gamma rays have great penetrating power. Beta and alpha particles, on the other hand, are not as hazardous because they cannot penetrate much below the upper layers of the skin. Thus, it is the gamma radiation which makes necessary the elaborate precautions taken in the Nautilus and in atomic plants to protect the personnel against tissue damage. It also accounts for the fact that the only pocket-sized nuclear power plants are those in science-fiction stories!

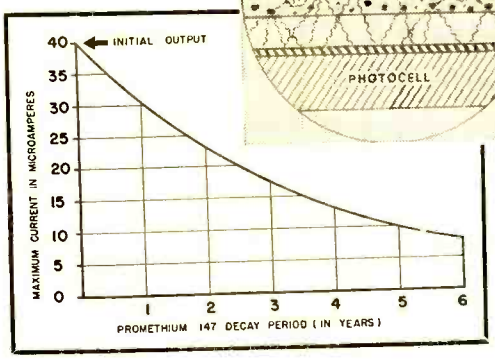
In 1947, a new element called *promethium* was discovered in the waste products of ordinary spontaneous uranium fission. Chemists dutifully studied its structure, catalogued it as element 61 in the periodic table of elements, tagged it as one of the "rare earths" falling between element 60 (neodymium) and element 62 (samarium) on the chart and then promptly forgot it. Almost 10 years later, practical-minded engineers casting about for a safe source of



Fingers loom large in comparison with the fully shielded atomic battery at left. It is just about cough-drop size. Without its external metal shield, the battery is no bigger than a shirt button (far left).

Promethium—a new atomic element—has made the nuclear battery possible. The cross-section drawings at right show the structure of the battery and how it works. Directly below is a life performance curve of the atomic cell.





atomic energy re-discovered promethium and immediately pounced upon it as the possible answer to their problems.

Promethium 147 has several interesting properties. When it decays, it emits beta particles in profusion but virtually no gamma or alpha radiations. Furthermore, it has a useful half-life of more than 2½ years and so represents a potential long-term power source if its beta rays can be utilized.

Beta radiations are elusive; they are difficult to capture and use in the direct production of energy. But, reasoned the inventors, why not make the conversion a two-step process? The beta particles could release their energy in another form—even if this form were still not usable—and then the secondary energy could be changed into a practical product.

Thus, the new atomic battery was born. The cough-drop nuclear cell is the result of this line of research.

Nuclear Battery. As the drawings above show, the cell is built in three layers. In the center is a wafer consisting of promethium 147 atoms and some phosphor material. The latter is a crystalline substance which gives off flashes of bright light when bombarded by electrons. Your television receiver picture tube screen has a phosphor coating of this type. The two outer wafers of the sandwich are miniature silicon photocells. As the brilliant scintillations of the embedded phosphor in the center wafer impinge upon the silicon cells, the "atomic light" is converted into electrical energy.

The life graph of the nuclear battery provides the story of its performance. When first made, a single atomic cell will provide approximately 40 *micro*amperes of electric current at about one volt of potential, the equivalent of 40 microwatts of electrical power. When you consider that an ordinary small desk lamp uses a *million times* this amount of power while in operation, all visions of atom-powered automobiles and washing machines in the very near future immediately collapse. With a bang!

Due to the decay rate of promethium 147, the available current falls off to 30 microamperes at the end of one year, to 20 microamperes at the end of the half-life period of 2½ years, and finally to 10 microamperes after five years. Any equipment that will

(*Continued on page* 118)

Indium cells, which are intended for use with electronic wrist-watches, show promise of things to come in the chemical battery field. One of them has about half the surface area of a copper penny.

Tuning the Short-Wave Bands

=with Hank Bennett=

IN TUNING across any of the various short-wave bands, the average listener may hear some rather unusual musical or animal-like sounds. These strange sounds, which may be repeated a number of times, are from one to ten seconds in length with a few seconds of "dead time" in between. They represent the interval signal identification of various s.w. stations. Such signals are used quite often just preceding the sign-on time of a station—to enable listeners in foreign lands to tune in, at times for test purposes, and frequently between programs—when there would otherwise be short periods of "dead air time." An IS helps DX'ers to identify readily the country in which a particular station is located.

Some countries have one common interval signal for all of their s.w. transmitters while several stations in a certain country may each have its own identifying signal. The signals of some countries are played on instruments that are native to that country or surrounding territory. Bird calls are often heard from stations in the Pacific. One of the most unusual interval signals heard by your Editor was the amusing cackle-call of "Woody Woodpecker," used by a station in Colombia; this one has not been heard recently and may no longer be in use.

(*Continued on page* 108)

Thomas Green, Pueblo, Colorado, at the dials of his National NC-173 receiver. For boosting weak signals, he uses a "Select-O-Jet" and "Q-5'er."

Colorful and interesting verification issued by Radio Monte Carlo. The 7349-kc. frequency shown is no longer in use; you can find them on 7140 kc.

INTERVAL SIGNALS

Australia—Radio Australia features a music box playing "Waltzing Matilda" for five minutes preceding transmissions. The programs open with the chimes of the Melbourne post office clock and the laugh of the native kookaburra bird.

British Honduras—Belize, on 3300 kc., uses a recording of "Greensleeves."

Canada—First four notes of the National Anthem, "O Canada."

Egypt—Camel bells.

England—Bow (church) bells. The chimes of "Big Ben" are also frequently heard.

Germany—Deutsche Welle, Cologne, plays a motif from Beethoven's "Fidelio" on the celesta.

Greece—A folk song played on a native flute and sheep bells.

India—A melody of 8 seconds duration with 10 seconds between playings. Instruments used include a violin, viola, cella, and tampura.

Italy—One of the very few stations in areas other than the Pacific to employ a bird call, Radio Rome can be noted with its bird-chirp IS. The type of bird is not known and may be any of several.

New Zealand—Call of the native bell bird at 5-second intervals.

THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

LITTLE has been said in recent *Transmitting Towers* about the 144 to 148 mc. (2-meter) amateur band; so let's discuss it now. Many of the remarks will apply specifically to Novice operators, because the 145 to 147 mc. segment of the band is open to Novice operators, but the general discussion should be helpful to the General Class operator as well.

Probably the first thing that a Novice notes about the 145-mc. Novice band is that it is the only band on which he can operate phone. The next thing that impresses him is the width of the band. Its 2000 kc. is 40 times as wide as either the 3.7- or 7.15-mc. bands and eight times the combined width of the other three Novice bands. Obviously, interference is not a major problem on 2 meters. A third feature of the band is the modest size of the antenna required, a ½-wave one for the center of the band being only 38" long.

Eddie, WN3JYM, offers to help prospective Novices obtain their licenses. His equipment and record are discussed in the News and Views section.

Undoubtedly, the big disadvantage to 2 meters in the eyes of many amateurs is its limited range. The reliable range of a typical, low-power, 2-meter station equipped with a simple, non-directional antenna in an average location will be between 10 and 20 miles. Substituting a small beam antenna for the non-directional one will probably double this range. Still better antennas, higher power, and very sensitive receiving equipment will push it out to 100 miles or so.

Compared to the distances that are covered regularly on the lower frequency bands, these distances are not very great. However, they can be covered 24 hours a day, 365 days a year. In addition, there are frequently special atmospheric conditions, especially in the warmer months of the year, that make it possible to work 500 miles or more, even with simple equipment. For the record, contacts of 1000 miles or so are not unknown on 2 meters, although they certainly cannot be called everyday occurrences.

The truth is that the thrill of working a new state a couple hundred miles away on 2 meters is just as great as spanning an ocean on 15 meters. However, not all amateurs are DX hounds. For many of them, the opportunity to make regular contacts via radio is the important thing. The small size of 2-meter antennas brings this goal into reach of many city dwellers, to whom an efficient, low-frequency amateur-band antenna is completely out of the question.

Paul Taylor is shown operating his amateur station, KN1AFI. He has worked 28 states, 27 of them confirmed. See News and Views for more details.

Equipment for 2 Meters. Many amateurs believe that high-frequency radio equipment is necessarily very complicated and expensive. This is not true. Oh, compared to the simplest practical station for the 3.7- or 7.2-mc. Novice bands, the 2-meter

HELP US OBTAIN OUR HAM LICENSES

In this section of the Transmitting Tower, the names of prospective amateurs requesting help and encouragement in obtaining their licenses are listed. To have your name listed, write to Herb S. Brier, W9EGQ, % POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

K1/W1 CALL AREA

Roy L. Laduke, 378 Blackstone St., Providence, R. I. (Code and theory)
William Cashman, Jr. (14), 59 Willow St., Reading, Mass. (Code)
Sam Lipson, 1 Kensington Hts., Worcester 2, Mass. (Code and theory)
Fred Foley, 21 Elmwood St., Worcester 2, Mass. (Code and theory)

K2/W2 CALL AREA

Frederick Mason, 1111 Park Ave., New York 28, N. Y. (Code)
Jack Kilroy (14), 59 Valley View Terrace, Packanack Lake, N. J. Phone: MO 8-0682. (Code and theory)
Bernard Greenberg, 2628 E. 29th St., Brooklyn 35, N. Y.
D. W. Brown, 34 Edgar St., Buffalo 7, N. Y. (Code and theory)
Edward Demchuk, 77-05 268 St., New Hyde Park, N. Y. (Code and theory)
Richard Palmer, Seneca Blvd., Hector, N. Y. (Code, theory and regulations)
Charles Fenning, Marle Rd., Valley Cottage, N. Y. (Code)
Weiker Calhoun (16), 38 W. 100th St., New York 25, N. Y. (Code and theory)
Alfred Mastarrigo (16), 105 Villa Rd., Pearl River 7, N. Y.
Michael Dinan, 104 W. 92nd St., New York 23, N. Y. (Code)
Robert Tucker, Box 408, Eastport, L. I., N. Y. (Theory)
George Yahwak, Jr., 119 North St., Auburn, N. Y. (Code and theory)
Ben Zobel, 135-03 120th Ave., S. Ozone Park, N. Y. (Code)
Sandy Johnson (15), % W. J. Handlen, Rockaway & Huron Ave., Oakland, N. J.
Dan Granoff, 73-31 187th St., Flushing 66, N. Y. (Code and theory)
Robert Kujawski (14), Box 146, Florida, N. Y. (Code and theory)
Robert Thomas, 1051 Boston Row, N. Y. Phone: LU 9-6908. (Code)
Joe E. Calzaretta, 2122 Haring St., Brooklyn 29, N. Y. (General Class theory)

K3/W3 CALL AREA

Samuel Passafiume, 1002 Farragut St., Pittsburgh 6, Pa. (Code and theory)
Thomas C. Miller, 120 Center St., Milton, Pa. (Code and theory)
Eddie Hensel, 1139 Third Ave., New Kensington, Pa. (General Class theory)
Eugene Robinson, 101 S. Pittsburgh St., S. Connellsville, Pa. (Theory)
Jack and Fi Fi Wilson, 1005 Greentree Rd., Hillside Heights, Newark, Del. (Code and theory)
Joseph Pearo, 126 Tree St., Philadelphia 48, Pa. (Code)
Carl Reinhart, 149 Skyport Dr., Dravosburg, Pa. (Code and theory)
John Hamilton (14), 1541 Crescent Ave., Lancaster, Pa. (Code)
Jerry Dickman, 6545 Darlington Rd., Pittsburgh 17, Pa. (Code and theory)
Stephen Rosen (15), 5427 Eighth St., N.W., Washington 11, D. C. Phone: RA 3-7448. (Theory)
Jim Stout, 525 West Ridge Ave., State College, Pa. (Code and theory)
John B. George III, 230 Beechwood Rd., Penn Sq. Village, Norristown, Pa. (Code and theory)
Samuel F. Nelson, 2000 Md. Ave. N.E., Apt. 11, Washington 2, D. C. (Code and theory)

K4/W4 CALL AREA

George Stone (15), Route 3, Lafayette, Tenn. (Theory)
Paul Kelly, 628 Jessamine, West Palm Beach, Fla.
Paul Hancock, P.O. Box 4543, Harkers Island, N. C. (Code and theory)
Kenneth Harrison, P.O. Box 237, Bogart, Ga.
Bill B. Purdie, 144 Clarmount Ave., Hampton, Va. Phone: NEwport News 4-4177.
Wallie Miller, Jr., Route 4, Lafayette, Tenn. Phone: NOrth 6-3016. (Code and theory)
Joe Cooper (15), 313 Garden Lane, Chickasaw, Ala. Phone: HE 8-1188.
Milton Ware (15), 324 Third St., Chickasaw, Ala. Phone: HE 3-4449.
Winfred Routh, Rt. #1, Franklinville, N. C. (Code and theory)
Bobby Sutton, Rt. 3, Box 671, Kinston, N. C.
David Matthews, Jr., Route #1, Turkey, N. C. (Code)
Robert Blumenkranz (13), 8927 Emerson Ave., Miami Beach, Fla.

K5/W5 CALL AREA

Randon Reaves, 8722 Lupton Lane, Houston, Tex. (Code and theory)
Elvis Link, 5712-5800 W. Montgomery Rd., Houston 18, Tex. (Code and theory)
Gary Allums (16), 209 Rush St., Bossier City, La. Phone: 3-5514. (Code and theory)

K6/W6 CALL AREA

Dick Schmieter (14), 2745 Glenn Ave., Los Angeles 23, Calif. (Code and theory)
Lester Shaw, 115 S. Flower Ave., Brea, Calif. (Code)
Mike Nagy, 1243 Colima Rd., San Bernardino, Calif. (Code)
George Drysdale, 4435 Josie Ave., Lakewood 8, Calif. Phone: GA 9-6319. (Code and theory)
Michael Gnau, 10 Saturn St., San Francisco 14, Calif. (Code and theory)
Forrest Myers, 647 Cascade Rd., San Leandro, Calif.
Rodney Wight (15), 250 N. McDaw, Susanville, Calif. Phone: 6857. (Code)

K7/W7 CALL AREA

Paul N. Hamilton, 19530 S.W. Blanton, Aloha, Ore. (Code and theory)
Wilbur C. Young, 8114 S.E. Mill, Portland 16, Ore.
Robert K. Gierke (15), Box 8229, Talbot Rd., Edmonds, Wash. Phone: GReenwood 4610. (Code)
Marcus Dilley, Tieton, Wash. (Code and theory)
Billy A. Blair, Box 87, Richmond, Utah. (Theory)

K8/W8 CALL AREA

George S. Lee, 1451 Sunset Rd., Mayfield Hts. 24, Ohio.
Wesley Rishel, 2100 Revely, Lakewood 7, Ohio. (Code and theory)
Richard Hansz, 11309 Arden, Livonia, Mich.
Joseph Pousak, 17815 Clark St., Riverview, Mich. (Code and theory)
James Everly (13), 540 Blaine Ave., Marion, Ohio. (Code and theory)
Lance Lyman, 8759 Usher Rd., Olmsted Falls, Ohio. (Code and theory)
Steve McShane (14), 12830 Wilshire, Detroit 13, Mich.

William Mark Boyd (16), 112 Poplar St., Bluefield, W. Va. (Wants pen pals; will answer all letters)
Gilman Huckins, 3333 Ruckle St., Saginaw, Mich. (Code and theory)
William J. Harvanec, 3816 W. 128th St., Cleveland 11, Ohio. Phone: OR 1-8301. (Code and theory)
David D. Phoenix Jr., 3351 E. 147th St., Cleveland 28, Ohio. (Code)
Richard R. Six, 501 Holley St., St. Albans, W. Va. (Code and theory)

K9/W9 CALL AREA

Bruno Wizolek (11), Chicago, Ill. Phone: PE 6-9449. (Code)
John Swanson (14), 14201 S. Dearborn, Chicago 27, Ill. (Code)
Gary Keener, R. R. #2, Union City, Ind.
John L. Robinson (14), 1228 W. Farwell, Chicago 26, Ill. Phone: RO 1-1376. (General Class theory)
Stephen Latuszek, 58 Robertson Ave., Lake Zurich, Ill. (Code and theory)
Fred W. Riehle, 1018 E. 6th St., New Albany, Ind. (Code and theory)
Vernon G. Packard, 3323-A W. Center St., Milwaukee, Wis. (Code and theory)
Dallas Bjella, 303 Boston St., Syracuse, Ind.
Danny Lee, 713 Sexton St., Aurora, Ill. (Code and theory)
Richard Kroes, 2413 Bate St., Racine, Wis. (Code)
Gilbert Russell (14), 1822 N. New York Ave., Peoria, Ill. (Code and theory)
Harry J. Lodyga, 746 S. Phillipa St., South Bend 19, Ind. Phone: AT-81350.
Peter Tremi, 733 Ida St., Menasha, Wis. (Code and theory)
William P. Bryan, RD 1, ET"A" School Bldg. 520, U.S.N.T.S., Great Lakes, Ill. (Code)

KØ/WØ CALL AREA

Vernon R. Beck (15), 5760 Madison Ave. N.E., Minneapolis 21, Minn. (Code and theory)
Maynard B. Wiemers, Gilmore City, Iowa. (Code and theory)
Gerald Schoenhofen, 3237 Fifth Ave. S., Minneapolis 8, Minn. (Code, theory and regulations)
Bobby Zehnder, R.R. 1, Milford, Iowa. (Code and theory)
David Gilchrist (13), 77 Fenno Rd., Riverdale, Iowa. (General Class code and theory)
Ronnie Lee (16), 112 Beatty St., Coffeyville, Kans. (Code, theory and selection of equipment)
Jerry Earsom (14), 636 Farror, Moberly, Mo. (Code)
Stephen Stearns (13), 4612 W. 72nd St., Prairie Village, Kans. (Code)
Milford Hett, R.R. 1, Marion, Kans. (Code)
David Beal, 2013 S. Locust, Pittsburg, Kans. Phone: 3275. (Code)
Bruce Becker, 4443 Denn, Kansas City, Mo. (Code)
Dale E. Gabrielson (15), 707 S. Fifth St., Virginia, Minn.

VE AND OTHERS

Peter Arthur (14), R. R. 2, Simcoe, Ont., Canada. (Theory)
Donald Grovestine (14), Chester, N. S., Canada.

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

The "CONELARM" Model CA Monitor makes it easy for you to comply with the regulations requiring amateurs to cease operation during a CONELRAD Radio Alert. Connected to the voice-coil circuit of any standard broadcast receiver, its built-in warning light will glow or an external warning device will be activated when an Alert is broadcast. For complete data on this unit, contact The Walter Ashe Radio Company, 1125 Pine St., St. Louis 1, Mo.

station will cost considerably more. However, compared to a typical, low-frequency Novice installation, the difference in cost is much less. A few figures may be helpful.

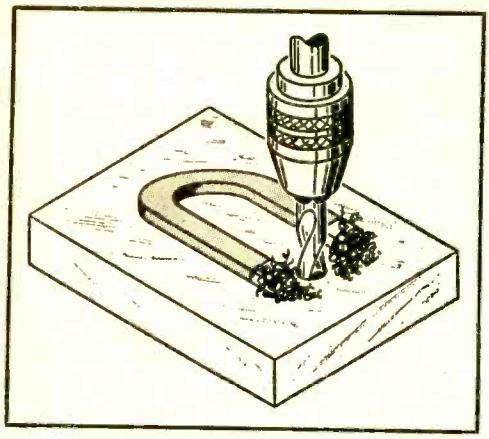
As anyone who reads the News and Views section of the *Transmitting Tower* can attest, a very popular Novice combination is a Johnson Adventurer transmitter and a Hallicrafters S-38D receiver. Adding a crystal or two and a telegraph key makes the basic equipment cost about $110.00, to which must be added the cost of the antenna installation. Many Novices spend more than this amount for their receivers alone, and some get by for less. Nevertheless, $110.00 is certainly a fair figure on which to base a comparison.

A typical, low-power, 2-meter station consists of a 15- or 20-watt phone transmitter and a converter to extend the tuning range of the regular station receiver to cover the 144-mc. band. Checking the cost of three commercially available amateur transmitters* shows a price range of approximately $75.00 to $100.00 for the transmitter, complete with tubes, crystal, and power supply. A microphone will add another few dollars to the cost.

The preferred receiving method is to use a 2-meter converter in conjunction with a regular communications receiver. It gives excellent results, because it combines all the good features of the regular receiver

(*Continued on page* 121)

* (1) Electronic Labs LW-50 transmitter, 15 watts input, with tubes and crystals—$39.50; power supply, approximately $35.00. (2) Tecraft 2-meter, 20-watt transmitter, complete with tubes, crystal and connectors —$59.50; power supply, $39.50. (3) Lettine Model 242 2-meter transmitter, 45 watts input, complete with tubes and built-in power supply, less crystal—$89.95. (Although the latter transmitter has a higher input rating than the others, its output tube operates as a frequency multiplier; therefore, its output power is only slightly more than that of the other two.)



Chassis-Drilling Hint

Drilling a hole in a steel chassis, after parts have been assembled on it and wired, is generally a hazardous process. The chips are likely to fall almost anywhere and cause short circuits. A good way to avoid such difficulties is to place a small Alnico magnet on the chassis as close as possible to the hole being drilled, as shown in the diagram at left. The magnet will attract and hold the chips as they are cut out by the drill. If you're working in close quarters, where there isn't any space for the magnet, try magnetizing the drill instead.

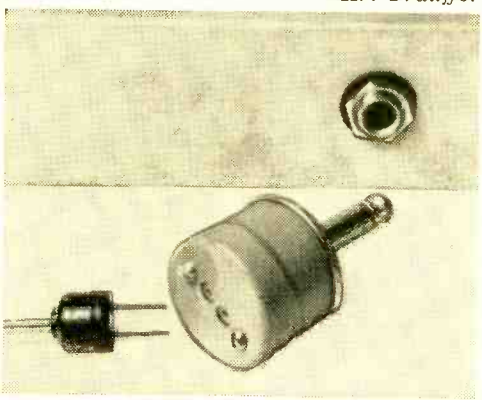
—Frank H. Tooker

Adapter Connects "Tiny Plug" to Standard Phone Jack

You can make a simple adapter that will connect a "tiny plug" (Lafayette MS-283) to a standard phone jack in a jiffy. Just obtain a metal can at least 1" in diameter having a friction lid (such as a bouillon cube can), and saw it off to a length of ¾". Drill or punch a ⅝" hole in the bottom center of the can. Then twist an Amphenol 75-MC1P phone plug into this hole and solder the plug to the bottom of the can.

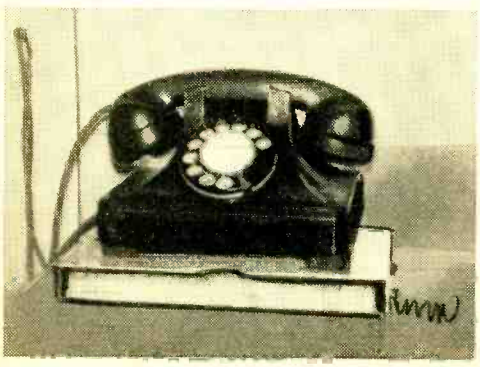
Drill four small holes for a "tiny jack" (Lafayette MS-284) in the lid of the can; the two outside mounting holes are 1/16" in diameter, but the two center holes should be about 5/32" in diameter to prevent shorting of the plug's prongs. Mount the "tiny jack" to the inside of the lid. Now solder a short flexible insulated lead from the center electrode of the phone plug to one lug on the "tiny jack," and solder another lead from the rim of the plug to the remaining lug on the jack. The completed adapter can be covered with Mystik tape, as shown in the photo, to improve its appearance.

—Art Trauffer



Telephone Line Antenna Provides Excellent Reception

A simple crystal radio receiver connected to a telephone pickup for an antenna and a good ground will give amazing reception. Making a direct connection to the phone line is strictly forbidden for obvious reasons, but use of a capacity pickup for receiving short-wave or AM broadcast signals is both acceptable and effective.

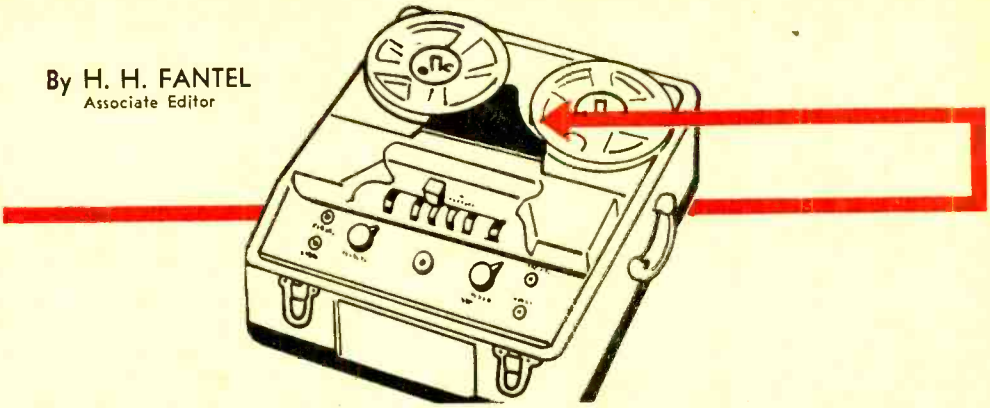


Shown in the photo at left is an attractive pickup which provides storage space for a small directory or note pad. It is made from a 7" x 12" piece of aluminum about 1/16" thick (the metal sheet should be at least as large as the base of the phone). Notch the two corners on one side and bend the adjacent edges down. File a curved notch in the front edge for access to the directory. Small pieces of felt cemented to the edges of the flanges at the corners serve as protective feet. A machine screw, hex nut, and a battery nut installed in a hole in one of the flanges make a binding post for attaching a wire.

Receivers with series antenna capacitors usually perform better with the telephone pickup if the capacitors are shorted.

—Serge L. Krauss

By H. H. FANTEL
Associate Editor



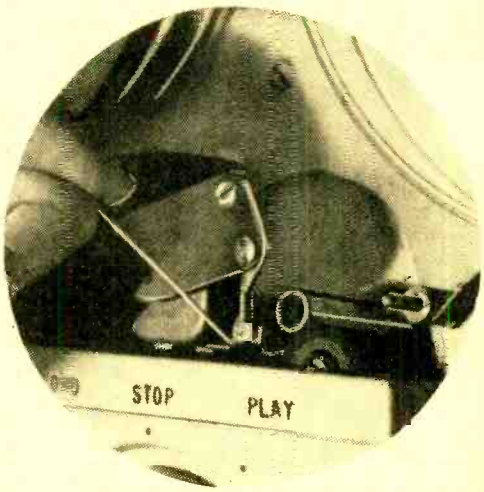
IS YOUR HEAD ON STRAIGHT?

SHOOTING trouble in the head may sound a bit radical, but it's a simple and effective way of curing most tape recorder complaints. Like the phono pickups discussed last month (POPULAR ELECTRONICS, April, 1957, page 66), tape recording and playback heads are also afflicted by minor ills, chiefly "bad posture" and "dandruff." For this reason, make sure your heads are (1) straight, and (2) clean.

Problems may come to a head when there is a screw loose somewhere. In that case, the head forgets which end is up and leans over a little to one side. Such a coyly tilted head can't take a forthright tone. Both in recording and playback, it muffles the bright tingle and clouds up the sparkling clarity that is the pride and joy of hi-fi tape fans. To retain the full advantage of wide-range tape recording, the head must always be proudly erect at strictly right angles to the direction of tape travel. In other words, as the tape travels sideways, the head posture must be straight up and down.

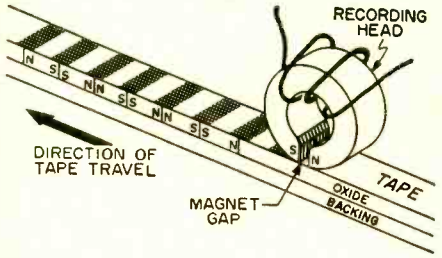
Up on the Angles. You can improvise your own test of head alignment by simply carefully skewing the tape (first in one direction, then in the other) as it runs past the head (see photo, above right). If the music brightens up with added highs as you deflect the tape, you know that your head is on crooked. But that's nothing that a small screwdriver won't fix. Adjustment screws are provided for this purpose.

For this test, you can't use tape recorded on your own machine—because the error in recording cancels the error in playback. Result: you still don't know whether or not your head needs fixing. For a valid test, you must use "pre-recorded" tape made on a perfectly aligned "professional" machine. Pre-recorded tape from reputable

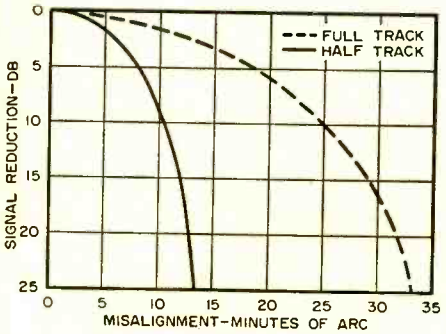


Wiggle toothpick slowly back and forth against tape near playback head. If highs increase while tape is in skew position, it's a sign that your head needs alignment for better signal pickup.

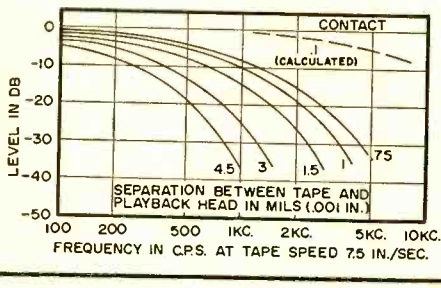
Cleaning head with carbon tetrachloride assures better tape contact, hence wider frequency range.



Magnet gap in recording head must make close contact with tape and lie athwart the direction of tape travel at precisely a right angle.



High frequency response drops rapidly as a result of either head misalignment (above) or poor contact between head and tape (below), as shown in tests by Minnesota Mining & Mfg. Co.



manufacturers is suitable for the purpose, but special alignment-check tapes are available. Play this tape while you adjust the inclination for maximum sonic brilliance. When you get that angle straight up, you're a lot closer to being up on all the angles of hi-fi tape recording.

Down with Dandruff. As miles of tape file past the recording and playback heads, friction between tape and head files away oxide particles and dust from the tape. After a while, a sticky mess of such hi-fi dandruff gums up the straight and narrow gap, which is the business end of the tape machine. The accumulated dirt prevents close contact between the magnetic gap and the tape, resulting in considerable loss of high-frequency response. For instance, if a welt of dirt on your head pushes the tape away by as little as seven-thousandths of an inch, all frequencies above 5000 cycles will drop 30 db. That's about as good as being lost altogether.

The Scotch tape people set up some fancy experiments to measure the precise loss at various frequencies due to minute separations between tape and playback head. The results, shown in our graph, are startling evidence that the cherished high-frequency tingle of wide-range tape goes right down the drain with the dirt.

The remedy is simple: just dab the tape recorder heads with a soft cloth soaked in carbon tet, and the gummy dandruff comes right off. The carbon tet won't attack the rubber parts of your machine, but be sure it's all dried off before you run tape over the freshly cleaned head.

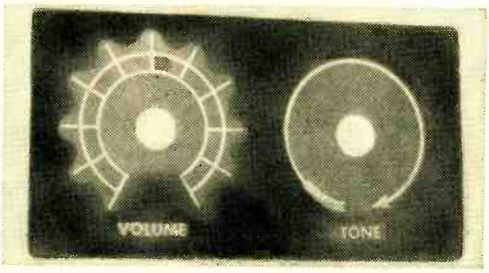
These "head cures" are almost childishly simple, but they go a long way toward making your tape recorder "bright." More of the "intelligence" contained on the tape gets across when heads are clear, clean, and straight. —30—

Make Your Own Professional-Looking Dial Plates

A professional-looking dial plate can be made from a strip of flashing copper and a few dial decals. Cut the copper strip to the desired size, flatten it, and then polish the best side to a bright finish. Rinse the plate well, dry it, and give it two coats of clear plastic spray to prevent it from tarnishing.

When the plastic has dried, lay out and apply the dial and lettering decals carefully, then put the plate aside for about 24 hours to allow the decals to dry thoroughly. At the end of this time, cut the necessary dial-center and mounting holes, and give the plate a second coat of plastic spray.

Dials can be made in a strip, as shown



in the photo, or individually, as preferred or as necessity dictates. Small brass escutcheon pins, available from almost any hardware store, may be used to affix the dial plate neatly to a wooden hi-fi or receiver cabinet. —*B. W. Blachford*

Transistor Topics

By LOU GARNER

BELIEVE IT OR NOT, there are still some individuals who haven't fully accepted the transistor as a practical electronic device—who still look on it as a "laboratory curiosity." But not children! In 1956, REMCO, a large toy manufacturer, sold over 500,000 . . . *over half a million* . . . transistor radio kits through toy outlets. These kits retailed in the range of $7.00 to $10.00. If the interest in scientific toys is at all indicative of our young people's inclinations, we won't have to worry about any future "shortage" of engineers.

Readers' Circuits. Last month we featured a transistorized audio preamplifier and mixer . . . in response to a number of requests from hi-fi and audio enthusiasts. We've also received a good number of requests from another group . . . the hams. So here's a circuit for you fellows. . . .

Stanley F. Kadron, W3WTV, of 3609 Latham Road, Baltimore 7, Md., proposes a simple c.w. *monitor*. In case you're not a ham and wonder what a "monitor" does, it's simply a device for listening to your own transmitter. In the case of a radiotelephone transmitter, a simple tuned circuit and crystal detector makes a fine monitor. But in the case of a c.w. transmitter, something is needed to convert the r.f. signal into an audible tone. In a receiver, the BFO (beat frequency oscillator) does this job.

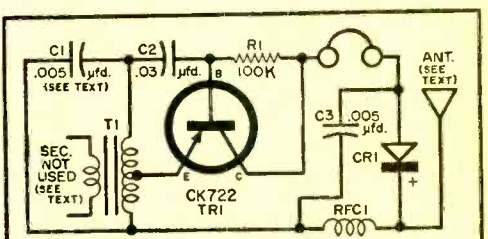
Stanley's approach is to use a transistorized audio oscillator which, in turn, is powered by an r.f. signal picked up from the transmitter. Whenever a signal ("dot" or "dash") is transmitted, the oscillator operates.

The *p-n-p* transistor, *TR1*, is connected as a simple audio oscillator, with feedback provided by the center-tapped primary winding of audio transformer *T1*. Operating power is supplied by the r.f. signal picked up by the antenna, rectified by crystal diode *CR1*, and filtered by the r.f. choke (*RFC1*) and capacitor *C3*. Frequency of operation is determined by tuning capacitor *C1*, across *T1*'s tapped coil.

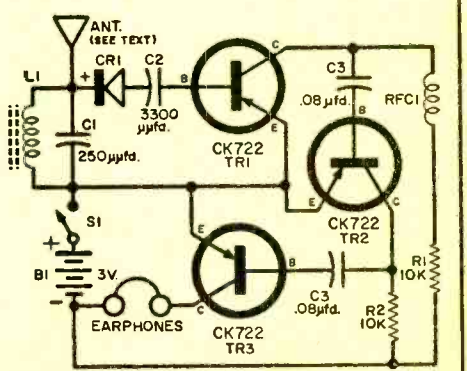
Construction and wiring are non-critical. *T1* can be practically any audio transformer with a 4000 to 10,000 center-tapped winding. Suitable choices are the Argonne Types AR-134, AR-135, and AR-158. Note that the secondary winding is *not* used. Tuning capacitor *C1* is chosen experimentally to give the desired tone. Stanley used a 0.005-μfd. unit, but you may prefer a larger or smaller capacitor here.

As far as the other components are concerned, *RFC1* is a standard 2.5-mhy. r.f. choke, while *CR1* is any standard diode . . . a 1N34A or a CK705 will work fine. The antenna (*Ant.*) is a random length of wire placed near the transmitter. Its length will depend on the power output of your "final." Stanley uses an antenna only 12 to 18 inches long.

Our second circuit this month is for another of those ever-popular simple *broadcast-band receivers*. Submitted by Mike Swink, 4627 Cedar Springs, Dallas 19, Texas, it is essentially a crystal detector fol-



MONITOR. This transistorized c.w. monitor circuit was submitted by Stanley Kadron, W3WTV.



RECEIVER. Mike Swink has had good results with his three-transistor broadcast-band unit.

lowed by a three-stage resistance-capacity-coupled transistorized audio amplifier. In operation, r.f. signals picked up by the antenna are selected by tuned circuit *L1-C1* and detected by a crystal diode (*CR1*). The resulting audio signal is amplified by transistors *TR1, TR2,* and *TR3,* with the final output signal driving a pair of magnetic headphones.

Standard components are used throughout. *L1* is a Feri-Loopstick, *CR1* a standard crystal diode such as a 1N48 or 1N34, and the r.f. choke (*RFC1*) a 2.5-mhy. unit. The capacitors may be paper, mica, or ceramic; the two resistors are ½-watt carbon units. *B1* is a three-volt battery made up by connecting two No. 7 cells in series. Moderate (1000-ohm to 4000-ohm) impedance magnetic headphones may be used.

According to Mike, the antenna is not especially critical . . . he indicates that he has had good results using only a 3′ "whip" antenna.

With the values specified, reception is limited to a portion of the AM broadcast band, depending on the value of *C1*. You select the desired station by adjusting *L1*'s iron core. If you would like to tune the entire band, you might replace *C1* with a 365-$\mu\mu$fd. tuning capacitor . . . an Argonne Type AR-94 would be a suitable choice.

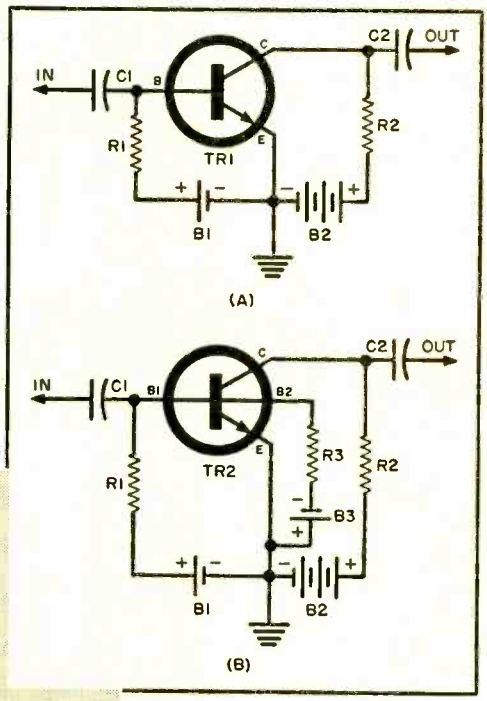
The Tetrode Transistor. The junction *tetrode* transistor, not as well known as the popular *triode* transistor, has potential applications in many fields but particularly in high-frequency communications. The tetrode is very similar to a junction triode . . . with but one change. An additional connection is made to the base electrode, just opposite the "conventional" lead connection. In use, d.c. voltages of opposite polarity are applied to the two base connections.

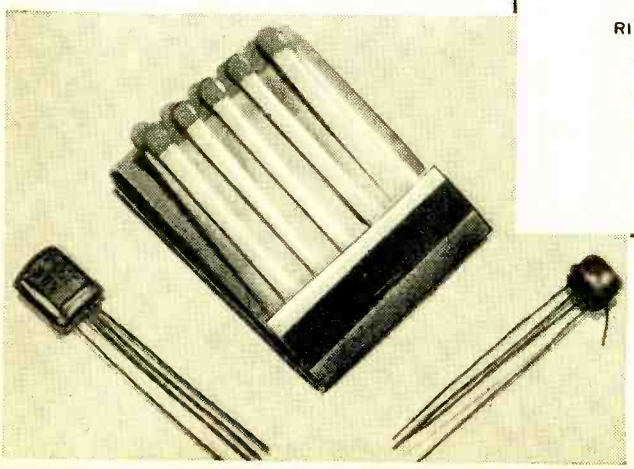
The diagram at the right shows two resistance-coupled single-stage amplifiers. A triode circuit is given at (A) . . . a tetrode circuit at (B). In both circuits, *C1* is the input coupling capacitor, *C2* the output capacitor; *R1* is the base bias resistor, *R2* the collector load resistor; base bias current is supplied by *B1*, collector bias by *B2*. Circuit (B) differs only by the addition of the second base bias battery, *B3,* and its associated resistor *R3*. The second base connection is identified as B_2. Voltage polarities shown are for *n-p-n* transistors.

In operation, the effect of the reversed bias on the second base lead is to reduce the effective conducting path between emitter and collector, forcing conduction to take place in the immediate vicinity of B_1's lead connection. This reduces the power rating of the transistor and, at the same time, lowers the transistor's inter-electrode capacity and base resistance. The net result is to *increase* the upper frequency limit of the transistor at the expense of a reduced power rating.

Thus, tetrode transistors may be used at much higher frequencies than conventional

(*Continued on page* 120)





TETRODE TRANSISTORS. In the diagram above is a comparison of junction triode (A) and tetrode (B) transistor circuits. Two commercial junction tetrode transistors are shown in the photo; the unit at the left of the book of matches is made by Germanium Products, the one at the right by General Electric Company.

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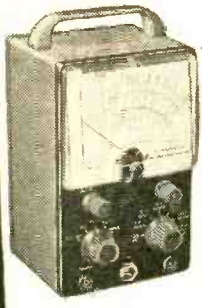

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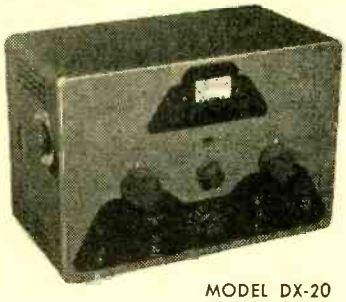

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Here is a straight-CW transmitter that is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. This 50 watt transmitter employs a 6DQ6A final amplifier, a 6CL6 oscillator, and a 5U4GB rectifier. It features one-knob band switching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms. If you appreciate a good signal on the CW bands, this is the transmitter for you!

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CABINET: Fabric-covered cabinet with aluminum panel as shown. Part 91-15A. Shipping wt. 5 lbs., $4.95 incl. Fed. Ex. Tax. $.50 dn., $.42 mo.

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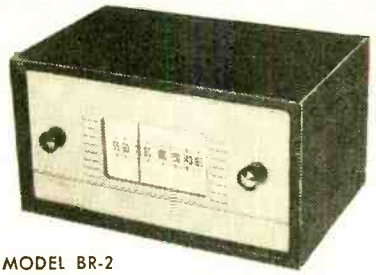
HEATHKIT BROADCAST BAND

RECEIVER KIT

You need no previous experience to build this table-model radio. It covers 550 KC to 1620 KC and features good sensitivity and selectivity. A 5½" speaker is employed, along with high-gain miniature tubes and a new rod-type antenna. The power supply is transformer-operated. The kind of a set you will want to show off to your family and friends. Construction is simple. You "learn by doing" as the project moves along.

CABINET: Fabric-covered plywood cabinet as shown. Shipping Wt. 5 lbs., .50 dwn., .42 mo., part No. 91-9A. $4.95 incl. Fed. Excise Tax.



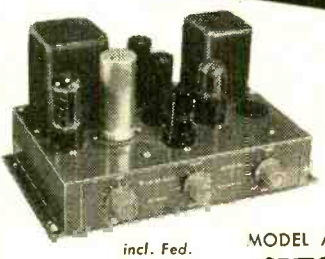
MODEL BR-2

$18.95

incl. Fed. Excise Tax (less cabinet)

$1.90 DWN., $1.59 MO.

Shpg. Wt. 10 lbs.



incl. Fed. Excise Tax

$1.80 DWN., $1.51 MO.

MODEL A-7D

$17.95

Shpg. Wt. 10 lbs.

REAL HI-FI PERFORMANCE AT MINIMUM COST

HEATHKIT 7-WATT

AMPLIFIER KIT

This 7-watt amplifier is more limited in power than other Heathkit models, but still qualifies for high fidelity, and its capabilities exceed those of many so called "high fidelity" phonograph amplifiers. Using a tapped-screen output transformer, the model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to surprisingly low level. The output stage is push-pull, and separate bass and treble tone controls are provided.

Model A-7E: Similar to the A-7D except that a 12SL7 tube has been added for preamplification. Features two inputs, RIAA compensation, and extra gain. $20.35, incl. Fed. Excise Tax, $2.04 dwn., $1.71 mo.

MODEL CR-1

$7.95

incl. Fed. Excise Tax

Shpg. Wt. 3 lbs.

$.80 DWN., $.67 MO.

. . . INTERESTING PROJECT FOR ALL AGES

HEATHKIT

CRYSTAL RECEIVER KIT

The crystal radio of dad's day is back again, but with big improvements! Sealed diode eliminates "cats whisker." Uses two high-Q tank circuits to tune 540 to 1600 KC. No external power required. Easy to build.

FOR AMATEUR OR PROFESSIONAL PHOTOGRAPHERS

HEATHKIT

ENLARGER TIMER KIT

This is an easy-to-build device for use by photographers in controlling their enlarger. It covers the range of 0 to 1 minute with a continuously variable control. Handles up to 350 watts. Timing cycle controlled electronically for maximum accuracy.

MODEL ET-1

$11.50

Shpg. Wt. 3 lbs.

$1.15 DWN., $.97 MO.

HEATH COMPANY • BENTON HARBOR 10, MICH.

A Subsidiary of Daystrom, Incorporated

NEW EDGE-LIGHTED TUNING DIAL FOR IMPROVED READABILITY

HEATHKIT HIGH FIDELITY

FM TUNER KIT

This FM tuner can provide real hi-fi performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature compensated oscillator, AGC, broad-banded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A ratio detector is employed for high efficiency, and all transformers are prealigned, as is the front end tuning unit. A new feature is the edge-lighted dial for improved readability, and a new dial cord arrangement for easier tuning. Matches the models WA-P2 and BC-1. Easy to build.

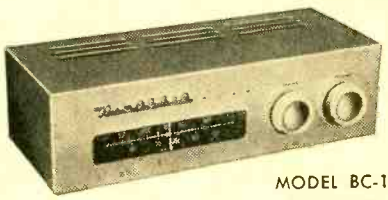
MODEL FM-3A

$25.95

incl. Fed. Excise Tax (with cabinet)

Shpg. Wt. 7 lbs.

$2.60 DWN., $2.18 MO.



MODEL BC-1

$25.95

incl. Fed. Excise Tax (with cabinet)

Shpg. Wt. 8 lbs.

$2.60 DWN., $2.18 MO.

NEW EDGE-LIGHTED TUNING DIAL. MATCHES MODEL FM-3A

HEATHKIT BROADBAND

AM TUNER KIT

The BC-1 was designed especially for high fidelity applications. It features a low-distortion detector, broad band IF's, and other characteristics essential to usefulness in hi-fi. Sensitivity and selectivity are excellent, and audio response is within ± 1 DB from 20 CPS to 2 KC, with 5 DB of pre-emphasis at 10 KC to compensate for station rolloff. 6 DB signal to noise ratio at 2.5 UV. Covers 550 to 1600 KC. RF and IF coils are prealigned, and the power supply is built in. Features AVC, 2 outputs, and 2 antenna inputs. Tuning dial is edge-lighted for high readability.

MODEL A-9B

$35.50

Shpg. Wt. 23 lbs.

$3.55 DWN., $2.98 MO.

FULL 20 WATTS FOR PA OR HOME APPLICATIONS

HEATHKIT 20-WATT

AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installation, but used extensively for public address applications. True high-fidelity performance with frequency response of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

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FEATURES GOOD LOOKS AND HIGH PERFORMANCE

HEATHKIT HIGH FIDELITY SPEAKER SYSTEM KIT

The model SS-1 covers 50 to 12,000 CPS within ± 5 DB, and can fulfill your present needs, and still provide for the future. It uses two Jensen speakers and has a cross-over frequency of 1600 CPS. The speaker system is rated at 25 watts, and the impedance is 16 ohms. The enclosure is a ducted-port bass reflex type and is most attractively styled. It is easy to build and can be finished in light or dark stain to suit your taste.

MODEL SS-1

$39.95

$4.00 DWN., $3.36 MO.

Shpg. Wt. 30 lbs.

MODEL SS-1B

$99.95

$10.00 DWN., $8.40 MO.

Shpg. Wt. 80 lbs.

ATTRACTIVE STYLING MATCHES MODEL SS-1

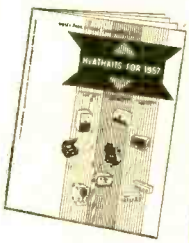
HEATHKIT HIGH FIDELITY

RANGE EXTENDING SPEAKER SYSTEM KIT

The SS-1B is designed especially for use with the model SS-1. It consists of a 15" woofer and a compression-type super tweeter to add additional frequency coverage at both ends of the spectrum. Cross-over frequencies are 600, 1600, and 4,000 CPS. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. The kit is easy to assemble with precut and predrilled wood parts. Power rating is 35 watts, and impedance is 16 ohms.

Free 1957 CATALOG

Our new 56-page 1957 catalog describes more than 75 different kit models for experimenters, hams, students, engineers, industrial labaratories, etc. Send for your free copy now!



HOW TO ORDER

It's simple — just identify the kit you desire by its model number and send your order to the address listed below. Or, if you would rather budget your purchase, send for details of the Heath Time Payment Plan!

ORDER BLANK

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Address_____

City_____ Zone_____ State_____

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- ☐ Freight
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Quantity	Item	Model No.	Price
		POSTAGE	
		TOTAL	

Enclosed find ☐ check ☐ 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 express agency at time of delivery. On parcel post orders include postage for weight shown. Orders from Canada and APO's must include full remittance. *NOTE: All prices subject to change without notice.*

WHAT'S THE PE ANSWER?

ANOMALOUS PROPAGATION

In an old issue of RADIO magazine (now discontinued), I saw the term "anomalous propagation." Then I saw it again in a book on radar that was written in 1946. My latest books contain no information on this term. What does it mean?

ROY MacDONALD
San Diego, Calif.

The phrase "anomalous propagation" appears to have originated during World War II. Both American and British scientists referred frequently to "anomalous propagation" when their radars performed beyond their expectations. Present-day radars are able to distinguish between unusual effects that troubled early radar investigators. Most scientists would agree that "anomalous propagation" was really another word for freak radar conditions due to the weather.

Radar signals will sometimes travel extraordinarily long distances if a particular type of meteorological inversion exists. In your location, it is not unusual for radars to pick up airplanes twice as far away as theory predicts. In 1943-45, this would have been referred to as an "anomalous propagation" effect. We now know that it is due to the high-level subsidence in your usual high pressure area. Or, in other words, it is due to a layer of very dry, warm air over a surface layer of cool, moist air. Such an inversion "guides" the radio waves over longer distances than radars usually cover.

WHAT IS A "PICOFARAD"?

The British magazines use the abbreviation "pf" in rating capacitors. Is this something new?

STANLEY SMITH
New York, N. Y.

No; "pf," or "picofarad," is used in Europe in place of the American μμfd., or micromicrofarad. They also use the μfd., or microfarad, but see no reason to add confusion when the value of the capacitor becomes very small. Although "pf" has been introduced several times in the United States, it has never caught on, or been accepted by the Radio-Electronics-Television Manufacturers Association.

CROSSOVER NETWORK THEORY

With reference to your article on crossover networks (January, 1957) I am confused over the matter of impedance matching. In the circuit shown on page 72 of that issue, if the voice coil of each speaker is 8 ohms, should the 4-, 8-, or 16-ohm terminals of the amplifier be used?

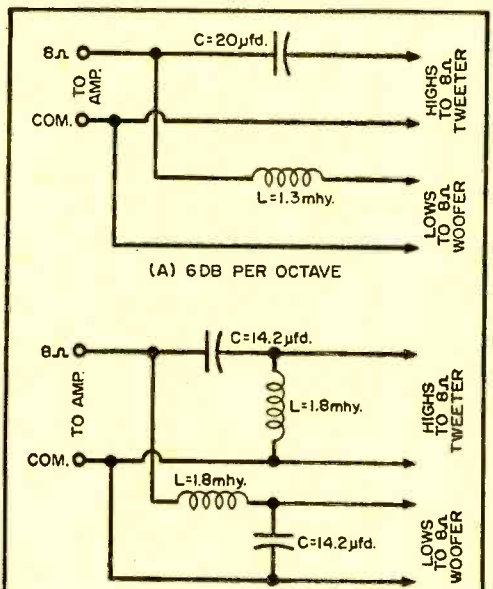
On the other hand, if the 6-decibel series circuit shown on page 71 is used with 8-ohm voice coils, which output terminals of the amplifier should be used?

Also, if the 12-decibel circuits are used, are the capacitance and inductance values the same as in the 6-db circuits?

Z. D. HARDING
Los Angeles, Calif.

Do not confuse "6 db" and "12 db" with impedance ratings. The former apply only to the rate of signal attenuation at the crossover frequency. The 4-, 8-, and 16-ohm figures refer to the impedances of speaker voice coils and amplifier output terminals. These should always match as closely as possible, regardless of the type of crossover network used.

Quite possibly, part of your misunderstanding may stem from the well-known rule of loads in parallel and in series. It is perfectly true, for example, that two 8-ohm speakers in parallel present a total impedance of 4 ohms. Connected in series, they present an impedance of 16 ohms. When they are used with crossover networks, however, this rule doesn't apply in the same way, because the reactances—set up by the capacitors and coils employed—add their own impedance effects to each speaker line. As a result, the entire speaker system may be connected to the same amplifier terminal as would be used for only one speaker without a crossover network. In other words, if 8-ohm speakers are used, with a crossover network, connect to the 8-ohm terminal on the amplifier.



Both these circuits provide 1000-cps crossover for two-way speaker system, but parts values differ for 6- and 12-db networks. See text for details.

The values of coils and capacitors are slightly different in a 12-db network than in the 6-db network. To find the 12-db value, multiply the value of the coil used in the 6-db circuit by 1.41; then divide the value of the capacitor by 1.41. —30—

$100,000 INVENTORY SALE!

NEW! COMPLETELY WIRED! 6-TRANSISTOR RADIO

POCKET SIZE SUPERHET
REGULAR PRICE $58.00, only $34.88

Exclusive! Outstanding ALL-TRANSISTOR pocket-size superhet radio! NO TUBES . . . completely transistorized printed circuit design gives rich, full tone and volume, unusual sensitivity and selectivity. Superb, top-make craftsmanship . . . attractive shock-resistant case. COMPLETELY WIRED, ready to play, with built-in ferrite antenna, 2½" heavy-duty Alnico 5 speaker, 6 hi-gain transistors, sharply tuned IF's, transformer coupled to push-pull transistor output for super power. Operates on single 9 volt mercury battery (94¢ extra). Fingertip tuning, with sub-mini 2-gang variable condenser, separate volume control. Pick first and 2nd choice of 4 colors: IVORY, MAROON, BLUE, BLACK. Only 5½ x 3¼ x 1¼", weighs less than a pound! RMA GUARANTEED! **GENUINE LEATHER CASE, $2.99 addl.**

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SUPER SOLAR BATTERY

Outperforms famed B2M many times . . . never wears out! 2½ x 1¾ x ½" molded case w/glass window. Unusual power for all sun battery uses. Plug-in type. REG. $10 **$2.98**

WORLD FAMOUS KIT KING® DOLLARBUYS!

15 ETCHED & PRINTED CIRCUIT SOCKETS, including mica-filled & shield type. Wt. 1 lb. Reg. $4. **$1**

100 CERAMIC CONDENSERS. Asstd. types, top mfrs. 30 values, color-coded. Discs, too. Reg. $15. **$1**

4 CRYSTAL DIODES, popular types: 1N34, 1N56, 1N58, 1N69. Reg. $5. **$1**

60 TUBULAR CONDENSERS. 30 types, .0005 to 0.5 mf to 1500V. Wt. 2 lbs. Reg. $12. **$1**

70 RESISTORS. Insulated IRC, A-B, etc. 5 ohms to 10 megs; ½, 1 & 2w. 1% & 5%, too. Wt. ½ lb. Reg. $10.95. **$1**

60 STANDARD KNOBS. Asstd. colors, bakelite & plastic. Wt. 2 lbs. Reg. $8. **$1**

70 TERMINAL STRIPS and boards. 15 types, 1 to 20 screw & solder pts. Wt. 1 lb. Reg. $5. **$1**

100 RADIO PARTS including resistors, condensers, strips, forms. Wt. 2 lbs. Reg. $6. **$1**

70 MICA CONDENSERS. 30 values: .00001 to .01mf to 1000V. Silver, 5% included. Wt. 1 lb. Reg. $5. **$1**

40 POPULAR BULBS. 1.1 to 6 V, screw & bayonet types, miniature. Wt. ½ lb. Reg. $3.20. **$1**

EMERSON TUNER, Hi-Q, permeability tuned ANT. & OSC. coils, w/padders, on 2 x 4" plate; w/variable tuning mech., 540 to 1600 kcs. Reg. $5. **$1**

40 MINIATURE CONDENSERS. Asstd. miniature, subminiature, printed circuit types; Centralab, Sprague. **$1**

40 MINIATURE RESISTORS in poly box. ¼" long. 20 values: 15 ohms to 10 megs. 1/5 w. Reg. $5. **$1**

25 SPRAGUE BLACK BEAUTIES, molded condensers, .0001 to 0.1 mf, asstd. voltages. Wt. 1 lb. Reg. $8. **$1**

30 POWER RESISTORS. WW, candohm, sandcoated vitreous. 15 values, 5 to 50w, 35 to 11000 ohms. Wt. 2 lbs. Reg. $8. **$1**

2 TRANSISTOR LOOPSTICKS. Tapped, hi-Q ferrite adj. core for best selectivity & sensitivity. Wt. ½ lb. Reg. $5. **$1**

30 PRECISION RESISTORS. WW & carbofilm, 20 values. 56 ohms to 1 meg; ½, 1 & 2 w. 1% tol. Wt. ½ lb. Reg. $21. **$1**

40 TUBE SOCKETS, 4 to 14 prong. Transistor & printed circuit, 7 & 9's, octals. Ceramic & mica, too. Wt. 1 lb. Reg. $8. **$1**

15 TRIMMERS, asstd. values, mini types incl. Air, ceramic, some w/shafts. Reg. $10. Wt. 1 lb. **$1**

15 VOLUME CONTROLS. Singles, concentric. TV, some w/switch. Std. shafts. Up to 1 meg. Some $2.50 each! **$1**

5 SILICION DIODES, 1N21, two 1N22, 1N23, 1N105. Reg. $15. **$1**

20 PRINTED CIRCUITS. Asstd. top makes, for transistor, radio, hobby circuitry. Reg. $10. **$1**

3 AC-DC CHOKES. 800 ohms, 3H-50ma. For hobby power supplies. Open frame mtg. Wt. 2 lbs. Reg. $1 each. **$1**

5 ROLLS TAPE, electrical, plastic, friction, rubber. For home, shop or lab. Reg. $2.50. **$1**

MINI-METER BUY! 1¾" round, chromed. 0 to 6 amps, AC. For model railroads, power supplies, mobile. Reg. $3. **$1**

60 XFMRS. & COILS. IF, RF, Ant., slug-tuned coils, chokes. 25 types! Wt. 3 lbs. Reg. $15. **$1**

WORLD'S SMALLEST RADIO KIT. 2½ x 1¼ x ¾". Permeability tuner, diode, pre-drilled case. All parts, instructions. Reg. $3.50. **$1**

8 TRANSISTOR SOCKETS, for subminiature tubes, too. Mica-filled. Reg. $3. **$1**

10 FP ELECTROLYTICS. Asstd. twist-lock units; singles, duals, triples. Wide variety values. Wt. 2 lbs. Reg. $12. **$1**

10 TUBULAR ELECTROLYTICS. Variety of pigtail units. Radio, TV & hobby must! Wt. 1 lb. Reg. $8. **$1**

VEEDER-ROOT COUNTER, 000 to 999, reset type. For all counting jobs. Motor, coils, recorder. Reg. $6. **$1**

30 DISC CAPACITORS. Most-used ceramics! Standoffs, too. Asstd. hobby values to .01 mf; to 3 KV. Wt. ½ lb. Reg. $6. **$1**

2 APPLIANCE MOTORS! Scoop! 115 VAC, 60 cycles. 3,000 rpm, for fans, blowers. Priced to move fast! Reg. $10 each! Wt. 3 lbs. **$1**

2 SUB-MINI Transistor Couplers for coupling transistor circuits. Center-tapped. 100K impedance, 5,000 DC ohms. ⅛ x ⅛". Reg. $10. **$1**

SUB-MINI CRYSTAL MIKE. Postage stamp size, ¾" sq.! Styrene cased. High imp., clear, crisp response to 8,000 cps. Reg. $6. **$1**

125 RESISTORS, ½ to 2w. 40 values: 5 ohms to 10 megs. 5%, too. Reg. $15. **$1**

3 LBS. HARDWARE! 2000 pcs. asstd. screws, springs, washers, etc. Reg. $8. **$1**

G-E PREAMP KIT for magnetic cartridges. Chassis, parts, diagram. Less 6SC7 (68¢ extra). Wt. 1 lb. Reg. $4.50. **$1**

175-ft. HOOKUP WIRE in 25-ft. rolls. Asstd. colors, stranding, insulation. 18 to 24. Wt. 2 lbs. Reg. $3.75. **$1**

15 ROTARY SWITCHES, ceramic & bakelite; 1, 2, 3, gangs. Std. shafts. Shop must! Wt. 3 lbs. Reg. $10. **$1**

20 AC-DC LINE CORDS for clocks, motors, etc. 2-cond. w/molded plugs. Wt. 1 lb. Reg. $5. **$1**

10 POLY BOXES, asstd. sizes. Clear plastic hinged boxes w/snap locks. Reg. $2.50. **$1**

8-PC. NUTDRIVER SET. Plastic handle, 3/16, 7/32, ¼, 5/16, 11/32, ⅜, 7/16" steel socket wrenches in plastic case. Wt. 1 lb. $3 value. **$1**

15-PC. TWIST DRILL SET. 1/16 thru ¼" by 64ths, in graduated plastic holders. Reg. $4. **$1**

PNP TRANSISTOR/REG. $5. SCOOP! Subminiature, herm. sealed. Poly-packed. Used in RCA, G-E personal radios. W/elect. data. **$1**

15 PANEL SWITCHES. Scoop! Push, toggle, micro, thermal, power. Wt. 2 lbs. Worth $17! **$1**

0-60 MIN. PHOTO TIMER. "Minute-Mizer" by Rhodes. Less dial & hardware. Built-in 15A microswitch, controls appliances, too! Wt. 2 lbs. Reg. $6. **$1**

R/C CONTROL SCOOP! Chassis includes 115 to 6.3-1.5A fil. xfmr; 3,000-ohm mini control relay, resistors, cond., pot., sockets. Wt. 2 lbs. **$1**

4 HOBBY TIMERS. 3-second limit. Handwound, multi-geared. Wt. 1 lb. Reg. $12. **$1**

3 P.P. OUTPUT XFMRS. Match push-pull 50B5, 50L6, 35L6 & 6V6 to 3-4 ohms. Open frame. Wt. 2 lbs. Reg. $8. **$1**

60 PLUGS & RECEPTACLES. Fine asst. of pop. chassis, panel, spkr., power plugs & receptacles, connectors. Wt. 2 lbs. Reg. $9. **$1**

18,000-OHM MINI RELAY. DPDT cont. for plate & control circuits. Wt. ½ lb. Reg. $5.50. **$1**

2 ASTATIC XFMRS, hi-fi type. 500/15 ohm pri. to hi-imp. grid. Herm. sealed. Wt. 5 lbs. Worth $5 each! **$1**

2 Transistor "OUNCER" XFMRS. Interstage, 1 x ¾ x ¾". Wt. 1 oz. Impedance ratios unknown. 5 color-coded leads. Reg. $8. **$1**

100 COIL FORMS. Wide variety sizes, insulation. Wt. 1 lb. Reg. $10. **$1**

5 JEWELER'S SCREWDRIVERS. Must for transistor, mini-hobby work! Swivel top, chromed brass construction. Reg. $3.50. **$1**

PIC-A-TUBE SALE! Any two for $1! RCA, etc. ☐ 6AK5, ☐ 6J6, ☐6C4. Check two for **$1**

World's Smallest Speaker

Only 1½" sq. For transistor radios, etc. 1 oz. magnet, 4 or 10 ohm v.c. available. Reg. $5 . . . . . only **$1.99**

8,000-ohm Dynamic Phone

Hearing-aid types, worth $10. Hi-fi, super-powered. Alnico magnet. Makes weak signals loud and clear. Cord attached **$3.99**

3-Tube AC/DC Amplifier

Wired! Lowest price ever! For phonos, P.A. etc. Sep. vol., tone controls. Reg. $5 . . . . . **$2.99**

Scoop! 12" PM Speaker

Famous make—in orig. cns. 10W "tru-fi" type, w/Alnico 5 magnet, 3-4 ohm v.c. Wt. 5 lbs. Reg. $10 . . . only **$3.99**

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Send check or MO including sufficient postage; excess returned. C.O.D. orders, 25% down. Rated, net 30 days.

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LEKTRON SPECIALTIES

131-133 Everett Ave. Chelsea 50, Mass.

Hellishcopter

(*Continued from page* 74)

this baby out so thoroughly—both electronically and mechanically—that only a windstorm could make it act erratically!"

"I envy you your confidence," she said.

"You'll see," I promised, picking up the rather large model and carrying it outdoors. "Why, even a mor—uh . . . even you could fly this little gem! And to show you how sure I really am, I'll let you have the pleasure of piloting its test flight!"

CAREFULLY placing the helicopter on the lawn, I set about starting the modified mower motor. A moment later, it exploded into action and I stepped out of the range of the three-foot-long rotor-blades which began slashing efficiently in a blurred orbit above the helicopter. I hurried over to the wife. She clutched the transmitter unit nervously, her eyes held to the helicopter with anxious fascination.

"It's running in neutral now," I told her. "Punch that button marked *Up.*"

She did and the pint-sized whirlybird slowly, smoothly rose from the ground. *Two feet . . . five feet . . . eight feet . . .* higher and higher it climbed, revolving in a circle as it ascended, the rotors screaming noisily. "Now, correct that revolving motion—punch the *Forward* button," I shouted. "It cants the blades sufficiently to tilt the helicopter into a forward position!"

She jabbed the button, desperately, and the little whirlybird began slowly flying across the yard.

"See!" I yelled. "It goes just like the real thing!"

"Here, *you* take it!" she screeched nervously, holding out the transmitter unit to me. "I—I don't w-want to r-run it a-any more! *Take* it!" Without warning, she all but threw the transmitter at me. I grabbed for it, missed, and the unit smashed to the ground. Frantically, I snatched it up.

It rattled ominously.

"Why did you do that?" I yelped. "I think you've busted something!" Gently, I shook the unit again. It rattled all right.

"Look at the gizmo!" she screamed.

Above us, the helicopter suddenly shot upwards about thirty feet, tilted to the starboard and shot off across the rooftops. Twice, before it flew out of sight, I saw it drop to within three feet of the ground, whip around in crazy maneuvers, and then steadily climb back into the sky. Now its clatter was fading into the distance. We stared, horrified, as it zoomed behind a row of trees several back yards away.

"I knew it! I knew it!" wailed the wife. *"I just knew it would happen!* Every time

(*Continued on page* 102)

STANDARD LINE

MANUFACTUFERS ORDERS INVITED

EXPORT ORDERS INVITED

FEATURING FAMOUS FACTORY

TUBES

- INDIVIDUALLY BOXED!
- GUARANTEED ONE YEAR!

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0Z4	.42	5AT8	.79	6BK7	.75	7A4	.46	12J5	.39
1A7GT	.42	5J6	.59	6BL7GT	.74	7A5	.52	12L6	.59
1B3GT	.66	5T8	.79	6BN6	.57	7A6	.44	12SA7	.47
1C5GT	.40	5U4G	.79	6BQ6GT	.79	7A7	.44	12SG7	.54
1C6	.25	5U8	.48	6BQ7	.75	7A8	.44	12SJ7	.44
1C7G	.25	5V4G	.57	6BY5G	.37	7AU7	.69	12SK7	.47
1D5GP	.42	5V6GT	.49	6BZ7	.75	7B4	.43	12SL7GT	.59
1H4G	.45	5X8	.79	6C4	.36	7B5	.40	12SN7GT	.56
1J6GT	.46	5Y3	.38	6C6	.50	7B6	.41	12SQ7	.39
1L4	.45	5Y4G	.42	6CD6G	1.17	7B7	.42	12V6GT	.44
1L6	.54	5Z3	.44	6CU6	.79	7B8	.46	12W6	.59
1LA4	.55	6A7	.56	6D6	.47	7C4	.40	12X4	.36
1LA6	.46	6A8	.46	6E5	.43	7C5	.41	14A7	.44
1LB4	.58	6AB4	.44	6F5	.36	7C6	.42	14B6	.44
1LC5	.48	6AC7	.66	6F6	.37	7C7	.44	14Q7	.44
1LC6	.46	6AF4	.75	6H6	.37	7E5	.44	19T8	.69
1LD5	.56	6AG5	.49	6J4	1.59	7E6	.44	19BG6G	1.17
1LE3	.56	6AG7	.68	6J5	.38	7E7	.48	25BQ6GT	.84
1LH4	.63	6AH4GT	.69	6J6	.48	7F7	.58	25CA5	.79
1LN5	.46	6AH6	.70	6K6GT	.38	7F8	.65	25CD6	1.29
1N5GT	.49	6AK5	.53	6K7	.38	7G7	.74	25CU6	.99
1R5	.50	6AL5	.41	6L6	.67	7N7	.57	25L6GT	.46
1S5	.45	6AM8	.79	6N7	.59	7Q7	.58	25W4GT	.42
1T4	.50	6AN8	.79	6Q7	.39	7X7	.64	25Z6	.36
1U4	.46	6AQ5	.45	6S4	.35	7Y4	.34	27	.24
1U5	.45	6AS5	.47	6S8GT	.70	7Z4	.39	35B5	.47
1V2	.70	6AS7G	2.25	6SA7	.47	12A4	.59	35C5	.47
1X2	.66	6AT6	.38	6SB7Y	.47	12A6	.40	35L6GT	.46
2A3	.49	6AT8	.79	6SC7	.40	12AB5	.49	35W4	.38
2A7	.54	6AU4GT	.64	6SG7	.42	12AQ5	.65	35Y4	.38
2D21	.95	6AU5GT	.60	6SH7	.42	12AT6	.42	35Z3	.40
3A4	.50	6AU6	.42	6SJ7	.42	12AT7	.58	35Z5GT	.38
3A5	.50	6AU8	.79	6SK7	.49	12AU6	.41	39/44	.25
3AL5	.52	6AV5GT	.64	6SL7GT	.56	12AU7	.66	50A5	.47
3AU6	.52	6AV6	.38	6SN7GT	.56	12AV6	.64	50D5	.47
3BZ6	.57	6AW8	.89	6SQ7	.40	12AV7	.62	50C5	.47
3BC5	.57	6AX4GT	.65	6SS7	.40	12AX7GT	.67	50L6GT	.44
3BN6	.57	6AX5GT	.56	6T4	.85	12AX7	.62	80	.39
3CB6	.57	6BA6	.46	6T8	.67	12AZ7	.67	84/6Z4	.45
3CB6	.55	6BC5	.49	6U5	.54	12B4	.45	117L7GT	1.25
3Q4	.56	6BC8	.89	6U8	.79	12BA6	.59	117M7GT	1.25
3Q5GT	.46	6BD5GT	.52	6V3	.79	12BA7	.45	117P7GT	1.25
3S4	.55	6BE6	.45	6V6GT	.45	12BE6	.39	117Z3	.36
3V4	.55	6BF5	.39	6W4GT	1.17	12BH7	.63	117Z6GT	.61
4BQ7	.75	6BG6G	1.17	6W6GT	.52	12BY7	.59		
4BZ7	.79	6BH6	.50	6X4	.38	12CA5	.79		
5AM8	.79	6BJ6	.46	6X5	.38	12CU6	.79		
5AN8	.49	6BK5	.67	6X8	.74	12DQ6			
5A95									

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19"	$56.00
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21"	$70.00
24" (when available)	$95.00
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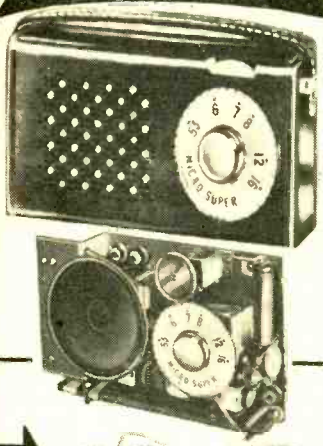
LAFAYETTE

6 TRANSISTOR SUPERHET RECEIVER KIT GIVES SUPERB PERFORMANCE . . . INCOMPARABLE VALUE



ONLY 33.50

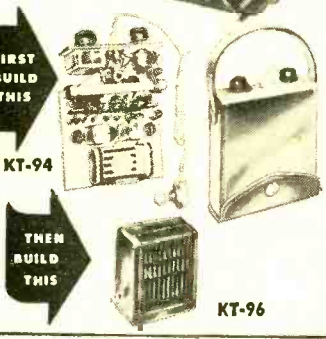
- 100% SUBMINIATURE PARTS—NO COMPROMISES!
- LABORATORY DESIGNED—SENSITIVE, SELECTIVE, STABLE!
- CLASS B PUSH-PULL AMPLIFICATION—PLENTY OF POWER!

Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. This kit represents the optimum in sensitivity, selectivity and stability. You'll be amazed at its superior commercial quality! You'll be elated with its surprising performance! The circuit uses 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode and features a specially matched set of 3 I.F.'s, Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2¾" speaker, and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, battery and easy-to-follow step-by-step instructions. 6" x 3½" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case.....Net 33.50
MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119 Shpg. wt., 1 lb.....Net 2.95
MS-279—Sensitive matching earphone.....Net 2.39

4 AND 6 TRANSISTOR RADIO KITS FOR SPEAKER AND EARPHONE OPERATION

- FOR GROUP AND PRIVATE LISTENING
- ONLY 6" WIDE x 3½" HIGH x 1½" DEEP



Completely self-contained, subminiaturized portable operates a miniature earpiece for individual listening. Uses new ultra-miniature "Poly-Vari-Con" 2-gang variable capacitor, four transistors (2 high frequency and 2 audio) plus germanium diode, 2 IF stages and built-in high gain ferrite core antenna. Extremely sensitive, stable and selective over entire broadcast band. Requires no outside antenna or ground connection. Kit supplied complete with transistors, all parts, drilled chassis, battery, and instructions with wiring diagrams. Shpg. wt., 2 lbs.

KT-94—4 Transistor Kit as above.....Net 19.95
MS-311—Leather Carrying Case.....Net 1.95
MS-260—Super Power Dynamic Earpiece.....Net 3.95
MS-278—Economy Earpiece.....Net 1.95

2 TRANSISTOR CLASS B PUSH-PULL OUTPUT SPACE KIT WITH SPEAKER SELF-CONTAINED IN HANDSOME PLASTIC CASE.

Converts KT-94 into a 6-transistor home radio with speaker. Complete Kit with 2 transistors, 2 transformers, 2½" PM speaker, pre-punched chassis, battery, case and instructions. KT-96—Shpg. wt., 1 lb.....Net 11.50

FM-AM TUNER KIT

Basic FM-AM Tuner having outstanding specifications and delivering astonishing performance — all at a budget price in easily assembled kit form.

34.95

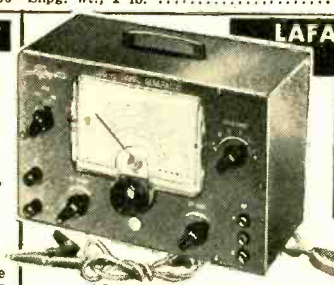
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL
- FOSTER-SEELEY DISCRIMINATOR CIRCUIT
- GROUNDED GRID TRIODE AMPLIFIER
- 20-20,000 CPS RESPONSE

Choose this 7 tube compact high-fidelity FM-AM tuner whose characteristic features are found in units costing many times as much, and whose performance is unheard of at this low price. There are two front panel controls, a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. Features Armstronf FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counter-weighted mechanism, high impedance phono input and high impedance audio output.

SPECIFICATIONS

FREQUENCY RANGE: FM 88-108MC, AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms, AM Ferrite loopstick and high impedance external antenna. **DISTORTION:** Less than 1% at rated output. **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps, AM ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 UV for 30 db quieting, AM, Loop sensitivity 80 UV/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down; 375 KC FM discriminator peak to peak separation, AM, 8 KC bandwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation: **TUBE COMPLEMENT:** 2-12AT7, 1-6BE6, 1-BA6, 2-6AU6, 1-6AL5 plus selenium rectifier. **SIZE:** 5¼" high x 9⅜" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Attractive etched copper-plated and lacquered finish. Less metal case. Shpg. wt., 9 lbs.

KT-100A.....NET 34.95
ML-100....Metal cage for above, Shpg. wt., 3 lbs. 5.00



LAFAYETTE SIGNAL GENERATOR

COMPLETELY WIRED AND TESTED! ACCURACY AND QUALITY GUARANTEED!

22.50

- FREQUENCY 120KC to 260MC!
- 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, 50-60 cycle A.C. Shpg. wt., 8 lbs.

LSG-10 — Signal Generator 22.50

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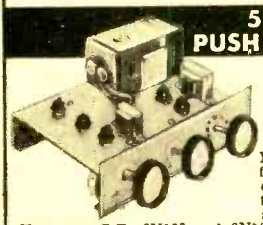
3 TRANSISTOR HI-FI PREAMPLIFIER KIT

New Lafayette Hi-Fi Pream Kit using new GE 2N190 quality audio transistors. Separate Volume, Bass and Treble controls. Frequency response 20-20,000 cps. Three phono and microphone. Provides low-noice, stable preamplification without hum and microphonics. Complete with all parts transistors, pre-punched chassis, battery and detailed step-by-step instructions. Size 4⅛" x 3¾" x 1½". Shpg. wt., 2 lbs.

KT-117 —Complete Kit.....Net **18.45**

5 TRANSISTOR PUSH PULL AMPLIFIER KIT



- ¾ WATT, CLASS B, PUSH-PULL OUTPUT
- CRYSTAL AND MAGNETIC INPUT
- SEPARATE BASS AND TREBLE CONTROLS

New 5 transistor audio amplifier for phonos—microphones—tuners—etc. Excellent for the experimenter—student—or any one desiring a good transistorized amplifier. Uses new G.E. 2N189 and 2N186A transistor. Inverse feed back for reduction of distortion. Transformer coupled driver and output stages. Complete with punched chassis, knobs, transistors, all parts and detailed instructions and diagrams.

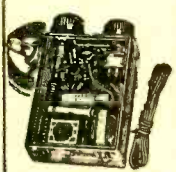
KT-104—3.2 ohm output.....Net **22.95**
KT-105—8 ohm output.....Net **22.95**

TRANSISTOR CODE PRACTICE OSCILLATOR KIT

For those interested in mastering the international code, an audio tone oscillator is essential. The circuit of this transistorized feedback oscillator has the simplicity of the neon glow, the signal strength of the vacuum tube, and requires only two penlite cells for weeks of service. It may be used for solo practice, or two may send and receive with the same unit. Kit comes complete with Transistor, Telegraph Key, Resistors, Condensers, Masonite Board, etc., and Schematic Diagram.

KT-72 .....Net **2.99**
Cannon ECI—Single Headset .....Net **1.13**

2 TRANSISTOR POCKET RADIO KIT



Packed into a 2½"x3½"x1¼" plastic case. This Two Transistor plus crystal diode radio kit offers many surprises, utilizing a regenerative detector circuit with transformer coupled audio stage, gives you high gain and excellent selectivity. Pulls in distant stations with ease with more than ample earphone volume. Kit comes complete with two transistors, crystal diode, loopstick, Argonne transistor audio transformer, resistors, condensers, plastic case, etc. Including schematic and instructions.

KT-68A Complete Kit less earphones. Net **10.95**
MS-260 New Super Power Dynamic Earphone, ideal for Transistor Circuit imp. 8000 ohm, D.C. 2000 ohm **3.95**

NEW POCKET AC-DC VOM MULTITESTER 2,000 ohm per Volt on AC & DC

- **Completely wired — Not a kit**

Accurate VOM with a sensitivity of 2000 ohms per volt on both AC and DC. Single selector switch. 3" 160 amp. meter. Scales: DC Volts: 0-10-50-500-1000; AC Volts: 0-10-50-500-1000; Ohms: 0-10K, 0-1 Meg; DC Current: 500 ua and 500 ma; Decibel: —20 to +22, +20 to 36; Capacity: 250 mmf to .2 mfd and .005 to 1 mfd. Heavy plastic panel, metal bottom. 4¼" x 3½" x 1⅝". With batteries and test leads. Shpg. wt. 4 lbs.

RW-27A **8.95**

NEW! Mail Order Center ------->

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. 4⅛"x2⅝"x1-1/16". Shpg. wt., 1 lb.

KT-116 —Complete Kit, less earphone.....Net 16.95
MS-260—Super Power Dynamic Earphone.....Net 3.95

1 AND 2 TRANSISTOR POCKET RADIO KITS

ONE TRANSISTOR POCKET RADIO KIT—KT-97

- IDEAL FOR STUDENTS, HOBBYISTS AND EXPERIMENTERS
- PRE-PUNCHED CHASSIS FOR ADVANCEMENT TO 2 TRANSISTOR KIT

Ideal, low-cost transistor pocket radio kit. Super-selective ferrite loop antenna permits good reception up to 50 mile radius with approx. 50 ft. antenna and good ground. Provisions for advancement to 2 transistor receiver. Complete Kit with simple detailed instructions. 3⅝" x 2⅝" x 1". Shpg. wt., 1 lb.

KT-97—Complete, less earphones..Net 4.50

TWO TRANSISTOR POCKET RADIO KIT—KT-98

Contains all KT-97 components plus additional R-C coupled transistor stage for increased sensitivity and output. Complete with instructions. Shpg. wt., 1 lb.

KT-98 —Complete 2 Transistor Kit, less earphone.....Net 5.95
MS-111—Crystal earphone for KT-97 and KT-98.....Net 1.49
MS-260—Super power dynamic earphone.....Net 3.95

20,000 OHM PER VOLT MULTITESTER SEMI KIT

A new kind of kit—the difficult work is already done—you wire in only a few multipliers and mount the battery holder to complete the unit. A fine high sensitivity (20,000 ohms per volt DC —5000 ohms per volt AC) instrument employing a 3" 40 microamp movement. Has 4 DC voltage, 4 AC voltage, 2 DC current, 3 resistance and 2 db ranges. Complete with test leads and detailed instructions. Size 3⅝" x 4⅝" x 1⅝". Shpg. wt., 3 lbs.

KT-20—Kit .....Net 11.95

Lafayette Radio DEPT. 1E **165-08 Liberty Ave, JAMAICA 33; N. Y.**

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NAME _____
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ZONE ___ STATE _____

CUT OUT AND MAIL TODAY!

Hellishcopter (*Continued from page* 98)

you start fooling around with these darned R/C—"

"WHO DROPPED THE TRANSMITTER?" I snapped savagely. "Come on, we've got to chase that baby and try to figure a way to catch it before—"

SOMEBODY — or something — screamed quite distinctly about half a block away. It was enough to curdle one's blood, that scream . . . especially if one happened to be responsible for letting a helicopter with three-foot-long blades loose in the neighborhood. Breaking into a gallop, I wondered how many years I'd get and if the wife would wait for me.

Suddenly the whirlybird appeared—chopping furiously across an empty lot, about ten feet off the ground—and veered sharply to port. I tried to head it off, but it climbed —just as I leaped, hoping to grab a pontoon —and chattered past me. Before I landed on my aching back I caught one short glimpse of a large and scrawny tomcat clinging to a pontoon, his yellow eyes blazing with madness. I hoped he accounted for the unholy scream.

"It went into Mrs. Millar's place!" babbled the wife, helping me to my feet. "Did you see that cat riding—"

"Saw it!" I agreed, and sprinted at a dead limp into the Millar yard. Ahead, I could hear the rise and fall of the mower-engine, its pitch changing. *It's too much to hope for power failure,* I thought, as I raced through a small vegetable garden, vaulted a fence and continued through somebody's roses, ignoring my wounds. *That baby's good for another forty minutes, and when I think of the damage she can do in forty minutes . . .*

I turned off the thought.

Again, suddenly, chillingly, somebody screamed with terror. I emerged into a back yard to see a matronly woman, her face blanched and twisted with fright, staring into the air. Twenty feet above her, flying in a wide circle and trailing a clothesline with several flapping items on it, was the errant helicopter—its motor snarling and coughing with almost vicious glee.

"Don't be alarmed, lady!" I gulped. "I'll try to—"

Just then she buried her head in her arms and mercifully passed out.

THE WHIRLYBIRD now widened its circle and I saw that it went by the limbs of a tall apple tree in the next yard with regularity. A desperate, unlikely idea popped into my mind. I streaked for the apple tree and began clambering up it. The helicopter passed twice before I made it to the limb

THE FINEST AND MOST COMPLETE LINE OF

Transistor Coils & I.F. Transformers

MILLER QUALITY PRODUCTS

All loops described below have a secondary which is overcoupled for maximum gain stability with a variation in output load. Designed to match an input impedance of approximately 600 ohms.
These loops also make excellent antenna coils for conventional vacuum tube receivers. They offer better signal pickup and increased selectivity over ordinary air loops.

SUBMINIATURE ANTENNA LOOPS

An adjustable antenna coil with a high Q ferrite core. May be used with any variable condenser having a maximum capacity between 250 & 450 mmf. Dimensions: ½" x 2½"

Cat. No.	Q @ 790 KC	Freq. Range	Tuning Cond. Max. Capacity	List Price
2002	250	540-1650 KC	250-450 mmf.	$1.50

I.F. TRANSFORMERS

Catalog Nos. 2041 and 2042 are miniature I.F. transformers having a tuned primary and untuned secondary. The primary is tapped for use in circuits which require a tap. Proper impedance match between primary and secondary insures optimum performance. Dimensions: ½" sq. x ¾" high.

Manufactured under K-TRAN patents of and by Automatic Manufacturing Corp.

Cat. No.	Freq.	Impedance	Use	List Price
2041	455 KC	25K— 600 Ohms	Input	$2.85
2042	455 KC	25K—1000 Ohms	Output	2.85

SUBMINIATURE

To our knowledge the 9-C1 and 9-C2 are the smallest I.F. transformers in existence. All technical specifications for the 2041 and 2042 apply respectively to the 9-C1 and 9-C2. Dimensions: ⅜" sq. x ⅝" high

Manufactured under K-TRAN patents of and by Automatic Manufacturing Corp.

Cat. No.	Freq.	Impedance	Use	List Price
9-C1	455 KC	25K— 600 Ohms	Input	$3.50
9-C2	455 KC	25K—1000 Ohms	Output	3.50

UNSHIELDED MINIATURE OSC.

These coils are designed for use in a converter circuit using only one transistor for both the oscillator and mixer. Dimensions: ⅜" x 1" high

Cat. No.	Tuning Cond. Max. Capacity	I.F. Freq.	Use	List Price
2020	365 mmf.	455 KC	Osc.	$2.00
2022	78-100 mmf.	455 KC	Osc.	2.00

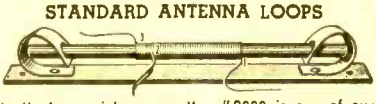
SHIELDED SUB-MINIATURE OSC.

The 2021 oscillator coil is a sub-miniature shielded version of the #2022 described above. Identical in size to our 9-C1 and 9-C2 I.F. transformers. Designed for use with a condenser having a maximum capacity of approximately 100 mmf. (Miller #2110). ⅜" sq. x ⅝" high

Manufactured under K-TRAN patents of and by Automatic Manufacturing Corp.

Cat. No.	Tuning Cond. Max. Capacity	I.F. Freq.	Use	List Price
2021	100	455 KC	Osc.	$2.50

STANDARD ANTENNA LOOPS



Due to its large pickup area the #2000 is one of our most popular loops. Dimensions: ¾" 9"

Cat. No.	Q @ 790 KC	Freq. Range	Tuning Cond. Max. Capacity	List Price
2000	450	540-1650 KC	365 mmf.	$2.75

MINIATURE ANTENNA LOOPS

Similar to the #2000 described above but smaller in size for miniature sets. Slightly less signal pickup than the #2000, but extremely high Q. Dimensions: ¾" x 3¾"

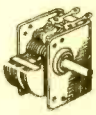
Cat. No.	Q @ 790 KC	Freq. Range	Tuning Cond. Max. Capacity	List Price
2001	550	540-1650 KC	365 mmf.	$2.50
2003	500	540-1650 KC	125 mmf.	2.50

FLAT FERRITE LOOPS

These coils are wound on flat ferrite strips rather than the normal ferrite rods. Due to this unique physical configuration they are remarkably sensitive for their small size. Dimensions: ¼" x ¾" x 3¾"

Cat. No.	Q @ 790 KC	Freq. Range	Tuning Cond. Max. Capacity	List Price
2004	500	540-1650 KC	365 mmf.	$2.50
2005	450	540-1650 KC	125 mmf.	2.50

VARIABLE CONDENSERS



Catalog #2110 is a miniature 2-gang variable condenser. The antenna section has a range of 10-130 mmf. Catalog #2112 is a standard size 2-gang condenser having a range of 10-365 mmf. for both sections. Shaft is ¼" dia. x 1⅛" long.

Cat. No.	Sections	Dimensions	List Price
2110	2	1⅝" x 1⅜" x 1¾"	$2.50
2112	2	2⅜" x 1 13/16" x 1⅜"	3.50

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which reached far out over the back yard.

"Think you can grab it as it comes by?" yelled my wife, watching tensely below. *"Here it comes . . ."*

Balancing precariously on the unsteady limb, I readied myself to make one grab, which had to be successful, as the helicopter chopped by me. It was slowly gaining altitude again, and if I missed it—the whole plan was shot. Then, the plane was within reach and I grabbed for it . . . missed . . . lurched recklessly forward . . . grabbed again, getting the starboard pontoon and a faceful of frenzied cat . . . was pulled completely off the limb—and went hurtling earthward.

The impact was horrendous, but I heard the blades snapping off and the motor dying before I sank into gathering darkness.

I came around to find myself sprawled in the wreckage, with a large and scrawny tomcat calmly cleaning his paw beside me and two people standing over me. As my head cleared, I recognized my wife and old Mr. Dixon, owner of the apple tree.

"Listen, young feller," said old Mr. Dixon softly, "You're kinda old for them kid stunts. After this, if you want an apple—just *ask* for it."

NEITHER of us uttered a word—taking the back-alley route home—until we were safely within my workshack again. Sadly, I regarded the shattered remains of what had been a stupendous project. Tenderly, I fingered the twisted, devastated chunks of helicopter.

The wife put an arm around my shoulder.

"Buck up, boy! Dismiss this whole thing from your unpredictable little mind and let's go downtown!" She smiled strangely.

"Downtown?" I murmured brokenly.

"Sure! We'll buy one of those tremendous R/C boat kits! The biggest and best one we can find!"

"A-After what I've done?" I moved slightly away from her, wondering how *my* fall could affect *her* head. "You'll buy me an R/C boat kit despite all this?"

"You bet!" she said, a determined look whipping over her face. "You're *grounded*, boy! From here on out, you're strictly water-borne! After all these hectic years, I know better than to try and *cure* you of these R/C spasms. But I can *modify* the results! Come on. I'll even buy you a yachting cap to go with it."

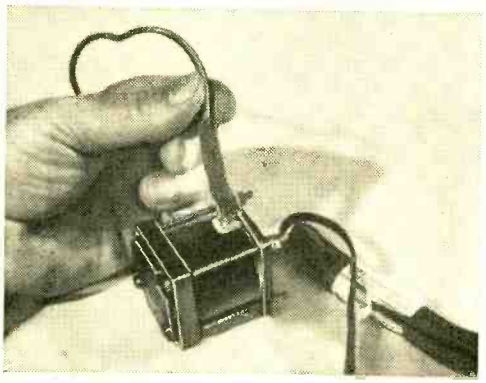
That was quite some time ago and I've got the five-foot model of a Navy PT Boat almost finished. The modified mower engine fits fine, and I'm really going to wow those characters down at the R/C Boat Club. I cut quite a figure in that yachting cap.

Call me Commodore. —30—

TIPS and TECHNIQUES

SHOELACE SPAGHETTI

Pieces of ordinary shoelace may be used as spaghetti for insulating connecting wires inside motors. The coils and wiring are doped with insulating varnish on finishing each job so the lace is satisfactory. It can also be used for insulating splices



and soldered connections, as shown here. After slipping the laces over the wires, a coat of varnish finishes the job. —*K. M.*

COVERING TABLE RADIO CABINETS

Self-adhesive plastic material may be used to dress up an old cabinet. Before applying, smooth out the scratches with

emery paper or fine sandpaper, and remove dirt or grease with soap and water or kitchen scouring powder. Be careful when cleaning the front of the cabinet, or

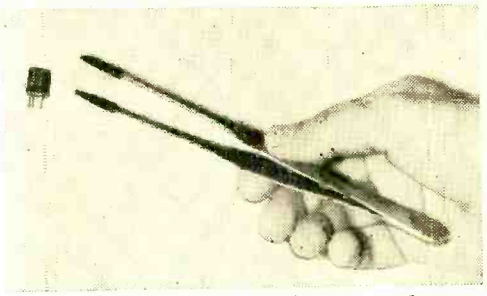
any other part of the cabinet not to be covered with the plastic material, as some of the older or cheaper cabinets have a color coating which dissolves and comes off when washed with soap and warm water, or cleaned with scouring powder. —*A. T.*

LOUDSPEAKER RATTLE

Loudspeaker rattle is often due to warped cones or to the voice coil rubbing the magnet pole piece. These difficulties can sometimes be eliminated or reduced in smaller speakers by slightly distorting the speaker rim. To do this, place enough washers under one or more of the speaker mounting screws to throw the speaker rim out of true. It is also sometimes effective to place slight pressure on a portion of the cone, after the proper area has been located, by lightly pressing the cone with the fingers at various points until the rattle is a minimum. Be careful not to rupture the cone. It may be brittle in older sets. The pressure can be maintained by sticking a small wad of masking tape on the desired cone area, the wad being formed with the adhesive surface on the outside. When the set is installed in the cabinet, the wad will be pinched between the cone and the wire mesh grill covering the speaker opening on the cabinet. Too thick a wad will puncture the cone. When speaker rattle is due to a tear in the cone, the edges of the tear can be held together by transparent cellophane tape. —*E.F.C.*

TRANSISTOR PULLER

Transistors in their sockets are often hard to reach using only the fingers. This job can be made easy with the tool shown in the photograph. Simply obtain a large



pair of tweezers—about 6" long—and wrap a single layer of rubber tape around the end of each blade. (A short length of rubber sleeving can be used instead.)

This rubber tip for the blade will not only provide a good surface for gripping the transistor but it will help prevent scraping the type numbers off the case. To use the tool, hold the transistor by its side or top depending on the layout of the nearby parts. —*J.E.P.*

Tuning the Short-Wave Bands

(*Continued from page 82*)

There are too many interval signals for s.w. stations the world over to include them all in this column, but a complete list can be obtained from the *World Radio Handbook*, available for $2.00 from Gilfer Associates, P. O. Box 239, Grand Central Station, New York 17, N. Y. Some of the more common ones that can be heard are featured on page 82. If you would like to know the interval signal of any particular country or station, send me a card.

Current Reports

The following is a resume of the latest reports that have been received. Please remember that these reports were correct at time of compilation; frequencies and schedules often change with little or no notice. All times shown are Eastern Standard, using the 24-hour system.

Andora—*Radio Andorra*, 5979 kc., is being heard in the Eastern USA in late afternoon with a variety of musical programs but no English. This station broadcasts mainly to Spain, Portugal, France, Switzerland, Italy, and North Africa. The IS is a low-pitched gong. (*26*)

Argentina—LRA, *R. Del Estado*, 9690 kc., Buenos Aires, has an English session at 2330-0000, Monday thru Friday. It features L.A. music, commentaries, and closes with a late news bulletin. (*RH, TC*)

Australia—New frequency changes from *Radio Australia* are as follows: to N.Z. & South Pacific Islands at 2329-0415 on 11,710 kc. (replaces 11,740 kc.); to the British Isles & Europe at 0245-0359 on 11,710 kc. (replaces 11,740 kc.); to Eastern N.A. at 0714-0845 on 11,810 kc. (replaces 11,770 kc.); and to South, S.E., & S.W. Asia at 1500-1700 on 15,315 kc. (replaces 15,160 kc.). The Western N.A. xmsn remains unchanged and is heard daily at 1015-1115 on VLC11, 11,770 kc. The DX program is heard Sundays at 0830 on 11,810 kc., to Eastern N.A., and at 1100 on 11,770 kc. to Western N.A. (*61, 82*)

Brazil—*Radio Sociedade de Bahia*, Salvador, is operating new stations on 11,875 kc., heard at 1400-2100 but usually covered by jamming after 1730, and on 15,125 kc. at 0600-1100. (*100*)

Radio Jornal do Comercio, Recife, currently has two English programs as follows: "About Brazil," broadcast at 2005 Mondays thru Saturdays; and "Brazil Calling," at 1630 Sundays. They can be heard on ZYK2, 6085 kc., ZYK32, 11,825 kc., and ZYK33, 15,145 kc. (*54, 66*)

Bulgaria—*Radio Sofia* is again operating in English on 9700 and 7670 kc. at 2115-2215 and 2300-2330. While not directed to N.A., it is well heard. (*JG, 187, 208*)

China—*Radio Peking* is being reported on 15,060 kc. at 1800 and on 15,350 kc. at 0940 and 1840, in language xmsns. It can be tuned on 17,745 kc. at 2155 s/on, 2200 news, 2215-2230

s/off with Chinese music and English anmts. This latter period is dual to 15,080, 11,650, and 11,960 kc. (*GA, 26, 184*)

Cook Islands—ZL1ZA, *R. Raretonga,* Raretonga, can still be noted on 5050 kc. on Wednesdays at 2315-0000. With QRM (7)

Cuba—*Reloj de Cuba* is operating on 5085 kc. (heard at 1730-0000) and 11,750 kc. (heard at 1300-0000) with various musical programs and Spanish language. COCO, Havana, 9530 kc., has returned to the air after a long absence and is noted on the east coast at 0700 s/on and in the west around 2300. (*DK, 7, 25, 54, 59, 100, 158*)

Czechoslovakia—*Radio Prague* has English to N.A. at 1930-2000, 2200-2300, and 0000-0030 on 6170, 6105, 6055, and 9535 kc. (*GA, 176*)

Ecuador—New stations noted include: *Radio Equinoccial,* Ibarra, 5943 kc. (1900-2300); *La Voz del Norte,* Ibarra, 5802 kc. (1900-2300); *Radio Sangi de Ibarra* (?), Ibarra, 6210 kc. (1900-2300). A previous unidentified xmtr on 4600 kc. is *Radio Atalaya,* Guayaquil. Other unidentified stations are noted on 4490, 4695, 4700, 4755, 4775, 4870, and 5202 kc. Except for HCJB, none of the stations in this country seem to give call letters but they do announce by station name. Any help in identifying the unknowns will be appreciated. (*100*)

Egypt—*Radio Cairo* has an English program on 9475 kc. at 1330-1400. An English newscast can be heard on 9730 kc. at 1530-1540 with a commentary to 1555. (*11, 26, 124, 127*)

England—The BBC has "Music For Dancing," Sundays at 1615-1700 on 17,700 kc. On Fridays at 1600, they present a program of light music on the same channel. (*156*)

Formosa—BEC27, Taipeh, 7200 kc., may have a new 1000-watt xmtr in use now as the signal is excellent on the west coast with AFRS programs. This is scheduled Saturdays and Sundays only. ID is *AFRS, Taiwan.* (7)

France—The only English xmsn from Paris is on 7240 kc. at 0900-1000 to England. Paris is also noted on 15,400 kc. in French at 1500-1530 to French Africa, and on 17,850 kc. in French to Canada at 1230-1245 (Mondays-Fridays only). (*116, 208*)

Gold Coast—The Gold Coast B/C Service, Accra, is being well heard in the east on 3366

English Newscasts

Here is a compilation of a few stations that carry English newscasts daily. Although there are many others, these are probably the easiest to hear. (*149*)

Argentina—LRA1, Buenos Aires, 9690 kc.; news & commentary at 2330; news at 2350.

Canada—CKNX, on 11,945 kc. at 2200; on 11,705 kc. at 2030 with news at 2000.

England—BBC news at 0100 on 9600 kc. and at 2145 on 15.070 kc.

French Equatorial Africa—From Brazzaville on 11,970, 9730, and 9620 kc. at 2150.

Japan—*Radio Japan* has news at 0000 on JOA4, 11,705 kc., and JOB20, 9525 kc.

USSR—From Moscow at 2000 on 11,760 and 11,870 kc., and at 2200 on 11,840 kc.

kc. daily from 1600 to 1716 s/off with news, drama programs and music, in English. In the west, it is best heard on this channel from 0100 to 0140 fade-out with a BBC relay until 0130 and a local musical request program after 0130. This station also operates on 9615 kc., according to latest word from the station. (*7, 52, 147*)

Greece—*Radio Athens* is still being noted on 17,757 kc. at 1230-1240 with English news. Another English period is reported on 11,718 kc. at 1400-1500. (*11, 208*)

Honduras—The latest frequency changes are: HRNQ, *R. Morazan,* has moved from 6090 to 6200 kc. and is heard from 1900 to 2300 s/off; HRN, *La Voz de Honduras,* is now on 5960 kc. and is heard at 0700-0800 and 1900-2300; HROW, *R. Montserrat,* has moved back to 5880 kc. and is heard at 0700-0800 and 1900-2300. The above three are in Tegucigalpa. HRVW, *La Voz de Centro America,* San Pedro Sula, has moved from 5967 to 5972 kc. and is heard at 0700-0800 and 1900-2300. HRVW verified promptly by airmail. (*100*)

SHORT-WAVE ABBREVIATIONS

AFRS—Armed Forces Radio Service
anmt—Announcement
BBC—British Broadcasting Corporation
c.w.—Code
Eng.—English
ID—Identification, identity
IS—Interval signal
kc.—Kilocycle(s)
L.A.—Latin America(n)
N.A.—North America(n)
QRM—Interference
R.—Radio
s/on—Sign-on
s/off—Sign-off
w.—Watts power
xmsn—Transmission from station
xmtr—Transmitter used by station

Hungary—*Radio Budapest* is again operating in English to N.A. daily at 1930-2000 and 2300-2330 on 11,910, 9833, and 7220 kc. The program features news, commentaries and music. (*BH, JS, 192, 202, 208*)

India—While this country currently has no programs beamed to N.A., *All-India Radio,* Delhi, can be noted on 17,795 kc. with English to S.E. Asia at 0830-0930 (news at 0830-0840). This xmsn is parallel on 21,580 kc. It can be

"It smokes up, you say?"

tuned on its xmsns to Great Britain at 1930-2045 on 9615 kc., and at 1445-1545 on 11,705 or 9850 kc. (*33, 208*)

Jamaica—ZQI, *Radio Jamaica*, Kingston, is often noted on 4950 kc. along the eastern seaboard at 1800-2000 with music, news, commercials, and frequent ID. They have English news at 1930. Tune carefully for this if you aren't along the east coast; it has been reported from all over the U.S. (*47, 184*)

Japan—JOB2O, Tokyo, 9525 kc., is noted at good level in South American beam at 0400 s/on. Spanish is heard until 0415, Portuguese until 0430. (*25*)

Lithuania—If you can read c.w., here is a chance to log a rare country. LYG, Kaunas,

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David Crockett (*DC*) Winston-Salem, N. C.
Tom Conner (*TC*) Ashland, Ore.
James Gere (*JG*) Owasco Village, N. Y.
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Ronald Hehn (*RH*) Bozeman, Mont.
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Walter Maychrovicz (*WM*) Ashtabula, Ohio
Jacob Schanker (*JS*) Brooklyn, N. Y.
David Wolin (*DW*) Kenmore, N. Y.
Bill Flynn (*7*) Berkeley, Calif.
Chuck Maxant (*11*) Baldwin, N. Y.
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Floyd Backus (*26*) Richmond, Va.
Bob Knowles (*28*) San Diego, Calif.
William J. Currell (*33*) Toronto, Ont.
Jerry Saval (*47*) Revere, Mass.
R. D. Kimpton (*52*) Cobourg, Ont.
Jim Cumbie (*54*) Sherman, Texas
Grady Ferguson (*59*) Charlotte, N. C.
John Beaver (*61*) Pueblo, Colo.
Jim Lothian (*62*) Hempstead, N. Y.
Frank Longenecker (*66*) Hollywood, Calif.
John Mann (*82*) Montreal, Que.
Jack Stephenson (*88*) Oklahoma City, Okla.
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Steven Beeferman (*184*) Bayside, N. Y.
Philip Danley (*187*) Muncy, Pa.
Danny Ferguson (*192*) Columbia, S. C.
David Tabaczyk (*202*) Auburn, N. Y.
Christopher Bennion (*208*) Riverside, Conn.

has a c.w. xmsn most evenings on 5940 and 8502 kc. A report to them was QSL'ed promptly with a prepared card. (*167*)

Luxembourg—*Radio Luxembourg*, 6090 kc., is currently being noted in the east on Sundays at 1500-1900 with no QRM. Programs are beamed to England. They feature "Top Twenty Tunes" from 1800 to 1900 complete with commercials. On other days, this xmsn is badly QRM'ed after 1700 by 4VB, *Radio Commerce*, Haiti. Another xmsn is heard around 0230 with an excellent signal and musical programs. Anmts are in Flemish. (*WM, 62, 208*)

Mozambique—Lourenco Marques is often reported from 9630 to 9638 kc., although a letter from the station states that they are on 9624 kc. The "Cactus Club" can be heard

at 2300-2355 with music and commercials. (*26, 28, 158*)

Netherlands—*Radio Netherlands,* Hilversum, is easily heard in the south on 9590 kc. in the L.A. beam at 1630-1800. On Sundays they have the "Happy Station Program" to the U.S. & Canada at 2130-2300 on 9590 and 11,950 kc. Alternate frequencies are 15,425, 15,365, and 6025 kc. (*DW, 54, 150, 152, 173*)

Nicaragua—Here is a list of stations currently operating in Nicaragua: YNRL, 5045 kc., 75 w., Granada—*La Voz de La Victoria;* YNWW, 5965 kc., 600 w., Granada—*Radio Sport;* YNDG, 5995 kc., 1000 w., Leon—*Radio Colonial;* YNBH, 6016 kc., 400 w., Managua—*Radio Panamericana;* YNLU, 6040 kc., 250 w., Managua—*Radio Managua;* YNOW, 6055 kc., 600 w., Managua—*La Voz de La America Central;* YNEQ, 6065 kc., 400 w., Managua—*La Voz de La Victoria;* YNVP, 6185 kc., 900 w., Managua—*La Voz de Nicaragua;* YNWN, 7312 kc., 150 w., Granada—*Radio Granada;* YNRM, 7602 kc., 500 w., Matagalpa—*Radio Musun;* YNCA, 7753 kc., 150 w., Bluefields—*Radio Atlantico;* YNBX, 7890 kc., 100 w., Granada—*Radio Oriental;* YNMS, 7660 kc., 250 w., Leon—*Radio Philips.* (*7*)

Poland—*Radio Warsaw* is heard well on 6010 kc. in English to N.A. at 2130-2200 and 0030-0100, with news and music. It is dual to 9525 kc. but not heard well there until the late xmsn. It is also noted on 17,800 and 15,120 kc. at 0600-0630 with English news and music. (*JG, 104, 153*)

Rumania—*Radio Bucharest* is being noted on 11,937 and 9570 at 2200-2230 and 2330-0000 in English to N.A. Music, news and talks make up the program. (*DC*)

Surinam—There will be a new s.w. outlet in Paramaribo on 11,590 kc. which may be in the Commercial Service. Further details are requested. (*163*)

Tanganyika—Dar-Es-Salaam now has a morning xmsn, audible in the U.S. at 2230-0000. (*100*)

Tangier—*The Voice of Tangier,* Br. P.O. Box 219, Tangier, operates as follows: at 0200-0230 and 0500-0900 on 7230 kc.; at 1330-1430 on 9444 kc.; at 0300-0500, 1200-1330, 1430-1530, and 1530-1815 on 9485 kc. *IBRA Radio* operates in English daily at 1615-1645 and on Mondays, Tuesdays, Wednesdays & Fridays at 1300-1315 on 11,515 and 8935 kc. (*82*)

United States—*The Voice of Maritime Labor,* New York, is still being noted on Sundays only at 1120-1135 with a program of interest to shippers & seamen. It is heard on 15,700, 15,850, and 19,850 kc. (*104*)

Venezuela—YVLK, *Radio Rumbos,* Caracas, 4970 kc., is heard at 1800-2230 with an English program, "Supper Club," at 1800-1900. Other programs are in Spanish. Another all-Spanish xmsn is noted over YVMQ, *Radio Barquisimeto,* Barquisimeto, 4990 kc., at 1915-2230. (*88, 116*)

YVLD, Valencia, is readable on the west coast at 2230/close. (*7*)

Yugoslavia—*Radio Belgrade* has an excellent signal in N.A. xmsn of news and features at 1715-1730 on 6100 kc. (*104, 208*) —30—

Racing Radio

(*Continued from page* 39)

Florida, recently served as the testing ground for an experimental installation of radio communication between pit crew and stock car race driver. The car was a Chevrolet racing sedan owned by Al Hobbs of Gibsonburg, Ohio. A Vocaline transceiver was bracketed on the transmission hump inside thick slabs of sponge rubber—no internal changes of the transceiver were necessary. A floor switch, on the car's floorboard, controls an externally mounted solenoid over the "Push-to-Talk" switch, and the standard crystal microphone is solidly taped to the sedan's gearshift lever under the steering wheel, only twelve inches from the driver's lips.

Mr. Hobbs' racing stock car is driven by his 22-year-old son, Chuck, who competes in NASCAR (National Association Stock Car Automobile Races) sanctioned races throughout the southern United States. They plan on extending the benefits of radio communication to other stock and modified racing cars of the Hobbs team if this initial installation proves successful. Perhaps in the not too distant future such radio communication will become standard procedure on the stock car racing track.

—*William Carroll*

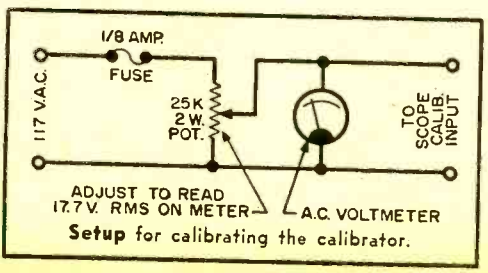
Oscilloscope Calibrator

(*Continued from page* 57)

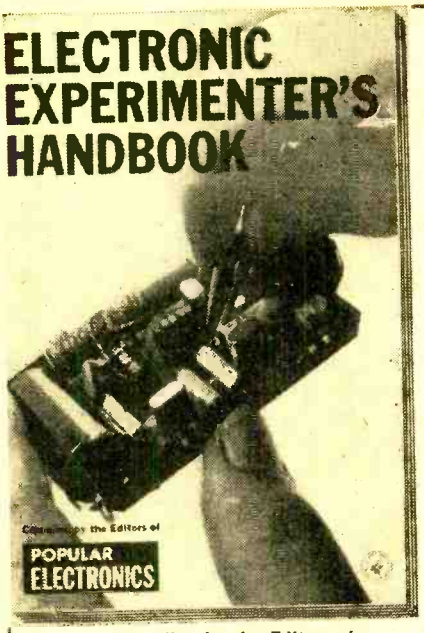
cilloscope gain for ten boxes of deflection. When switch *S2* is placed in the 0.5-volt peak-to-peak position, the deflection should be one-half box if the divider is accurate.

During actual use of the calibrator, the unit is left connected to the vertical input of the oscilloscope and the signal waveforms under observation are fed into the *input* terminals of the calibrator. With the switch *S1* in the *scope* position, the oscilloscope input terminals are merely transferred to the input terminals of the calibrator.

Using the Calibrator. To measure the voltage of a waveform being fed into the oscilloscope, use a reverse procedure to



Setup for calibrating the calibrator.



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that of the calibration just described. To measure a peak-to-peak voltage, first calibrate the screen of the oscilloscope in terms of volts with the calibrator. This is done by placing switch *S1* in the *cal.* position. Then set switch *S2* to one of the voltage settings on the calibrator. For our discussion, let's use the 10-volt position.

Adjust the vertical gain of the oscilloscope to produce a signal of a specific number of boxes on its face. If you make the calibrator signal ten boxes high, then each box on the oscilloscope face will represent one volt. If you adjust the oscilloscope vertical gain so that a 10-volt calibrator output is only one box high, then ten boxes on the oscilloscope face will represent one hundred volts. Thus, it can readily be seen that the three ranges included in the calibrator will cover any voltage normally encountered with the oscilloscope. —30—

Sound Impressions

(*Continued from page* 61)

ven throws music at you in massive chunks that can emotionally bowl you over if you listen attentively.

Try his *Seventh Symphony* as recorded on Angel 35330 by Otto Klemperer conducting the Philharmonia Orchestra. This performance carries the composer's moods from the depths of tragic utterance and loneliness to flights of wild exuberance. Pervading the whole is the driving, almost compulsive sense of urgency that represents the joining of Beethoven's own personality to the rhythmic quality of the music. This is one piece that doesn't ask you to listen; it *tells* you to. The disc itself proclaims the music with tremendous dynamic range and convincing acoustics. Musically and technically, this is a big and full record. A giant speaks.

Lush Rapture. By the time of the Civil War, composers had learned some tricks that later won this period the name of "the romantic era." Slick harmonies slithered from key to key, giving you that aching, longing kind of feeling that makes music "sweet." Orchestration changed: instead of having choirs like strings, brass, and woodwinds always together like platoons on the parade ground, the romantic composers often let single instruments murmur mysteriously, wail plaintively, or sing out triumphantly against their massed companions.

Tschaikowski blended these tricks into deeply personal and genuinely felt music of compelling sweep and passion. Even at first hearing, his music carries you along in an avalanche of rich-hued sound. West-

minster's version of his *Fifth Symphony* (XWN 18355) is the unbelievable ultimate in vibrant hi-fi, and conductor Rodzinski wrings out music for the last drop of blood. Play it loud, and it'll wring you, too.

Brahms, contemporary with Tschaikowski, had the same harmonic and orchestral tools to work with. Yet he disdained emotional rampage and used the new musical devices for more austere and contained expression. Try his *Fourth Symphony* as done by the Vienna Philharmonic under Kubelik on London LL 1485. Its beauties don't jump at you, but they'll come out after a few playings.

Bridge to Present. In Gustav Mahler's music, we find a bridge from the past to our own time. Still richly melodious in the old tradition, his music already throbs with the nervous tension of modern life. He uses a huge orchestra to build cunning "sound effects" ranging from hushed and breathless whispers to strident caricature or majestic climax.

Mahler's *First Symphony,* played under Rodzinski on Westminster XWN 18014 or under Bruno Walter on Columbia 5SL-218, is a rich lode for your musical digging and tailor-made for audio.

Here and Now. Much of today's music is frankly experimental and often falls harshly on ears unused to dissonance. Yet there are some living composers with a knack for making modernism inviting even to novice listeners. Full-fledged sympho-

The hi-fi bug, a highly virulent germ, scored a stinging bite on Mr. Magoo, the famed motion picture star. The event and its dreadful consequence (see illustration above) were duly recorded by RCA Victor (*Magoo in Hi-Fi* LPM-1362). Timid souls may suffer magoospimples from overdoses of this disc but will recover quickly by listening to the soothing *Mother Magoo Suite* on the flip side, where they encounter *Sheepish Bo-Peep* and find *The Little Miss Muffed It.* But *Very Contrary Mary* is real pretty and full of hauntingly modal chords.

nists of this kind are Dmitri Shostakovich and Ralph Vaughan-Williams.

Shostakovich's youthful *First Symphony* was handed in as a sort of "term paper" for his graduation from music school. Its durable freshness, witty and hard-biting satire, and the undisguised fervor of its often bitter feeling make it one of the most popular symphonies written in our own time. Soaring strings, full-throated brass and snarling drums ring out convincingly in the Angel recording (35361) by the French National Radio Orchestra under Igor Markevich, while nose to nose in the Shostakovich hi-fi race is Westminster's XWN 18293 with Howard Mitchell conducting the National Symphony Orchestra of Washington, D. C.

Ralph Vaughan-Williams is one of the few living composers who can express the tensions of our age and yet instill in his music a feeling of quiet repose. His *Sixth Symphony,* for instance, was written in recollection of the London blitz with the city under the terrible, random rain of bombs. Anger and agony flare in this music, but yield ultimately to a pervasive calm that bespeaks the inner peace of brave men who, having come to terms with life, can fight for it to the death. The symphony celebrates the human spirit rising above the hell of war. Adrian Boult projects this work with force and dignity in a technically matchless recording on London LL 976.

Such music is more than mere entertainment, for it demands of the listener the vigorous exercise of heart and mind. You don't just sit back and let the music pass by. To get the most out of a symphony, you have to go out mentally and emotionally to meet it half-way. Sure, it takes a bit of concentration, but so does every activity sufficiently worthwhile to absorb you and reward you completely.

Each of the records listed here is a standout . . . a beacon light in the realm of music. As such, its purpose, besides casting its own light, is to steer your symphonic safari toward the many exciting "discoveries" that lie between and beyond these musical landmarks. —30—

After Class

(*Continued from page* 81)

operate satisfactorily on 10 microamperes will run for a minimum of five years with absolutely no attention.

The atomic cell functions well over wide temperature ranges from boiling heat to bitter cold. This feature could make the battery valuable for use in high-altitude

rockets and missiles or deep-space meteorological survey gear. At 200° below 0° F, the cell has a little better output than at room temperature. Used in conjunction with telemetering equipment, it could provide power for years for units dropped into remote polar regions or used in oceanographic studies. It is believed that the cost of promethium—which is now prohibitive commercially—will soon be reduced by the current expansion program in the atomic energy field.

Indium Cell. What of other microcells? One of the more recent and promising developments in the chemical (rather than atomic) battery fields is the indium cell. Indium, a relatively rare metal, has shown itself to be excellent battery material when properly combined with other chemicals.

The indium cell shown below is characterized by high reliability, long life, zero leakage over the period of its entire life, and the absence of swelling or other dimensional changes. It provides about 1.15 volts compared to 1.35 volts for the mercury cell and has a capacity of approximately 120 *milli*ampere-hours, enough energy to operate a #47 panel lamp for about three-quarters of an hour. Thus, the small cells now in production, intended for use with electronic wrist-watches, have a capacity per unit volume which is at least 125% that of comparable mercury cells.

So—there again go any illusions we may have about atomic engines or battery-powered automobiles for the common man. But the ice has been broken; there *is* an atomic battery in operation! There *is* a button-size chemical battery which will run a wristwatch for a respectable period! —30—

Kit Builder's Korner

(*Continued from page* 70)

It has d.c. current ranges of 0-100 microamperes and 0-250 milliamperes. Two db scales are calibrated: —20 to +10 db, and —8 to +22 db. Finally, ohmmeter ranges of 0-5000, 0-500,000 and 0-5,000,000 ohms are provided.

The most interesting feature of the kit is the fact that it is partially assembled. Much of the most difficult work is already completed, thus simplifying considerably the final assembly of the instrument. You'll also like the use of a small clip for the ohmmeter batteries.

Comment. The instrument assembles without difficulty, works nicely, seems fairly rugged, and has ample accuracy for most practical work. The meter face is large,

calibrations are fairly easy to read, and the knife-edge pointer permits readings with good accuracy. Thus, the KT-20 is a valuable instrument and represents a good buy, whether purchased in kit form or as a factory-assembled instrument.

Our personal preference would be for an additional current range or two. This is not especially critical, but more current ranges would be handy for some types of work. In addition, the ohmmeter batteries used, though of standard types, might not be available in all localities . . . again, our personal preference would be for standard penlite cells in place of the shorter version used. —30—

Transistor Topics

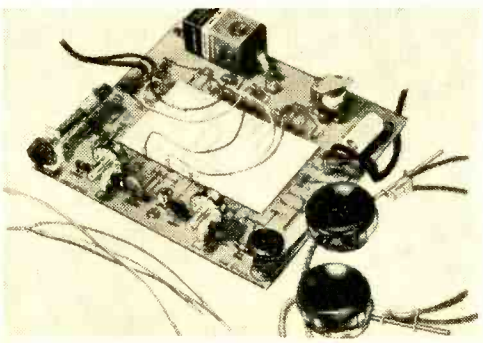
(*Continued from page* 90)

triodes. Commercially available units have operating frequencies up to 250 *megacycles*. Currently, junction tetrode transistors are available from General Electric, Germanium Products, and Texas Instruments.

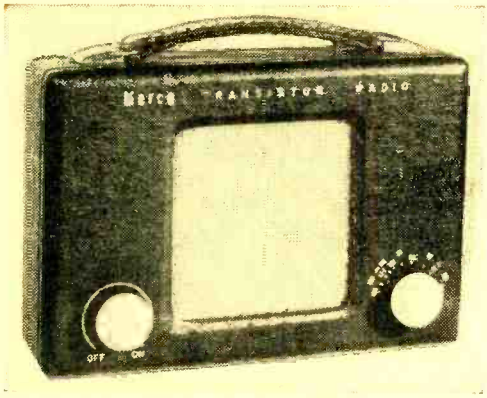
Your columnist has just completed the design, construction and test of an FM "wireless microphone" using a single G.E. junction tetrode transistor and operating at approximately 100 megacycles. With a six-volt battery, the unit could be picked up at 15 to 20 feet from a low-sensitivity table model FM receiver using the oscillator's coil radiation alone . . . *no antenna!*

The second base connection in the tetrode can be used for signal insertion if necessary. For example, one r.f. signal can be applied to the "conventional" base lead, another signal to the second lead, and the tetrode used as a *mixer* or *converter*.

New Manual. General Electric has issued a new *Transistor Manual*. A 64-page booklet, it includes information on basic semiconductor theory, transistor specifications and body outlines, definitions, and a good selection of circuits. It sells for fifty cents (50¢) and is available through all



Allied Radio's "10-Circuit Transistor Lab Kit."



Merco's low-cost all-transistor radio receiver.

G.E. distributors . . . or direct from General Electric Company, Semiconductor Products, Dept. TT, Electronics Park, Syracuse, New York. Our advice? Get a copy as soon as you can!

Product News. How small can you get? It looks like someone asked a popular hearing-aid manufacturer this question. Sonotone has introduced a hearing aid which occupies only three-tenths of a cubic inch, yet contains three transistors and 87 subminiature components . . . plus a battery!

Sylvania has reduced the price of its 2N229 transistor to seventy-five cents (75¢). An *n-p-n* type, the 2N229 is intended for audio applications. The manufacturer has issued an interesting four-page booklet which includes basic data on the transistor as well as three suggested circuits.

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., has introduced a "10-Circuit Transistor Lab Kit." Your columnist hasn't had a chance to examine this item, but it sounds like an interesting kit.

Merco Recording Company, Inc., 147-33 231st St., Springfield Gardens 13, L. I., N. Y., has announced an all-transistor radio which is priced at *less* than thirty dollars, including battery. The set features a nine-volt battery with a 700-hour life and has a 4" loudspeaker.

Well, fellows, that's all for now. See you next month. . . .

Lou

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The Transmitting Tower

(*Continued from page* 85)

with the advantages of a "front end" especially designed for 2-meter reception. Two typical 2-meter converters are: the Electronic Labs LW-61, which has good sensitivity and sells for $18.50, wired and tested; and the Tecraft CC5-144, which is very

sensitive and sells for $42.50 ready to operate, and as a kit for $29.75.

For those who prefer a separate receiver, rather than a converter, there are several available. One is the Hallicrafters S-102, which sells for $59.95. It is approximately comparable in performance on 2 meters to that of an S-38D on the lower frequency bands.

From all of these figures, it can be seen that getting on 2 meters is not fearfully expensive. You might note that a good part of the slightly increased cost of the transmitters is invested in the modulation equipment, because practically all 2-meter contacts are made on phone. Also, it is worth mentioning that the slightly lower power rating of the 2-meter transmitters mentioned compared to the power of a typical, Novice c.w. transmitter is of little importance. Fifteen watts on "2" will do as good a job as 50 watts on the lower frequencies.

A 38"-long, ¼"-diameter rod, cut in half and fed in the center via a 50 to 75 ohm transmission line or a 38" folded dipole fed with 300-ohm feed line, as described in the booklet "How To Become a Radio Amateur," is a satisfactory antenna for many contacts. However, the improvement obtained from even a small beam makes a beam highly desirable. One can be purchased for a few dollars or constructed from data in the *Radio Amateur's Handbook* to increase your effective transmitted power four to ten times and still be smaller than many TV antennas.

In the above discussion, certain pieces of commercial equipment were mentioned. Any amateur parts catalog will list other pieces of equally useful 2-meter gear. Home-built equipment also works well. A complete 2-meter station is described in the booklet "How To Become a Radio Amateur." Data on 2-meter transmitters, antennas, and converters, and how 2-meter signals are propagated, are available in the v.h.f. chapters of the *Handbook*.

Conclusions: Two-meter operation is not for all amateurs, any more than is 15-meter c.w. or 75-meter phone. In general, it has the most to offer to hams who like phone operation and who live in or near the larger cities—so that there will be enough stations in range to work without having to depend upon special conditions to extend the normal range of the band. Two meters also has much to offer the ham, no matter what his location, who is more interested in experimenting with antennas and equipment than in making contacts.

News and Views

To the information given in the February, 1957, *Transmitting Tower* on obtaining a WAS (Worked All States) certificate by sub-

mitting proof of 2-way contact with each of the 48 states to the American Radio Relay League, Inc., **F. E. "Ed" Handy, W1BDI,** ARRL Communications Manager, adds a suggestion. Too many applicants fail to receive their certificates on the first attempt because of insufficient evidence. Usually, they submit 48 cards, but they accidentally include two cards from one state and none at all from another. Ed suggests preparing a list of the states in alphabetical order and filing your QSL (confirmation) cards in the same manner for easy cross-checking. ARRL absolutely will not issue a WAS certificate without written proof of each claimed contact, although a District of Columbia contact counts as a contact with Maryland.

Dave, KN2VJO, now employs the NC-33 he formerly used as his SWL receiver as a CONELRAD monitor by tuning it to a local broadcast station while he is on the air. If his keying has sounded rather bad lately, he asks: "Ever try to send code while listening to Elvis?". . . . **Gerald, KN4LXT,** operates a Globe Chief 90 running 85 watts on 40 and 15 meters into a 40-meter folded dipole. In 45 days on the air, he has worked 26 states in all call areas, including five KN6's on 40 meters. He also raised some foreign DX, but his nervousness prevented him from making the contacts. Before getting his Novice license, KN4LXT had a 76% return on SWL cards to amateurs!

Larry, KN4JNM, uses an AT1 transmitter and a Space Spanner receiver, with a Windom antenna about 30′ high. In a month on 80 meters, he has worked 29 states and one VE call area, with all but one state confirmed. Best DX is Nevada. . . . **Gil, WN1NZY,** got on the air last September with a home-built 25-watt rig, full of bugs. New York was his best DX. Now, he has a Globe Chief running 75 watts. His antenna is a folded dipole, his receiver an S-53A with a Q-Multiplier added, which helps when interference is bad. Gil operates every morning between 2:30 and 4:00 a.m. and he has 20 states worked. . . . **Eddie, WN3JYM,** (17), has worked 24 states, 22 confirmed, in six weeks of operation on 40 meters. He uses a Globe Chief transmitter running 75 watts, and his receiver is a Heathkit AR3 with Q-Multiplier*, although he used a Space Spanner for a few weeks with good results. Eddie suggests that many Novices could study proper operating procedures with profit. He offers to help anyone obtain his license between looking for 6's and 7's.

Buddy, KN4KQI, uses an AT1 transmitter, feeding a 66′ doublet, and an HQ-129X receiver. In five months on the air, he worked 19 states on 40 meters. He now has his 15-meter beam finished and will undoubtedly be on 15 by the time you read this. . . . **Mike, KN2VXE,** works 40 meters only, because his surplus BC-455B receiver tunes only that

* Speaking of the Q-Multiplier, it seems that the 7-henry, 15-ma. filter choke, *CH1*, used in the power supply in my article entitled "Use a Q-Multiplier" (Popular Electronics, May, 1956), is hard to locate in dealers' stocks. Any small filter choke of 7 henrys or more inductance and a current rating of 40 or 50 ma. may be substituted for it.

band. His transmitter is a DX-35 feeding a long-wire antenna. In about four months, the combination has accounted for 20 states and Hawaii. He wishes all hams would QSL 100%, as he does.

Bob, WN3HKK, claims that he has not worked much because of receiver trouble. His Knight 50-watter feeds a 40-meter doublet 8' high, and has worked only 37 states—33 confirmed, three Canadian provinces, and Hawaii. When he gets his new 35' poles up and the receiver back from being repaired, Bob may do a little better. . . . **Mike, KN5HWY,** (15), didn't have room to put up a full-length (66') ½-wave doublet in a straight line, so he bent the ends down. Still, in four months of operation, he has worked 44 states—30 confirmed, Canada, and Puerto Rico on 80, 40, and 15 meters. Fifteen meters is his favorite band now. Mike uses a Globe Scout transmitter and an NC-173 receiver. He'll soon have a VFO, too, because he passed his General exam a few weeks ago.

Bob KNØIEU, (14), says that ham radio is the first hobby that ever held his interest, except stamp collecting. In 12 days on the air, he has made 18 contacts in 13 states and Hawaii, with all states confirmed. All work has been on 40 meters so far, but Bob plans to put his DX-35, 40-meter doublet, and SX-71 on 15 meters soon. . . . **Paul, KN1AFI,** concedes that his S-38D receiver is not quite as good as a 75A-4, but with it and his Harvey-Wells TBS-50, which feeds a 66' antenna through an AC-1 antenna coupler, he has worked 28 states, 27 of them confirmed, all on 40 and 80 meters. Along with many others, Paul has his doubts as to whether there actually are any amateurs in Vermont. He has never heard one. . . . **Dave, KNØHJT,** worked a Canadian for his first contact on 15 meters. On the other Novice bands, his SX-71, Globe Chief and "long-wire" antenna have chalked up 13 states, eight of them confirmed, in a few weeks of operation. He offers to help anyone obtain his Novice license.

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Your friends would like to read about you in the *Transmitting Tower;* so write that letter to me now. Address it to Herb S. Brier, W9EGQ, c/o POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N.Y. Include a sharp picture of yourself and your equipment—if you have one available. Until next month, then, 73,

Herb, W9EGQ

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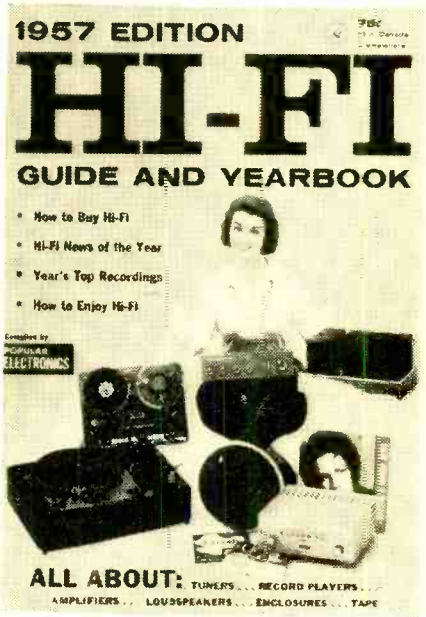

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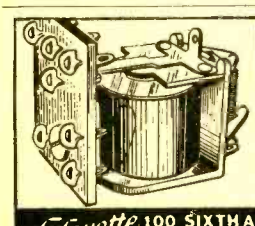

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CITIZEN'S band radio plans for building your own receiver and information on transmitter design, FCC requirements, etc. plus special discount on type approved transceivers. All for $1.00. Springfield Enterprises, Box 54-E5, Springfield Gardens 13, N. Y.

DIAGRAMS for repairing radio $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

WALKIE-TALKIE. Build wireless portable radiophone for less than $10.00. Plans for variable frequency and crystal control types, only 50¢ for both, including assembly photographs. Springfield Enterprises, Box 54-E5, Springfield Gardens 13, N. Y.

TRANSISTOR devices, walkie-talkies, VHF AM-FM portable radios, wireless mikes, etc. at wholesale prices direct from our factory. Free literature. Springfield Enterprises, Box 54-E5, Springfield Gardens 13, N. Y.

TUBES-TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed 1st Quality Top Name Brands Only. Write For Free Catalog or Call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

DIAGRAMS! Repair Information! Radios—Amplifiers —Recorders $1.00. Televisions $1.50. Give Make, Model, Chassis. TV Miltie, Box 101-PE, Hicksville, New York.

COMPLETE Television sets $11.95. Jones TV, 1115 Rambler Avenue, Pottstown, Pa.

"TEST 'Ur Own" Radio and TV tube testers. Total investment in tester, all accessories, and tubes, $400. These units in drug and food stores net 12% per month. Can finance with small down payment. If really interested in complete details, call John Poier —JOrdan 3-2705. General Electronic Research, P.O. Box 94, Fort Atkinson, Wis.

WORLD'S smallest wrist radio. Transistors, mercury batteries, earset, case, expansion strap, etc. Illustrated instructions. Complete kit only $12.95. Without earset—$9.95. Perry, 23 Knickerbocker Drive, Newark, Delaware.

TRANSFORMERS—115V: 6V@15A—$2.00 each and 115V: 1V@100A—$2.50 each. Remit with order. Durson Company, 10416 National, L.A.-34, Calif. Shipments postpaid.

CAR Television. Television in your car. Easy to build and install. Complete Diagrams and instructions. $1.25. C. Carrier Co., 734—15th St., N.W., Washington 5, D. C.

2 WAY Wrist Radio with auxiliary long distance booster. Complete diagrams and instructions. $1.25 C. Carrier Co., 734—15th St., N.W., Washington 5, D. C.

ELECTRONIC Hypnotizer. Simplifies the art of Hypnotizing. Diagrams and operating instructions $1.25. Kit $16.50. Wired & tested $29.50. C. Carrier Co., 734—15th St., N.W., Washington 5, D. C.

TELEPHONE Extension in your car. Answer your home telephone by radio from your car. Complete diagrams and instructions. $1.25. C. Carrier Co., 734—15th St., N.W., Washington 5, D. C.

EAVESDROP with a pack of cigarettes. Miniature transistorized radio transmitter. Complete diagrams and instructions. $1.25. C. Carrier Co., 734—15th St., N.W., Washington 5, D. C.

SUPERSENSITIVE, Single Transistor radio circuits and construction book; sun powered, miniatures, etc. All new data! Send $1.00 to T. R. Electronics, 1465 Prospect Road, Pittsburgh 27, Pennsylvania.

ELECTRONIC Tubes—9 New Assorted—$1.25 Postpaid. Free list. Bigelow Electronics, 105 North Main, Bluffton, Ohio.

ELECTRIC Guitars, amplifiers, wholesale, free catalog, Carvin Pes, Covina, Calif.

WANTED

CASH Paid! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, klystrons, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone: Barry, 512 Broadway, New York 12, N. Y. WAlker 5-7000.

CYLINDER and old disc phonographs. Edison, Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and Coin-operated cylinder Phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. POPULAR ELECTRONICS, Box 50.

WANTED: Used Citizens band mobile 2-way Radio, 10 or 12 watt RF power output or more. John J. Strouhal, Hungerford, Texas.

BUSINESS OPPORTUNITIES

TO $100.00 Weekly. Sparetime, Home Operated Mail-order business. Successful "Beginner's" Plan. Everything Supplied. Lynn, 10420-E National, Los Angeles 34.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

$200 MONTHLY Possible, Sewing Babywear! No house selling! Send stamped, addressed envelope. Babygay, Warsaw 80, Indiana.

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INVENTIONS wanted. Patented; unpatented. Global Marketing Service, 2420—77th, Oakland 5, Calif.

HELP WANTED

HIGH Paying Jobs: Foreign, U.S.A. All trades. Travel paid. Information. Application forms. Write Dept. 21M National, 1020 Broad, Newark, N. J.

INSTRUCTION

LEARN While Asleep! Complete instructions $2.00. Guaranteed. Research Association, Box 610-PE. Omaha, Nebraska.

ENGINEERING Degrees earned by home study. (Residential Courses also available.) Pacific Internation University, Box 27724-D, Hollywood 27, California.

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DON'T Cry if you're having code trouble. Shortcut methods are pure fantasy. We teach the association method approved the world over. Novice course, basic instruction plus practice material to 8 WPM, $5.95. Advanced course, practice material 9 to 18 WPM, $4.95. Combined—$9.95. Magnetic recording tape, 7" dual track, 3¾ IPS. Tapedcode, Box 31-B, Langhorne, Penna.

ELECTRONICS training. Recognized public college. Degree granted. Low cost. Catalog free. Electronics Dept., Trinidad Junior College, Trinidad, Colo.

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NEW Liquid Casting Plastic, clear, colors. Embed real flowers, coins, photos. New Manual shows fine things you can make at home and sell at big profit. Send 25¢. Castolite, Dept. E-115, Woodstock, Illinois.

HIGH FIDELITY

"DIAMOND Needles", $8.95, when we retip your sapphire with finest diamond. Send needle only. Packard Radio, 67 Littlefield St., Pawtucket, R. I.

HI-FI twin reflex enclosure kits. New table model design permits optimum performance with four to six inch speakers. $10.95. Custom Design, Box 43, Waverly, Iowa.

DISGUSTED of "Hi" Hi-Fi Prices? Unusual discounts on all high fidelity requirements. Write now. Key Electronics Co., 120 Liberty, New York 6, N. Y.

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RECORDERS, Tape. Hi-Fi. Wholesale Prices. Catalogue. Kerstin, 215 E. 88 St., N. Y. C. 28.

TAPE Recorders, Tape. Unusual Values. Free Catalog. Dressner, 69-02F, 174 St., Flushing 65, N. Y.

STEREOPHONIC, Monaural Recorded Tapes, Recording Tape, Accessories. Write. Efsco Sales Company, West Hempstead, N. Y.

REPAIRS & SERVICINGS

"KITS assembled and wired; Construction from magazine article. Expert workmanship. Estimates. C. Spinner, Box 102, Massapequa Park, N. Y."

ALL Type kits expertly wired and tested including all ham gear. Satisfaction assured. McSwan, Box 1101, Culver City, Calif.

BOATS

NEW! "How to Build Your Own Fiberglass Boats" and "How to Make Old Boats New with Fiberglass." Send 10¢. Castolite, Marine Division, Dept. EM-115, Woodstock, Illinois.

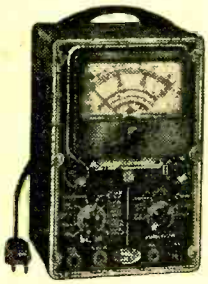
MISCELLANEOUS

SONGPOEMS and Lyrics Wanted! Mail to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.

ADVERTISER'S INDEX

Superior's New Model 670-A

SUPER-METER



A Combination VOLT-OHM MILLIAMMETER PLUS CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/ Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electroylic condensers)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18, +14 to +38, + 34 to +58

ADDED FEATURE:
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

28.40

Superior's New Model 770-A

The FIRST POCKET-SIZED

VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER.

71% MORE SCALE AREA!!

Yes, although our new **FULL-VIEW** D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

8 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts. **6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts. **2 RESISTANCE RANGES:** 0-10,000 Ohms 0-1 Megohm. **3 D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps. **3 DECIBEL RANGES:** —6 db to +18 db, +14 db to +38 db, +34 db, to +58 db.

FEATURES

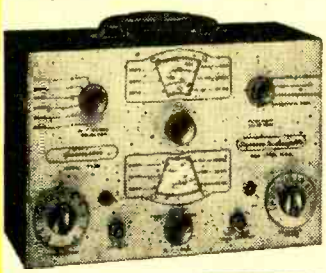
Compact — measures 3⅛" x 5⅞" x 2¼" Uses "Full View" 2% accurate 850 Microampere D'Arsonval type meter. Housed in round-cornered, molded case. Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Model 770A comes complete with self-contained batteries, test leads and operating instructions.

15.85

Superior's New Model TV-50

GENOMETER



7 SIGNAL GENERATORS IN ONE! R. F. Signal Generator for A.M. • R. F. Signal Generator for F.M. • Audio Frequency Generator • Bar Generator • Cross Hatch Generator • Color Dot Pattern Generator • Marker Generator

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only

47.50

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SEE FOLLOWING PAGE FOR COMPLETE DETAILS

MOSS ELECTRONIC DISTRIBUTING CO., INC. DEPT. D-337 3849 TENTH AVENUE, NEW YORK 34, N. Y.

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

Superior's **New Model 76**

IT'S A

CONDENSER BRIDGE

with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A

RESISTANCE BRIDGE

with a range of 100 ohms to 5 megohms.

IT'S A

SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A

TV ANTENNA TESTER

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

Specifications

✓CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

✓RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT

L. MELENKEVITZ

✓SIGNAL TRACER SECTION

A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

✓TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy ..... Only

$26.95

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We invite you to try before you buy any of the models described on this page, the preceding page and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC DISTRIBUTING CO., INC.
DEPT. D-337 3849 TENTH AVENUE, NEW YORK 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payments when due, the full unpaid balance shall become immediately due and payable.

- ☐ Model TW-11...Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-12...Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- ☐ Model 670-A...Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.
- ☐ Model TV-50...Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 76 ... Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
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Name _____

Address _____

City _____ Zone _____ State _____

All prices net, F.O.B., N.Y.C.

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

ALSO TESTS TRANSISTORS!

TESTING TUBES

• **EMPLOYS IMPROVED TRANS-CONDUCTANCE CIRCUIT.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading. • **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%. • **SAFETY BUTTON** — protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching. • **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale. The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50

Superior's new Model TW-11, **STANDARD PROFESSIONAL**

TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.
- **NOISE TEST:** Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

- **SEPARATE SCALE FOR LOW-CURRENT TUBES** — Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50

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NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!