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JULY 1956

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Build This Single Transistor Megaphone

(see page 31)

ALSO IN THIS ISSUE:

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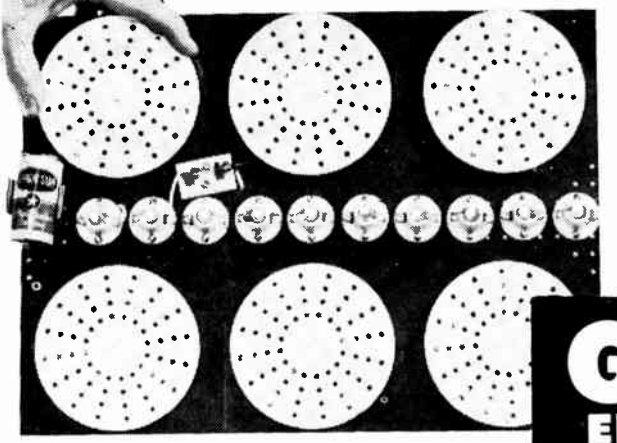

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POPULAR ELECTRONICS

NEWS of Electronic Developments

See also page 94 (What's New in Hi-Fi)

By JOHN T. FRYE

Anchors Aweigh

IT WAS a beautiful July day. The warm sun sparkled on the little ripples produced by the gentle breeze moving over the broad expanse of backwater above the dam in the St. Joseph River, and there were just enough white clouds drifting in the sky to bring out its deep summer blue.

All this natural beauty was wasted on Carl and Jerry, however. As they knelt on the bank, their admiration was entirely absorbed by the gleaming brasswork of the three-foot-long radio-controlled model tugboat resting on the ground between them.

"I still say it was a dirty gyp not to let me help put it together," Carl complained.

"But I *told* you my uncle in the Navy sent me the plans for the boat, the motor, and the radio-control equipment from England," Jerry said patiently. "He wrote that he wasn't going to have an ignorant landlubber swab for a nephew if he could help it, and that I was to build the thing *all by myself* and have it ready for his inspection when he arrives next month on leave. If I had let you help me put it together—and I really ached to show it to you—that would have been cheating."

"Well, all right," Carl said grudgingly; "but let's get started. I want to see it work."

"FIRST," Jerry began, as he took out three bottles from a box beside him, "we've got to mix the fuel. This water-cooled diesel motor runs on equal parts of ether, castor oil, and kerosene."

"If you don't mind, I'll move up-wind while you mix," Carl said, hastily scrambling to his feet. "I've got a grandmother who thinks castor oil is good for whatever ails boys, and Mom believes everything Grandma says. As a result, I know I've taken enough castor oil to float that boat easily; and I just can't stand the smell of the stuff. How much moxie does that motor have?"

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"A half horsepower, huh? That's a real powerhouse! But then, I suppose a tug

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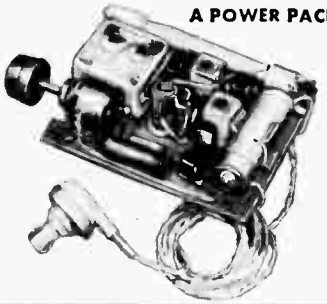

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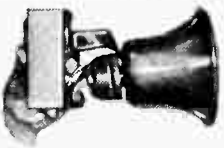

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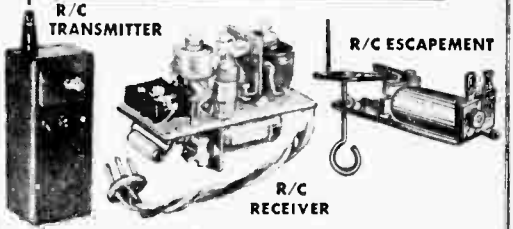

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Carl & Jerry (*Continued from page* 8)

should have power. How about the radio controls?"

"I built up a sensitive three-tube receiver to go with the six-channel reed bank my uncle sent over. Servos operating with the reed selector unit give me any degree of right or left rudder, and I have full control of the motor speed from idle to full-throttle. Since the diesel won't run backward, I can't reverse the boat yet; but I hope to have a gear-box installed in there pretty soon that will let me reverse it. The unused channels will be used at a later date to carry out some big plans I have."

The boys put the fuel into the motor fuel tank and checked out the radio controls. Jerry plugged a milliammeter into a jack on the boat receiver and tuned the input circuit to the frequency of the transmitter, with the meter serving as tuning indicator. Then they watched the operation of the servos connected to the rudder and throttle arm as the buttons on the remote control transmitter case were depressed. Everything worked perfectly, and they were just preparing to start the motor when a harsh, high-pitched voice behind them demanded:

"What're you kids fixing to do?"

THEY turned around to see a sour-visaged old man standing beside a boat tied to the bank. Under his arm were several long cane poles, and he carried a battered minnow bucket in each hand.

"We're just going to try out our radio-controlled boat," Jerry explained politely.

"I knew it!" the man exclaimed with triumphant satisfaction. "I just felt in my bones you were up to some devilment like that. Well, let me tell you brats something: I'm going out there in the middle of the river to fish for crappie, and when I fish I want things quiet. That silly contraption had better not come within a hundred yards of my boat, or you'll be sorry. Do you get that?"

"We'll keep the model away from your boat," Jerry promised.

Muttering to himself, the old man loaded his paraphernalia into his boat and shoved off. As he leisurely rowed toward the middle of the wide river, the boys exchanged glances.

"Gee, what a grouch!" Carl exclaimed. "I had a big notion to tell him off."

"I'm glad you didn't," Jerry said slowly. "In the first place, he's an old man and should be shown respect. More important, though, is the fact that his hobby of fishing is just as important to him as our hobby of playing with this boat is to us. He's probably been fishing here for a long,

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Carl & Jerry (*Continued from page* 10)

long time and has a right to keep on doing so without interruption.

"Anyway, I'd just as soon not send the tugboat out any distance today. We'll keep it here close to the bank while we become familiar with the controls. Then, too, I want to see which one of these propellers I brought along will provide the most push. Running the motor for only short stretches at a time should help to break it in."

WITHOUT further talk, the boys started the motor and gently placed the little boat in the water. It rode beautifully as they sent it in tight circles close to the bank, and they were deeply gratified at how quickly and completely it responded to signals sent out by the transmitter. Then Jerry fastened a line from one of the towing irons at the stern of the little tug, and fastened the other end of the line to a spring scale held just above the surface of the water. Carl pushed the full-throttle button on the transmitter, and the popping exhaust suddenly rose to a high-pitched whine. The water boiled up behind the stern of the little vessel as it squatted low in the water to pull with all its might against the scale.

They noted the measured pull of the boat and then placed another propeller on the drive shaft and repeated the test. One propeller of the four eventually tried showed several ounces more pull than any of the rest; so the boys left it on the shaft. Then they refilled the fuel tank and prepared to proceed with their next experiment: trying to "dock" an old railroad tie floating leisurely past by pushing against it with the fender around the tug's bow.

"Old Sourpuss must have caught one," Carl commented, as he rose from placing the boat back in the water, and glanced out to where the old man was standing up in his boat a couple of hundred yards away.

"No; he's pulled in the anchor and is letting the boat drift with the breeze. I've been watching him. He ought not be standing up in a narrow boat that way, though—"

Jerry broke off with a gasp as the old man, who had been transferring a minnow bucket from one side of the boat to the other, suddenly lost his balance and toppled out of the boat backward, the minnow bucket still clutched in his hands. The departing thrust of his feet gave the boat a shove and it was a good thirty feet away when his head bobbed to the surface.

"HELP! HELP!" the choked voice of the old man came faintly to the boys.

"Can't you swim?" Carl called through

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Carl & Jerry *(Continued from page 12)*

the megaphone his cupped hands made.

"Nary a stroke," was the answer. "This minnow bucket is holding me up, but it leaks and won't last long."

Carl sat down on the grass and began tearing at his shoelaces.

"That's too far to swim," Jerry said desperately. "He'll have gone under long before you get there."

"I've gotta try. We can't just sit here and watch him drown."

"The tugboat! The tugboat!" Jerry exclaimed, as his eyes lighted on the puttering little model that slowly had put out from shore while it was left unattended. He pushed a button on the transmitter case, and the motor exhaust rose to a scream of power as the tug shot ahead. It performed a graceful arc and hurtled across the surface of the water.

"What are you going to do?" Carl demanded, watching the swiftly narrowing gap between the little tug and the head of the old man—which could just be seen in the water beyond the drifting rowboat. "That little model will never keep him afloat. It might if he were careful, but he's too excited to think. He'll capsize the tug at his first grab."

"Don't forget that this is a tugboat we've got," Jerry remarked, without taking his eyes off the little radio-controlled craft. As he spoke, the little boat's motor slowed to an idle, and it settled down in the water as it moved slowly ahead to nuzzle its prow against the square stern

. . . Just as the rowboat was almost within reach of the old man's outstretched hand, it turned aside; Jerry had pushed the wrong button . . .

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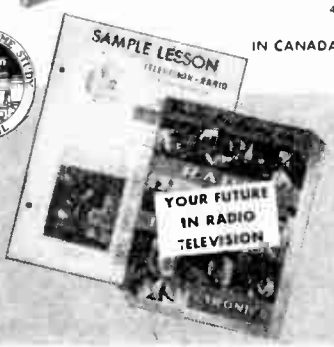

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Carl & Jerry (*Continued from page 14*)

of the rowboat. Then Jerry pushed a button and the motor again revved up to full-throttle. The rowboat lazily moved ahead toward the head of the old man. Just as it was almost within reach of his outstretched hand, it turned aside; Jerry had pushed the wrong button and the bow of the little model slipped off the transom of the rowboat.

"Hey, what are you doing?" Carl demanded accusingly.

"This is tricky," Jerry explained desperately. "You gotta make the tugboat go to the right when you want the rowboat to go to the left."

As he talked, he sent the little boat in a tight circle and brought it into position once more. This time he successfully maneuvered the rowboat into the reach of the barely floating man.

AS SOON AS the old man had safely hold of something substantial, the paralyzing fear went out of him. He moved hand over hand along the side of the boat to the square stern and then pulled himself into the boat over the transom. After resting a few seconds, he took in his poles and started rowing toward the boys, keeping an interested watch on the little tug that performed triumphant circles around him as he rowed along.

"Well, boys, I just don't know what to say," he admitted candidly, stepping out on the shore. "I know as sure as I'm standing here that if weren't for you two and that dandy little boat of yours I'd be dead right now. But I can't seem to think of any way to tell you how much I thank you."

"Don't worry about that," Jerry said, with a friendly grin. "We're just tickled to pieces that everything worked so well."

"This much I HAVE to say," the old man went on. "I sure feel bad about the way I talked to you two a little while ago. From now on in, as far as I'm concerned, you can run that wonderful little contraption right up and down my backbone any time you please."

"Then maybe you'd like to come down here tomorrow and watch us try it out for some speed runs," Carl suggested.

"I'd be proud to," the old man said promptly. "Fact is, I'm kind of hankering to have one of those things myself. While I was rowing in, I had the idea that if a man trolled a pork-rind spinner off the back of that thing there's no telling how many bass he might take! And he could just sit here on the bank and smoke his pipe while he was doing it, too!" —30—

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"HI-FI LOUDSPEAKERS AND ENCLOSURES" by Abraham B. Cohen. Published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. Soft cover, 368 pages. Price, $4.60. (Hard cover, $5.50.)

Suppose you could have, as a permanent but undemanding guest in your home, one of hi-fi's leading authorities on speakers, crossover networks, and baffles—who would answer practically every single question on those subjects that could come up. It sounds like an audiophile's wild dream, but this incredible book almost makes the dream become a reality. For this volume is, without doubt, the clearest and most complete treatment we have yet reviewed on the entire subject of converting electrical impulses from an amplifier into the acoustical energy we perceive as sound in our listening room.

The book is divided into three main parts, each of which, in turn, is subdivided into detailed chapters. The general topics include loudspeakers, enclosures, and "the room." Various types of reproducers are described, their advantages and limitations are listed, and recommendations for their use are included. The non-technical music lover will enjoy the lucid explanations and discussions of recent equipment; the technically minded will find ample material for cogitation as well as "do-it-yourself" action in the instructions for winding one's own crossover coils and constructing numerous types of enclosures.

Theoretically solid and practically indispensable, this is a book that fills a big gap in the literature of high fidelity. It is, in a word, the best discussion yet published of hi-fi's most controversial and disturbing area.

Recommended: as a must for every music lover and audio enthusiast.

"THE MIGHTY FORCE OF RESEARCH" by the Editors of Fortune. Published by McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. Cloth bound. 308 pages. Price, $4.00.

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time somebody wrote a book telling us what it's all about. This volume provides insight into the methods, aims, and results of organized research. Also, by presenting a detailed panorama of this activity, it may indicate to many a possible choice of career. Electronics is deeply involved in most scientific work today both as a tool of research and as an area of exploration for new developments and applications.

Several important areas of science are covered in the text. Notable for their intrinsic interest to POP 'tronics readers are the chapters on "The Peaceful Atom," and "The Automatic Factory." Possibilities of new avenues of communication are explored in "The Information Theory," which forms part of the basis for certain computers.

Recommended: as an engaging treatise on the relation of modern science to modern life.

"HOW TO SELECT AND USE YOUR TAPE RECORDER" by David Mark. Published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. Paper bound. 140 pages. Price, $2.95.

This book will enable you to get the most enjoyment out of your tape recorder, regardless of make or cost. If you are one of the legion of hobbyists on the verge of buying a tape machine, and still undecided about the kind to get, some of the points covered here may clarify your own thinking and help you make a selection of a unit that will best serve your needs.

Almost every phase of home recording is covered, with the exception of servicing the equipment. Included is some notable material on microphone placement and techniques, tape editing and splicing, and hookup methods. A "Buyer's Guide" section describes and illustrates 79 different tape recorders that are commercially available.

Recommended: for everyone interested in using a tape recorder at home, in business, at school, etc.

"THE QUEST FOR QUALITY" by Norman Crowhurst. Published by Norman Price Ltd., London, England. Distributed in the USA by British Radio Electronics, 1833 Jefferson Place N.W., Washington 6, D.C. 80 pages. Paper bound. Price, $1.50.

This little volume contains a concise discussion of the salient points that audio engineers "go after" in designing hi-fi equipment and in setting up sound systems. Descriptive rather than expository, the text discusses briefly some of the techniques used in checking system perform-

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ance, measuring distortion, analyzing flutter and wow, etc. A chapter on acoustics contains information that could be of value in setting up one's own hi-fi system, such as the relation between standing waves and speaker placement.

Recommended: for the advanced audio enthusiast.

"INTRODUCTION TO COLOR TV" by M. Kaufman and H. Thomas. Published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. Paper bound. 160 pages. Price, $2.70.

This is the second edition of a book which first appeared in March, 1954. The field of color television has developed to such an extent in the past two years that a revision of the original treatise was needed. The present volume covers such advances in the art as the magnetic convergence principles used in connection with the larger screen picture tubes. Also discussed are the new and simplified circuits used in receivers.

A basic understanding of the NTSC color video system as well as an insight into the workings of a color TV receiver can be obtained from reading this book, but it is well for the reader to have some previous understanding or training in monochrome television. For such a reader, the schematics and technical explanations included could prove of great value.

Recommended: as a basic book on color television.

"TAPE RECORDERS AND TAPE RECORDING" by Harold D. Weiler. Published by Radio Magazines, Inc., Mineola, N. Y. Paper bound. 190 pages. Price, $2.95. (Cloth bound edition, $3.95.)

This is another informal introduction to the general subject of tape recording at home, in schools, and for business purposes. Only the most fundamental aspects of the subjects are covered; advanced tape enthusiasts may find the treatment somewhat lagging. Many points are touched on briefly, such as live recording techniques, editing, sound effects, and some maintenance.

Recommended: as a possible "first" book for the newcomer to tape.

"THE AUTOMATIC FACTORY—A CRITICAL EXAMINATION" by Stephen A. June and others. Published by Instruments Publishing Co., 845 Ridge Ave., Pittsburgh 12, Pa. Cloth bound. 81 pages. Price, $1.50.

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THE NEW EDITION of "The Ultimate in Sound" is a 28-page booklet containing consumer information on the University line of speakers and enclosures. For your free copy, write to University Loudspeakers, Inc., Desk LA2, 80 S. Kensico Ave., White Plains, N.Y.

"Money Making FCC Commercial License Information" is the title of a large, attractive booklet available on request from the Cleveland Institute of Radio Electronics, 4900 Euclid Ave., Cleveland, Ohio. The booklet explains some of the jobs available to license holders and details a home-study method which can be used in order to qualify for the license.

Components for assembling home music systems are described in the "BIC High Fidelity Plan Book." Write for your copy to British Industries Corp., 80 Shore Road, Port Washington, N.Y.

All miniature tubes, regardless of make, are described in Bulletin #PA-1, available from CBS-Hytron, Danvers, Mass. This 16-page brochure supplies data for 416 miniature tube types.

"High Fidelity Home Music Systems" is the title of a large and lavishly prepared booklet describing the complete Altec-Lansing hi-fi line. Hints for home users are included. For your copy, write to either Mr. H. S. Morris, Product Sales Manager, Altec Lansing Corp., 161 Sixth Ave., New York 13, N. Y., or to Altec Lansing Corp., at 9356 Santa Monica Blvd., Beverly Hills, Calif.

A miniaturized and inexpensive test instrument known as the "Diagnyzer" is described in an illustrated data sheet which outlines the device's use to servicemen, SWL's, audiophiles, and handymen. Write to Apparatus Development Co., 115 Main St., Wethersfield 9, Conn. —30—

WHAT'S THE PE ANSWER?

PHASE THE "INTRUSION ALARM"

I put together the "Photoelectric Intrusion Alarm" described in your October, 1955, issue. After I plugged it in, the thyratron turned blue and the relay closed, but then the phototube would not let the relay open.

DONALD TRAVER
Alameda, Calif.

The thyratron photocell alarm is a half-cycle device and must be properly phased for the phototube to assume control of the thyratron grid. The theory (backed by practical examples) was discussed in our May, 1955, issue on page 82. To alter the phase of the positive-going a.c. cycle, simply reverse the transformer primary or secondary leads (either one will do—don't do both or you'll be back where you started). As soon as the phase has been corrected, the light shining on the photocell will cause the relay to open. Breaking the light beam will cause the relay to snap shut, but then reopen as soon as light strikes the cell.

INCREASING STROBE FREQUENCY

I am building the "Workshop Stroboscope" (September, 1955, page 55), and would like to increase the frequency of flashes to 240 cycles. Is it possible with this design?

DAVID A. KAVANAGH
Southbridge, Mass.

Contributing Editor Harvey Pollack reports that the original flash rate of 60 cycles could probably be increased by reducing the value of cathode resistor R8, but this might not work too well. Gas tubes are considered to be very poor oscillators even at medium audio frequencies. When higher flash rates are called for, the general practice is to use a multivibrator circuit rather then a gas tube. Keep in mind that frequencies of revolution as high as 3600 cycles can be clearly seen with this basic design.

REGENERATION IN TV BOOSTERS

Since I live in an area where we can tune in a number of TV stations over 100 miles away, I was wondering if the "Regenode" principle (January, 1956, page 51) could be applied to a TV booster?

S. W. BITTENBENDER
Eagle River, Wis.

The "Regenode" idea proposed by Tooker in his article on a standard broadcast AM receiver would not be suitable for TV booster circuits. There are a variety of good reasons, but the most important one involves obtaining

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1A4P	.33	3Q4	.46	6B8	.69	6N7	.60	7E6	.55	19T8	.65
1A7GT	.43	3Q5GT	.57	6BA6	.47	6Q7	.40	7E7	.70	24A	.39
1B3GT	.65	3S4	.47	6BA7	.58	6S4	.40	7F7	.59	25AV5GT	.78
1C5GT	.41	3V4	.47	6BC5	.47	6SA7	.45	7F8	.70	25BQ6GT	.78
1D5GP	.43	5BQ7	.89	6BC7	.80	6SC7	.48	7G7	.75	25L6GT	.47
1E7GT	.41	4BZ7	.95	6BE6	.45	6SG7	.41	7H7	.50	25W4GT	.43
1G6GT	.41	5AW4	.75	6BF5	.40	6SH7	.43	7J7	.75	25Z5	.37
1H4G	.43	5J6	.63	6BF6	.50	6SJ7	.43	7K7	.75	25Z6	.37
1H5GT	.47	5T4	.69	6BG6G	1.15	6SK7	.45	7L7	.75	27	.25
1J6GT	.47	5U4G	.43	6BH6	.50	6SL7GT	.55	7N7	.50	35A5	.46
1L4	.45	5UB	.74	6BJ6	.47	6SN7GT	.55	12AT6	.37	35B5	.50
1L6	.55	5V4G	.59	6BK5	.68	6SQ7	.39	12AT7	.66	35C5	.50
1LA4	.57	5Y3	.31	6BK7	.76	6SR7	.42	12AZ7	.63	35L6GT	.47
1LA6	.47	5Y4G	.36	6BL7GT	.75	6SS7	.41	12AU6	.41	35W4	.34
1LB4	.57	5Z3	.41	6BN6	.58	6T4	.95	12AU7	.53	35Y4	.34
1LC5	.49	6A7	.87	6BQ6GT	.78	6T8	.68	12AV6	.35	35Z3	.39
1LC6	.47	6A8	.45	6BQ7	.78	6U8	.75	12AV7	.67	35Z5GT	.34
1LD5	.57	6AB4	.43	6BY5G	.58	6V3	.80	12AX4GT	.65	37	.29
1LE3	.57	6AC7	.67	6BZ7	.88	6V6GT	.46	12AX7	.58	50A5	.46
1LG5	.57	6AF4	.79	6C4	.37	6W4GT	.39	12B4	.68	50B5	.50
1LH4	.64	6AG5	.50	6C5	.35	6W6GT	.53	12BA6	.46	50C5	.50
1LN5	.47	6AG7	.69	6CB6	.49	6X4	.34	12BD6	.48	50L6GT	.43
1N5GT	.50	6AH6	.69	6CD6G	1.15	6X5	.34	12BE6	.46	75	.42
1R5	.50	6AJ5	.70	6D6	.48	6X8	.73	12BH7	.60	76	.42
1S5	.42	6AK5	.54	6E5	.44	6Y6G	.55	12BY7	.65	77	.38
1T4	.50	6AL5	.39	6F5	.37	7A4	.45	12BZ7	.61	78	.38
1U4	.47	6AQ5	.46	6F6	.38	7A5	.53	12CU6	.95	80	.34
1U5	.42	6AR5	.46	6G6	.40	7A6	.45	12SA7	.45	84/6Z4	.44
1V2	.65	6AS5	.48	6H6	.38	7A7	.43	12SJ7	.45	117L7GT	1.09
1X2	.61	6AS6	1.70	6J4	1.79	7A8	.45	12SK7	.45	117N7GT	1.09
2A3	.55	6AS7G	2.19	6J5	.39	7B5	.39	12SN7GT	.56	117P7GT	1.09
2A5	.57	6AT6	.39	6J6	.47	7B6	.42	12SQ7	.37	117Z3	.35
2A7	.55	6AU4GT	.65	6J7	.43	7B7	.41	12SR7	.45	117Z6GT	.63
3A4	.51	6AU5GT	.59	6J8G	.85	7B8	.45	12V6GT	.45		
3A5	.50	6AU6	.42	6K6GT	.37	7C4	.39	12X4	.37		
3AL5	.45	6AV5GT	.65	6K7	.39	7C5	.42	14A7	.42		
3AU6	.48	6AV6	.39	6K8	.65	7C6	.43	14B6	.38		
3BC5	.54	6AX4GT	.60	6L6	.68	7C7	.48	14Q7	.50		
3BN6	.70	6AX5GT	.57								

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signal gain in the booster without introducing unnecessary circuit noise. A regenerative circuit does not meet these requirements. The "Regenode" operates by properly coupling the regenerative circuit to the antenna as well as to the detector stage. At broadcast station frequencies, and probably up to 20 mc., the "Regenode" idea would be fine. At v.h.f., the regeneration noise would overshadow the gain and produce a TV picture full of "snow." In addition, a regenerative circuit is sharply tuned—which is just what we don't want in a TV booster.

MORE ON "PROXIMITY DETECTOR"

Is it possible to use the "Proximity Detector" (April, 1956, page 65) under outdoor conditions and with a hundred feet of "feeler" wire?

JAMES W. PLUMMER
Portland, Maine

No. Growing things in the neighborhood of an outdoor feeler wire would seriously change coupling conditions to ground and trigger the system spuriously. What you probably have in mind is an electric fence capacity relay or something very similar.

I would like to know if a Raytheon 2C33 thyratron could be made to work in the capacity-operated relay instead of the 2D21.

KENNETH LUNDGREN
Blue Island, Ill.

As the characteristics of the 2C33 thyratron are appreciably different from those of the 2D21 type, we would hesitate to recommend the use of this tube in this circuit.

Canadian Jobber Addresses

In the May issue, we published a letter from POP'tronics reader S. Cramp, Welland, Ontario, concerning the availability of radio parts and components. Information was requested from our other Canadian readers as to names and addresses of parts jobbers that carry large stocks and who might do mail order business.

Within the past few weeks, we have received many letters answering Mr. Cramp's questions. Messrs. Lavoie, Ikuta, Hunter, Rees, McKinley, Golding, and others suggested the companies listed below:

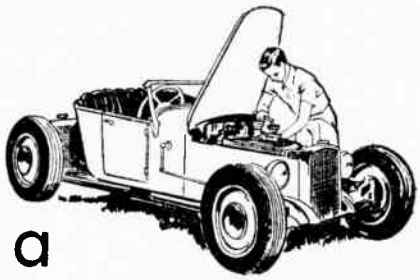
Universal Electric Co.
5375 Cochrane Pl.
Montreal, Que.

Electro-Sonic Supply Co.
543 Yonge St.
Toronto, Ont.

Alpha Aracon Radio Supply
29 Adelaide St. West
Toronto, Ont.

Canadian Electrical Supply
522 Yonge St.
Toronto, Ont.

Factory Products Ltd.
88 Arthur St.
Winnipeg, Man.



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Build a Single Transistor Megaphone

By
LOUIS E. GARNER, JR.

Save your voice . . . let the electronic megaphone do all your shouting for you

Cover Photo by Maynard Frank Wolfe

ATHLETIC COACHES, lifeguards, policemen, firemen, plant guards, construction foremen, CD workers, and carnival spielers are but a few of the people who need to use their voices to issue commands, make requests, outline directions or to instruct and influence the public. If you or any of your friends have ever handled one of these jobs, you'll know how easy it is to strain your lungs and vocal chords in the attempt to outshout background din or to project your voice over a moderate distance. And you'll know how valuable a simple megaphone can be in directing your voice.

The conventional megaphone is a conical tube used to concentrate and to direct one's voice. It is named from the two Greek words meaning "great or mighty" (*mega*) and "sound or voice" (*-phone*). While such an instrument does concentrate and direct the voice, the user still has to shout to obtain any real volume. Even if the only time you have to raise your voice is to call the children home from play, you won't have to strain your lungs to give your voice the authority of power when you use the electronic megaphone described here. Lightweight, compact, portable and comparatively inexpensive, this instrument can be assembled and wired in one or two evenings, even by a hobbyist who is still fairly new to the electronics "game."

Construction Hints. In the author's model, the amplifier circuit is housed in a standard ICA "Channel-lock" aluminum uti ity box. The University speaker trumpet, battery boxes, terminal strip, and transistor were attached to this housing. The microphone is mounted by cutting a slightly undersized hole in the "back" cover of the amplifier housing, then using a force fit to mount the microphone cartridge and its rubber mounting ring in place. If you

Almost all the transistor project construction articles published thus far have featured the use of low-power transistors. "High-power" units (1 to 5 watt ratings) have, in the past, been relatively expensive and difficult to obtain. The device described in this article uses a commercially available power transistor. Although the transistor used is more costly than lower power units, the total cost of the components needed is comparable with other transistor projects—for only a single transistor is used and other expensive components, such as matching and interstage transformers, have been eliminated. Thus, this project is suitable both for the more advanced worker desiring to gain experience with power transistor circuits and the experimenter looking for a simple—yet useful—project.

THE EDITORS

wish, you can apply a thin coating of rubber-to-metal cement around the rubber mounting ring prior to installation.

In the interior view of the completed model, the parts arrangement used by the author is clearly shown. However, since neither circuit layout nor lead dress are critical, you can either follow the model or design your own amplifier "cabinet" and layout, as you choose. Resistor *R1* is made up of three (3) 10-ohm, 1-watt carbon resistors, installed so that all three may be connected in parallel, two may be used in parallel, or one may be used alone. The final arrangement is determined after all wiring is completed and the unit is ready for test. Connect the microphone's return lead temporarily to the center of the power pack, so that only three (rather than six) volts are applied to this circuit.

The 2N68 power transistor may be supplied with either of two types of lead connections. These are shown at (A) and (B) in Fig. 1. If your unit is provided with the lead arrangement shown at (B), you can use a subminiature "in-line" tube socket for the transistor. If your unit has the lead arrangement shown at (A), you'll have to make soldered connections to the transistor terminals. Leave the transistor leads at least one inch long and protect with insulating spaghetti tubing. While soldering each connection, hold the lead with a pair of long-nosed pliers at a point between the body of the transistor and the place where the soldering iron is applied. The pliers act as a "heat sink" to absorb excess heat and to prevent accidental damage to the transistor.

Note that no "ground" connection is shown in the schematic diagram. The collector electrode of the transistor is connected—internally—to its outer shell, and this is automatically "grounded" to the amplifier housing when the transistor is installed. *Do not connect any other part of the circuit to "chassis ground."*

Parts Substitutions. Quite a number of parts substitutions are possible if needed to meet the requirements of the individual builder. The transistor specified in the parts list and used in the model is a Sylvania Type 2N68 *p-n-p* junction power transistor. A Sylvania Type 2N101 may be

HOW IT WORKS

The megaphone is basically a single-stage *common-emitter* transistor amplifier. It differs from conventional audio amplifiers in several respects. First, the use of a transistor permits a single low-voltage (6-volt) power source to be employed. Secondly, the low input impedance of the transistor permits direct coupling between the carbon microphone and the base-emitter circuit, eliminating the need for the usual input matching transformer. In a similar fashion, the low output impedance of the power transistor permits direct coupling to the small paging "trumpet" used as a loudspeaker, eliminating the need for an output transformer. Finally, since the instrument is designed for "close-talking," its output level may be varied simply by varying the level of the voice. Hence, no volume control is needed or provided.

In operation, sound waves vary the mike resistance which, in turn, results in a similar variation of the transistor's base bias current. Since the base bias current determines collector current, the audio signal appears in the collector-emitter circuit, but it is of much greater amplitude due to the gain of the transistor. Small variations in base current result in much larger variations in collector current.

Emitter resistor *R1* provides a degree of d.c. stabilization by setting up a bias voltage which tends to oppose major changes in the transistor's d.c. operating currents. If the collector current tries to increase appreciably, the bias across *R1* tends to reduce base current, restoring collector current to normal. This resistor, by providing some degeneration, helps keep distortion to acceptable figures and, at the same time, increases the input impedance of the transistor to insure a more efficient transfer of the signal from the microphone to the transistor.

The remaining electrical components in the circuit are capacitors *C1* and *C2*, switch *S1*, and the *power* source. Capacitor *C1* is used simply to absorb transient peaks as the circuit is turned "on" and "off" and thus to prevent current surges from shortening the life of the transistor. Capacitor *C2* is a simple bypass unit to reduce microphone "hiss" and is furnished by the manufacturer of the microphone as a part of the "mike" assembly.

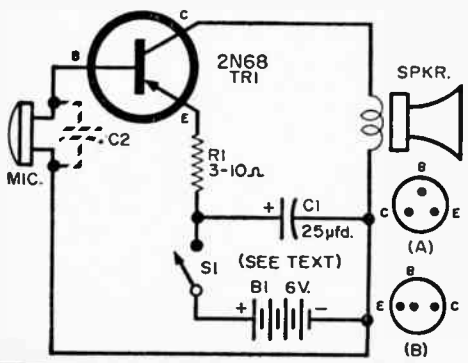
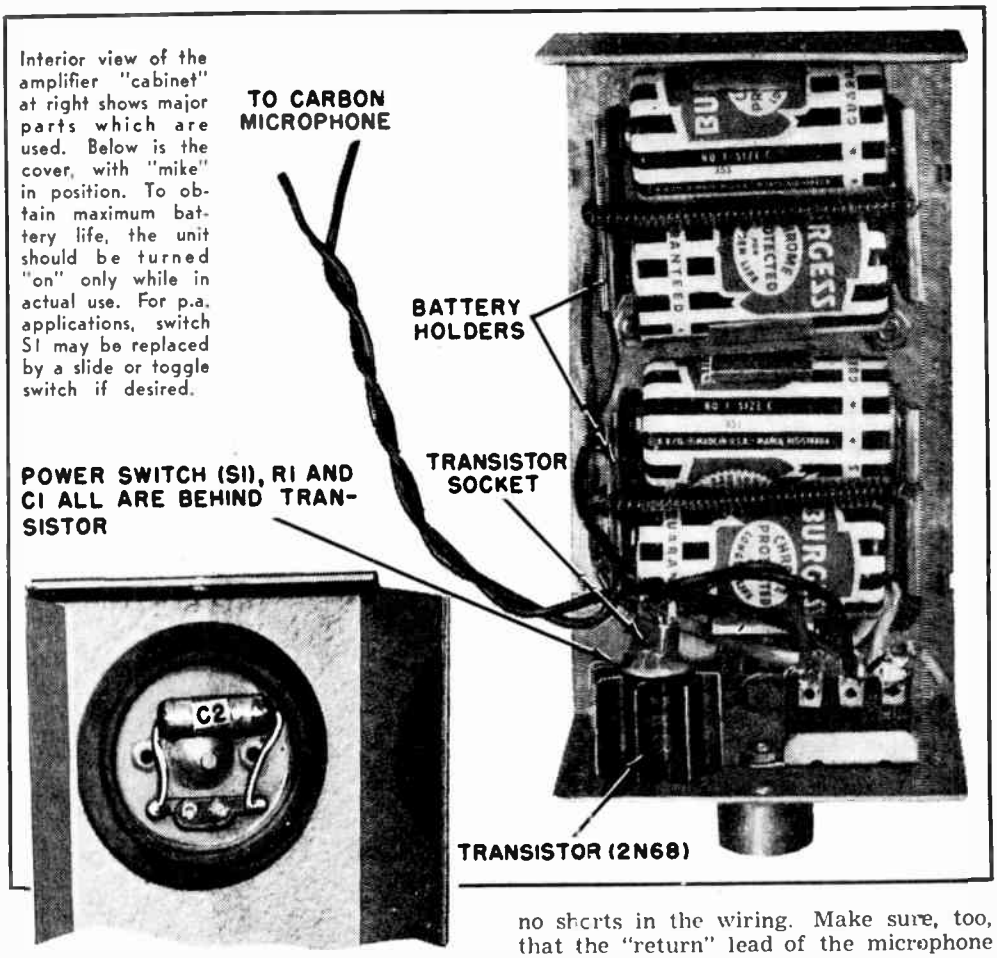


Fig. 1. Schematic wiring diagram of transistorized electronic megaphone. See parts list at right.

B1—Four 6-volt Size "C" flashlight batteries in series (Burgess No. 1)
C1—25-μfd., 6-volt capacitor (Barco P6-25)
C2—Paper bypass capacitor (part of MIC.)
R1—Three 10-ohm resistors (see text)
S1—S.p.s.t. push-button switch
TR1—P-n-p power transistor (Sylvania 2N68)
MIC.—Carbon microphone cartridge (Shure R-10)
SPKR—45-ohm low-power "paging" speaker (University No. MIL-45)
1—Cabinet, 5½" x 3" x 2⅛" "Channel-lock" box (ICA No. 29410)
2—"Battery-boxes" holding two Size "C" cells each (Austincraft)
1—Microphone adapter (Atlas AD-11)—optional
1—Terminal strip, with 3 insulated terminals
1—Transistor socket (if needed—optional)
1—⅜" rubber grommet
Misc. machine screws, nuts, lock washers, wire and solder



Interior view of the amplifier "cabinet" at right shows major parts which are used. Below is the cover, with "mike" in position. To obtain maximum battery life, the unit should be turned "on" only while in actual use. For p.a. applications, switch S1 may be replaced by a slide or toggle switch if desired.

substituted directly for the 2N68. If desired, *n-p-n* junction type 2N102 may be used in place of the 2N68, *provided the battery polarity is reversed* as well as the leads to capacitor *C1*.

Although Burgess No. 1 (size "C") flashlight cells are employed in the model, other size cells may be used instead. A size "D" cell will provide slightly longer battery life. And if the individual builder's layout and housing permit, four large mercury cells (such as Mallory Type RM12R) will provide the maximum in battery life.

Capacitor *C1* is non-critical, and either a larger or smaller unit may be employed here. It is best to use at least 10 μfd., if possible, but values as large as 200 μfd. may be used if desired. Regardless of the capacity, make sure that the working voltage at least *equals* 6 volts. A higher working voltage is all right.

Adjustment and Test. With the wiring completed, double-check all connections *before* installing the batteries. Make sure that *C1* is installed with the proper polarity, that *S1* is "open," and that there are no shorts in the wiring. Make sure, too, that the "return" lead of the microphone connects to the "3-volt" position on the power supply (two cells on either side).

When you are sure there are no errors in wiring, push the switch "on" and speak in a normal or slightly loud voice into the mike. Have a friend listen to note volume and quality of the amplified voice. Now, connect two of the 10-ohm resistors in parallel to change *R1* from 10 to 5 ohms. Try the unit again. You'll probably notice an increase in volume. Finally, connect all three resistors in parallel, dropping the total resistance to a little over 3 ohms. Again try the unit. For a final connection, use the *maximum resistance you can which gives the best compromise between volume and distortion*. In general, the larger *R1*, the better.

Once you've selected the best value for *R1*, try transferring the "return" microphone lead to the 1.5-volt (one-cell), 4.5-volt (three-cell) and 6-volt (four-cell) positions, trying the unit after each change. Make the final connection to the terminal which gives the best over-all results. The 3-volt (two-cell) tap was used here. —30—

TV FOR THE TROOPS

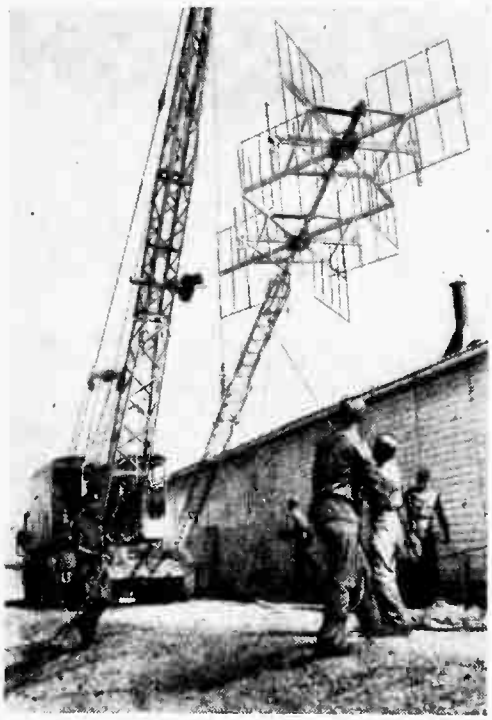
Live and filmed shows are now telecast to men at remote installations

Gathered round the TV set in the dayroom of the 1605th Air Base Sq., these men stationed in the Azores are enjoying one of the many video shows recently made available to them. This installation is the Armed Forces' first overseas setup.

Department of Defense Photos

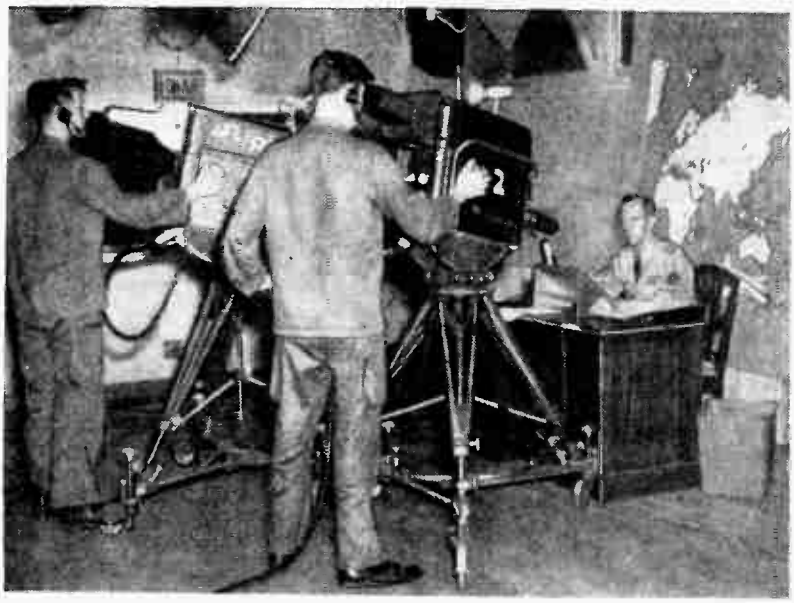
GROUCHO MARX, Marilyn Monroe, and Boston Blackie in the dayroom! Is this the figment of some lonely GI's imagination, or is it another super-colossal USO show on tour?

Neither—it's the new Armed Forces Radio and Television service in action. Specially constructed networks are now sending both entertainment and educational programs to our overseas troops in many remote spots not previously reached by any telecast. As a result of close cooperation by commercial organizations, at least eleven GI stations are now operating, with



Service personnel pitch in to help set up a new transmitting site in Bermuda. Men and machine combine to raise antenna and set it in place. Four corner reflectors are mounted on top of tower.

With frank eagerness, air base men hasten to uncrate a new and welcome arrival at their field (right). TV transmitter and related equipment are purchased by Armed Forces for overseas sites.



Live programs of interest and importance to service personnel are a part of the programming of the OAFIE television system. Base commanders can reach large numbers of troops conveniently and efficiently. Cameras are manned by enlisted men at base.

as many more planned for the coming year. Programs are mostly on film, but a large number of live shows of special and personal interest to servicemen are also transmitted.

Responsible for selecting and sending the programs is the Office of Armed Forces Information and Education (OAFIE), which was assigned the task in October, 1953, by the Department of Defense (DOD). Up to this time, the Air Force—on its own—had started a test station at Limestone (now Loring) Air Force Base in northern Maine. This station began telecasting on Christmas Eve, 1953, to its air base population of 15,000 men, women and children—nearly all service personnel and their families.

Arrangements were soon made by the Air Force whereby sponsors of commercial programs furnished film recordings (kines) and filmed programs for use over the Loring station. When it became apparent that TV activity would increase, formal agreements were made between DOD and the networks, in which DOD got agency and sponsor clearance for use of their shows. Performances were soon un-

One of the most popular of the "live" shows is this indoctrination program on which wives who have been at a base for a fairly long time answer questions from wives who have just arrived. Other "live" shows make wide use of local talent.

Soldiers monitor an outgoing telecast. Stations have been operated by military personnel as an additional duty. Since schedules may run as high as 50 to 60 hours weekly, other personnel assignment arrangements are expected. Studio equipment is complete, even to the twin turntable console behind operators' control panel. Note tape equipment at left.

der way. Kines have since been augmented by industrial films, Armed Forces Information films for orientation and training, and feature pictures furnished by the film industry and TV producers. Stations now operate in the Azores, Libya, Iceland, Greenland, Saudi Arabia, Bermuda, Eritrea, Cuba, and the Philippines. Unlike the wartime years, when most bases and camps were populated entirely by GI's, many present installations have a large family population. Programs are often designed to appeal to women and children as well as to the men.

In addition to films and kines, each station has a limited live capacity of its own which is exploited to the fullest by local commanders—to keep personnel advised and to boost morale by shows that utilize local talent and familiar faces.

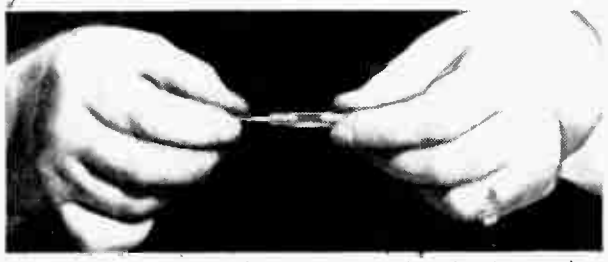
The Department of Defense may edit films, but OAFIE does not. Anything contrary to DOD policy is more easily eliminated by not using the show. Kines are run as received, commercials and all. After use, kines and films are returned to their sources.

Servicemen and women are grateful to the television industry, whose cooperation has brightened many a lonely hour. —30—

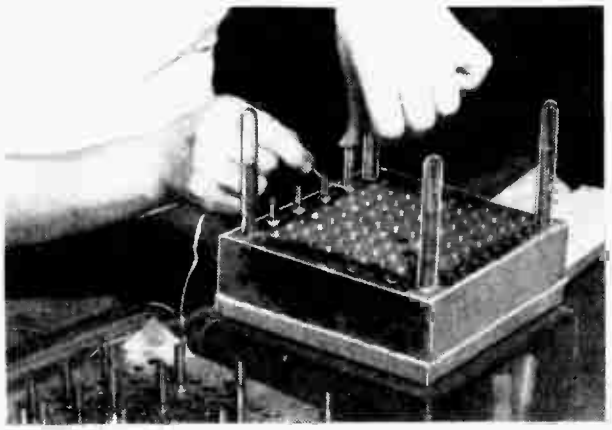
Radio Speeds Drive-In Service

SPEEDING service at drive-in restaurants is Motorola's "Handie-Micro-Talkie," which enables carhops to call in orders in much less time than it takes to write them down and deliver them to the kitchen. Calls are received by one person who turns the orders over to the kitchen.

Piston Capacitors Require Watchmaker's Skill



Glass cylinder, which has been coated with silver and fired to make it suitable for soldering, is shown being fitted to the tuning piston. Jewelers' loupes are used here to give the operator a clear view of the tiny components.



Tuning piston is spring-loaded in the capacitor assembly, using a watchmaker's miniature screwdriver. Spring and nut are placed into position with the aid of tweeezers. The silver band on the glass cylinder (above) is soldered to the capacitor base and then put on a "cool-off" plate.

The pigtail is soldered to the silver electrode band on the glass (right). Piston will then be thoroughly cleaned and inspected. Note size of piston in comparison to tip of soldering iron. Finished units are viewed under magnifiers.

YOU MIGHT NOT expect to see jewelers' loupes, magnifiers, miniature screwdrivers—and, yes, even tweezers—in a piston capacitor manufacturing plant. These are some of the "tools" usually found in the watchmaking industry. But a stroll through the Capacitor Department of the JFD Manufacturing Co., Inc., in Brooklyn, N. Y., would reveal many such instruments in use.

The minute sizes of the piston capacitors make precise "watchmaking" procedures necessary. Some of them measure only 5/16" in length. Delicate hand operations must be performed with parts so tiny that several thousand would fill an ordinary thimble.

Follow the photographs for some of the steps involved in creating one of these "mighty midgets"—which are destined for such electronic equipment applications as guided missiles, digital computers, sonar, radar, and the like. —30—

Tubeless Radio Powered by Sun

THE WORLD'S first sun-powered tubeless radio designed for consumer use has been introduced by the Admiral Corporation. Using six transistors in place of vacuum tubes and powered by a 32-cell "Sun Power Pak," the receiver is compact enough to slip into the pocket, or be carried around in a leather case, as shown in the photo.

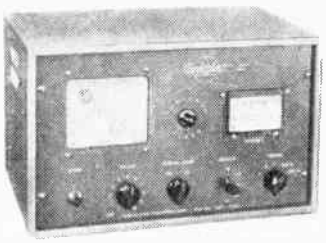
Plugging into the set's cabinet, the "Pak" converts the energy from sunshine into electricity to run the radio. The power unit is sensitive enough to pick energy from the sky on cloudy days. Light from an electric bulb or an infrared lamp may also be used.

Without the "Power Pak," the receiver can be operated on six ordinary flashlight cells. The set requires less than one-tenth the power consumed by a conventional portable radio. Printed circuitry has been used extensively, and a directional antenna pops up by push-button action and can be rotated manually for best reception.

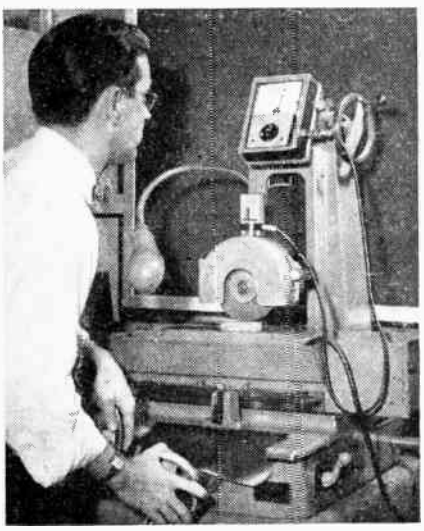
The receiver alone retails for $59.95. The "Sun Power Pak" is priced at $175.00, and the leather carrying case at $29.95. This relatively high price for the power pack is due to the cost of the pure silicon ($300 per pound), which is its principal element.

Receiver for Conelrad and Standard AM Broadcasts

"CONALERT II" is a five-channel, fixed-frequency receiver designed to pick up all Conelrad Radio Alert broadcasts as well as standard AM programs. Designed for silent or audible round-the-clock monitoring, Conalert II gives both an audible and visual alarm when a Conelrad Radio Alert is broadcast. It then receives all messages until manually reset by the user. A unique feature of this set is the alarm it gives if a tube or other major component fails. Made by Kaar Engineering Corp., 2900 Middleton Rd., Palo Alto, Calif., it is priced at $140.00, f.o.b. Palo Alto.



Transistorized Meter Tracks Annoying Vibrations



TRACKING and measuring mechanical vibrations in the 10 to 1000 cps frequency range is facilitated by an all-transistor meter announced by Consolidated Electrodynamics Corp., Pasadena, Calif. Containing its own battery power supply, the device is completely portable. Four junction transistors are used in place of vacuum tubes. All circuit components are mounted on a single etched-circuit board which forms the chassis.

Because of its portability, the new meter can be used in making flight-line vibration checks, trouble-shooting machine tools, and performing many other tests where it is inconvenient or impossible to stay "hitched" to an a.c. socket. Known as "Type 1-128," the instrument is claimed to provide accurate readings under the severe environmental conditions encountered in these applications.

Full details are contained in Bulletin CEC 1566. Write to the company at 300 North Sierra Madre Villa, Pasadena, Calif., for a copy.

TV Will Unravel Traffic Snarls

CAR OWNERS and traffic authorities alike are anxiously awaiting the outcome of an experiment being conducted in Detroit. The tests may have far-reaching results which can make highway driving faster and safer.

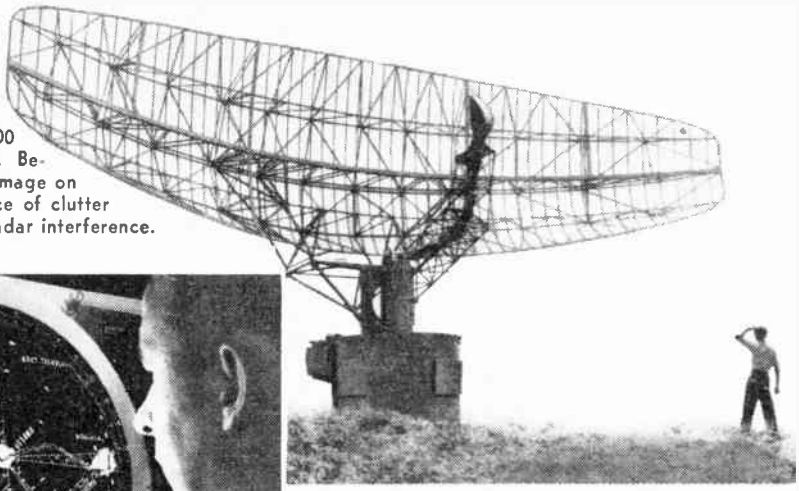
With almost a quarter of a million cars choking the City of Detroit's two expressways daily, authorities had to find some way of keeping vehicles moving rapidly. After trying special signal systems, lane and ramp controls, and augmented police patrols, the city turned to television to solve its problems.

Details of traffic show up clearly on TV screens (top photo). Camera (center photo) can be positioned by remote control. Government officials (bottom photo) show great interest in new system.

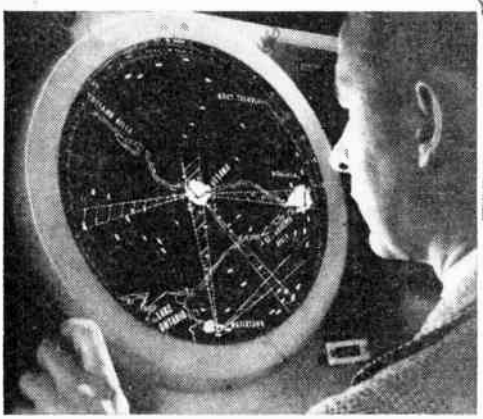
The result is an elaborate experiment in closed-circuit TV. The whole panorama of traffic conditions is available as a series of clear, conveniently viewed television pictures. Accidents, and congestion at the points of their occurrence, can be immediately detected. Enough picture detail comes through to permit observers to fully evaluate a situation. Moreover, the TV rig is part of a super-dispatch and control system in which police, fire, and other emergency vehicles can be sent quickly wherever they are needed. Traffic on highway lanes and ramps can be controlled at a moment's notice.

Months of elaborate tests, in which all types of available equipment were used around the clock under all possible weather conditions, preceded the present setup, which authorities claim will work. The system now uses TV cameras that can be moved up or down, rotated, focused, and even have their lenses changed—all by remote control. Problems of "pan" and "tilt" by remote control were also solved. Weather, a constant enemy, was met with weatherproof housing for each camera as well as windshield wipers for the camera lenses. A special tower was erected with an elevator to test the cameras at different heights.

Major credit for planning the system and directing the tests goes to Alger F. Malo, Director of the city's Department of Streets and Traffic. A detailed report on his work, which was conducted in cooperation with Roy Head, senior engineer of the Michigan Bell Telephone Company, was delivered recently at the 25th annual meeting of the Highway Research Board, Washington, D. C. —30—



Scanning range up to 200 miles is possible with this 40-foot antenna. Aircraft flying as high as 70,000 feet can be tracked. Below, operator views image on screen. Note absence of clutter and other types of radar interference.



Radar Uses "English" to Get Clear Signals

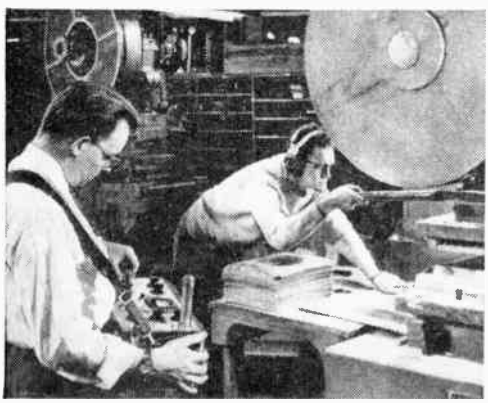
A NEW RADAR system, developed by Raytheon for Canada's airways, takes a lesson from billiard sharps—its antenna puts "English" on outgoing signals to solve the problem of clutter in returning echoes.

The antenna achieves its "cuestick" action by applying circular polarization to the outgoing beam. When the resultant microwaves hit a storm cloud, millions of spherical raindrops bounce them back to the antenna with a reverse twist. A filter keeps them out of the receiver and thus prevents them from registering on the radar scope. However, when the outgoing beam strikes the irregular surfaces of a solid object such as an airplane, many of the microwaves return to the antenna retaining their original twist. These pass unhindered through the filter and register as targets on the screen.

Cutting out bad-weather clutter is only one novel feature of this radar system. Another is its ability to select only moving objects by filtering out echoes from fixed objects such as buildings and mountains. This feature enables the operator to spot aircraft in flight clearly and quickly. Immediate and exact geographical pinpointing of a detected plane is facilitated by a map of the area scanned. Electronically generated, this map appears on the face of the 'scope with flip of a switch.

A network of these radar systems, for 15 major airports, will stretch across the width of Canada. Delivery of the first units is expected early in 1958.

Portable Meter Tracks Down Industrial Noise

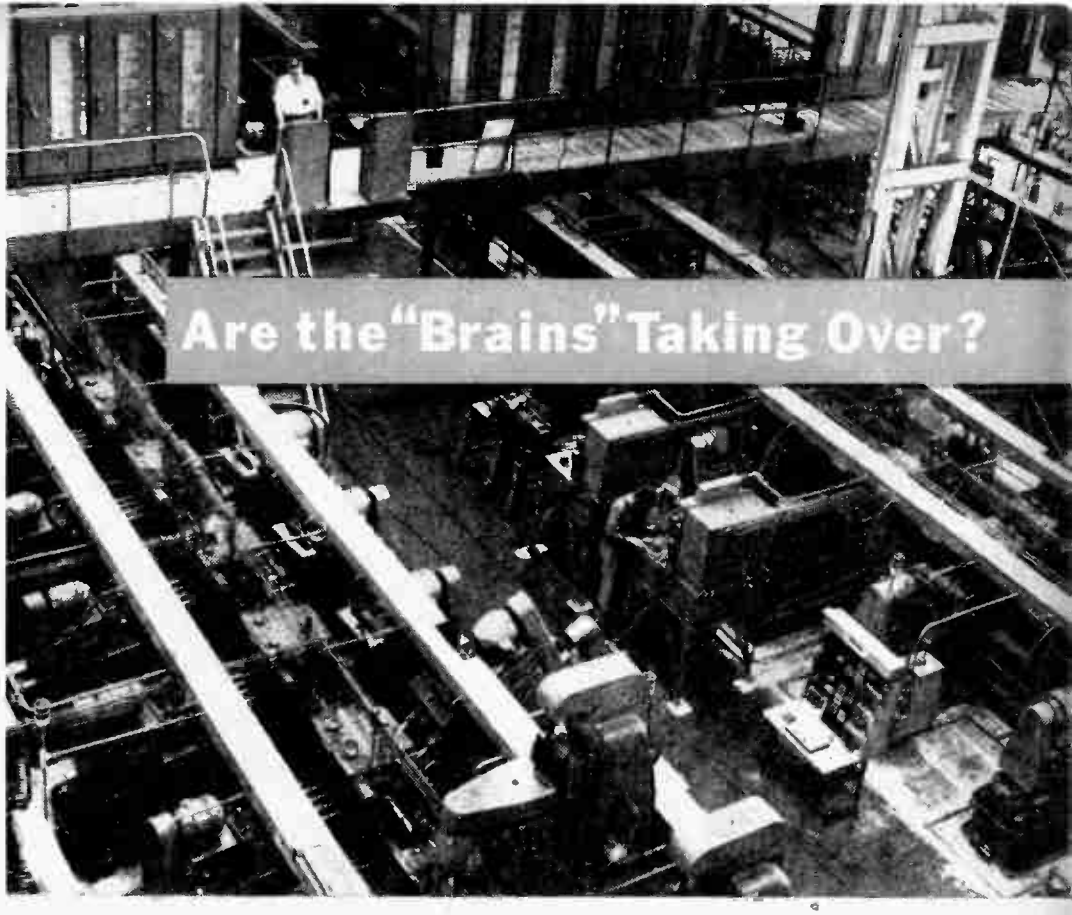


TWO BILLION dollars' worth of noise is the target of the "Soundscope," an all-in-one portable noise meter and analyzer. This staggering figure is the amount of the damage claims filed against industry as a direct result of noise and its attendant hazards to personnel.

Shown in a typical application taking sound level readings at a punch press, the "Soundscope" measures noise levels, analyzes peaks within any of eight sound octaves, and can also check sounds in very narrow frequency bands.

Details are available from the manufacturer, Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

Are the "Brains" Taking Over?



Automated production line grinds out Plymouth cylinder heads. Electronic equipment on transverse bridge controls entire process.

By HERBERT REID

You've heard from labor . . . you've heard from management . . . now, a POP'tronics exclusive gives you a broad, long-range perspective on the future of our industry

THE owner of a small tool factory outside Chicago finally lost his temper and blurted to the union leader: "So go out on strike! You'll be sorry!"

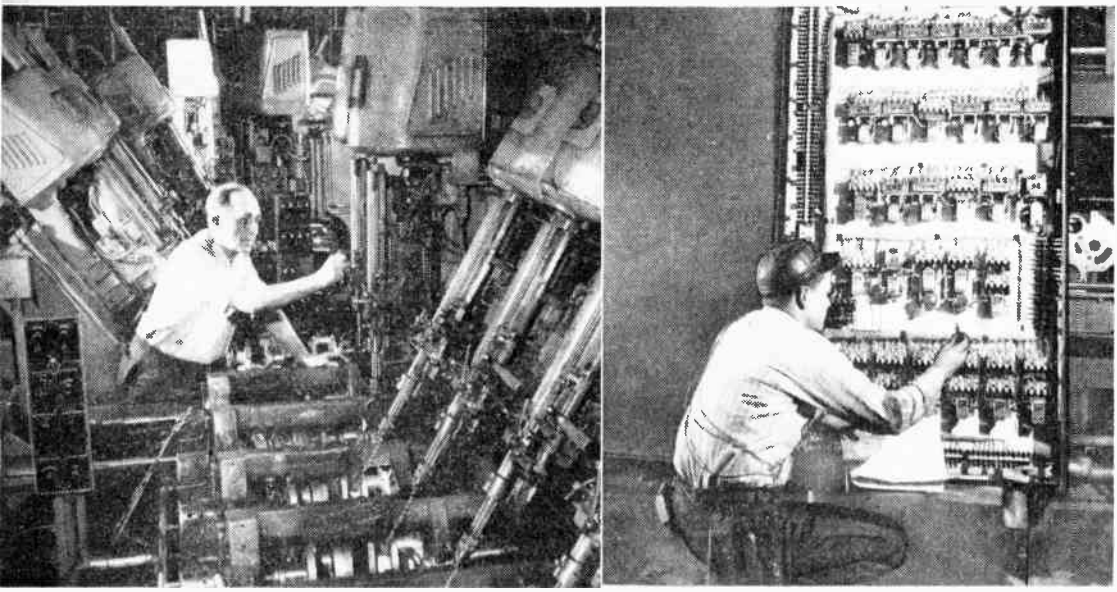
It was a plant employing eighty-two people. They produced only one item . . . an odd-shaped metallic wing section made expressly for a large aircraft manufacturer on the west coast. The union had got wind of a new sales contract. They wanted another nickel an hour. They struck.

While the pickets walked with signs for the next few weeks, some strange trucks pushed back and forth through the lines. Activity could be heard in the plant. Then, exactly four weeks later, the manufacturer called in the union head.

The workers' representative stood once again across the desk. The shop owner settled back into a large armchair and chortled: "You can have your nickel an hour, but I have a surprise for you. I don't need your full force any more. While you were striking, I installed some electronic brains." He took a leisurely puff on a cigar, and then said: "Send me back eighteen men."

Jobs and Machines. Incidents like this, though widely publicized, are basically misleading. Automation won't replace men. It will merely change the kind of work they do. Don't be fooled or frightened by the horizons now looming up behind electronics' new frontier. The age of automation is not a threat but a promise.

We learned in the last hundred years that the living standard of a whole country rises as more and better machines are put to work. To prove it, just compare the life you are leading now with that of your grandparents, or with that of people in non-industrial countries. The invention of



Human intruder in automation's realm (left) makes minor adjustments on a row of self-governing machines which drill the entire oil system in an automobile crankshaft in one continuous operation at Ford plant in Dearborn, Mich. Relay banks (right) control sequence and quality of machining operations. Electronic switching devices such as tubes and transistors augment electromechanical relays in recent designs.

power machinery has brought our generation a richer life than any of our ancestors enjoyed.

Now we are ready for the next forward step. Electronics multiplies the efficiency of machines by giving them automatic controls, self-regulation, and self-checking. The entire process of industrial production now moves up to a higher level. The material bounty of our lives will be correspondingly multiplied.

How would you like shorter hours, three-day weekends, and more money to boot? The electronic brain, if properly employed, can produce more leisure *plus* more wealth for everyone. The process has already begun.

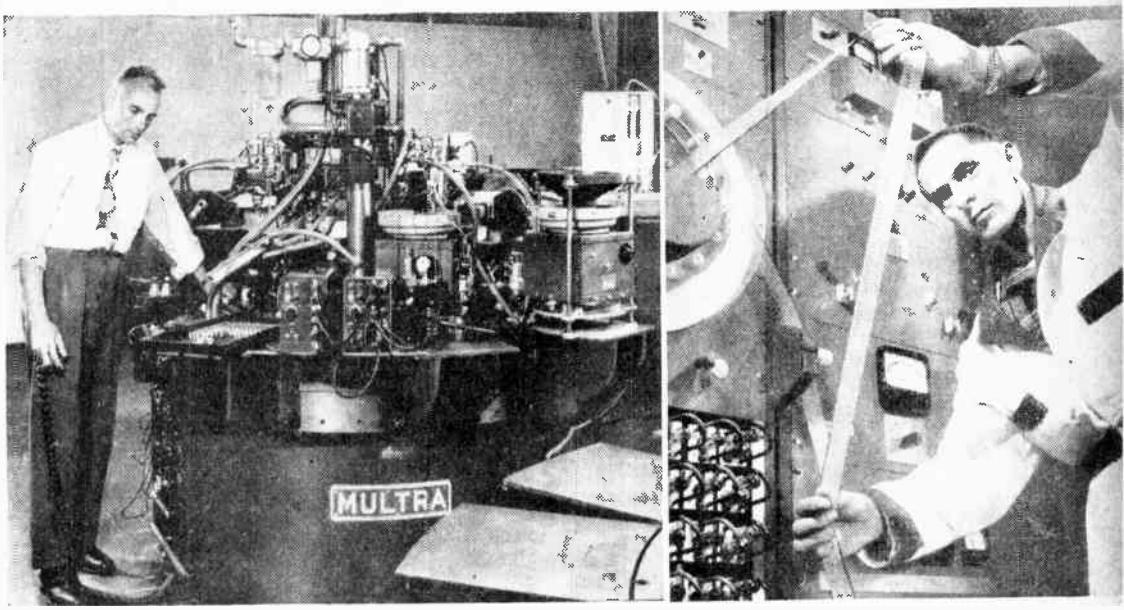
A Ford executive once took Walter Reuther, president of the United Auto Workers, on a plant tour. As they passed a row of robots turning out intricate engine parts, the Ford man cracked: "None of these gadgets pay dues to the union!" Reuther just smiled. "But none of them buy new Fords, either."

Here lies the key to the problem. The new electronically guided machines can produce immense wealth to benefit us all. But neither management nor labor can profit unless there are enough customers who can afford to buy what the machines produce. The answer to the problem of automation is therefore bound to be in terms of greater buying power and higher living standards for more people.

General Leslie Groves, wartime director of the atom bomb project, now a civilian executive of Remington Rand promoting peacetime applications of electronic computers, lays the issues clearly on the line in historical perspective:

"Replacement of people with some form of automation has been resisted consistently by certain types of individuals from time immemorial. If they had had their way, those people who have resisted it would apparently be glad to have ditches dug by pick and shovel. They ignore the fact that the pay rate of the laborers would be so low that they could hardly exist, and that the ditches would cost so much that few householders would be able to have running water in their homes. Today, the might-have-been pick-and-shovel laborer is running a mechanical ditcher or some other machine at ten times or more the hard-labor wages, to say nothing of doing a better job."

Automation does not make Man unproductive. On the contrary, it helps him become more productive, versatile, and, above all, more interested in what he is doing. It frees him of the boredom and monotony that are the curse of factory and office chores like assembling, figuring payrolls, etc. Now, for the first time in industrial history, machines can take over this dull drudgery. Human beings can turn to more imaginative and interesting work, and can have more leisure.



Assembly machine by Multra Corporation (left) performs 16 production steps along circular track. Variable work program includes inspection, with machine catching its own mistakes. Engineer (right) checks tape on which blueprint dimensions are encoded to provide electric guiding signals to the automated lathe shown on page 44. Self-checking through feedback circuits is a common feature of all these devices.

Jobwise, this means that there will be fewer unskilled routine jobs, but limitless opportunities for upgrading workers willing to get technical training. Some unions are starting their own training programs to prepare their members for the switchover to automation. In addition to people setting up automatic machines for given production tasks, many technicians will be busy with the maintenance of this complicated equipment. On the average, large computers employed in bookkeeping and similar "paper work" require one hour of maintenance for about every ten to twelve hours of operation.

Hurry and History. "Well," you might ask, "with so many men needed to keep a computer going, what's the point in having one?" The answer lies in the incredible rapidity of the computer. It literally works at the speed of lightning. This counts especially when you need a fast solution to a tough paper work problem.

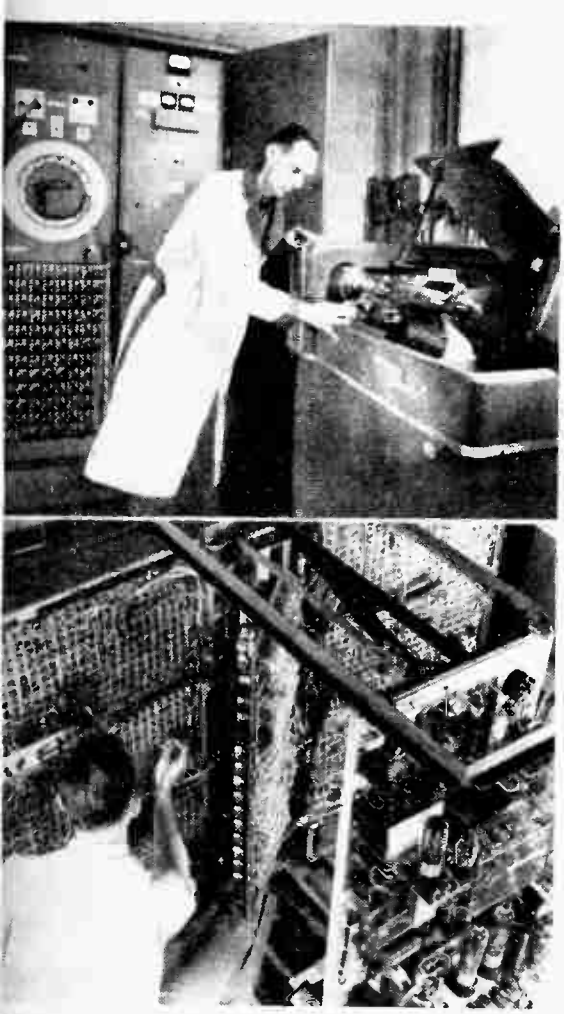
A guided missile manufacturer had 25 designs. Each had its good points but he wanted to select the one that would give him the best over-all performance under varying conditions. Taking into consideration shape, wind draft, fuel combustion, etc., involves a vast array of complex equations. One man on a desk calculator would have to work seven years to find the answer. A high-speed computer picked out the best design in seven minutes.

Burroughs has a machine that it rents out for about $300 an hour. There is a waiting list for it extending for many months. One large manufacturer who had about four months to wait before his turn was asked if it were worthwhile to sit on his hands all that time. He answered: "It's either wait four months for the brain or spend years doing it myself."

Machine computation is the promised land of modern engineering. But the principle is already centuries old. The abacus, the oldest mathematical machine, reaches back to the antiquity of the Orient. The slide rule and adding machine have seen more than three centuries of use.

The first thought of modern computers dates from 1822, when an eccentric British genius, Charles Babbage, dreamed up a room-size, two-ton "Difference Engine" to solve complex problems by a system of shafts and odd-shaped cams. The changing diameter of these cams, as they rotated, represented changes of numerical magnitude. Babbage induced the British government to finance the project by optimistically predicting: "I'll have this thing finished in two or three years and it will cost between 3000 and 5000 pounds."

Ten years and 23,000 pounds later, he was still working away. The British government dropped the project. Discouraged but not quite beaten, Babbage went ahead and designed a new computer that he called the "Analytical Engine," but he could find no backers. He died shortly



Tape-controlled lathe (top), developed by Bendix Aviation Corp., automatically turns out complex cam shapes from instructions which are fed to it from electronic control rack at rear. Tape reel is clearly visible. Technician (below), checking assembly of IBM data processing machine, exemplifies one of many new job opportunities created by automation in the field of electronics.

after that and the plans ended up in the Kings College Museum. Yet there was nothing musty about Babbage's theories.

Present-day scientists examining his yellowed notebooks find them very disturbing. Babbage's early ideas were so well put together that our mathematicians use many of them directly for today's developments.

The turning point in computer history came about twenty years ago with the development of fast and accurate electronic circuits. These circuits are able to create electric equivalents of nearly any mathematical function and perform counting operations at the rate of more than 100,000 per second. Computers had come a long way from Babbage's slow and bulky camshafts. Later, punched cards and magnetic tape provided the computer with a "memory" for remembering whatever it needed to know for a given job.

One of the first modern computers had a regular "baptism of fire" during the war. A distraught general called a meeting of our country's leading mathematicians, and said: "I have a math problem. The answer will decide who wins the war!"

Intelligence had gotten wind that the Germans were working on a new secret weapon to obsolete bombers. It was called the "Electric Cannon." The cannon was to be able to fire a shell for thousands of miles and with pinpoint accuracy. Our cloak and dagger boys reported that the Nazis were going all out and diverting money, material and scientists from the race for atomic supremacy. They were gambling, with the world as the stake.

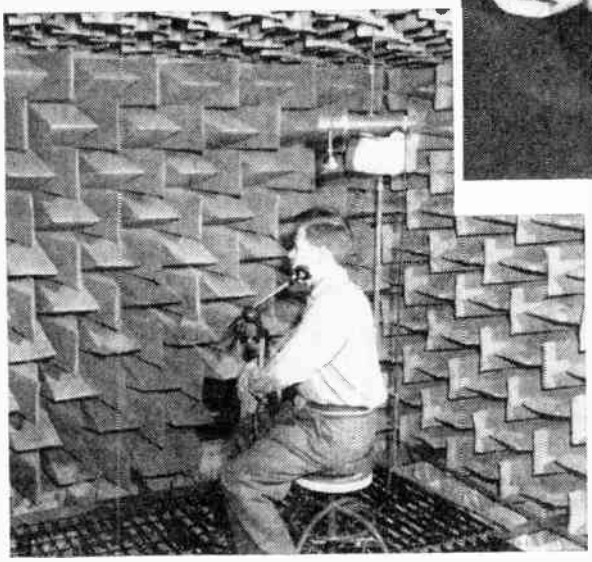
Could it work? That was the big question. The answer could be calculated, but ordinary computation methods might take a lifetime. Our mathematicians brought their new computer into play. The Germans had no such device. In a few weeks, the machine garbled out numbers that said: "The electric cannon will never work!" Our army crossed its fingers and stayed with the atomic bomb. Hitler's hired hands continued the impossible cannon project by trial and error to its futile end. History tells the rest, and the electric brain was a deciding factor.

Ultimate Aims. In recent years, computers attained amazing versatility. In addition to doing all sorts of paper work, called "data processing," and performing control functions, they are now learning to "lend a hand" in an increasing number of production jobs. The computers present their results in the form of electrical voltages which then control the actual working motions of the machine.

Here again, the machine, seemingly independent of man, needs plenty of human help. The electronic "brain" cannot actually think for itself. Technicians must tell it exactly what to do in a given situation. After it gets the routine down pat, it can repeat the job by itself. The "brain" is actually a mindless robot depending entirely on human guidance. But by freeing Man's hands and mind from dreary routines, the widespread use of computers in the future may liberate Man's time and energy for wider and deeper thinking and more creative work. This has tremendous social and spiritual implications, and points the way to what Dr. Norbert Wiener, the great automation pioneer, has called "the human use of human beings." —30—

Ultrasonic Bath for Parts

SOUND WAVES, pitched far higher than the human ear can hear, are used to clean bearings employed in high-precision aircraft gyros. The technician in the photo at the right is administering a supersonic bath to a component being made at the Minneapolis-Honeywell plant in Wisconsin. This cleaning method rids the delicate assembly of all dust, for even a microscopic speck of foreign matter could ruin one of these costly instruments. Later, gyros are tuned to within .0001% accuracy.



Anechoic Chamber

ILLINOIS TECH student Jack Kiser takes part in a binaural hearing experiment at Chicago's Parmly Foundation for Auditory Research. Kiser is listening to two different tones (one in each earphone) in order to determine their relative directions. Rooms like this are used widely by researchers to discover secrets of human hearing as well as to test new hi-fi equipment.

SHORAN Radar Trainer

THE FIRST trainer capable of teaching Air Force radar operators to guide their aircraft to a target, bomb the target, and return—completely and solely with SHORAN radar—has been developed by the Air Research and Development Command.

This complex $100,000 equipment permits trainees to use SHORAN (short-range navigation) radar under all simulated flight conditions. It can chart the entire course and altitude of a bombing run, then study data to pinpoint any errors. The instructor acts as pilot of the imaginary aircraft while trainee takes over as navigator and bombardier, solving flight problems and giving "flying" instructions to the "pilot."

Illuminated Alarm Clock

IT IS a great convenience to have a bedside clock with an illuminated dial to show the time distinctly all night long. Unfortunately, some of the clocks which have luminous hands and numerals are bright for only half an hour or so after the lights are switched off. Then they slowly fade into a faint indefinite glow.

The small ¼-watt argon gas lamp (AR-3) produces light in the near ultraviolet—or black light—spectrum and very little visible light. Black light possesses the energy to cause luminous paints to glow—it will energize the hands and numerals on your luminous clock dial. If your clock dial is not of the luminous type, then buy a small tube of white luminous paint and paint the hands and the numerals.

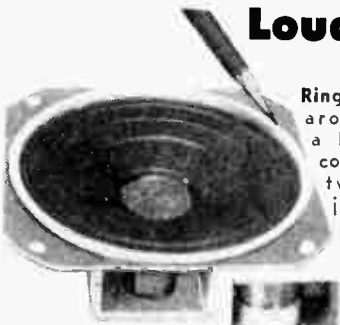
Most radio parts houses stock the AR-3 bulb—which costs about 70 cents and has a candelabra base. A handy socket for the bulb is a Dialco pilot light assembly, such as the No. 137 jewel cap, which has a clear lens and a candelabra socket suitable for the ¼-watt lamp.

Argon gas lamp produces "black light" to energize the numerals and hands on your luminous dial.

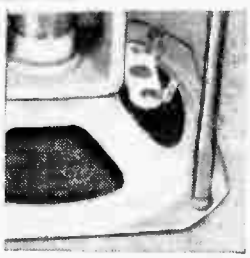
Life of the argon bulb can be extended many times if a 50,000-ohm, ½-watt resistor is attached in series with the a.c. line. This reduces the amount of black light emitted, but the luminous paint will accumulate energy and there will be sufficient light energy to keep it activated.

The pilot lamp assembly can be mounted in a 1" hole in a strip of plywood or a strip of metal fastened to the bedside table. Point the lamp to the center of the clock so that you will get the full effect of the black light. —*George P. Pearce*

Loudspeaker Installation



Ring of cardboard around edge of a loudspeaker's cone (left) has two important jobs to do.



Mount the speaker securely, but be sure not to overtighten the mounting screws (right) when installing a loudspeaker.

EVER WONDER about the thick cardboard ring around the edge of a loudspeaker's paper cone? Most electronics hobbyists, and even experienced technicians, pay little attention to this ring. Actually, it has two very important jobs to do.

Helping to secure the edge of the speaker's cone is only a minor function of the ring. In a well-constructed speaker, the outer edge of the cone is firmly cemented to the metal frame before the ring is installed. Thus, the cardboard ring is not really needed for this job. But it does serve as a *spacer* and as a *cushion*.

By acting as a *spacer*, the ring holds a mounted loudspeaker back from its baffle or mounting board, thus reducing the possibility of the paper cone striking the board during its forward movement. Since the maximum cone movement depends on the maximum amount of audio power the loudspeaker is designed to handle, you'll generally find that "heavy-duty" speakers have a much thicker cardboard ring than inexpensive, light-duty units.

The second important function of the cardboard ring is to serve as a *cushion*. If an excessive strain is applied to a loudspeaker's metal frame, the frame may be twisted or warped. The warped frame, in turn, will twist and distort the loudspeaker's cone, again impairing quality of reproduced sound. In extreme cases, the paper cone may be so warped out of shape that the voice coil assembly rubs on the pole piece or magnet frame. By serving as a resilient cushion, the cardboard ring permits a loudspeaker to be securely mounted with screws or bolts without an excessive strain on its metal frame.

So the next time you install—or replace—a speaker, remember the two important jobs of the cardboard ring. Mount the speaker securely, but *don't overtighten the mounting screws or bolts*. If you do, you may crush the ring slightly, defeating its job as a spacer—or you may even warp the metal frame. —*Eugene Richardson*

"Flyingest" Model Tests Antennas

A SIX-FOOT MODEL airplane "flies" half a million miles a year at up to 10 miles "altitude" without ever leaving its rooftop mount. Perched atop a laboratory building at Republic Aviation Corp., this model of the atom-bomb-carrying F-84F "Thunderstreak" banks, turns, climbs and dives by electronic remote control. The purpose of all these bantam acrobatics is to check antenna radiation patterns under all kinds of flight conditions without costly and dangerous tests in an actual plane.

Horn antenna, eleven feet long, beams radio signals at many receiver antennas in aircraft model to check effect of sleek hull and flight maneuvers on reception

Control room engineers "fly" model plane to plot radiation pattern from its transmitter at many different flight altitudes.

The size of a metal aircraft naturally affects the working of its antennas. Wavelength, antenna and fuselage dimensions must remain in the same ratio as on a real plane. Therefore, the scale model operates at proportionally shorter wavelengths than the full-size plane. Antennas are flush with the plane's streamlined skin, being recessed in plastic-covered cavities to avoid turbulence at high speeds.

Republic's adroit armchair flyer ranges over "distances" of 220 miles and altitudes up to 50,000 feet in search of the best possible solution to the dilemma of conflicting requirements. Through a funnel-shaped antenna, engineers beam radio signals at the model some 30 feet away. Then they check the model's reception in various "flight positions." This assures intelligible voice communications and clear signals for split-second radar and guidance decisions at the crucial combat moment. -30-

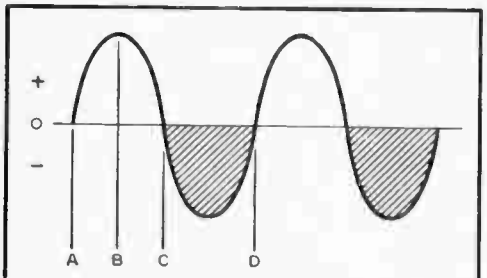
Tiny Record Player Gives Sales Talks

THE OIL CAN in photo at left delivers its own sales talk. Inside it is a unique device known as "Sellavox." Measuring 3½" by 5" and powered by two flashlight batteries, "Sellavox" is a miniature record player. Its motor is as big as a thumb; the disc it plays is the size of the label on an ordinary record. It uses no tubes or transistors; rather, amplification is achieved mechanically, by linkage between the pickup and the cone of the 2" speaker. The device is made by Minitone, Inc., 55 West 13 St., New York City, and its application to on-the-spot advertising is the work of Carter & Galantin, 710 West Jackson Blvd., Chicago. Other uses of the device are in "talking" cigarette machines, food displays in supermarkets, and numerous toys.

About Selenium Rectifiers—Keep This in Mind!

PROBABLY the most popular power source for small preamplifiers, code practice oscillators, radio tuners, and simple control circuits is the half-wave rectifier type supply using a selenium rectifier and a single filter. The circuit of such a supply is given in the wiring diagram where typical component values are listed.

In operation, the selenium rectifier permits electron flow in one direction only. Thus, when a.c. is applied to the input, half



The a.c. input to the rectifier will look something like this. If the switch is closed when the wave is at point "B," there is a good possibility of the rectifier blowing out—if the series resistor mentioned in the article is not included in the circuit.

of the cycle is "stripped" away, leaving pulsating d.c. This pulsating d.c. acts to charge capacitor *C1*, which then discharges slowly through *CH1* and the load connected across the output. The choke and capacitor *C2* serve as a filter network to smooth remaining pulsations and to insure that "pure" d.c. is supplied to the load.

The circuit of this power supply is almost identical to that of a vacuum-tube half-wave rectifier type power supply except for one small but important feature—the presence of series resistor *R1*. Since this resistor is not used or needed in vacuum-tube supplies, beginners—and even experienced technicians—will often leave it out of the circuit, connecting the cathode of *SR1* directly to *C1*.

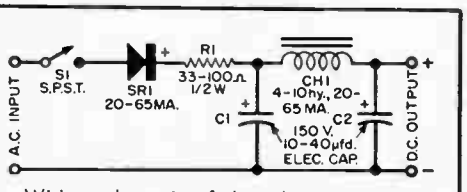
When this is done, things may go along smoothly for quite a while—but one fine day, when the experimenter throws his power switch "on," the selenium rectifier will go up in smoke. Unless he knows the reason for having *R1* in the circuit, chances are that this chap will attribute his trouble to a defective rectifier, to a leaky capacitor (*C1*), to an accidental short, or to some similar defect. He'll make the usual replacements and go along his merry way . . . until it happens again!

Looking at the small resistance (33 to 100 ohms) of *R1*, we know right away that it is of negligible value as a part of the filter network. Actually, *R1* serves as a sort of protective load. Its purpose is to protect the selenium rectifier from a damaging current surge.

Consider the rectifier action that takes place *at the instant* that the power switch is thrown "on." Since capacitor *C1* is discharged, it acts—for practical purposes—like a short circuit. If *R1* were not in the circuit, an extremely high current flow could take place through *SR1* as *C1* charges, *provided a moderately high voltage is applied to the input.*

However, we know that an a.c. voltage constantly varies, going from zero to a peak value with one polarity, back to zero, then to a peak value with the opposite polarity, and again back to zero. A high voltage is applied to the input *only* if the switch is closed while the line voltage is at the peak of its positive cycle. If the line voltage is in the vicinity of its negative half-cycle, where the rectifier does not conduct, there is little or no danger of a damaging current surge through *SR1*.

Thus, *R1* is provided simply to limit current flow through the selenium rectifier in the event that power is applied to the circuit when the applied a.c. voltage is near its peak in the conducting direction. It is not needed once *C1* is charged, nor if the switch is turned "on" during the negative half-cycles, nor when the line voltage is near



Wiring schematic of the selenium rectifier described in the text. Values are arbitrary within the ranges shown in the drawing.

zero. Nor is it needed in vacuum-tube rectifier circuits—since the slow heating of the vacuum-tube cathode allows the input capacitor to charge slowly.

In practice, the use of series resistor *R1* is essential if the source voltage is the a.c. line. Its use is optional where a transformer secondary supplies the a.c. voltage, for the inherent d.c. resistance of the transformer windings, as well as inductive lag, will generally prevent an excessive current surge. But it's a good idea *always* to include such a resistor in selenium rectifier circuits.

—*E. G. Louis*

Elimination of human error in dispatching elevator cars is major contribution of new Otis "Automatic Program Selection." Left, passengers are assured steady, uncrowded traffic flow in large office buildings. Below, indicator and control panel of the system; switches can be preset to handle any flow of passengers in any of six traffic patterns.

No Guesswork With These Elevators!

THE APPLICATION of electronics to elevators has solved one of the thorniest problems in vertical transportation—traffic scheduling.

Since time is money in modern business, seconds spent waiting for an elevator can be expensive. In manually controlled scheduling systems, the starter knows that at certain times of the day most of his traffic is in one direction. He can tell what floors are calling for elevators. But he has no way of knowing the exact amount of traffic, how many people are in an elevator at the upper floors, or how many are waiting for a car at any particular floor. The result is that the starter must 'juggle" his cars. If he guesses wrong, some people have an overlong wait for an elevator as cars, loaded to capacity on upper floors, continue to pass them by.

With Otis Elevator Company's new Automatic Program Selection, the starter is replaced by an electronic system that does his job automatically and with great efficiency. This equipment almost thinks for itself.

First of all, it is prepared for known traffic situations. During the up-peak periods, cars are dispatched as soon as they are filled to comfortable capacity, indicated by a load-weighing device in each car. During the down-peak periods, if traffic indicates the necessity for it, the building is automatically zoned so that certain cars will not go above a particular floor. This prevents the elevators from skipping pas-

sengers on lower floors because the cars have been loaded to capacity at upper floors. If a single down call remains unanswered for a predetermined time, the first available car—even though it might be traveling upward and must reverse itself—is made to stop in answer to that call.

Under quieter traffic conditions, the scheduling is designed to dispatch cars and answer calls as soon as possible, with the distribution of cars determined automatically. Doors are prevented from closing on passengers by an electronic proximity device mounted on the leading edges of both elevator doors which causes them to stop and reverse if a passenger's arm or any other part of his body is in their path. If someone stands in the doorway beyond a fixed time limit, an impatient buzzer sounds a warning, and the doors close at greatly reduced speed. The passenger is then firmly but gently nudged from the path of the closing doors.

The heart of automatic programing is an electronic mechanism that utilizes relays, tubes and transistors in an effective memory system. This equipment receives the information, memorizes it, analyzes it, and distributes the correct answer to the elevators themselves for up or down movements.

The system begins its operation when a passenger signals for the elevator. A touch of the call button, which is a proximity detector, activates a "memory" circuit by gas tube ionization. The signal is relayed to the car. When the car arrives, the circuit is broken again and the call signal is canceled.

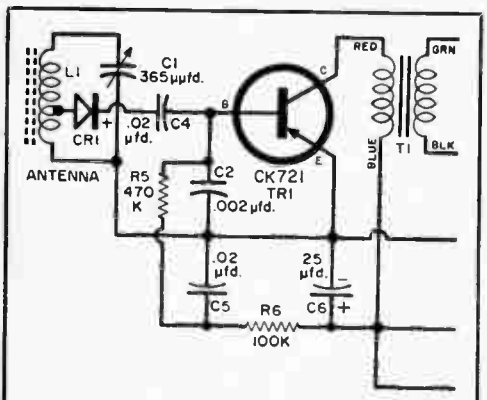
Each car is suspended on rubber insulation blocks, with a tripper mechanism under the mounting. When a car is loaded to a comfortable capacity, the rubber blocks are depressed, the car hits a microswitch, the tripper is activated, and the car is dispatched.

All elevator calls are communicated to the traffic programing mechanism, which holds the information in memory circuits. As calls accumulate, indicating a change in traffic pattern, the information is sent to the dispatch timing mechanism, and the scheduling of cars is changed.

Building owners report that Automatic Program Selection not only satisfies tenants in terms of time saved and less crowded elevators, but also that elevator starters are freed to perform public relations duties as building receptionists. —30—

More Sensitivity for the "Transistor Portable"

THE IMMENSE INTEREST evidenced in the "Transistor Portable with a Punch" (POPULAR ELECTRONICS, May, 1956, page 42) has occasioned several experiments designed to increase the sensitivity. Results have shown that the volume obtainable from this receiver can be nearly tripled. Additional components required consist simply of two resistors and three capacitors. The partial wiring diagram at left shows where the new components are located in the circuit.



Partial schematic of the "Transistor Portable with a Punch." Complete original ran in May, 1956, issue. Circuit components to be added or changed are explained in text. These modifications can result in three times higher output.

Capacitor *C4* has been added to isolate the crystal diode *CR1* from the first audio stage, *TR1*. Resistors *R5* and *R6* plus bypass capacitors *C5* and *C6* will effectively bias the base of transistor *TR1*, permitting more efficient operation. In weak signal areas, the addition of these few parts will increase the volume of the weak signals rectified by the crystal diode detector.

SUBSTITUTIONS: Several attempts have been made to substitute "regular" ferrite loopsticks for the Miller Type 2000 transistor loopstick mentioned in the parts list. At the present time, it appears doubtful that other commercially available loopsticks are as sensitive—if the receiver is used without an outside antenna. I would also recommend that the CK722 *not* be substituted for the CK721 used in the first audio stage, *TR1*. If this substitution is made, the constructor will be disappointed because of the increase in background hiss and noise.

Some improvement in volume and freedom from distortion can be effected if the value of *R4* is reduced to less than 10,000 ohms. A value of 4700 ohms for this resistor has been found to be fairly satisfactory.

—Edward Duda

THIN AIR my foot!

By Carl Kohler

AS A rosy-cheeked lad, standing with awe at my father's knee while he performed such magic as winding antenna coils or constructing a crystal set, I was exposed to an important factor in electronic know-how. It was dinned into me with patient repetition (and a skilled hand with the razor strop) until I knew it better than I did my own name. It was, simply: "A place for everything and everything in its place."

I have since tried to introduce this cardinal rule of good craftsmanship into my own household . . . a task which—at times—seems comparable to destroying Boulder Dam with a penknife. I just can't seem to get the Missus (by far, the most outrageous offender of the rule) to put anything back where she found it, and most of the time I'm fortunate beyond my wildest hopes if she even remembers where she misplaced it. When it comes to tracking down mislaid tools, Little Bo-Peep searching for her flock at a wolf-rally stands a better chance of finding what she's looking for than I do in the simple effort to locate "that Phillips screwdriver which was on the workbench just a minute ago."

If this smacks of gross exaggeration, then, you, dear reader, are either single or the possessor of a workshop guarded by trained lions and a time-lock.

THE FOLLOWING dismay-tinged notes are but a few of the cryptic entries in a small book which I carry with me, recording weekly accounts of lost-tool matters:

Monday—Found partially rusted open-end wrench under lilac bush in front yard. Wife claimed she borrowed it to loosen soil.

Tuesday—Discovered cutters lying under sofa. Wife's story: she needed "something" to cut up coat hangers for project she is working in wire.

Wednesday—Found soldering gun in upper hall. Wife boldly admitted using same to hammer nail into wall for picture-hanging.

Thursday—Took socket-wrench, gently, away from Junior. Wife claims I left it lying on washporch (not true, *I* put things back where I find them) and allowed child to amuse himself with it.

Friday—Discovered rachet-wrench in silver-drawer while drying silverware for Wife. No explanation offered by anyone.

Saturday—Stepped on pliers . . . nearly broke my fool neck. When questioned, Wife allowed as how she was using them to pull tacks from old chair before attempting re-upholstering. Gave her short, spirited talk on leaving tools upon basement floor. Mentioned that our insurance clauses don't include "death by pliers."

Sunday—Came upon strange hand-drill. Not mine. Asked around neighborhood. Found owner two blocks south. Kids were drilling for oil with it. Am reassured I am not alone in this fight.

And *those* are the trivial facets to this multi-sided pain where it aches the most. At least, I was able to get my pinkies on the abused tool and carefully put it back, in each instance, in its allotted niche or on its own peg.

SOMETIMES finding a missing tool gradually becomes a trek of similar proportion to that of searching for the famed dodo bird. And, frankly, I would a darn sight sooner have to limp through the danger-infested jungles of, say, darkest Brazil, in my bare feet and armed only with a

. . . Sometimes finding a missing tool gradually becomes a trek of similar proportion to that of searching for the famed dodo bird . . .

water-pistol, than be faced with the prospect of ferreting out some completely vanished tool . . . particularly when Friend Wife kicks the hunt into action with: "It simply disappeared into thin air!"

Those are fightin' words in my book.

They are, also, the fantastic symbols of feminine reasoning substituted for cold,

. . . But how did you know it would be there?" asked Friend Wife, with eyes the size of dinner plates. "I hear voices," I admitted, mystically . . .

male logic . . . logic being as foreign to the mind of woman as Martian sand would be to an Ozark hillbilly. Nevertheless, those six, absurd words have been hurled into my stunned face each time Friend Wife is queried concerning the whereabouts of a missing tool.

One morning, I became aware that my prized and treasured electric drill was not suspended in its customary place. Before succumbing to hysteria, I forced myself into a tense, controlled state of mind and made a trembling inch-by-inch check of the workbench, the larger drawers, the cabinets and, finally, the workshack floor.

No electric drill.

Fair-minded lout that I am, I sauntered casually through the house and grounds, keeping two weather eyes straining from their sockets for even a hint of a misplaced, unreturned electric drill. I happened upon my extra pliers (half-buried among the ferns) and a given-up-for-lost-long-ago screwdriver (encrusted with dried paint), but still no electric drill.

So, letting my fury lash itself into a rousing lather, I abandoned further coolheadedness and charged off to fight "City Hall." Electric drills don't grow on trees.

THE CULPRIT was in the kitchen, affecting an air of spritely cheer and threadbare innocence as I boiled into the room. Gripping the edge of the sink for support, I glared at her from head to toe. Her cheer dampened visibly.

"Well, what's eating *you?*"

"Where is it? Come on, now. Where is it? Stop stalling and just tell me what you did with it and I won't—"

"Where is *what?*" She had the audacity to smile.

"The electric drill," I snapped peevishly. "My fine, wonderful electric drill that I am lost without. It's gone and you know where it's gone to, and I *demand* that you—"

She rested her chin upon a slender finger and stared thoughtfully at me. "Electric drill. Is that the gun-like gismo that goes rrrrrrrzzzzzzz and makes holes in things?"

"*That's* it," I agreed. "That's my electric drill which I bought with my own little money and have cherished like some men cherish their—"

"Wellllll . . . let . . . me . . . think . . ." Her eyes glazed over with vague thought.

I drew myself up and stood, with folded arms across my chest, peering mercilessly into her little act with what I was sure were gimlet-colored glances. Friend Wife has a nice trick of assuming a cooperatively confused aspect when cornered in matters of vital concern - like lost tools and such. I've had reason to suspect, in the past years of marriage, that this is what my mother used to refer to as "the wiles of women."

"*What did you do with my electric drill?*" I hissed.

"Oh, *now* I remember!" She beamed joyously at me, and I could sense a real humdinger building up voltage. "I used it to put drainage holes in those tin planters you made for me! And was *that* ever a job! Drilling . . . drilling . . . drilling . . . all those oodles of holes! Gosh, I never realized how much —"

"Listen, lady," I said patiently, "I don't want to sound like so much tube noise, but I insist upon knowing exactly where my drill is—right now."

"How should *I* know?" she complained, shrugging. "It just seems like I lay things down and—and the very next minute, they disappear into thin—"

"HOLD IT!" I shrieked. "*Hold it, right there!*" Unnerved, I collapsed into the nearest chair, every muscle in my body quivering. "I've been led over that 'thin air' route before. I'm not buying it this trip. And now that you're a great, big grown-up girl, I think you're old enough to face facts. Lady, despite your fondest wishes, nothing—absolutely *nothing*—disappears into thin air." I stopped for a

(*Continued on page* 124)

Two-Penny Direction Finders

By ELBERT ROBBERSON

You can find your way simply and inexpensively if you navigate by radio

TO THE NAVIGATOR of a steamship, fog is not so tough. He turns on the radar, or the radio direction finder, and steams on through. But in the 14- to 40-foot boats that some tens of thousands of us are going to be cruising around in this year, fog means: *go home!* The trouble is that when it closes in, you can't go home.

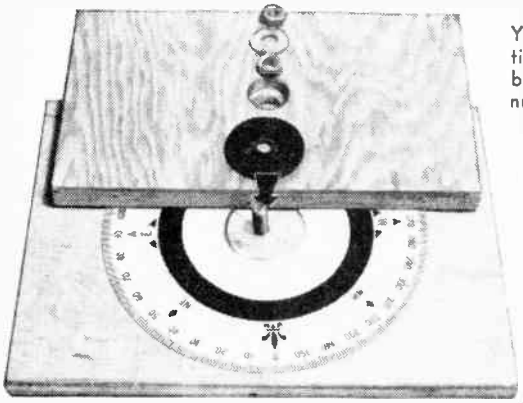
After bumbling blindly through quite a bit of fog, I decided that I would carry along a radio direction finder whenever I take a boat out on open water. You can do it, too—even if the boat is a mere skiff. Here's how. Loop antennas are directional, portable radios have loop antennas; therefore, we can find directions with a portable radio.

Portable radios have several forms of loops (Fig. 1 on page 55 shows the most common forms). All loops behave similarly. Maximum signal pickup occurs along the line of the wire of the loop winding, while a sharp signal "null"—or "no-signal" area—is found perpendicular to the plane of the loop windings. The null is used for taking bearings, since it is much sharper than the broad lobes of maximum response.

Old-line steamship direction finders had their loops mounted on a pedestal above the wheelhouse, the energy being fed to the receiver at the bottom of the loop-support shaft. Then smaller DF's were built, having the loop and slip-ring assembly directly on top of the receiver cabinet. In both of these types, bearings were taken by rotating the loop, then reading the direction of the null line from a pointer traversing a calibrated scale—known as a compass rose or azimuth circle.

With a portable radio direction finder, things are much simpler. Instead of rotating the loop separately, you rotate the entire set. This works just as well.

Take Your Bearings. To get to actual direction finding, it is first necessary to look inside the portable receiver and find out what form of loop is used, and how it is oriented. Card loops are usually mounted vertically along the rear edge of the chassis, so the bearing line on a null would be squarely through the front panel and out the back of the set. Some frame-wound antennas are similarly mounted, but a few sets using this construction have the loop flat against one end of the chassis. This puts the bearing line on a null edgewise through the set, parallel to the front panel. Ferrite-rod loops may be aligned either



Exploded view of azimuth base. To assemble, black Bakelite circle is set over bolt-bearing, then rotary platform and other hardware are placed on top.

You can adapt a common portable radio for direction finding. Azimuth base gives relative or magnetic bearings. Arrow on platform (below) is on loop's null line, running through set from front to back.

way. The null line runs lengthwise through the rod.

It is best at this point to draw an arrow on the set along the null line. If the loop is off-center, it isn't necessary to mark the line off-center also. It's more convenient for the line to be drawn on the center of the set. Just be sure the line is parallel to the imaginary line through the loop.

Now hie yourself outdoors (in a building, wiring and pipes upset loop indications), portable radio in hand. Tune in a good loud local, and set the volume to a comfortable level. Then *slowly* turn completely around, listening to the program strength as you do so. You should find two directions, 180° apart, where signal level drops, or the quality mushes up and noise increases. These are the directions of the null line, and at this point the radio-station antenna lies along the line drawn on your receiver. Basically, that is all there is to radio direction finding.

Do not be amazed to find that the transmitting station is not in the direction you expected. For instance, where I live, several stations with studio locations in widely separated cities all line up on approximately the same bearing, and not where you'd expect them to be at all. But if you drive out to a certain flat spot in New Jersey, you see the reason: virtually acres of antenna systems fed by a number of different stations.

This is no great drawback in radio navigation. You simply mark the location of the various radio towers on your chart, and they are just as good as lighthouses looming out of the fog.

Troubles and Cures. Someone is bound to find that his particular portable does not act as described above. Here are possible causes for non-operation.

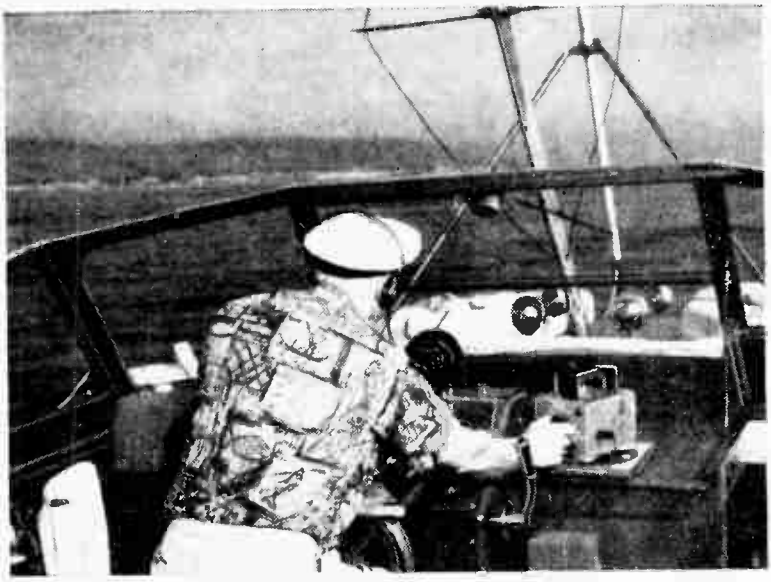
First of all, the two nulls 180° apart may be distorted, swung toward each other, or even merged, if any antenna other than just the loop is connected. Some portables have another wire connected to the input to augment loop pickup. Take the extra wire off. Signal current arriving by this route will lead to all sorts of unpleasant complications.

Sometimes the loop circuit is out of tune, or does not "track" properly on the station frequencies. This will cause about the same kind of trouble as having an extra antenna connected.

To cure this out-of-tune fault, "peak" the loop tuning by adjusting the main capacitor trimmer on the input stage so it will be "on the nose" for frequencies on which you want to take bearings. In the case of poor tracking, the simplest cure is to install a 50-$\mu\mu$fd. midget variable capacitor across the loop terminals. With this capacitor set to mid-point, peak the main trimmer. Then, loop tuning can be touched up as required all the way across the band with the auxiliary capacitor. Proper loop tuning is indicated by loudest signals "off the null," and the sharpest and cleanest null when the loop is turned "broadside-to." The auxiliary trimmer should be mounted directly at the loop terminals, and should be insulated from the chassis.

Another feature which tends to mask loop nulls is active and efficient a.v.c. action in the receiver. Under other conditions, a.v.c. is fine, but in a direction finder it will often "fill in" the nulls by increasing sensitivity at these points and make accurate location of the line impossible.

Here the cure is to disable the a.v.c. while using the set as a direction finder. Where this is easiest done depends upon



This navigator is using a commercial version of a portable radio adapted for small-boat radio direction finding. Ferrite loop is on top of cabinet; reception is by headphones. Set rotates on azimuth base which provides numerical bearings.

the circuit, and determination of the right place will take a little tracing and experimenting.

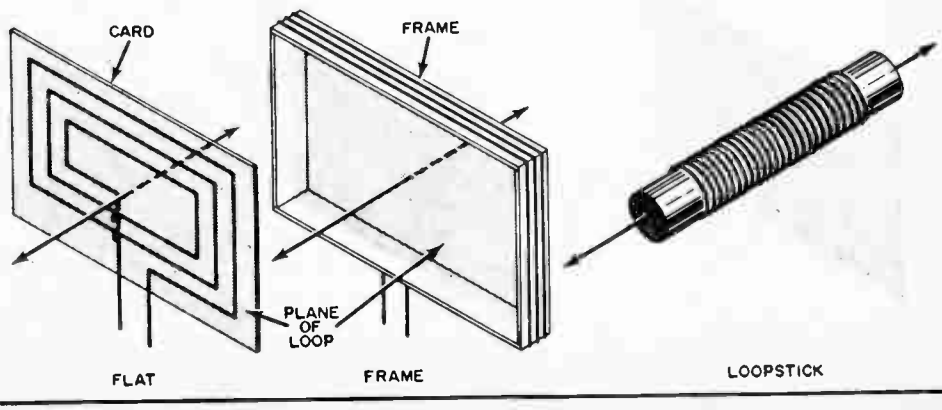
Figure 2 shows a typical circuit. The "hot" side of the loop is connected to the grid of the input stage, while the other end is grounded for r.f. current by capacitor *C1*. Resistor *R1* brings a.v.c. voltage in from around the detector stage. *C2* and *R2* perform the same function for the next stage. A.v.c. voltage can be removed simply by grounding the points marked "A" and "B" by a jumper wire. These grounds may be made through a toggle switch mounted on the chassis, and the a.v.c. restored for null-free broadcast reception, if desired.

With the a.v.c. disabled, a station coming in at comfortable volume should drop out almost completely when the set is rotated through the null points.

Even though a portable performs perfectly in the back yard, take it on a boat and you'll probably find that motor roar and the sound of wind and waves make loudspeaker listening very difficult. Headset listening is the remedy. Figure 3 shows the circuit I like best, since it will feed any wire-wound headset; and when the phones are plugged in, the speaker stops squawking.

Portable Platform. Navigation is made easier by using an "azimuth indicating" platform for your portable. The photographs show the scheme, and Fig. 4 gives dimensions of critical parts. All that is needed is a little plywood, a carriage bolt and a short length of brass pipe, a wafer of Bakelite and a bearing circle, giving degrees "around the clock" from 0 to 360. Marine and surplus houses can steer you onto such scales, or you can make one

Fig. 1. Arrows indicate line of null for common varieties of loop forms.



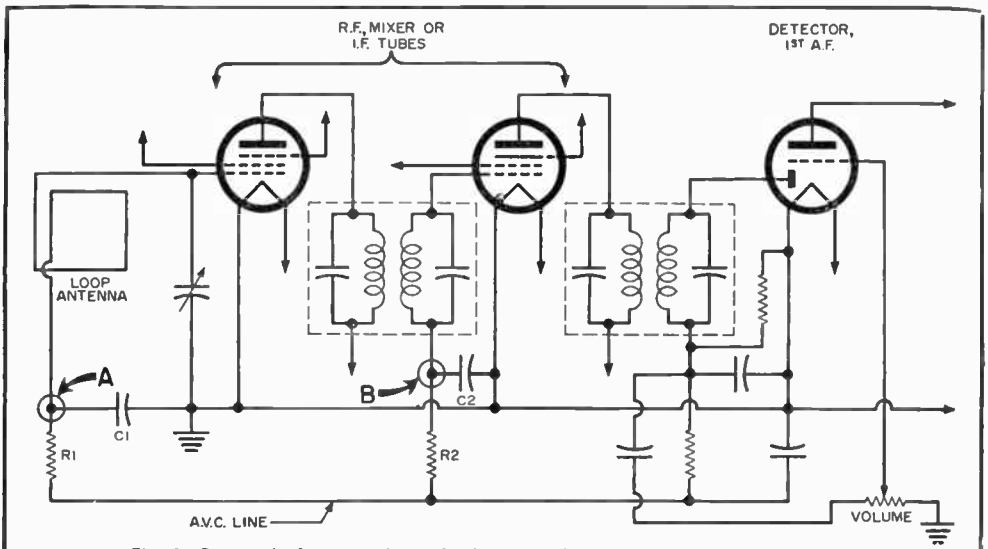


Fig. 2. Removal of a.v.c. voltage for better nulls by grounding points A and B.

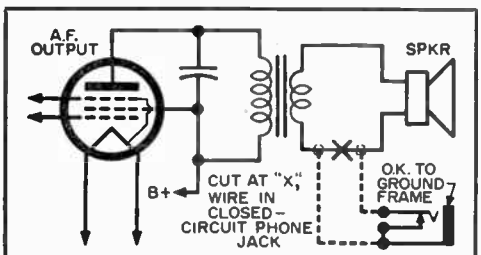


Fig. 3. Jack for headset listening. Disconnect a wire between output transformer and speaker voice coil, then connect closed-circuit phone jack between the disconnected points.

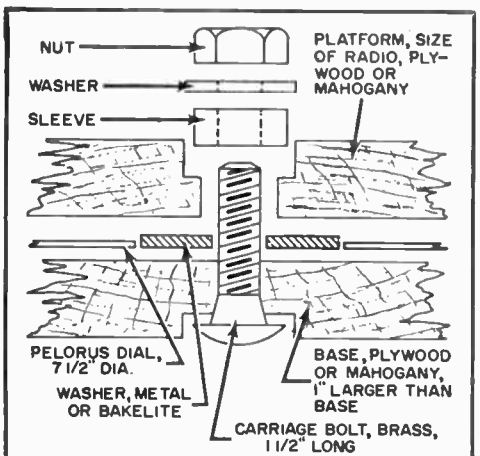


Fig. 4. Critical parts for azimuth indicating platform. Bore platform so that bearing rides on washer. Recess platform and base for carriage bolt head, nut and washer. Enlarge hole in dial so that it will turn freely.

yourself by using a protractor to mark the points on a cardboard or plastic disc.

The azimuth scale should be free to turn, and large enough to extend out past the rotary radio platform, which should also turn, free of both the base and the circle. On the base, make a "lubber's line" mark squarely through the center. Extend the null line on the radio case down its sides, and mark or glue on a pointer arrow.

Square up the base with the fore-and-aft line in the boat. The azimuth circle can then be set so 0° is dead ahead, to give "relative" bearings—or using the lubber line, to the same heading as the boat steering compass. This will give magnetic bearings of the null line which can be transferred directly to the chart.

Direction finders using this principle are produced commercially, and used with great success. There's no reason why your portable-radio hookup should not give results every bit as good. The main precaution is to keep the instrument away from encirclements or large masses of rigging, or other wire, and metal masses.

The first time out on the water, give the DF an accuracy check by cruising to within sight of the radio tower of a known station. Take radio bearings on it, at the same time sighting visually over the null-line mark on the radio. Visual and radio lines should coincide. If they do not, simply move the null-line mark until they do. When this is done, the set is "calibrated," and your radio observations will be just as good as an actual sight of the station.

With a little practice, your "two-penny" direction finder will take you anywhere you want to go. —30—

Tuning the Short-Wave Bands

with Hank Bennett

THIS MONTH let's talk about another POP'tronics short-wave reporter: John Beaver of 1726 East 14th St., Pueblo, Colorado. John, who will be 28 on July 19, has a wife, Georgia, and two daughters. He is employed by the Pueblo Star-Journal, an afternoon daily newspaper, as a Linotype operator.

John writes: "I've been interested in radio all my life. I've always enjoyed radio listening, and I purchased my first s.w. receiver in 1953." John has been active at SWL'ing since March, 1953. His logbooks are crammed full of information and programming of stations in 56 countries. When not occupied with chores around the house, this reporter can usually be found at his Hallicrafters SX42 receiver.

Two double-whip antennas connected together to act as one are currently in use at the Pueblo listening-post. John says this is his own personal experiment and that "it works perfectly"—a most modest statement, as John's volumes of loggings will attest. There is no other equipment in the Beaver "shack." So his success is due largely to careful tuning mixed in with a lot of patience—the key to logging those rare stations!

To date, John has received verifications from six countries out of a total of 56 heard. His best veri is from *Radio Australia* in Melbourne.

We asked John about his favorite DX stations and bands, and his best DX. He prefers the 49-, 31-, 25-, 19-, and 16-meter bands—all favorites. And he thinks that *Radio Australia,* Melbourne, is the best station on the air, tops in music and other excellent programming. John's best DX includes: *Radio Australia* and Djakarta, Indonesia, in the South Pacific; the BBC, *Deutsche Welle* (Germany), *Radio Netherlands,* and Rome, in Europe.

In addition to being a consistent and valuable reporter for our column, John is a member of the Newark News Radio Club and a loyal contributor to their s.w. section. His other hobbies are "reading, writing, television, experimenting with radio receiving antennas, and 100% SWL card swapping," all of which make up a pretty full schedule. Keep the reports coming, John, especially on those rare ones!

Club Notes

The International Shortwave Club of England is spearheading a drive aimed at the countries responsible for jamming the transmissions of other stations. The ISWC, in its bulletins, is urging every SWL, DX'er, and s.w. publication to cease sending reception reports to the guilty countries as well as to stop publishing listeners' reports on the offending countries. Such countries are mainly those behind the Iron Curtain, although there may be one or two others that transmit jamming signals from time to time. The ISWC asks for the cooperation of DX'ers the world over. Further details can be had from your Short-Wave Editor.

The Newark News Radio Club, in a recent election of officers, came up with the following: President, Irving Potts; Canadian Vice-President, G. Dudley Clarke; Treasurer, Walter Townley; Executive Secretary, Miss Joan Koempel; Ass't. Ex. Sec'y, Ben Feinstein. In addition, there were 12 Vice-Presidents elected; Page Taylor was appointed Corresponding Secretary; and Bob Cooper was named Bulletin Chairman, succeeding John Reichert.

(*Continued on page* 119)

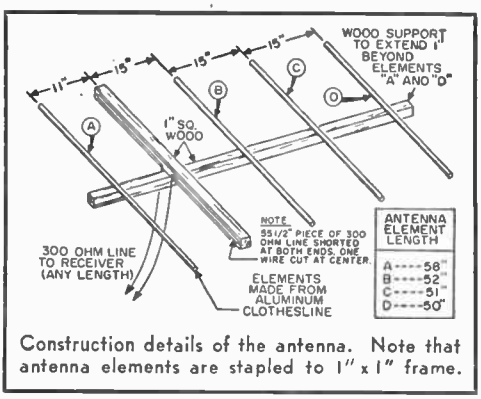
John Beaver, short-wave reporter from Pueblo, Colorado, listens to his Hallicrafters SX42 receiver.

A Simple FM Yagi Antenna That You Can Make

IF YOU are situated 30 to 40 miles from a large city and want to take advantage of high-quality FM broadcasts, you will probably find that a directive antenna must be attached to your FM tuner or receiver. The antenna described in this article can be constructed on a Saturday morning from a few short lengths of solid aluminum clothesline, some scrap lumber and enough 300-ohm twin lead for the lead-in and radiator. If all parts are purchased new, total cost should not exceed $1.50.

Dimensions of the antenna are shown in the drawing. Its frame is constructed with scrap 1" x 1" lumber and extends one inch beyond the end of the elements. Just staple or tack the 300-ohm line and the aluminum wire rods to the crossbar. Tape the connection between the lead-in and antenna to prevent weather damage to the connection. When completed, the antenna should be elevated as high as possible and the lead-in connected to the receiver.

A directive Yagi antenna (named after the designer) acts to receive stations best when "aimed" by pointing it at the FM transmitter. Aluminum length "A" is a reflector, while lengths "B," "C," and "D" are directors. Properly erected, the antenna has the effect of providing the tuner with a signal that appears to be five or six times as strong as that obtained with a simple dipole. —*Donald L. Stoner*



Construction details of the antenna. Note that antenna elements are stapled to 1" x 1" frame.

Telling Printed and Etched Circuits Apart

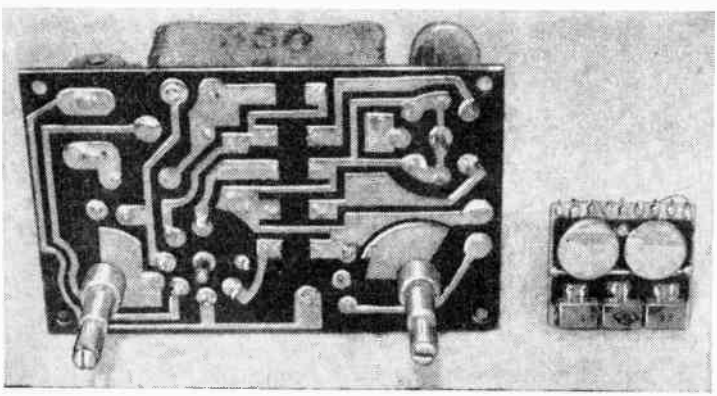
THE TERM "printed circuit" is almost universally used with all types of mechanically applied wiring. In practice, however, there are many types of printed circuits, each with its own method of manufacture and its individual electrical and mechanical characteristics.

In most commercially built equipment, two major types of printed circuits are employed—the "etched wiring board" and the "printed circuit plate."

The "etched wiring board" consists of a conductive foil bonded to an insulating board. Conventional electrical components (resistors and capacitors) are mounted on the board and soldered in place. This is the type of printed circuit you'll find in most TV and radio receivers.

The "printed circuit plate" is generally a ceramic plate or wafer on which a conducting pattern has been fired, with resistors and capacitors as an integral part of the circuit. Such plates are used for complete amplifiers in some instances, but more often are encountered as *RC* networks in TV receivers. In many cases, the complete plate will be covered by a molded plastic or wax coating and can be identified only by its type number or its multiple lead connections.

Both types of printed circuits are shown in the photograph. You'll find it worthwhile to be able to recognize the difference. The larger unit at the left is an "etched wiring phenolic board," the smaller a "printed circuit plate." Both are audio amplifiers—the larger a two-tube phonograph amplifier, the smaller a three-tube hearing-aid amplifier. The larger unit incorporates volume and tone controls right on the board, while the other one uses a separate volume control. A stethoscope using the latter method of printed circuitry is scheduled to appear in an early issue of POPULAR ELECTRONICS. —*E. G. Louis*



Transistor Topics

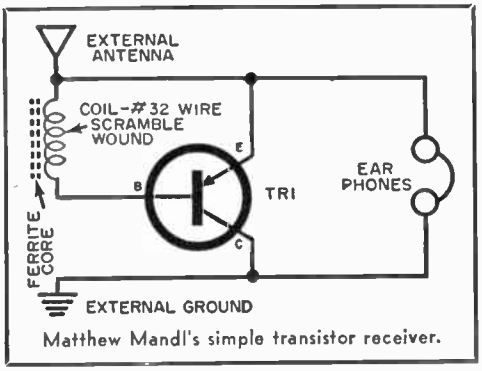
By LOU GARNER

THE SUNNY SUMMER MONTHS are upon us again . . . the time when a man thinks more of sitting in the shade with a long, cool drink than of chasing electrons with a hot soldering iron. But it's a good time to plan the projects you'll want to build this fall . . . and to start accumulating parts. And it's a good time to pull out your transistorized portable receiver and give it a good workout.

For some time I've been trying to dream up a good name for the transistor enthusiast . . . maybe you fellows can help me. As you know, many other electronics hobbyists have names which identify their fields of interest. Radio operators are *hams*, shortwave enthusiasts are *SWL's*, and the hi-fi boys are *audiophiles;* but there's no recognized name for the chaps who are interested in working with transistors. How does the name *transistor tinkerers* strike you? Or perhaps you can think of something better . . . let me know.

Readers' Circuits. This month's circuits have been suggested by two author-readers. Matthew Mandl of 120 Riverview Ave., Yardley, Pa., has sent us an extremely simple receiver circuit. You may recognize the name. . . . Matthew has published numerous articles in electronics magazines and has several books to his credit. The second circuit contributed this month was sent by Donald L. Stoner, P.O. Box 137, Ontario, Calif. Donald has published several pieces in POP'tronics.

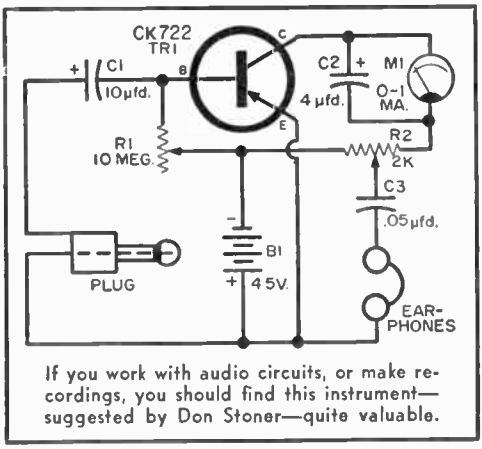
How Simple Can You Get? Matthew's receiver is about the simplest we've seen . . . it uses no capacitors, no resistors, no batteries . . . in fact, very little of anything except transistor, headphone, and tuning coil.



Matthew Mandl's simple transistor receiver.

As with most simple receivers, a good external antenna and ground system is needed. But you can use just about any junction transistor in the circuit, whether *n-p-n* or *p-n-p*. Typical types are the 2N107, CK722, 2N170, 2N47, GT-14, 2N34, 2N35 . . . or what have you?

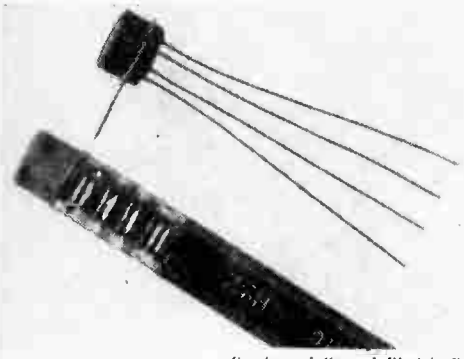
To eliminate the need for a tuning adjustment, the coil is wound to tune the strongest local station, using its own self-inductance and distributed capacity. Use a ferrite core (salvaged from an old coil) and "scramble wind" No. 32 enameled wire on it. The total number of turns needed will vary with the size and type of core, and with the station's frequency; so keep adding turns until you get the station you want. Afterwards, add five or six extra turns. Finally, "cut-and-try," removing a half-turn or so at a time until you peak the output.



If you work with audio circuits, or make recordings, you should find this instrument—suggested by Don Stoner—quite valuable.

According to Matthew, detection of the r.f. signal occurs in the base-emitter circuit of the transistor, with some of the rectified signal energy used in the emitter-collector circuit to provide amplification. He suggests the use of low-impedance headphones for best results.

Can anyone suggest a *simpler* receiver



Courtesy of General Electric Co.

Signal transistor package sponsored by the U. S. Air Force is compared in size to the eraser on the head of a standard wooden pencil. All new G.E. signal transistors announced at the 1956 National IRE Convention will use this package.

circuit than Matthew's? How about eliminating the tuning coil?

Headphone Adapter and Output Meter. An *output level* indicator is valuable for most types of audio work, and is almost a necessity when making recordings. If the recording level is not monitored, sections of the recording may vary from so soft as to be almost inaudible to so loud that "blasting" and distortion occur. On "playback," the operator has to fight a constant battle with the gain control.

Don Stoner has sent us a circuit of an interesting instrument which may be used as an accessory with tape or wire recorders. Using it, an operator can check the average recording level and, by adjusting the gain control of his recorder, can insure that different sections of a recording are made at the same average level . . . and even that different tapes match.

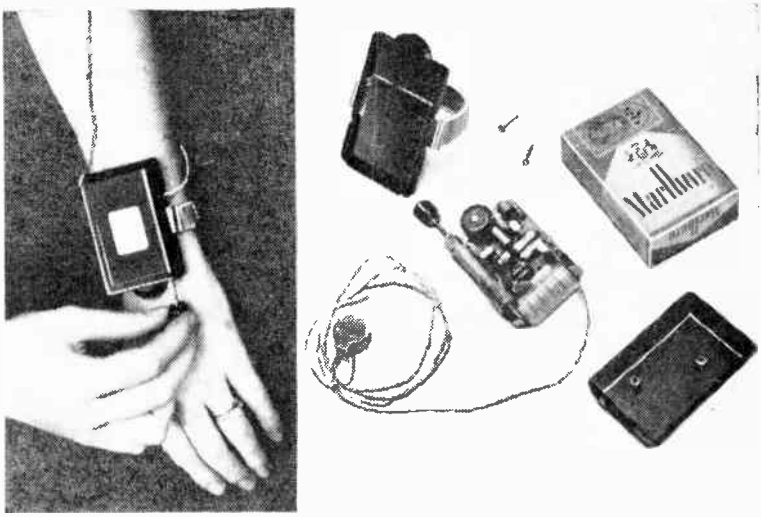
In Don's circuit the transistor serves three functions . . . it matches the low impedance of the recorder's output jack to the meter and headphone . . . it rectifies the signal, insuring an up-scale reading as output increases . . . and, finally, it provides gain. The instrument may be assembled in a small metal box. Three penlite cells, in series, serve as *B1*. Either high-impedance magnetic or crystal headphones can be used for monitoring.

To use the instrument, first set *R1* for a meter reading near zero. Plug into the monitor or output jack of your recorder. Speaking into the recorder's mike, adjust its gain control until overload occurs (usually indicated either by a flashing neon bulb or a "tuning eye"). Note *M1*'s reading at this point. This is the maximum allowable reading. The setting of *R2* will not affect the meter reading . . . this control is used only to set the earphone's volume. Finally, by adjusting the recorder's gain control to keep *M1*'s reading more or less constant, you can record at any desired level.

Shades of Dick Tracy! A famed prediction of the comic strips has at last come true in the form of a fully transistorized wrist radio, offered by LEL Sales Corporation, 380 Oak St., Copiague, L. I., N. Y. Although not a "two-way" radio, the tiny receiver will pick up stronger local broadcast stations with its built-in antenna . . . weaker stations with a 3" to 6" external antenna.

Using three transistors in a unique regenerative-reflex circuit, and featuring a

Three commercial transistor test instruments. At left is Lafayette's transistor checker which checks for opens, leakage, shorts, and current gain. In center is G.E.'s transistor tester; it comes in a package which includes five replacement transistors. Quantum's junction transistor analyzer is shown at the right. For details on all of these units, see page 116.



The transistorized wrist radio has finally arrived. Utilizing three transistors, this LEL receiver weighs only 2½ ounces. Note its size in comparison to the pack of cigarettes. Two models are currently available, one with an expansion band, the other with a pocket clip attached.

two-stage audio amplifier, the small receiver weighs only 2½ ounces, including its 6-volt mercury battery. Battery life is approximately 100 hours.

Two controls are provided, and operation is similar to that of any regenerative receiver. The regenerative control is set to a point just below the oscillation level, and the tuning control is used to select the desired station within the AM broadcast band. The usual regenerative "whistle" is missing when the receiver goes into oscillation, however, and in its place a low-frequency "putt-putt" sound is heard.

Two models are available . . . one with an expansion wrist band, the second with a clip for pocket use. The selling price is under thirty dollars, with distribution planned through regular distributor and retail outlets.

Transistor Brochure. Lafayette Radio, 100 Sixth Ave., New York 13, N. Y., has just issued a 32-page brochure every experimenter will want. It has circuit data, parts values, characteristics of commercial transistors, and one of the most complete listings of transistors, kits, and transistor components we've ever seen. *What's more, it's free* . . . just write them and ask for Catalog T4-56.

New Book. By the time you read this, your columnist's new *Transistor Circuit Handbook* should be available. This volume contains close to two hundred practical transistor circuits. About half are "basic" (one-stage) circuits, and the remainder are complete equipment circuits—including amplifiers, receivers, instruments, controls, and gadgets. Also included is data on techniques, testing, definitions, and a complete bibliography.

If you're interested, check with your local distributor or write to the publisher: Coyne Electrical School, Book Division, 1536 West Adams St., Chicago, Ill.

Tech News. General Electric has announced a whole series of new semiconductor products, including several new transistors, two new silicon rectifiers, and a double-based diode. Many of these items were shown at the IRE show in New York. The new transistors and the double-based diode are mounted in a redesigned package which is now under consideration of Joint Electron Tube Engineering Committees responsible for industry standardization.

Among the new transistors is a high-frequency *tetrode* produced by G.E.'s melt-back process. This unit may be used up to 50 mc. and higher, and is capable of dissipating 50 mw. at 25°C. Design center is for 40-50 mc. alpha cutoff frequency.

The double-based diode is especially interesting, being the first such unit of its type to be commercially available. Previously, these had only been made and used in laboratories. The double-based diode may be used as a trigger or "switch" and, in such applications, can replace two conventional transistors connected in a bistable circuit.

Marvelco is now offering a "tandem" transistor. Essentially two transistors in the same envelope, direct-coupled internally, this unit features a high input impedance, high gain, and a variable gain characteristic, analogous to variable-mu vacuum tubes. More on this later.

Price Cuts. General Electric has announced its third price reduction on transistors within the last 14 months. The latest price cuts range from 22 to 53% on five different types of high-frequency transistors used in portable and table model radios. This new price reduction should result in

(*Continued on page* 116)

Radio Stamps Make Rare Collection

Postal authorities throughout the world have marked the rise of radio in rare stamp issues

STAMP collecting has come a long way from the old-fashioned system of assembling stamps according to country and issue. "Topical collecting," a new trend in this ancient hobby, picks out stamps on a specific theme, such as flowers, horses, medicine, or what have you.

Herbert Rosen, whose business is radio and whose hobby is stamps, combines the two in a unique collection of stamps picturing nearly every aspect of electronic communications. Starting with the scientists whose discoveries cleared the way for modern electronics, his collection takes us right through the current spread of TV to various countries of the world.

Part of this collection has been published in a book titled *Radio Philatelia* (reviewed in our April, 1956, issue). Mr. Rosen kindly gave us permission to reproduce some of his rare stamps.

First transatlantic radio signal, broadcast from Cornwall, was received by Marconi at this tower overlooking the Newfoundland coast. Now a historic landmark, the tower was pictured in this memorial stamp issued in 1928. Spanning ocean by "wireless" gave rise to marine radio, ending ages of dreaded isolation for ships at sea.

The hundredth anniversary of electric communications in Turkey, from the first use of wire telegraphy (1855) to modern radio, is celebrated in this 1955 stamp (left, below). The French stamp at its right illustrates early military radio, showing the antenna of the desert fort Sebha in the African colonies.

Paris rooftops sprouted antennas when TV came to France. The Eiffel Tower, like the Empire State Building in New York, makes an ideal antenna mast for the city and its surroundings. With more than 800 lines, French TV boasts the world's best picture quality. The 1955 postage stamp (above, right) symbolizes TV signals radiating over Paris skyline. Guatemalan stamp (above, left) marks introduction of radio-telegraphy in South America.

Argentina's mail offers "spoken letters" recorded on discs. Special "Fonopostal" stamp is issued for this unique service.

With the outbreak of the Second World War in 1939, military radio suddenly burst into prominence. This special set of German stamps features pictorial motifs of ground-based army signal service. Note schematic of tuned circuit at lower right. Primitive antennas on stamps are a far cry from the highly advanced but then-secret designs actually used.

Of all the Oriental countries, Japan was the first to take a serious interest in Western science. Having introduced broadcasting as early as 1925, Japan celebrated the 25th anniversary of its radio service in 1950 by a special stamp issue contrasting an old-fashioned microphone with a recent model patterned after American designs. Japan's radio is noted for high-quality transmissions as well as excellent programs.

Hungarian stamp (above, left) pictures the unsung heroine of all electronics: the patient, unknown worker who assembles the equipment. Spanish stamp (above, right) marks 25th year of Radio Barcelona.

Italians took to television (right) with typical gusto when their network finally reached all the main regions. Transmitters were designed with special radiation patterns to jibe with heavy population areas. Stamp at far right shows Monaco, whose powerful radio station perches atop a mountain overlooking Monte Carlo and the sea. One of Europe's few commercial stations, it can be heard throughout the Mediterranean area and recently formed the hub of broadcasting activities connected with the wedding of Grace Kelly and the Prince of Monaco. TV service has now been added.

Emergency Traffic Control

EMERGENCY vehicles can automatically turn all traffic signals red while speeding through congested streets. It's done by means of an electronic device called "El-Tec." made by Standard Coil Products Co., Inc., Melrose Park, Ill. "El-Tec" activates traffic lights, turning them red in all four directions after a rapid flashing signal by the yellow caution light.

The small radio transmitter in the ambulance, police car or fire engine is operated by a single switch. A radio receiver is installed in each traffic signal control box, and several antennas—mounted on the vehicle's hood—radiate the beam three to four blocks in advance.

Tiny Receiver to Cover Conventions

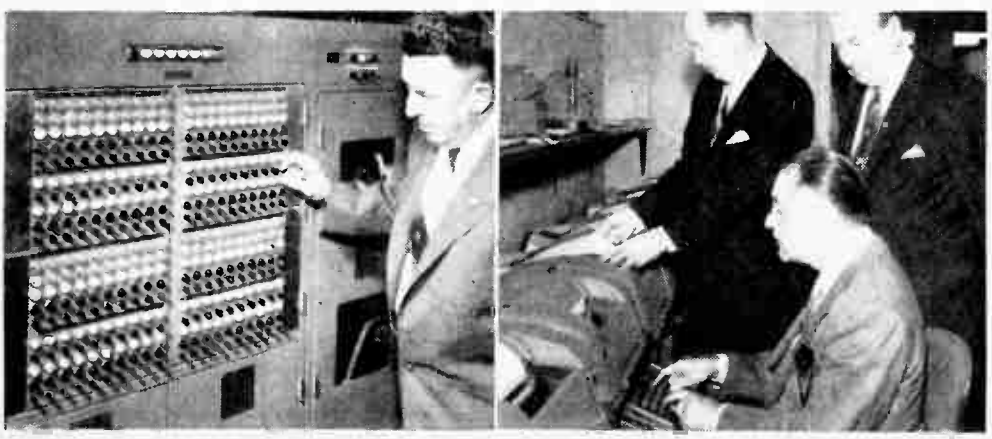
NOT ONLY will there be new Republican and Democratic delegates at the political conventions in August. Also present for the first time will be "Audipage"—a personal, transistorized receiver developed by Philco Corp., Philadelphia, Pa. Operating within the restrictions of a wire loop strung around the area, it will be used by the roving commentators at both presidential conventions, permitting them to receive instructions directly from control points without connecting wires or cables.

Complete with its tiny mercury storage battery, an Audipage weighs only an ounce and is about the size of a cigarette lighter. Sound, audible only to the wearer, is received through a small, flesh-colored earpiece.

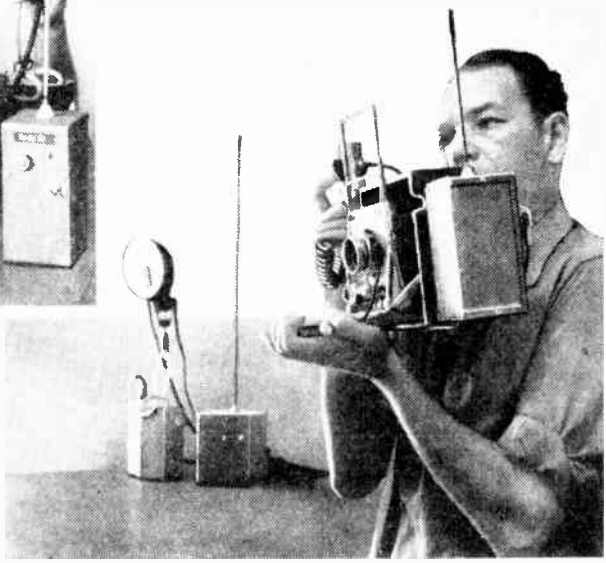
"Brain" Operates Wire System

IT'S A FAR CRY from the old-fashioned hand telegraph system that the brokerage firm of E. F. Hutton & Company once operated to its new automatic transcontinental wire system. Designed by Western Union to meet the needs of a brokerage business, it is run by an electronic brain which reads, deciphers and routes messages to their destinations in seconds, and is said to be the world's fastest private wire system.

In the photo at left, William E. Brown, communications manager of E. F. Hutton, looks over the electronic control panel at Los Angeles. The panel provides, at a glance, an instantaneous check on the condition of the entire system, coast to coast. At right, Ruloff E. Cutten, senior partner, flashes the first order from Los Angeles to New York.



R/C Slave Photoflash Tackles Football Parade



Complete outfit includes receiver, camera and transmitter. Lyle Byland, who developed units, looks at flash in top photo.

ALONE photographer stood in the center of Flagler Street in downtown Miami, Florida, that eventful night, waiting for the first section of the Orange Bowl parade to pass by. He carried a 4x5 camera with a single flash, obviously incapable of illuminating more than a small portion of the long procession. Clipped to the side of the camera was an aluminum box not much larger than a king-size pack of cigarettes, with what looked like some kind of antenna quivering from the top. But how could he expect to get good photos with just one flash?

Now the photographer was ready to snap his first picture. He peeked through the range finder for focus, then lined up the scene in his sports finder. As he pressed the trigger on the camera, a brilliant blast of light turned Flagler Street into day! Result: a noon-bright picture.

The 250,000-candlepower blast had exploded from atop a tall building on Flagler Street. Was it possible—without the usual maze of extension cords from the lights to the camera?

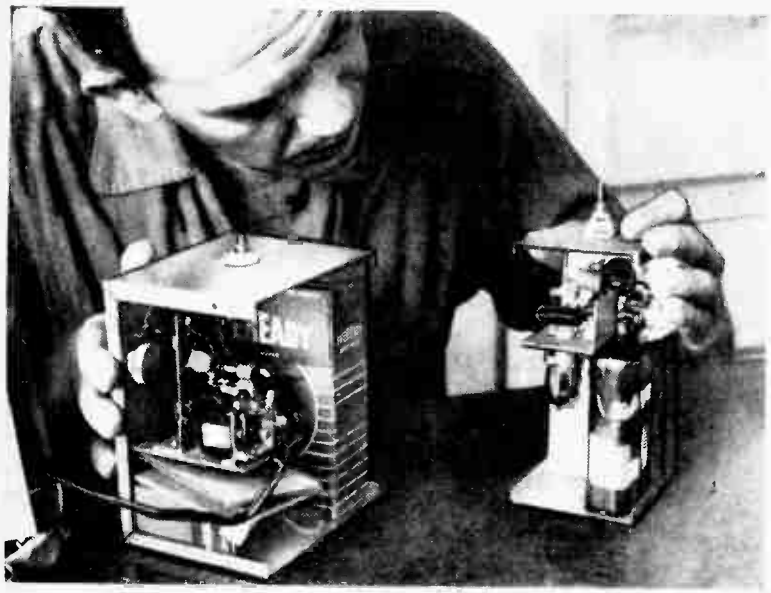
The Secret. That photographer was Lyle Byland of the Miami Herald. And the sudden flash of light which brought the parade into full sight climaxed two years of experimenting with and perfecting his "radio signal flash."

Actually, the "radio signal flash" is a single-tube miniature transmitter and receiver, crystal-controlled with a power supply from hearing-aid batteries, and operating on 27.255 mc. No license is required to operate such units, but the equipment itself must be licensed by the FCC (Form 505).

The small box attached to the camera was, of course, the miniature transmitter, which tripped off big electronic flash lights in coordination with the rapid camera shutter. It is mounted on the side of the camera, flash gun fashion, and is activated by the "X" shutter contact. The transmitter can be tuned to any number of receivers, each having its own "slave" light. The trick is to synchronize shutter and light.

Such a system would seem to be far superior to stringing wire between photoflashes or using some sort of photocell arrangement. With the more common system of "slave" lights used by photographers—each containing a photoelectric cell sensitive to light, any bright light could set off the slave flash, not necessarily that of the master flash on the photographer's camera. With Byland's system, the slave lights cannot possibly be flashed without a command from the master transmitter.

Some of you R/C readers may want to branch out into R/C photography. Why not try adapting the "Lorenz" R/C transmitter and receiver (described in the November



Looking into both units (small one is the transmitter) of the R/C slave photoflash system. Receiver and transmitter operate independently of connecting cords, and are topped by 24" antennas when in use. Transmitter mounts on camera, receiver on any photo slave light.

and December, 1954, issues of POPULAR ELECTRONICS) to do a similar photoflash job? The transmitter can be mounted on any type of camera with the "X" shutter contact and the receiver on any photo slave light. The perfect model would be effective for a range of about one-half mile from camera to light.

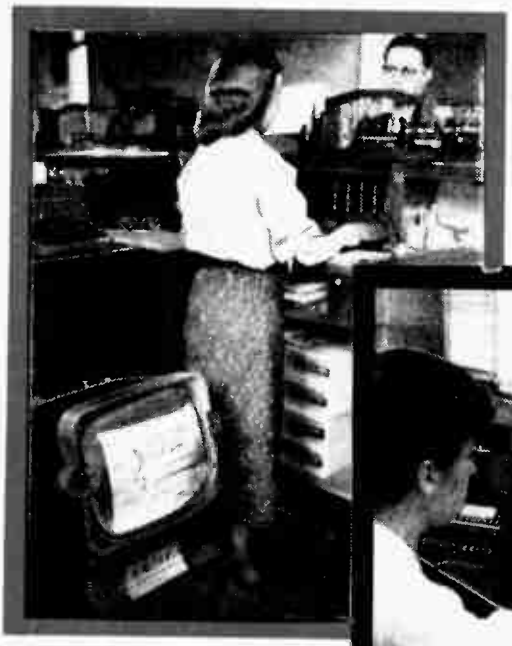
Other Events. In addition to lighting up night parades, excellent results have been obtained with the "radio signal flash" at other night events where extensive light is required. Following the unveiling of the system, Byland received inquiries from photographers all over the United States requesting that he build sets for them. Recently the Knight Newspapers adopted his units as standard photography equipment on their various publications.

During night football games, the lights are stationed in the upper tier of the Orange Bowl stadium on the 35-yard line, 375 feet from the center of the playing field. Again, with a lone camera and a little aluminum box hooked on the side, Byland sets off the 250,000-candlepower blast from the sidelines that lights up every corner of the huge stadium. —*Joe Edwards*

Safe Method for Testing Second-Hand Sensitive Meters

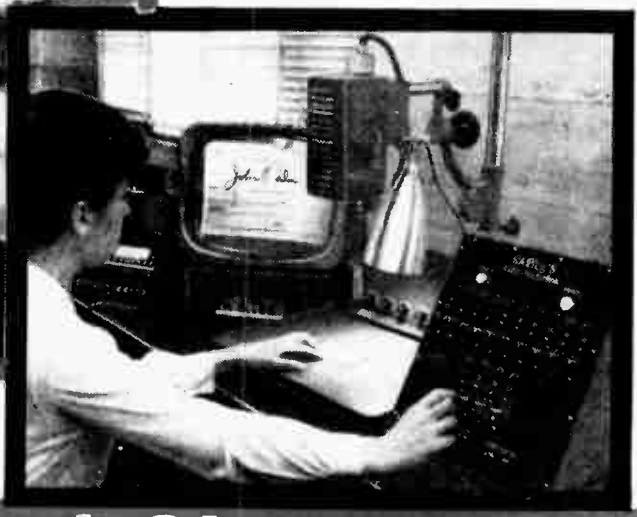
WHEN BUYING second-hand milliammeters and microammeters, it is a good idea to have a safe and simple method for testing the meter movements for burn outs and free movement of the needles. I find it a good plan to bring along a B2M "Sun Battery," or to borrow one from the dealer who is selling the meters. These selenium cells, when used singly, generate far less voltage than flashlight cells. And since the voltage can be varied from zero to about ½ volt simply by using it under different light conditions or by covering part of the sensitive surface with a finger, there is little danger of damaging a meter.

The photo shows a 0-1 milliammeter being tested under a desk lamp containing a 60-watt bulb. Less sensitive meters can be tested under brighter lamps, or in direct sunlight; more sensitive meters can be tested farther away from the lamp, or in ordinary room light, or with pocket flashlights, etc. Further control of the sun battery's output can be had by simply covering a part of its sensitive surface with a finger. The two color-coded leads on the sun battery are handy for quick and correct connections to the meter.—*Arthur Trauffer*



Seeing is believing when bank teller checks customer's signature with master copy flashed across television screen. Using this system, a teller at any cage can serve any customer. TV setup has speeded operations by 20% over former method where teller had to hunt through files for original signature.

By JOHN A. NORMAN



Clerk in bookkeeping department (right) has access to all cards bearing customers' signatures; she selects one called for by teller.

Closed-Circuit TV— New Communications Tool

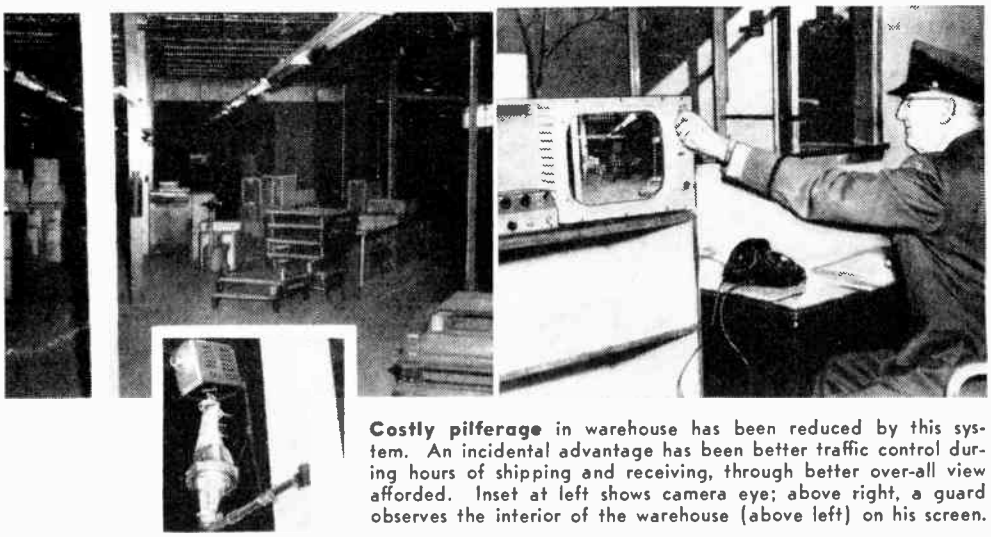
THERE'S MORE on the video screen these days than the antics of antiquated alligators or the bubbling of bucolic biographers! Aside from its widespread and inevitable use in the field of entertainment(?), television is more and more coming into its own as a super-tool in business, industry, education, and religion.

It's not the kind of tool that drills holes or rivets steel girders, but it enables scenes to be viewed by people who otherwise would not have access to what is going on. As a "communication tool," it brings the machine shop into the executive's office; it stands guard over exposed stretches of valuable property; it provides scores of physicians with a simultaneous close-up view of critical surgery.

Known as "closed-circuit television," this type of TV uses transmission lines (not air waves) to carry pictures from a camera via a control unit directly into the receiver. No transmitter is involved. In many applications, the control unit is built into the camera to make for compactness. Usually, several different receivers are operated from one camera. Signal strength to run additional receivers is obtained by the use of line amplifiers which boost signals coming from the control unit. In many applications, a public address system is used in conjunction with the video system. Sensitive microphones pick up sounds which, together with the transmitted pictures, provide complete coverage of a scene. Two-way voice systems are used when needed.

Business. Acting as an extension of human vision, a TV camera has cut pilferage in the Needham, Mass., warehouse of Filene's, a large Boston department store. As shown on page 68, TV cameras are hung high at strategic spots from which they overlook the entire receiving and storage area. Seated in his office, a guard can point the cameras in any direction by remote control. In this way, he watches entrances, exits, and even remote bins—all presented clearly on the screen of his receiver.

The "eyes of Texas" have also been im-



Costly pilferage in warehouse has been reduced by this system. An incidental advantage has been better traffic control during hours of shipping and receiving, through better over-all view afforded. Inset at left shows camera eye; above right, a guard observes the interior of the warehouse (above left) on his screen.

proved by this type of TV. At the Texas National Bank in Houston, for example, the video system has speeded up operations and reduced the number of cumbersome files from four to one. By using TV, the bank has successfully avoided duplication of more than 17,000 signature cards four times—one for each teller. This system provides a video hookup between the main bookkeeping department and the new drive-in branch two blocks away. When a customer presents a withdrawal check at the drive-in bank, the teller asks the bookkeeping department in the main building two blocks away for the signature card kept in the files. The customer's signature is transmitted from the main bank and appears on the TV screen viewed by the teller at the branch.

A similar system has been put into operation at Chicago's National Bank of Hyde Park. Using standard home-type TV receivers, slightly modified, this setup provides tellers with a view of customers' signatures and other data as needed. Details of this installation were handled by Havill's Radio, 1461 E. 55th Street, Chicago.

Industry. A closed-circuit TV system is credited with having cut waste and increased efficiency at the Great Lakes Steel Corporation's No. 3 Slabbing Mill in Detroit. This video setup solves a problem common to steel mill production—that of obtaining "maximum cut lengths" when shearing red-hot slabs.

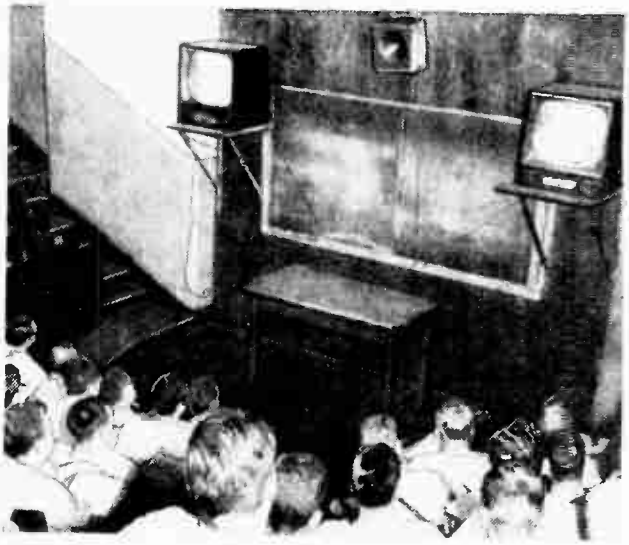
Shearmen in the mill must make two cuts in the hot slabs coming down the line. To make these cuts accurately, the men must know how long the slabs are to begin with. A scale in front of the shearman shows him how long his first cut will be. But even by using an elaborate set of mirrors, he could never be sure of the length of the entire slab. Consequently, he had no positive way to get maximum length from his last cut.

This problem was solved by the TV rig. The camera, mounted in a critical spot, focuses on the scale and transmits the image to the receiver which is installed next to the shearman. As a hot slab comes down the line, the shearman can see a close-up of the scale on his TV screen. The red-hot glow from the slab illuminates the scale and helps brighten the transmitted picture.

The shearmen in this mill report that the closed-circuit TV has practically eliminated waste in cutting by providing an accuracy previously unobtainable. What's more, their job has been made easier and safer, since the men can remain in the control booth instead of frequently scampering up and down to inspect each slab personally.

Education. As an audio-visual aid in schools, the closed-circuit system has no equal for meeting classroom needs. One system, known as "DAVITS" (Dage Audio-Visual Integrated Television System), sends complete video and audio programs from a central point to wherever they are needed throughout the school. Laboratory demonstrations, lectures, film programs, etc., can be seen simultaneously by any number of students. In addition, important broadcast TV programs can be made available over the system. "Room assemblies" for special events are also possible without the need for everyone converging in one large, central auditorium.

All of the installations described so far (except for the one in the Chicago bank) are the work of the Dage Television Divi-

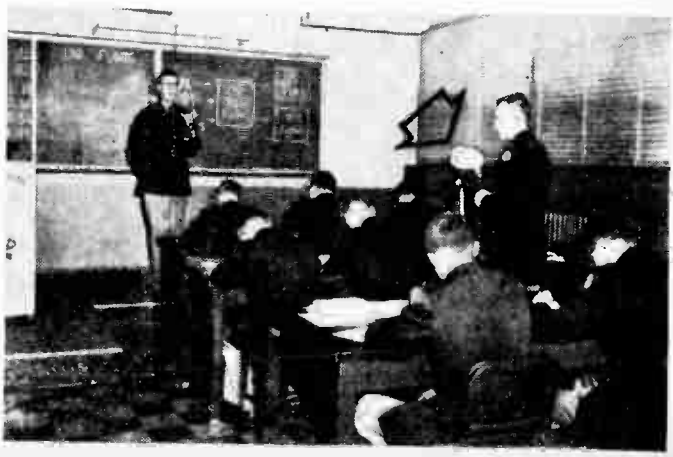


Lecture-demonstration (left) in operative dentistry at Loyola University's School of Dentistry in Chicago is given by teacher from small TV studio in room adjacent to this large amphitheatre. With TV close-ups seen on two large-screen monitors, the entire class of 94 students gets intimate view of teacher's operative technique. This eliminates previous method in which only 5 or 6 students at a time clustered about teacher, who was then required to repeat same demonstration several times for other groups.

Students (above) are watching the work of the professor (right) as he demonstrates dental technique. Monitor screen shows picture as seen by students.

sion of Thompson Products, Inc., Michigan City, Indiana. Although one of the leaders in the field, this company is not the only one engaged in such work, however. General Precision Laboratory, of Pleasantville, N. Y., recently set up a closed-circuit TV system for the Army Signal School at Fort Monmouth, N. J. Using this rig, one instructor is able to conduct three classes, in different rooms, at the same time. As a supplement to the video system, a two-way audio system was set up which permits voice communication between the instructor and any student.

Another noteworthy installation by General Precision is the system used at the Nebraska Psychiatric Institute, Omaha. This rig shows advanced students actual treatment of patients. By watching the ex-



Classroom session in the Signal Officers' Basic Course at Fort Monmouth, N. J., was televised "live" to two other classrooms in the same school by means of a portable 5-pound TV camera. Arrow points to camera which picked up action. Sound was carried by public address system to other classrooms. Equipment provided by General Precision Laboratory of Pleasantville, N. Y., was used in this demonstration of combining "three classrooms in one."

Many community activities are enjoying wider audience participation as a direct result of closed-circuit television setups. The equipment in the photo at left is part of the rig used at the Calvary Baptist Church in Lexington, Ky., to carry services to overflow crowds in a chapel adjoining the main auditorium. Twelve-inch monitor is used to tune the system.

perts at work, prospective specialists can be trained more thoroughly and in less time.

Also used for teaching, but pointing the way to wider use in professional applications, is the installation at the School of Dentistry of Loyola University in Chicago. Another Dage system, this one is an elaborate and complex setup which transmits video and sound from seven different rooms in the building to key assembly points throughout the school. An operation in an amphitheatre, an experiment in a laboratory, or a discussion in a seminar room can readily be transmitted to enough different parts of the school to permit nearly all students to witness the event at close-up range. Before the advent of the TV system, an instructor might have to repeat a demonstration as many as 20 times until all the students in the class would have seen it. Now, he runs through it once. As much as three weeks' time can be saved this way for each instructor on a single project.

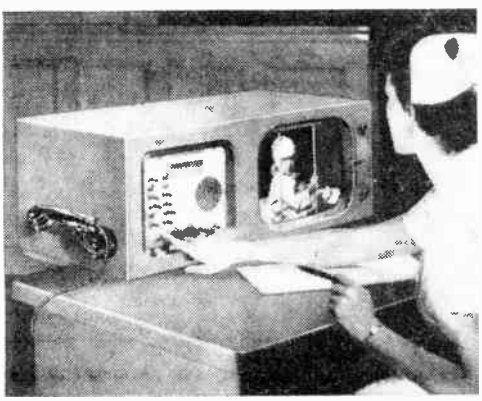
Religion. A boon for communities whose existing space facilities are inadequate to handle increasing audiences, the closed-circuit TV system is also finding its way into churches. For example, the Calvary Baptist Church, in Lexington, Ky., found it had developed a serious lack of seating space in its auditorium. Rather than turn people away, or get involved in the problems and inconveniences of two Sunday services, the church installed a compact Dage system.

The camera was installed in the rear of the auditorium, and receivers placed in the chapel and nearby classroom. A wide-angle lens on the camera covers the church choir and pulpit, while a telephoto lens is used for close-ups of the pastor. Voice transmission is handled by a p.a. system. Church officials report that the new system makes people sitting in rooms other than the church auditorium feel that they are really part of the services.

Recent Improvements. Latest developments include remote control systems for the camera and a built-in "memory" system. The former enables the camera to be set up in hazardous locations. All functions, including changing of lenses, are controlled by a knob on a console located elsewhere. The "memory" feature permits the camera to be preset for different lens angles, and is activated by a push-button control on the console.

The extent to which closed-circuit TV has advanced is indicated by a recent RCA installation made at the pharmaceutical firm of Smith, Kline, and French in Philadelphia. This system shows dramatically and graphically the action and effects of various drugs being tested on living organisms. Fluoroscope images of the insides of animals are picked up by the TV camera and viewed conveniently on receivers by laboratory personnel.

Uses of closed-circuit TV appear to be almost limitless. The increased attention it is receiving from such major firms as RCA might well indicate its coming importance in the fields which have been mentioned in this article. -30-



Nurse tunes in on one of several hospital rooms under her care. Screen shows pictures of all that goes on in areas for which she is responsible. This Sperti Faraday "Visicall" system includes a small loudspeaker (to left of screen) by means of which nurse can talk privately to any one patient.

Coils for magnetic heads must be wound with precision accuracy. A minimum of 1000 coils per day may be wound on each of these machines. Erase coils are wound with 1000 turns of fine wire and record coils use 2000 turns. Automatic counters maintain winding accuracy for all three bobbins. Coils, when wound, are fitted to heads to provide required magnetic field for recording, erase, and playback of tape.

Tape Recorders Take Time

THE manufacture of tape recorders involves many people using different types of equipment to perform a multitude of tasks. But mostly, it takes time—time to work out design details, time to machine special dies and jigs, time to drill and tap and slot, time to wind coils requiring thousands of turns, time to punch chassis, time to wire parts, time to assemble, and time to test.

A tape recorder, like any electronic product, is born in the engineering laboratory. Here, ideas are argued, parts researched, and techniques evolved. Once a final design is agreed on, the orders go out and arouse a vast industrial world to life.

Precision parts for the new product as well as for use in making other parts in the machine shop are produced in the tool shop. Delicate head assemblies must be precision-made.

A plant in which two main lines of products are made, such as at Pentron in Chicago, operates two distinct production systems—one for turning out its popular-priced "all-in-one" tape recorder, the other for producing the higher priced "professional" recorders.

Inspection and testing is a twin-headed problem, involving checks of both mechanical and electronic parts and subassemblies. Tape recorders, more than any other type of equipment, depend on high quality in both areas for their successful operation.

"Behind-the-scenes" highlights are shown in the photos. —30—

These product on lines concentrate on assembling mechanical parts of Pentron recorders. Other lines wire in electronic components. At selected intervals in both lines, testers inspect partially finished chassis and subassemblies. Due to increase in production, this company invested an additional $25,000 in quality control equipment and personnel last year.

Recorder undergoes rigid performance tests before final okay. Here, technician runs checks on Dynacord "professional" recorder. Instruments used include impedance bridge, wow meter, distortion analyzer, oscilloscope, audio oscillator, a.c. vacuum-tube voltmeter, audio amplifier, d.c. voltmeter. Only units which pass all tests are tagged acceptable.

Sea-Going "Scan-A-Graver" Livens Shipboard Newspapers

First shipboard installation of "Scan-A-Graver" has been made on Italian liner "Cristoforo Colombo." Capt. C. Pinotti inspects machine and its results.

OCEAN voyagers need no longer feel "at sea" about the latest happenings on shore. Thanks to the Fairchild "Scan-A-Graver," spot news photos taken on land can be reproduced in shipboard newspapers and seen by passengers no later than they are seen by readers ashore.

The "Scan-A-Graver" makes halftone engraving plates from photos received by the ship's radio-photo equipment. It may also be used with any glossy photo.

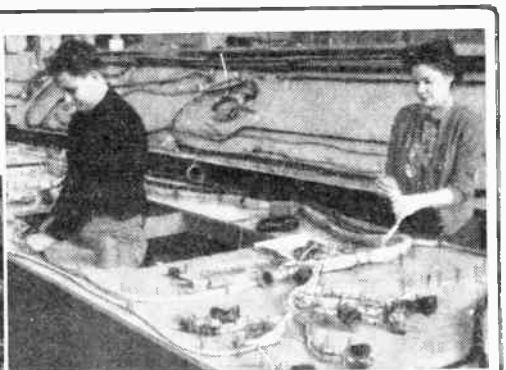
Two rotating cylinders are the main feature of this device. The photo to be reproduced is placed on one; a special plastic sheet known as a "scanner plate" is wrapped around the other. As the photo cylinder rotates, light reflections from the picture are picked up by a photocell and converted to electrical energy. This signal, whose amplitude varies in proportion to the relative darkness and brightness of the photo, is fed to a 75-watt amplifier. The amplifier's output then modulates the vibrations of a stylus which cuts into the plastic on the scanner plate. The stronger the signal the deeper the cut.

The stylus is set in motion by a motor. Its number of vibrations per second determines the "screen value" of the engraving. For example, stylus vibration of 400 times per second produces a number 85 screen (85 dots per linear inch). This happens to be the type of plate used for the photos in POPULAR ELECTRONICS.

A plate made on the "Scan-A-Graver" is ready for the press in a matter of minutes. Picture quality compares favorably with that of conventionally made plates.

The amplifier produces its high power by operating class AB_2 with four type 6BG6 tubes in push-pull parallel. The dark-and-light contrast ratio provided is more than enough to etch the plastic plate; suitable electronic circuitry is employed to reduce this contrast ratio to the level required for proper operation.

JOB-TITLES IN THE AGE OF ELECTRONICS, or "What's In a Name?" Department: Grandfather might be confused at the equipment used in today's industry, but he'd recognize the names of the jobs still in vogue—not that the names would clarify anything for him. The gentleman



at the left is a "potter" at the Martin aviation plant in Baltimore; his "potting" consists of encasing wires and plugs in an airtight seal for critical installations on aircraft. The couple above are "harness-makers"—they make one neat cluster out of many cables. Clear?

Anyone can shoot movies with this camera. "Electric eye" sets lens at proper exposure and continues to open or close the lens iris as changing light requires. It takes the hard work out of photography.

Movie Camera's "Electric Eye" Automatically Sets Lens

THAT "scene you couldn't shoot" would have been a cinch with this camera. All the photographer has to do is focus the camera and press the shutter slide—an "electric eye" automatically sets the lens for perfectly exposed pictures.

Fully automatic, this is a 16-mm. magazine camera which has just been introduced by Bell & Howell of Chicago. Known as the Model 200-EE, it operates on the same general principle as the human eye. Its photoelectric cell with a thermistor balancing circuit opens and closes the lens iris to adjust to varying indoor and outdoor light intensities. Like the human eye, the iris of the lens contracts in bright light, dilates as the light decreases.

The camera sets the lens at the proper exposure by means of a battery-operated motor, controlled by the photoelectric cell. Current is supplied by six tiny mercury batteries. As light strikes the photoelectric cell, it activates a bridge circuit, which in turn controls the rotation and direction of the motor. The motor, through a gear train, opens and closes the lens.

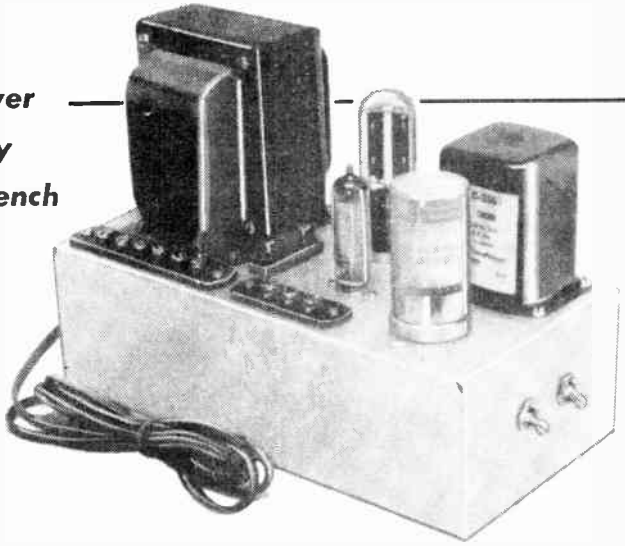
Probably the most difficult situation in motion picture photography for the amateur—panning from a sunlit area to a shadow area—is no problem at all with this camera. Faced with changing exposures in a continuous scene, you might be accustomed to set your lens midway between the lightest and darkest areas, with the result that some frames would be underexposed and some overexposed. Or you might interrupt the scene to reset the lens. With the 200-EE, the lens automatically sets itself at the beginning of the sequence. As you pan the camera, the lens adjusts itself as it goes along.

For most situations, the photographer's exposure meter is unnecessary. A warning flag in the viewfinder signals when the light is not sufficient for good movies. If you want to under- or overexpose a scene for special effects, the photoelectric cell can be deactivated. The automatic control system means greater freedom of movement and consistently good exposures.

Children at play may run from sunshine to shade. At a baseball game, the batter may be shadowed by the grandstand while first base is bathed in sunlight. A swimmer may emerge from the water and head for a beach umbrella. As the camera follows the action, automatically accommodating itself to the changing light conditions, it simultaneously solves the trickiest problem of movie making. —30—

Good voltage regulation is built into a simple power supply that is specifically designed for your test bench

By FRANK H. TOOKER



This rugged bench-type supply has two fixed voltage ranges. It will give good regulation over a wide range of currents, and will handle most design and experimental jobs. Note simplicity of construction in the under-chassis view at right.

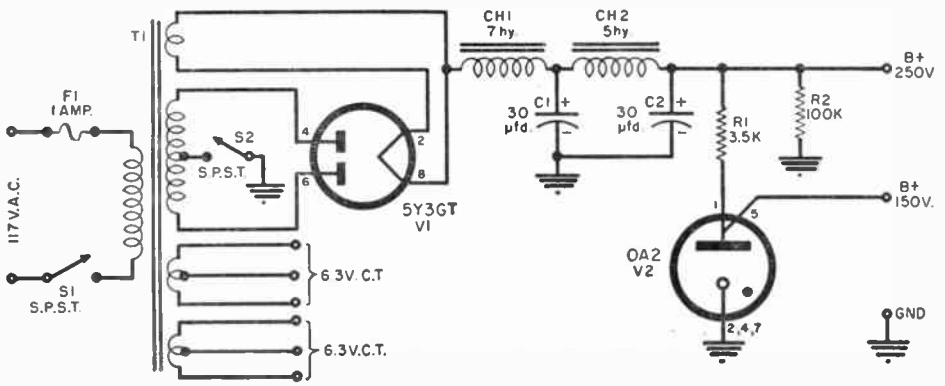
ONE of the most useful tools an electronics experimenter can have is a good, dependable power supply. The supply described in this article contains several innovations which are not immediately obvious at a casual glance.

First, consider the matter of regulation. We don't want our B voltage to soar up to 400 or 450 volts when we're drawing little current, and drop down around 250 volts when we're drawing 100 milliamperes. We want it to stay around 250, and we'd like it to stay there without too much variation.

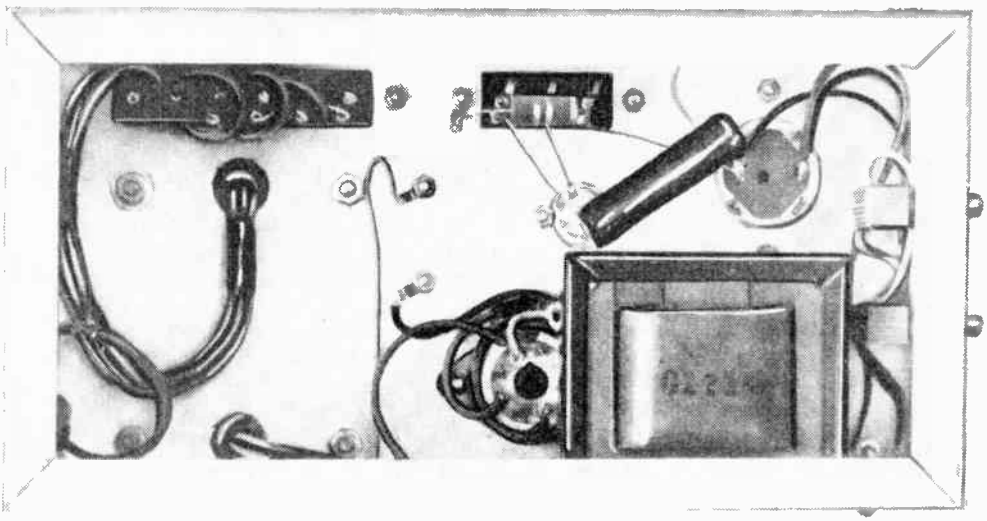
A power transformer that will handle our requirements without getting red in the face is one necessity for good regulation. For average work, we won't be drawing over 100 milliamperes of high voltage. There are several good, easily available transformers which will fit the bill. The author chose a Thordarson 22R32—its high-

Parts list and wiring diagram for the power supply. A minimum number of parts is necessary.

C1, C2—30/30 μfd., 450-volt dual electrolytic capacitor
CH1—7-henry, 150-ma. filter choke (Stancor C-1710)
CH2—5-henry, 100-ma. filter choke (Stancor C-2305)
F1—1-amp., 250-volt fuse
R1—3500-ohm, 20-watt wire-wound resistor
R2—100,000-ohm, 2-watt composition resistor
S1, S2—S.p.s.t. toggle switch
T1—Power transformer, 350-0-350 volts at 110 ma., 5 volts at 2 amp., 6.3 volts at 3 amp. (Thordarson 722R32 or equivalent)
V1—Type 5Y3GT rectifier tube
V2—Type 0A2 voltage regulator tube
1—6-terminal screw-type heavy-duty terminal strip
1—3-terminal screw-type heavy-duty terminal strip
1—5" x 10" x 3" chassis
1—Octal socket
1—7-pin miniature socket
1—Fuse holder
1—Line cord and plug
Misc. hardware, rubber grommets, wire, solder, etc.



An Experimenter's Handy Power Supply



voltage specifications are exactly what we're looking for, and it has two 6.3-volt heater windings instead of the usual one. Two separate heater windings are useful in isolating two tubes in an experimental set-up. In addition, we can connect the two windings in series to get power for the heaters of 12.6-volt tubes. The rating of 3 amperes per winding will handle almost anything we'll have to work with.

In the supply shown in the photos, the leads from the two windings are brought out to a heavy-duty 6-terminal strip near the power transformer. For maximum convenience, the windings are phased so that connecting a jumper wire across the two center terminals will give us 12.6 volts across the two outside terminals.

Our next item of concern is the filter. A capacitor-input filter is notorious, regulationwise, so we'll use a choke-input filter. However, this filter won't keep the d.c. output voltage from soaring up to the peak voltage rating of the high-voltage winding of the transformer unless there is a certain minimum load always connected across the output. A wire-wound power resistor could do the job, but it may run too hot to be located inside the chassis.

The way to get a good load resistance and a well-regulated tap on the B-voltage output at the same time is to install a voltage regulator tube. Since most experimental setups require either 250 volts or 150 volts, an OA2 was selected to make the tube draw a full 30 milliamperes at no load. Not only does it keep a good minimum load on the supply—so that the output doesn't go much above 250 volts with nothing else connected—but it looks neat, gives us 150 volts well-regulated at up to 25 milliamperes, and we can easily pull it out of its socket when we want to draw 100 milliamperes or so at 150 volts.

Note that the dropping resistor, *R1*, is connected to pin 1 of the OA2 and that the "B+ 150V." output terminal is connected to pin 5. The circuit is completed through a jumper from pin 1 to pin 5 *inside the tube*. When the tube is removed from its socket, the circuit is automatically broken, and the "B+ 150V." terminal is left floating, i.e., completely disconnected.

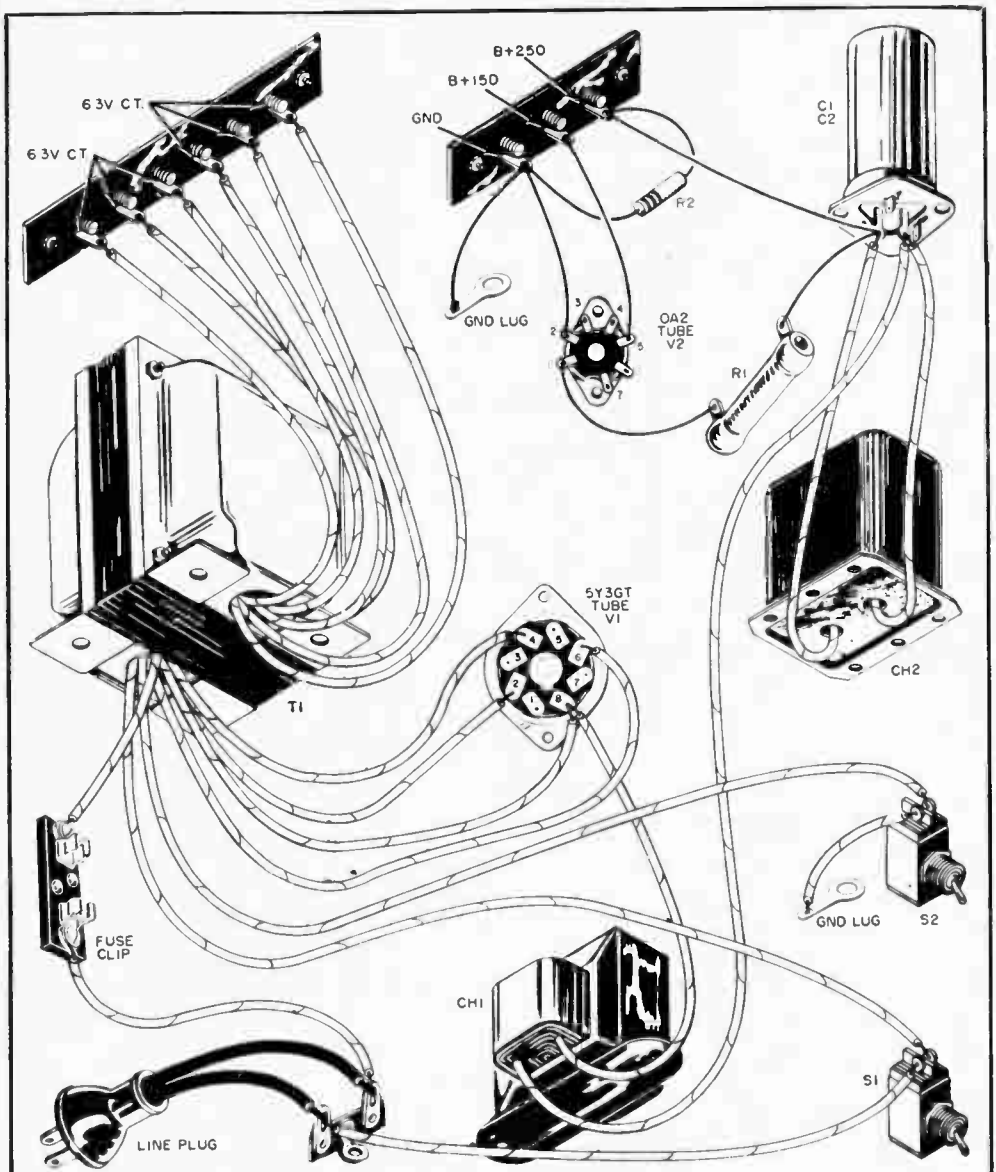
The one remaining feature is the fuse in

HOW IT WORKS

This is a full-wave rectifier capable of producing 250-volts d.c. output at a current drain of about 100 ma. All components have been especially selected for their current-handling capacities. The circuit includes a choke input filter, i.e., the high voltage (unfiltered d.c.) taken from pin 8 of the rectifier tube is fed directly into choke *CH1*. Reactance of this choke helps in maintaining voltage regulation. The remaining filter (*C1*, *C2*, and *CH2*) is standard for power supplies of this type.

Resistor *R2* is used solely to "bleed" off the charge impressed on the filter capacitors. This is a safety measure. Resistor *R1* drops the high voltage to a level that can be handled and regulated by *V2*. A voltage picked off the junction of *V2* and *R1* will be 150 volts, and will remain regulated at this level for current drains of from 1 to 25 ma.

Two filament windings are provided by the power transformer. They may be wired (externally across the terminal strip) in series and render an output of 12.6 volts at 3 amps. for circuits that require this heater voltage.



Pictorial diagram of the experimenter's power supply shows interconnection of parts.

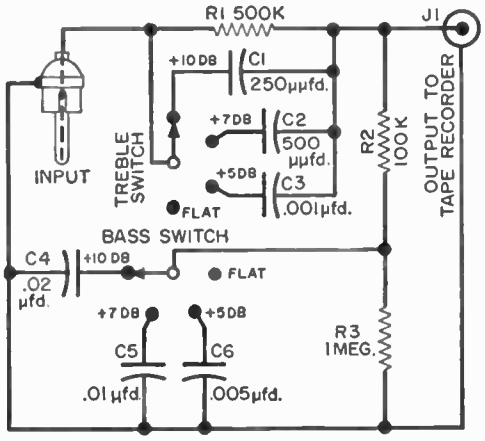
the line side of the power transformer. No matter how careful you are, you will sooner or later make a mistake in your wiring or otherwise accidentally short-circuit either a heater or a B+ line—it's easy when you're working with haywire experimental circuits. So don't leave out the fuse. A fuse is much cheaper to replace than a transformer or a rectifier tube would be, and it will safeguard the equipment.

Construction is so simple that there is little to be said concerning it. The chassis size given in the parts list is ideal for the components I have described. Obviously, if bigger or smaller components are used, the chassis size will need to be varied accordingly.

Holes are drilled through the chassis top for the tube sockets, transformer and choke leads, and for the two terminal strips. I mounted the toggle switches at the end of the chassis, but they could have been mounted just as well on top or on one of the other sides. The fuse clip is mounted under the chassis, although some constructors may want to buy a fuse cartridge and use that instead. —30—

Tone Compensator for Your Tape Recorder

ALTHOUGH most tape recorders are properly compensated, many of us would like to have some control over the amount of bass or treble that goes on the tape. When recording, the frequency response is fixed and varying the tone controls has no effect. In dubbing records that are a little scratchy, it is handy to be able to cut the highs off. When dubbing records that are not scratchy, but lack the highs, the tone compensator will bring out the highs. For those who like lots of bass, this unit will boost the bass notes about 10 db—a level greater than this might possibly overload the tape recorder amplifier.



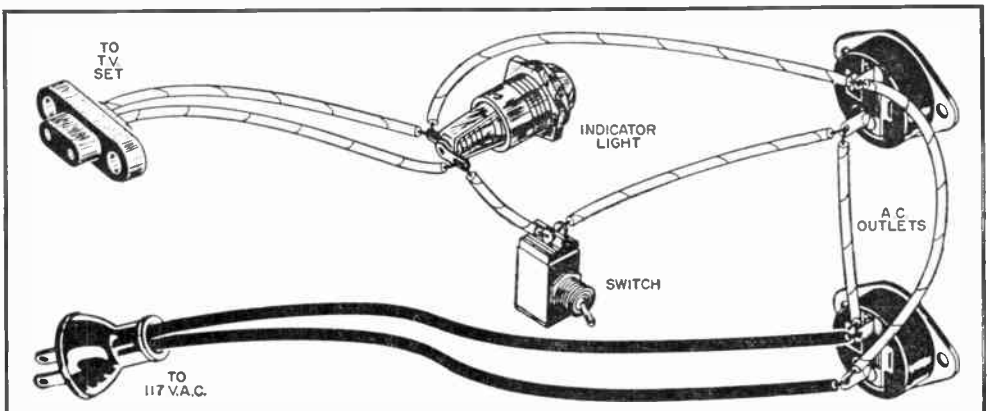
The compensator has separate bass and treble switches, as shown in the schematic diagram. All components and the two s.p. 4-t. switches can be mounted in an aluminum box of convenient size. It could be incorporated on the amplifier chassis if desired—the circuit is in no way critical. The source of audio is connected to the input connector and the compensated audio is connected to the tape recorder through a length of shielded cable. It is advisable to keep this cable short to eliminate loss of the highs. After the unit is connected, adjust the switches until the most pleasing sound is obtained. As a check, a recording should be made and then played back and compared to the original sound. —*Donald L. Stoner*

TV Cheater Cord and Outlet Assembly

A VERY WORTHWHILE project for a radio-TV serviceman, experimenter, or radio amateur is a combination TV cheater cord and dual a.c. outlet assembly.

After the TV repairman removes the back from the television set, he puts the a.c. plug in the wall outlet and the TV plug into the set. He can plug a trouble light into one a.c. receptacle, and a soldering iron or v.t.v.m. into the other outlet. He can turn the television set off and on with the toggle switch, and the indicating light will tell him whether the set is on or not.

I built my combination cheater and outlet in a small aluminum box measuring 1⅝" x 2⅛" x 2¾". The a.c. receptacles are mounted on the top of the box, while the s.p.s.t switch and neon indicator light are on one end. Both a.c. cords pass through a grommeted hole at the other end of the aluminum box. —*James Fred*



The outlet assembly shown in this pictorial diagram can be installed in any standard aluminum box. Mount the a.c. outlets on top of the box, and the pilot light and switch at one end. The cord to the television set should be about three or four feet in length.

THE TRANSMITTING TOWER

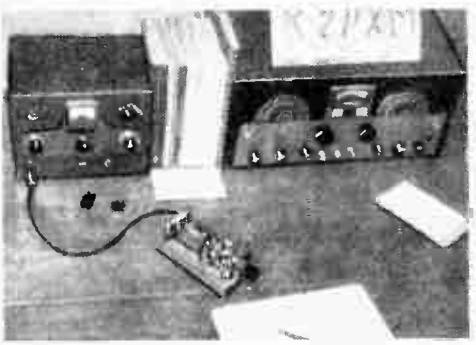
Herb S. Brier, W9EGQ

THE BASIC DIFFERENCE between a broadcast type short-wave receiver and an amateur "communications" receiver is that the latter has provisions for receiving c.w. code as well as phone signals. It also has many specialized features and controls to aid it in bringing in amateur signals under the most difficult conditions. Tuning one for best results is a real art.

A two- or three-tube regenerative receiver will bring in amateur signals fairly well, but the ability of its single tuned circuit to separate stations is so poor that a single strong signal will occupy an entire Novice band. A superheterodyne receiver is much to be preferred. Besides being much more selective, it is more sensitive, more stable, and easier to tune. Our discussion will be limited to that type.

In a superheterodyne, all incoming signals are converted to a single lower frequency, usually around 455 kc., and go through an amplifier tuned to this frequency before being detected and fed to the audio amplifier.

The advantage of this arrangement is that the lower the resonant frequency of a tuned circuit the more selective it is. For example, a 455-kc. tuned circuit may be over eight times as selective as one tuned to 3700 kc. Also, because this *intermediate-frequency* (i.f.) amplifier is fixed-tuned, it is practical to incorporate several double-tuned circuits and tubes in it to obtain high selectivity and high amplification. In fact, to obtain still higher selectivity and other operating advantages, some *double-conversion* communications superhets put incoming signals through two i.f. amplifiers, one around 1600-2000 kc., and the other around 100 kc.



KN2PXM (Dave Laird) explains apologetically on page 117 that his "poor" record of working England, France, and Switzerland with the station equipment shown above may be due to the fact that he uses his 80-meter doublet on 15 meters! W9EGQ could work nothing on 15 with his 80-meter doublet.

From the i.f. amplifier, the signal goes to a second detector, which extracts the intelligence from it and delivers it to the audio amplifier. The second detector also develops an automatic-volume-control (a.v.c.) voltage which varies the receiver amplification in inverse proportion to the strength of the received signal: strong signal, low amplification; weak signal, high amplification. Thus, the receiver output volume is held relatively constant as signals of different strengths are received.

The a.v.c. voltage also controls the receiver "S"-meter, which permits measuring the relative strengths of received phone signals.

For code reception, a beat-frequency oscillator (b.f.o.) tuned to a frequency a few hundred cycles different from the intermediate frequency is coupled to the second detector, to produce an audible tone in the speaker or phones. As will be explained later, the b.f.o. is also used for receiving single-sideband (SSB) signals.

Using a Communications Receiver. If the receiver covers the broadcast band, turn its *band selector* to that band, as the signals there do not constantly pop on and off the air as they do in the amateur bands. Otherwise, set selector switch to the lowest frequency band the receiver covers.

Turn the b.f.o. switch off, the a.v.c. switch on. Set the *bandspread* dial to 100 (capacitor plates unmeshed) and the *antenna trimmer* to about half scale. Advance the *r.f. gain* (*sensitivity*) control full on and adjust the audio *volume* control for the desired speaker volume.

Slowly tune across the band with the *main tuning* dial. Observe that as a signal is tuned for greatest clarity the S-meter pointer deflects the greatest amount. Strong signals naturally deflect it more than weaker ones. Also note that peaking

the *antenna trimmer* may have a decided effect on the amount the pointer deflects.

Leave the main dial tuned to a station and turn the *bandspread* dial. You will discover that a signal which occupies only a dial division or so on the main dail will occupy 5 to 20 on the bandspread dial. On the short-wave bands, where the main

James H. Bryant, W4FNN, Corbin, Ky., worked 20 different states in one week on 40-meter c.w. (code) with his AT-1 transmitter and HQ-129X receiver.

dial covers thousands of kc. for each band selector position, setting the main dial to a predetermined position, an amateur band or other restricted range of frequencies is spread over most of the bandspread dial.

Specialized amateur receivers accomplish this result by restricting their tuning ranges to the amateur bands exclusively.

Next, turn off the a.v.c.* and again tune across the band. Most signals will undoubtedly overload the receiver so badly that the output signal will be much distorted and the signals will appear very broad. Retard the sensitivity control, however, and the distortion will disappear and the tuning will become sharper. Speaker output level can then be controlled with the volume control.

Careful comparison will show that the receiver tunes more sharply with manual gain control than it does with a.v.c. As a result, it is frequently possible to copy a weak signal that is completely smothered by a strong one a few kc. away with the a.v.c. on by resorting to manual control. This is particularly true when copying a conventional phone signal near a single-sideband (SSB) signal.

Some of the less-expensive receivers do not have a separate sensitivity control; consequently, their r.f. sections run "wide open" all the time. The only way to protect them from spreading signals is to use a short antenna when signals are loud. This expedient also works wonders even with expensive receivers when the rock crusher down the street opens up.

Still with the a.v.c off and the sensitivity control retarded, turn on the b.f.o. A sharp whistle will appear on each signal. Furthermore, adjusting the *pitch* control will vary its pitch from zero beat (no whistle) in the center of its range to a high pitch on either side of this position. Use either setting for code work.

The pitch control is set properly when a signal that is tuned in for maximum clarity with the b.f.o. off produces a beat-note most pleasing to you when the b.f.o. is turned on without touching the tuning dial. The sensitivity control must be well retarded or beat-note will sound "mushy."

By leaving the pitch control set and carefully tuning the bandspread dial, you will find that there are two settings on it that will produce a beat-note of the same pitch on each signal. One will be louder than the other. The more selective the receiver is, the greater the difference will be. Always tune for the loudest beat-note, a process that will soon become automatic.

Tuning Single-Sideband Signals. An SSB signal differs from a conventional phone signal in that its carrier and one sideband are suppressed at the transmitter and only the remaining sideband, which contains all the desired information, is transmitted. Consequently, an SSB signal *from a properly adjusted transmitter* is slightly less than half as wide on a *properly adjusted receiver* as a conventional phone signal.

To receive an SSB signal, tune it in with the a.v.c. on and the b.f.o. off for the greatest gyrations of the S-meter pointer. Then, shut off the a.v.c., turn the sensitivity control completely off, and advance the volume control full on. Next, advance the sensitivity control for the desired volume from the loudspeaker. Don't worry if the signal sounds like pure gibberish. Finally, turn on the b.f.o. and adjust the pitch control until the signal becomes readable. This last adjustment is very critical.

Once the pitch control has been adjusted to receive an SSB signal, it will not have to be readjusted to receive other stations transmitting on the same sideband. But those transmitting on the other sideband will be unreadable until the pitch control is adjusted to the "other side of zero beat." The two positions can be marked on the pitch control knob.

High Selectivity Operation. After becoming familiar with the operation of the receiver set for minimum selectivity, push up the selectivity control a notch at a time and repeat the steps. You will quickly

*Should the b.f.o./a.v.c. switch be one unit, leave the a.v.c. on and retard the sensitivity control until the S-meter no longer swings as signals are tuned in and out.

HELP US OBTAIN HAM LICENSES

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

W1 CALL AREA

Robert G. Gadbois, 279 Elm St., Holyoke, Mass. Phone: 3-9014.

Robert King (14), P.O. Box 492, Sanford, Me.

Frank Mancusi, 19 Acadi Park, Somerville, Mass.

Roland Gobin, 270 Suffolk Ave., Pawtucket, R. I.

Richard St. Amond (23), 1847 Thomaston Ave., Waterville, Conn. (Code)

Michael Drew (15), 20 Maple St., Lisbon Falls, Maine.

Bill Smith, 247 South Main St., Andover, Mass.

Gerald Ceccarini, 27 Stillman St., Framingham, Mass. Phone: TR 3-7557. (Code)

W2 CALL AREA

Richard Frank (14), 14 Malan Ave., Berlin, N. J.

John R. Hampton, Jr., 726 New Bridge Road, Teaneck, N. J., % New Milford P.O.

John Epstein, 153 Wood Hollow Lane, New Rochelle, N. Y. (Help in obtaining his amateur license)

Mel Becker, 720 Hunts Point Ave., Bronx 59, New York, N. Y. (Code and theory)

Victor Ortiz, Apt. 12, 51 Norfolk St., New York, N. Y.

Joseph F. Foster (13), 28 Iroquois St., Rochester 9, N. Y. (Code)

Bill Addison (15½), 8566 Krull Parkway, Niagara Falls, N. Y. (Code and theory)

Marvin Gurlin, 111 White Horse Pike, Audubon 6, N. J.

Fred Tarter, 1864 85th St., Brooklyn, N. Y. (Code)

Henry H. Blankinship, 4260 Broadway, New York 33, N. Y.

Stephen Gross (15), 2 Vassar St., Poughkeepsie, N. Y.

W3 CALL AREA

Larry Myers (15), 1104 Agnew Dr., Rockville, Md.

David Simons (13), 903 Frazier St., Springdale, Pa. (Wants tips and help on passing Novice examination, also someone to give him the test)

Sidney Bergman, 8806 Tyson Road, Philadelphia 18, Pa. Phone: WH-8-3297.

Edward K. Stults, 1183 Balmoral Dr., Allison Park, Pa.

Howard A. Lurkins, Mission Rd. 199, Jessups, Md.

John Harris, 645 Gettysburg St., Pittsburgh 6, Pa.

Harold T. Baldwin, 16 S. Farragut St., Philadelphia 39, Pa.

Thomas Hinkle, 369 Church St., Phoenixville, Pa. (Code)

W4 CALL AREA

Ralph H. Johnson, 317 47th St., Virginia Beach, Va. (Code)

Harold Schivay, 2225 Meridian Ave., Miami Beach, Fla.

Glen R. Starkey, 2119 Bethune St., Falls Church, Va.

Gerald Tyson (15), 308 East College St., Valdosta, Ga.

Bryan Green, W4-SWL, 1141 Hamilton Ave., Clifton Forge, Va. (Code)

W5 CALL AREA

Ronald Perry, 808 Cleveland St., Alvin, Texas. Phone: 981.

Bing R. Corpier, Route 4, Box 480, Marshall, Texas.

Gus R. H. Feltner, Sr., 324 W. Call St., New Braunfels, Texas. (Code)

Richard Matzner (14), Rt. 1, Box 599-Z, Fort Worth, Texas.

W6 CALL AREA

Dave Higgins (13), 1000 W. Howard, Glendale 7, Calif.

Robert B. Ryan (26), 1936 Mellon Ave., Los Angeles 39, Calif. Phone: Normandie 3-1839.

Joe Beeler (13), 1555 Fairfax Dr., San Bernardino, Calif.

George H. Zoellner (38), 6011 Malcolm Dr., San Diego 15, Calif.

Pvt. Page Schorer, ER19-54D-961, RF's Co. "C", Fort Ord, Calif.

John Schroeder, 5735 Jefferson Ave., Hollydale, Calif. (Code)

W7 CALL AREA

Ronnie Crater, 2916 South 128th, Seattle 88, Wash. (Novice license)

Bobby Francies (15), Myrtle Point, Oregon. (Code and theory)

Lyle E. Wood, Box 28, Cascade Locks, Oregon.

Floyd Gerstenfeld, 11385 N.W. McDaniel Rd., Portland 1, Oregon. (Code)

W8 CALL AREA

"Larry," KN8AXS, 7 N. Shirley St., Pontiac, Mich. (Needs help with code to get his speed up to pass the General code test)

Paul Geerdes, 345 Auburn, S.E., Grand Rapids 6, Mich.

Lloyd Chamberlin, 2617 Royal Ave., Berkley, Mich. (Would like to contact anyone using a WRL "Globe Trotter" transmitter)

Robert O. Martinez, 1439 Bagley Ave., Detroit 16, Mich. (Wants help in getting his license, also information on 1¼- and 2-meter equipment)

Richard E. Arthur (13), 1050 Harrison Ave., Defiance, Ohio.

Don Ritchie, 811 E. 256 St., Euclid 32, Ohio. (Code and theory)

Dennis Shesterkin (14), 19520 Georgia, Roseville, Mich. (Code)

Allen Krugler (13), 4191 Second St., Wayne, Mich. (Code)

Paul M. Kankula (15), 1233 Austin St., Lincoln Park 25, Mich. (Code)

David Jones (14), 37 Chippewa, Pontiac 18, Mich.

Fred L. Scheuering (50), 5116 Harlem Ave., Cleveland, Ohio. (Code and theory)

Donald B. Straley, Route #2, Cedarville, Ohio. (Code and theory)

Frank Gale, 19991 Garfield, Detroit 19, Mich.

Clifford Wiehr, 14803 Snowden, Detroit 27, Mich. (Code)

W9 CALL AREA

John J. Kallal, R2, Box 760, Zion, Ill.

Bill McLafferty, R.R. 4, Carbondale, Ill.

Bob Garske (15), 2103 South 79th St., West Allis 14, Wis. (Code)

Gary Towner, KN9BNJ, 1017 W. 42nd Ave., Hobart, Ind.

Art Katz (12½), 1717 E. Beverly Rd., Shorewood, Wis. (Code and theory)

WO CALL AREA

Peter A. Flaton, 8735 Ivy Ave., Affton 23, Mo. Phone: FL 2-0126. (General class theory)

Joe J. Stoupa, Rte 3, So. Omaha 7, Nebr. (He and six friends are studying for their Novice license and are looking for "sure-fire" plans for 2-tube, battery-operated transceivers)

Earle R. DeMattos (26), 828 Madison, Topeka, Kansas.

W. H. C. Angerman, R3, Bolnville, Mo. (Would like to hear from members of the old R9LL and Grand National SWL clubs)

Frank Gilmore, Route 2, Box 286A, Springfield, Mo. (Will answer all letters and offers to help amateur listeners with their problems)

Billy Martinson (12), Box 185, Ellendale, N. Dak.

Curtis Lund (13), R.R. 1, Brocket, N. D.

Donald E. Simonsen (23), P. O. Box 155, Fairplay, Colo.

Lee Swenson (11), Box 7, Bagley, Minn. (Theory)

Jim Molkenthin (14), 633 1st Ave., S.W., Sioux Center, Iowa. (Code)

Ronnie McCarrell, 3620 North 33rd St., Kansas City 4, Kans. (Code)

VE, AND OTHERS

Michael Bell, P.O. Box 367, Aurora, Ontario. (Theory)

Elwood Rhoddy, Aylesford RR #3, Kings County, Nova Scotia.

Bill Harrison (15), 78 Gooderham Drive, Waxford, Ontario. (Code)

Paul Beauchemin (18), 57 Buade St., Quebec.

Ric Lightfoot (14), 89 Carruthers Ave., Kingston, Ontario. (Code)

Peter Orobko, VE7-SWL, (17) % M. J. Tompkins, 19071 Ford Rd., RR1, Pitt Meadows, B.C. (Code, theory and regulations)

Miquel A. Castillo, Jr., Morelos 8 St., Villahermosa, Tabasco, Mexico. (Would like pen pals; will answer all letters)

Luis G. Piris, Entrada San Anton #10, Ponce, Puerto Rico.

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, Suite 800, Wyatt Bldg., 777 Fourteenth St., N. W., Washington 5, D. C.

learn how much more carefully tuning must be done. Also, phone signals become impossible to read if selectivity is made too great. The limit is about 2.5 kc. for phone work, but selectivity of a quarter kc. or less can be used for code work in a stable receiver, incorporating adequate bandspread and first class dials.

In amateur work, it is usually wise to keep the receiver adjusted for reasonably high selectivity, because in almost every contact you will need it to combat interference. In this manner, you become adept in handling the high selectivity at times when you're not concentrating your entire attention on copying a weak signal through heavy interference.

Most receivers incorporating variable selectivity also have a "phasing" or "null" control. It is used to "null out" the whistle (heterodyne) produced in the speaker when two signals only a kilocycle or so apart are received at the same time. By careful manipulation of the control and the bandspread dial, the undesired signal can be reduced in strength, permitting the other one to be read.

Most communications receivers contain noise limiters. Their operation is obvious. Turn them on when noise is troublesome; turn them off when it is not. They are most effective against automobile ignition interference and least effective against steady grinding noises.

These remarks do not cover every panel control that may appear on a communications receiver. If I have missed one that is on yours, don't be afraid to experiment with it until you know how to use it.

Amateur Radio Theory Course

The Ameco *Amateur Radio Theory Course* ($3.95), by Martin Schwartz, published by The American Electronics Co., 1203 Bryant Ave., New York 59, N. Y., is possibly the best single book available today for use in preparing to pass the various written exams for amateur licenses.

Its 297 pages are divided into chapters and sections which start at the bottom to explain everything one must know to pass the examinations. Each section is complete with many test questions, permitting the student to check how well he understands what he has just studied. In addition, simulated examinations are included, so that he knows when to say: "O.K., FCC, here I come!" Correct answers for all questions are listed in the back of the book.

The Ameco *Amateur Radio Theory Course* can be obtained directly from the publisher or via any of the amateur supply houses that advertise each month in POPULAR ELECTRONICS.

(*Continued on page* 117)

Tape System Records and Plays Video and Sound

TAPE RECORDING and playback of television—both video and sound portions—has come of age with the new Ampex VTR (video tape recorder) system. Both picture and sound are recorded on a single magnetic tape two inches wide, moving at 15 inches per second. Quality of picture and audio is high, with all shades from black to white accurately reproduced. Picture resolution is said to be excellent inasmuch as the VTR can record and play back more horizontal lines than the average home TV receiver needs for good picture resolution.

With the VTR, programs can be recorded directly from the TV camera, from a TV receiver, from TV transmission lines, or from microwave relay systems. The program can be played back at once with no processing of any kind necessary. Recorded programs can be erased when desired. Special machines have been developed for these functions.

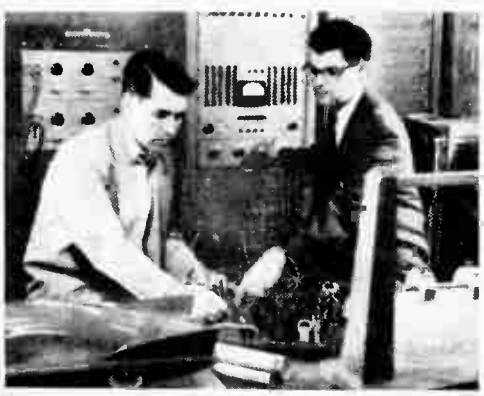
Several of the video tape recorder systems have already been sold to the major television networks at a cost of $75,000 each. Wide use of the VTR is foreseen in the near future.

New Network Speeds Army Supplies

ANY DOUBTS about electronics' ability to perform miracles should be dispelled by the news that it is now helping to reduce paper work for the Army. A recently announced transceiver network links together key Signal Corps depots throughout the nation and the Army Signal Corps agency in Philadelphia. Via this system, information on stock levels of supplies is electronically interchanged. Data is punched on cards and sent along telephone circuits. The network helps speed supplies for the Armed Forces in a matter of minutes instead of several days.

Computer Road-Tests Cars Before They're Built

ENGINEERS at Chrysler Corporation take "rides" over chuck-holed roads and smooth boulevards—without ever leaving the confines of their laboratories or stepping into a car.

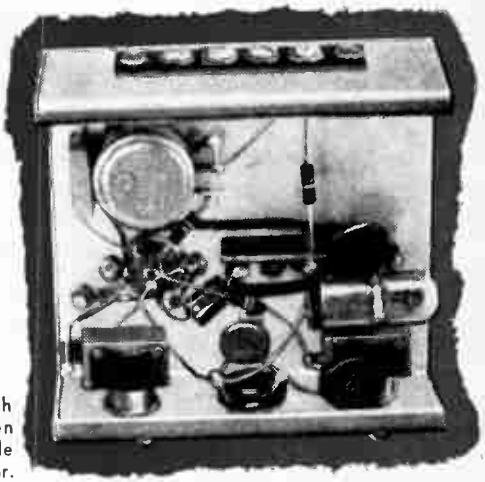


By using a computer, new car designs can be tested accurately before a working model, or any of its parts, is actually built. Data, reproducing given road conditions, is fed into the computer which provides correct answers to design questions. As a guide to design, the computer saves time, man-power, and materials—and helps develop better suspension systems, engines, etc. Shown in the photo are Fred F. Timpner (right) and Raymond R. McHenry, preparing the computer's problem board for a "road test" of a car not yet built.

Chrysler spokesmen point out that the results predicted by the computer check very closely with the design's actual performance when it is later built as a real car and tested on the road.

Code Reception on "All-Wave" Receivers

By B. W. BLACHFORD

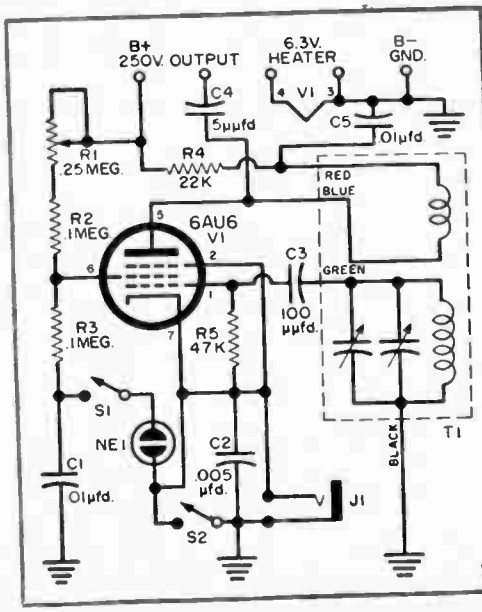


Above- and below-chassis views of an i.f. oscillator which incorporates an audio frequency modulator. When used with an "all-wave" receiver, it will receive code stations and also serve as a code practice oscillator.

MANY A NOVICE HAM has become interested in ham radio through listening to the short-wave bands on a typical, living-room type "all-wave" receiver. Such a receiver does a pretty fair job of bringing in voice signals but the c.w. can be seldom heard. Why?

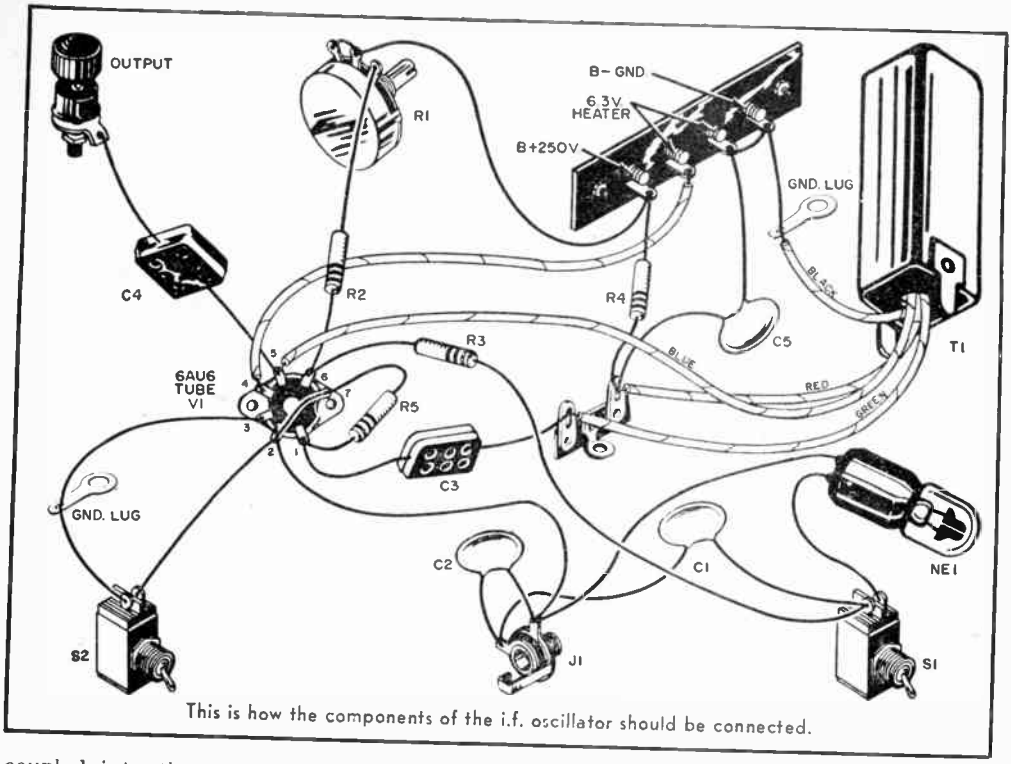
Well, it's not especially difficult to understand. Code transmissions are made in quite a simple manner. You merely turn the transmitter on and off by means of a telegraph key. Since these pulses are not modulated by voice or by a tone, they contain nothing of the nature of an audio frequency. Therefore, they cannot be heard properly when they are picked up by an ordinary "all-wave" receiver. Something additional is needed to make them audible. This extra unit is an integral part of all communications receivers. We call it a beat-frequency oscillator—b.f.o., for short.

Can a b.f.o. be built into an existing "all-wave" receiver? Probably not—there isn't room on the chassis for it. It can be built as a separate unit, though, and simply



C1, C5—0.01-μfd. ceramic capacitor
C2—0.005-μfd. ceramic capacitor
C3—100-μμfd. mica capacitor
C4—5-μμfd. mica capacitor
J1—Open-circuit phone jack
NE1—Type NE-48 neon lamp
R1—0.25-megohm potentiometer, screwdriver adjustment
R2, R3—0.1-megohm, ½-watt composition resistor
R4—22,000-ohm, ½-watt composition resistor
R5—47,000-ohm, ½-watt composition resistor
S1, S2—S.p.s.t. toggle switch
T1—B.f.o. coil (Meissner Type 17-6753 or equivalent)
V1—Type 6AU6 tube
1—7-pin miniature tube socket
1—Open-end chassis, 3¾" x 4⅛" x 1½"
1—4-terminal screw-type terminal strip
1—Binding post for output terminal
Misc. hardware, tie points, wire, solder, etc.

Schematic diagram and parts list for the i.f. oscillator.



This is how the components of the i.f. oscillator should be connected.

coupled into the receiver. The i.f. oscillator described in this article really is a glorified b.f.o. Like a b.f.o., it operates at the intermediate frequency of a superhet receiver. But this little unit is more than an ordinary b.f.o., for it contains an audio frequency modulator. Thus, it is also an excellent code practice oscillator.

At the flick of a switch, the unit will generate its own tone signal and deliver it to any superhet receiver—even an ordinary a.c.-d.c. "broadcast-only" receiver. There is a jack on the oscillator chassis to accommodate a phone plug attached to a telegraph key. To have a code practice session, all you need do is tune the receiver to a spot on the dial where no station is received and pound out dits and dahs to your heart's content.

Adjustment of the i.f. oscillator is quite simple. The data sheet accompanying *T1* will provide step-by-step instructions.

The b.f.o. can be connected to the last i.f. tube in your receiver. If you don't know just where to make this connection, try connecting a length of insulated wire to the output terminal of your new i.f. oscillator, wrap a layer or two of insulating tape over the other end, and push it directly under the receiver chassis near the i.f. amplifier tube. If the output from the speaker is too low with the modulator switched on and the receiver's volume control set at maximum, move your insulated lead to a point under the mixer tube. On the other hand, if the output is too strong, move the insulated lead to a point under the detector tube.

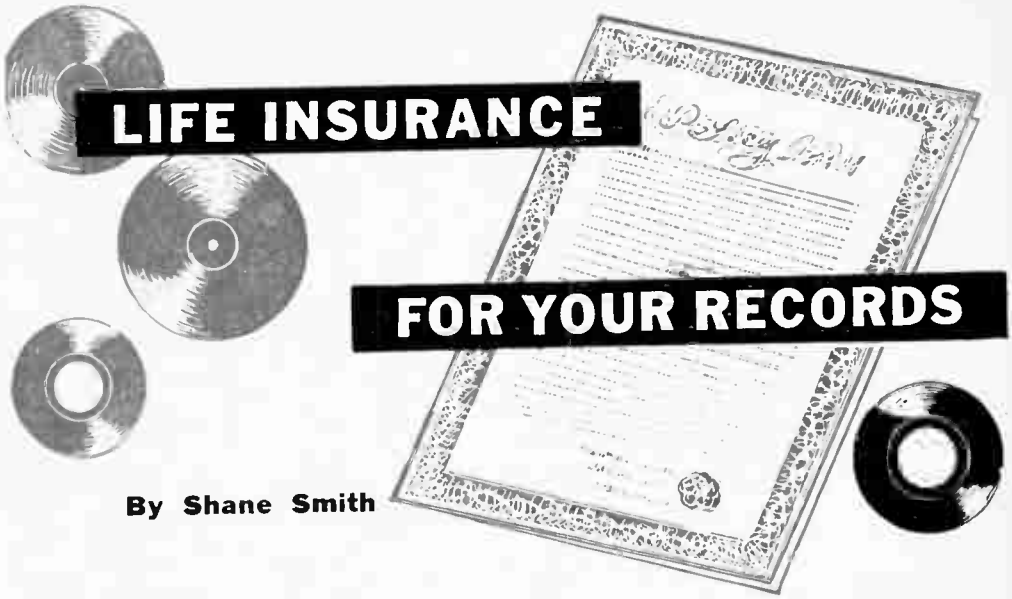
Potentiometer *R1* should be adjusted for the most pleasing tone from the modulator as heard in the speaker of your receiver. The range of adjustment of *R1* is quite wide, and the neon lamp may not oscillate over this entire range. The proper way to adjust this control is as follows: (1) Adjust *T1* with *S1* switched off, *S2* switched

(*Continued on page* 124)

HOW IT WORKS

The audio modulator portion is a ¼-watt neon lamp, *NE1*, which—by virtue of *C1*, *R1*, *R2*, and *R3*—is made to operate as a simple relaxation oscillator. But the b.f.o. tube, *V1*, obtains its screen voltage through *R1* and also through *R2*. Therefore, when the relaxation oscillator is operating, the screen voltage of *V1* is varied at the audio rate. Thus, *V1* is screen-modulated by the relaxation oscillator and the output from the b.f.o. will carry the audio tone as amplitude modulation. Resistor *R1* keeps the percentage of modulation at a relatively low level to prevent any significant frequency modulation of the output from the b.f.o.

The r.f. portion of the oscillator is a "tickler" coil feedback arrangement which might be found in a regenerative receiver. The inductance of *T1* has been selected to provide optimum feedback, or oscillations, over a range of from about 500 to 650 kc. This tuning range is controlled by the unmarked variable capacitors in the wiring diagram.



LIFE INSURANCE FOR YOUR RECORDS

By Shane Smith

Feed them a dust-free diet of atom particles and watch that tone arm weight to assure long life for your spinning spirals

PERMANENCE is the unique virtue of recorded music. Until the invention of the phonograph, all music vanished with its own sound. Now its volatile essence is cast into a solid mold.

But how long does this "permanence" last? How long is it before the music on your treasured discs gets fogged over by the wheezes, scratches and pops that careless handling and poor equipment imprint upon the once smooth and shiny surfaces?

You plunk down three or four dollars for an LP record. Presumably you like the music so much that you want to have it around all the time. It's a long-term investment. To collectors, a record worth having is worth keeping.

A pampered LP record will sound almost as well on the 200th playing as on the first. But neglected records wear out after about 20 spins. In other words, by proper handling of your records, you get ten times your money's worth out of them. Figure it this way. Say you bought a $4 record containing about 40 minutes of music. If your record lasts 20 playings, you get 800 minutes of music from it at the price of 0.5 cent per minute. If you prolong the life of the record to 200 playings, a minute of music costs you only 0.05 cent. Besides, some records are irreplaceable, and if you happen to be fond of them, their preservation yields a value beyond dollars and cents.

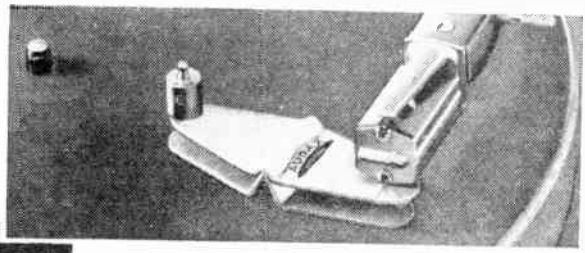
Hi-fi fans, particularly, find that proper record care protects their investment and compounds their pleasure. Their wide-range equipment not only coaxes the subtlest whisp of music from good records, but it also renders every scratch and screech of the bad ones. Hi-fi demands unmarred records or else you feed distortion into your system at the very source of the signal.

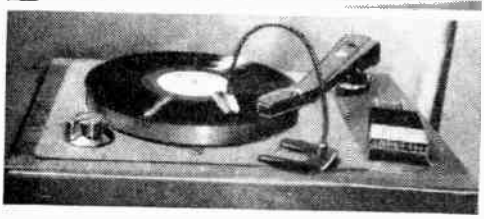
Even if you haven't gone hi-fi yet, good record care will pay off nicely when you finally get your equipment. You'll then be able to hear and enjoy older records as you never heard them before. But if you grind them up meanwhile with bad needles or overweight tone arms, dust and fingerprints, your records will only scream and hiss at you in justified reproach for their mistreatment.

To hi-fi fans, present and future, we are proposing the following "Life Insurance Policy" for records.

§ 1. A Needling Problem

If you believe in "permanent" needles, you might as well believe in fairy tales. Yet the persistent faith in the mythological existence of such needles still takes a heavy toll among records. "Groovicide" is rampant. Torn carcasses of records are abundant "habeas corpus" and the circumstantial evidence points accusingly at the culprit: your needle. Here are the facts





Stylus pressure gages of many kinds are available to help adjust the downward force of your pickup. The Garrard gage (top, left) and Clarkstan gage (left, center) use spring mechanisms. The Audax Stylus Balance (top, right) is built like a chemist's precision scale, employing calibrated weights instead of springs. Exact stylus position is marked by hairline groove to keep lever moments accurate. "Staticmaster" brush (lower left) sweeps dust from records while neutralizing static charge by nuclear radiation from radioactive isotope in handle.

about this incipient "murder" of music:

A metal-tip stylus lasts about 8-10 playing hours before showing the first signs of wear.

A sapphire stylus lasts from 40-50 hours.

A diamond stylus lasts a thousand playing hours.

And what happens after that? The worn needle develops a chisel-like cutting edge, which insists on bulldozing its own way instead of wiggling with the music. The net result in the groove is something like a plow ripping through a furrow. The delicate groove contours are cut up into microscopic clumps. With every playing, the music gets more screechy and garbled. The spiral on your record soon turns into a gravel rut. As the needle climbs over the miniature wreckage, crunching the debris into the remaining smooth portions of the surface, your pickup faithfully reports every tiny impact to the amplifier. After all, it's high fidelity. And if you are lucky, you can still hear some tatters of music above the racket.

For any dedicated collector, the rescue of his imperiled records is a question of cold cash and hot passion. In this rare case, both factors point the same way.

A sapphire stylus costs about $2.00 and a diamond costs about $10.00-$15.00. The diamond plays 20 times as long and costs only about 6 times as much as the sapphire. This makes the diamond the cheapest as well as the safest way to play a record by a 3 to 1 margin. Besides, once you put a diamond needle into your rig, you can forget about it for a long time. Assuming you play your phonograph two hours per day, the diamond will last nearly two years, provided that your tone arm has the correct needle pressure and your records are fairly clean.

Most hi-fi stores will check your needle under a microscope without cost. Whenever you see worn spots on the side of the stylus near the tip, let them take it away: it's time for a change.

§ 2. A Weighty Matter

Now you've gone and got yourself a brand-new needle. Nothing wears down that new needle as fast as an overweight tone arm. So check the tone arm weight (stylus pressure) before you put your needle to work. The proper stylus pressure for your pickup is usually specified by the manufacturer.

Professional-type pickups mounted in the best tone arms track the groove with only 2-3 grams stylus pressure. This reduces needle and record wear almost to the vanishing point.

Pocket microscope made by Duotone magnifies 50x to detect early signs of needle wear. Many hi-fi shops offer microscopic needle inspection service.

Ordinary home hi-fi, using magnetic cartridges like the popular G.E. Model RPX, usually requires 6-8 grams tracking pressure. Anything heavier than 8 grams makes the slow death of your needle a lot faster but no less painful.

Recent crystal and ceramic pickups are also designed for 6-8 grams stylus pressure. Older crystal pickups, particularly those using straight needles (without a right-angle bend in their shank) mounted in a setscrew chuck, are too stiff for lightweight tracking. Don't use them with microgroove records. Besides, their lateral stiffness causes distortion of the signal.

The tip of an LP stylus measures only 1 mil (=1/1000 inch) in radius. Since the total tone arm weight rests on that tiny point, the pressure at the tip is roughly equivalent to 10,000-20,000 pounds per square inch. No wonder it takes a diamond, the hardest known material, to withstand high-frequency wiggles under such a load. Because of this immense concentration of weight on so small an area, even a small amount of overweight speeds up the wear and tear at an alarming rate. One or two grams "off" may seem negligible, but at 6 grams total pressure, it is actually an enormous error of up to 33%.

On most record players, you can adjust the stylus pressure either by tightening a spring or by shifting a counterweight on the tone arm. You select the correct value by means of an inexpensive stylus pressure scale, like those pictured on page 86.

Another vital point is that the turntable must be absolutely level. Even the slightest tilt puts more pressure on one groove wall than the other and causes rapid wear of the overstressed wall. Besides, the tilt plays havoc with the delicate forces involved in tracing a microgroove. Your cabinet or floor may be out of plumb without your being aware of it. Check your turntable with a liquid level.

§ 3. Dust to Dust

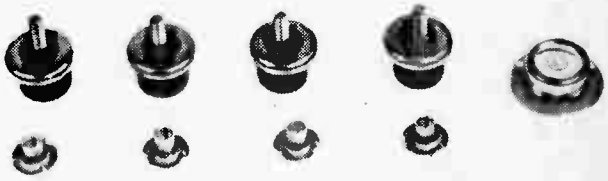
The funereal phrase is evoked by the dust-caused mortality of phonograph records. Consider that most dust particles are hard rock with razor-sharp edges. Imagine what happens when these "rocks" are pressed into the soft vinyl groove by the relentless force of the 10,000-psi stylus.

Atomic radiation is harnessed for hi-fi by the Mercury "Dis-Charger" (top, left) and the Eby "Stati-Mute" (top, right). These small clip-on cylinders contain a radioactive isotope which ionizes the air near the record surface and eliminates electrostatic attraction of dust. Anti-static spray (below) neutralizes electric charge with silicone film, which may also be applied with chemically treated Duotone "Electro-Wipe" cloth. Soft plastic "DisCovers" keep records dust-free on shelf.

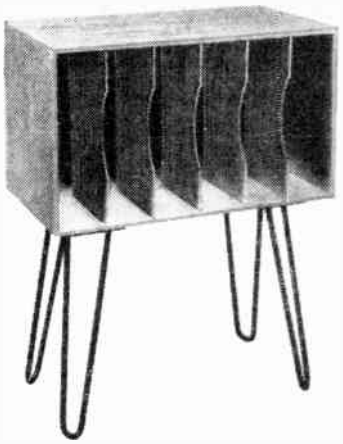
Just brushing the dust off the records before each playing doesn't really help much. Brushing merely sets up a charge of static electricity which catches the dust right back and holds it firmly on the record surface. The record has to be literally tricked out of this fatal attraction.

This is done by coating the disc with a thin silicone film, which neutralizes the static charge. The film can be wiped on with a specially impregnated record cleaning cloth, which simultaneously cleans the record; or it can be sprayed on after cleaning from an aerosol pressure can.

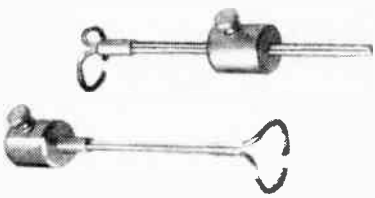
To wipe that grit off the face of your



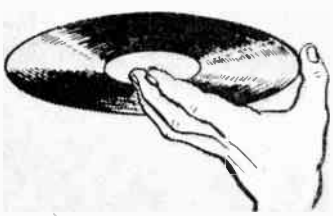
Strictly level turntable is a hi-fi "must." Cabinart level set includes liquid bubble indicator to show tilt in any direction and four adjustable screw legs to keep turntable base horizontal.



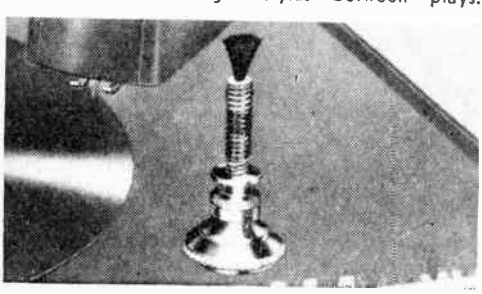
Cabinart file keeps close ranks among your records. Bins are spaced to give sufficient lateral support to prevent warpage and let you arrange your records by category. Any disc can then be quickly located.



Sliding counterweight by Mercury Scientific Company comes to the aid of tone arms without built-in stylus pressure adjustment. Just slip the clip on the arm, then set weight for right balance.



Right way of holding records (above) keeps surface free of fingerprints. "KLeeNeeDLE" brush (below) automatically wipes dust and grit accumulation from changer stylus between plays.



records, hi-fi'ers even harnessed the formidable forces of atomic radiation. In fact, hi-fi claims the honor of having espoused the first (and still the only) use of atomic radiation in the home. It takes the form of a tiny piece of radioactive isotope (usually polonium) clipped to the tone arm. The radiation from this metal, too weak to cause any biologic risk, is strong enough to ionize the surrounding air and dispel the static charge permanently from the record. After two or three playings (before which the record should be wiped), you can simply flick off the dust with cheesecloth or a soft brush. Since the isotope remains radioactive for several thousand years, you needn't worry about its wearing out. The Mercury "Dis-Charger" and the Eby "Stati-Mute" are products of this type. Another atomic gambit in the anti-dust campaign is the "Staticmaster," a soft-bristled record brush with radiation source built into the handle.

§ 4. Hands Off

We won't refer to your delicate digits as greasy paws, but the fact remains . . . and so does an oil film every time you touch the record. The film then gathers dust and turns it into grime, for which there is no cure. But the ounce of prevention is simply to keep your fingers off the groovy parts of the record.

Another handling trick is to squeeze the record envelope when you slide the record in or out, so that the cardboard sides buckle outward and away from the record. That way the record moves freely in the envelope without being scratched.

§ 5. At-Ease Position

Your records spend most of their time idle on the shelf. See to it, therefore, that their off-duty hours are spent in a wholesome environment. An upright attitude will keep your records from developing warped personalities.

Stand them up straight in bins about eight inches wide so that they support each other with gentle pressure from the side. A strongly slanted position is bound to warp them. Never stack your records on top of one another, because the weight of the stack will grind dust into the "low man" on this totem pole.

And keep your records away from heat. Even direct summer sunlight is hot enough to soften them.

§ § §

Under the terms of this "policy," your records are assured prolonged life. The policy also pays regular dividends in better sound.

—30—

AFTER CLASS

FROM CORN-POPPING TO WOOD-GLUING

NOBODY IS SURPRISED when a kettle boils or when a steak sizzles over a crackling fire. Even the phenomenon of a tiny flame producing intense cold in a gas refrigerator no longer excites the incredulous wonder it once did. These are familiar manifestations of heat energy at work. But a dielectric heater in the act of popping corn or cooking a large roast in minutes never fails to evoke gasps of astonishment from the audience.

Without smoke, flame, noise, or fuss, the dielectric heater produces uniformly distributed heat never before obtainable by surface heating methods. Because it acts simultaneously on all the particles of a whole mass, it is uniquely adaptable to such industrial processes as controlling

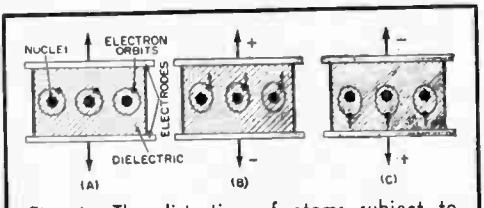


Fig. 1. The distortion of atoms subject to an electric field: (A) neutral electrodes—no distortion, (B) charged electrodes—electrons are attracted upward toward positive plate, (C) charged electrodes—attraction is again toward positive plate, this time downward.

chemical reactions, removing moisture, softening plastics before shaping, drying wood glues, and the sealing of plastic containers.

Is dielectric heating different? Heat is a form of energy. As the temperature of any substance is made to rise by adding energy to it, its molecules dance violently in vibratory, haphazard paths of ever-increasing speed. A flame works on the surface molecules first, inciting them to increased motion while they in turn communicate their energy to the inner molecules through elastic collisions. This is the mechanism of heat conduction, a relatively slow process in many materials. If you like your roast beef rare, you can thank this sluggishness of conduction for the roast that's "done to a turn."

Dielectric heaters reach right into the very heart of the individual atoms that make up insulating materials. With invisible electrical tentacles, they twist and torture the innards of the atom until each moulecule is in a state of violent agitation. This unrest manifests itself as heat more or less uniformly distributed through the body of the material rather than on the surface alone.

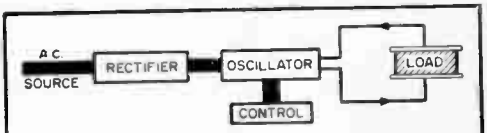


Fig. 2. Diagram of typical dielectric heater.

How a heater works. Matter is composed of atoms. Each atom consists of a positively charged nucleus of rather massive structure surrounded by one or more electrons carrying a negative charge. In an electrical conducting material such as copper or aluminum, the orbital electrons may be displaced easily by electromotive forces such as voltage or an electric field. As a matter of fact, this helps to explain why metals are conductors: the displaced electrons are free to move within the

Westinghouse Electric Corp.

Table radio cabinet with 28 joints, all of which have been glued and cured by dielectric heating.

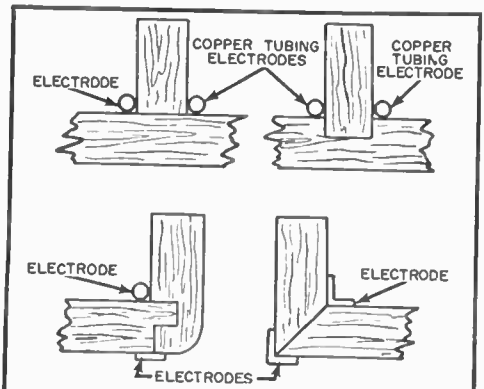


Fig. 3. Two of the various forms of electrode arrangements for setting glue in joints.

metal and so may serve as "carriers" of charge from one place to another.

The picture changes when we consider insulators. In nonconducting materials, the electrons are tightly bound to their nuclei and stubbornly resist any effort to move them from the atoms to which they belong. The word *dielectric* was originally defined by Michael Faraday to describe a medium through which electric forces can act but which, in itself, does not carry an electric current—in other words, an insulator. Consider what must happen when a dielectric is placed between two electrodes across which a very rapidly alternating voltage is impressed.

Impelled by the strong electric field, the electrons try to move first one way, then the other, as the polarity of the field reverses at high frequency. Unable to break their internal ties, however, they remain within the atom causing it to stretch and distort (Fig. 1). As the frequency of the impressed voltage is increased, the change from one direction of stress to the other occurs more often, resulting in molecular agitation which evidences itself as heat. With a given applied voltage and frequency, some materials heat more readily than others; these are said to have a higher *loss factor*. A high loss factor merely means an ability to convert electrical energy into heat with greater effectiveness.

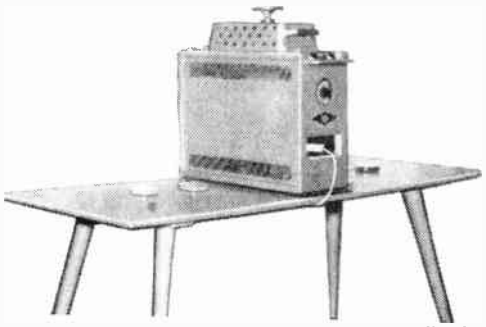

Curtiss-Wright

Table-top dielectric heater of medium power.

Vacuum-tube circuits are used almost exclusively to produce the necessary high frequencies in commercial dielectric heaters. The larger units utilize frequencies from 1 to 50 megacycles while some of the smaller ones may work at frequencies as high as several thousand megacycles. Output powers range from a few hundred watts to hundreds of kilowatts. One industrial unit employs a Meissner-type oscillator operating at 26.8 mc., and having a full-load output close to 1 kw. Another contains a high-powered push-pull oscillator tuned to 27.120 mc. with a maximum dissipation of approximately 5 kw.

Basically, however, all dielectric heaters comprise four major components: a power supply, an oscillator, a control circuit, and the load electrodes (Fig. 2). The first has its usual task of providing the correct a.c. and d.c. potentials and currents for the remainder of the equipment; the oscillator generates the penetrating high-frequency field which is applied to the dielectric with the assistance of the electrodes. These may take a variety of forms (Fig. 3), but in every case they behave like the plates of a capacitor with the dielectric in between. The control circuit sets up the necessary oscillator-operating conditions and governs its "duty cycle" or active time.

The output electrodes may be coupled to

(*Continued on page* 115)

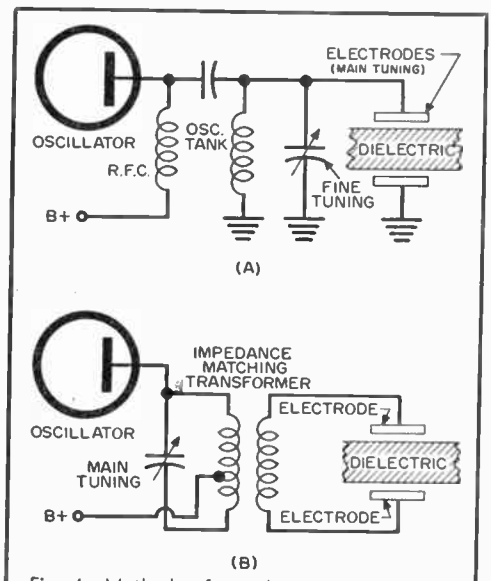
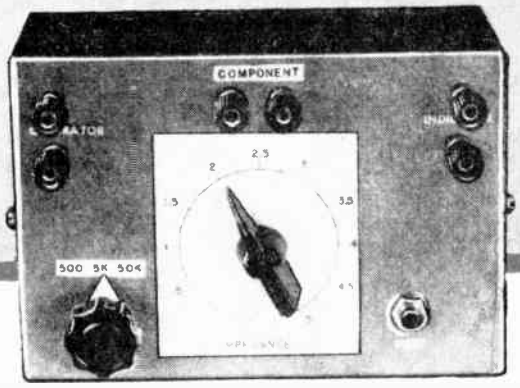


Fig. 4. Methods of coupling output of oscillator to electrodes: (A) direct coupling, and (B) through impedance-matching transformer.

Impedance Checking Made Easy

A. c. voltage drop in a calibrated resistor is compared with that in the unknown impedance



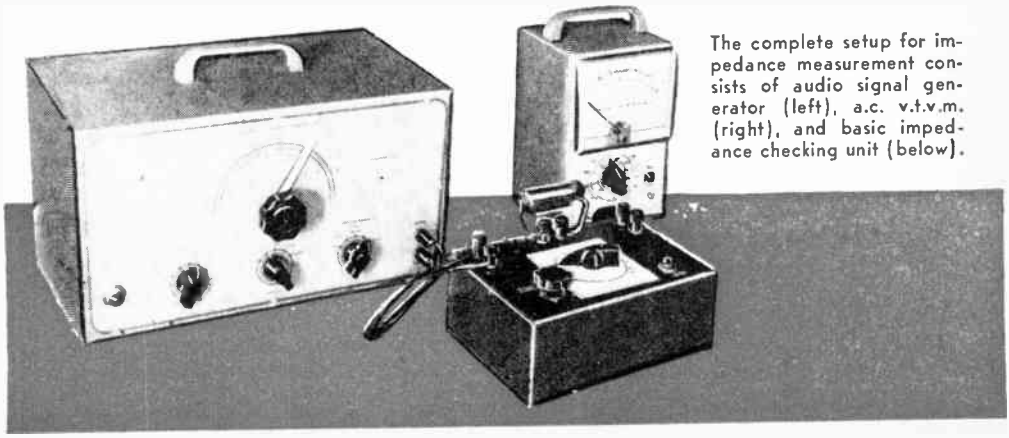
By RUFUS P. TURNER

MAKING impedance measurements is usually considered to be rather difficult with expensive equipment required. Such is not the case if the simple, inexpensive scheme outlined below is followed.

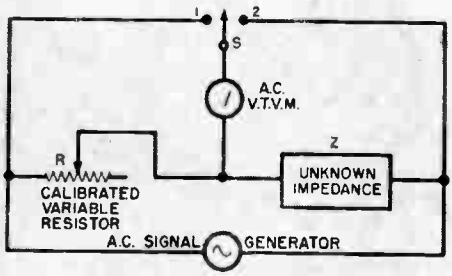
For economy and simplicity, where extreme accuracy is not required, a volume control-type potentiometer can be used as the variable resistor. But since the resistance setting of such controls cannot be read below about one-tenth of their full resistance reliably, several controls would be needed to cover an appreciable impedance range. In order to simplify the process, a three-gang control (*R1-R2-R3*) has been employed in the completed impedance checker. See Fig. 1 for the circuit. This checker has a range of 50 to 50,000 ohms.

All three controls (500 ohms, 5000 ohms, and 50,000 ohms) have linear tapers (taper A). The three-gang unit must be assembled by the operator in the following manner. The basic potentiometer (*R1*) with the shaft is an IRC Type PQ11-103 500-ohm unit. To the back of this control, fasten an IRC Type M11-114 5000-ohm rear section. And to the back of the latter, fasten an IRC Type M11-123 50,000-ohm rear section. Complete instructions for the simple assembly operation are supplied with the control and rear sections.

The single-pole, three-position switch, *S2*, provides range switching by permitting selection of the potentiometers. *S1* is a push-button switch used to connect the external vacuum-tube voltmeter either across the potentiometer selected by range switch *S2* or across the unknown impedance connected to terminals No. 5 and 6. In the resting position (B) of this switch, the meter is



The complete setup for impedance measurement consists of audio signal generator (left), a.c. v.t.v.m. (right), and basic impedance checking unit (below).



HOW IT WORKS

The unknown impedance in this arrangement is connected in series with a calibrated variable resistor and an a.c. signal generator. The a.c. vacuum-tube voltmeter is switched back and forth to read the voltage drop across the calibrated variable resistor and the unknown impedance. Adjust the variable resistor so that the readings are equal. The unknown impedance is then read from the dial or scale of the variable resistor.

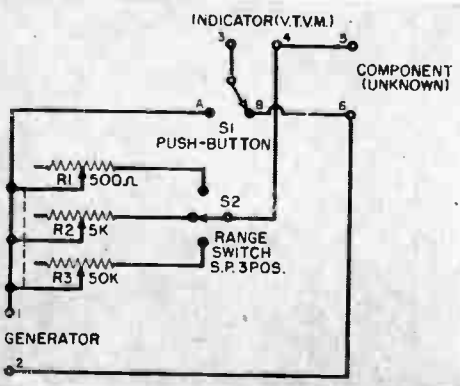
connected automatically across the impedance. When the button is depressed, the meter is switched across the potentiometer (position A).

The instrument is built in an aluminum chassis box—7" long, 5" high, and 3" deep. The front panel layout is clearly visible in the photo at the top of page 91, and internal wiring is shown in the photo at right. Insulated binding posts are used for the generator, component, and indicator terminals.

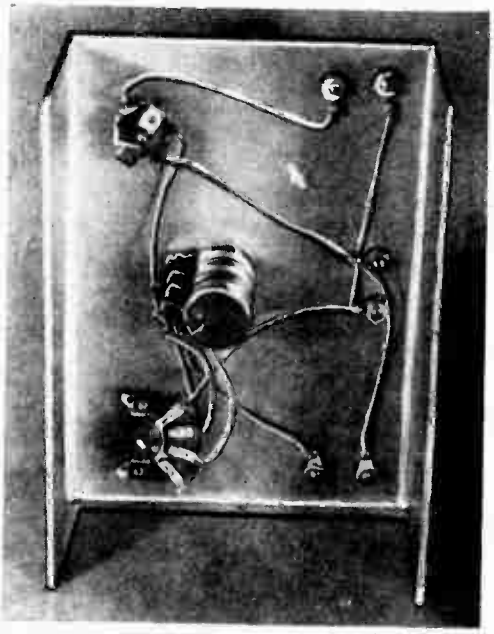
R1, R2, R3—3-gang, linear taper potentiometer (R1 = 500 ohms—IRC Type PQ11-103, R2 = 5000 ohms—IRC Type M11-114, R3 = 50,000 ohms—IRC Type M11-123), see text
S1—S.p.d.t. push-button switch (Switchcraft 203 or equivalent)
S2—S.p. 3-pos. wafer switch (Centralab 1461 or equivalent)
6—Insulated binding posts
1—Aluminum box, 7" x 5" x 3"
1—Small finger-grip knob with pointer
1—Large pointer knob
Misc. wire and solder

Catalog price of parts, approx. $6.50

Fig. 1. Circuit of impedance checker.

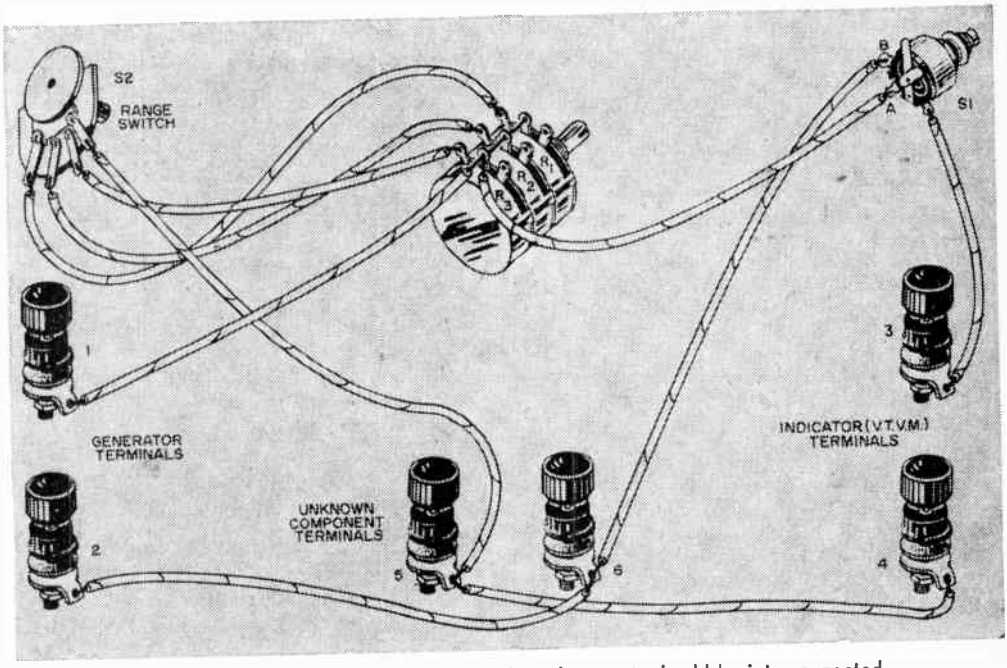


Use an ohmmeter to calibrate the impedance checker. The calibration procedure is as follows: (1) Fasten a blank paper square temporarily under the pointer knob of the three-gang potentiometer. (2) Connect the ohmmeter to binding post terminals No. 1 and 4. (3) Set switch *S2* to its 500 position. (4) With the aid of the ohmmeter, set the potentiometer to 50 ohms. Mark this point "0.5" on the paper scale. (5) Next, set the potentiometer to 100 ohms and mark this point "1." (6) Continue until as many calibration points as possible have been obtained up to 500 ohms, and mark this last point "5." (7) Obtain as many fill-in resistance points as possible (points like 75, 125, 175 ohms). (8) Remove the scale, ink in the figures and lines, and replace the scale (using the ohmmeter to line up the knob pointer with the 400- or 500-ohm line).



Under-chassis view shows internal wiring.

Use of a single resistance scale for all three potentiometers assumes that the three "track" well. Tracking means that when *R1* is set to 250 ohms, for example, *R2* will be at 2500 ohms, and *R3* at 25,000 ohms. Actually, conventional volume controls do not track this closely. However, the single scale will be close enough for many practical applications. Where accuracy is desired, the builder can draw three separate scales (as concentric circles), repeating the calibration procedure for each position of *S2* but remembering



Pictorial diagram of impedance checker shows how parts should be interconnected.

that the resistance ranges and ohm calibration points will be different for each—500 ohms maximum for *R1*, 5000 for *R2*, and 50,000 for *R3*.

To use the impedance checker: (1) Connect an audio oscillator, set to the desired test frequency (usually 400 or 1000 cycles), to terminals No. 1 and 2. (2) Connect an a.c. vacuum-tube voltmeter to terminals No. 3 and 4. (3) Connect the unknown impedance to terminals No. 5 and 6. (4) Switch on the oscillator and meter. (5) Set switch *S2* to its 500 range. (6) Observe the meter reading. (7) Depress push button *S1* and rotate the potentiometer knob. (8) Alternately release and depress *S1* while watching the meter reading and adjusting the potentiometer control. (9) When the potentiometer is adjusted properly, there will be no shift in meter reading as *S1* is pressed and released. If this point is not obtained in the first (500) range, switch to the 5000 range and continue the operation, and to the 50,000 range if necessary. (10) When the point of no meter shift is obtained, read the potentiometer dial and note the range to which switch *S2* is set. This is the unknown impedance value.

When 60-cycle impedance measurements are acceptable, the audio oscillator is not necessary. In its place, connect the 6.3-volt secondary of a power-line-operated filament transformer to the *generator* terminals No. 1 and 2. —30—

Modern "Radar-Lamp" Replaces Kerosene Lantern

THIS modern-day version of the old-fashioned kerosene- or gasoline-fueled utility lantern is powered by a two-in-one battery which yields up to four times the life of the ordinary lantern battery. The lantern head is attached to the completely self-contained battery with two simple screw caps. There are no wires to connect or spring contacts to make.

Developed by Burgess Battery Company, Freeport, Ill., the "Radar-Lamp" is simple and safe to operate. Both windproof and weatherproof, it is convenient for outdoor, sports, home and industrial use. The lantern sells for $8.95 complete with battery.

what's new in hi-fi

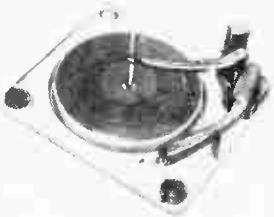
LAFAYETTE RADIO
100 Sixth Ave.
New York 13, N. Y.

Coaxial speaker (12"), Model SK-58, has frequency range of 30 to 15,000 cps and is rated at 20-watts maximum output. Woofer cone is made of processed fiber with free edge of sheepskin to suppress unwanted vibrations. Cone tweeter (2½") is mounted in its own metal case with covering grille. Crossover network is built in. Tweeter level control permits variation of up to 6 db. Voice coil impedance is 8 ohms. Net price, $29.50.

SONOTONE CORP.
Saw Mill River Rd.
Elmsford, N. Y.

Ceramic phono cartridge, Model 3T, is turnover type with two styli, one for microgroove discs and the other for 78-rpm records. Cartridges in this series are available with either diamond or sapphire styli. Because of high signal output, no preamplifier is needed. Playback characteristics obviate the need for phono equalizer. Net price of pickup with two sapphire styli, $5.95.

ROCKBAR CORP.
650 Halstead Ave.
Mamaroneck, N. Y.
Att: M. Wimpie



Record changer, Model RC-456, operates at three standard speeds (78, 45, and 33⅓ rpm) as well as new 16⅔-rpm speed. Records of varying diameters (7", 10", and 12") may be intermixed on spindle for automatic playback. Manual operation at all four speeds is also possible. Other features include automatic idler disengagement, 4-pole induction motor, rubber-covered turntable, easy interchangeability of all standard cartridges. Net price, $34.50.

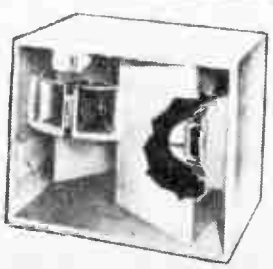
FENTON COMPANY
15 Moore St.
New York 4, N. Y.

Tape deck and matching preamplifier are available as separate units for custom installation, or as combination in Model BCC carrying case. Brenell tape deck and PRO-2 preamp is complete hi-fi system for recording. Playback is via an external amplifier and speaker. Deck and preamp combination may be used either horizontally or vertically. An 80° tilt makes loading of tape a simple "drop-in" operation.

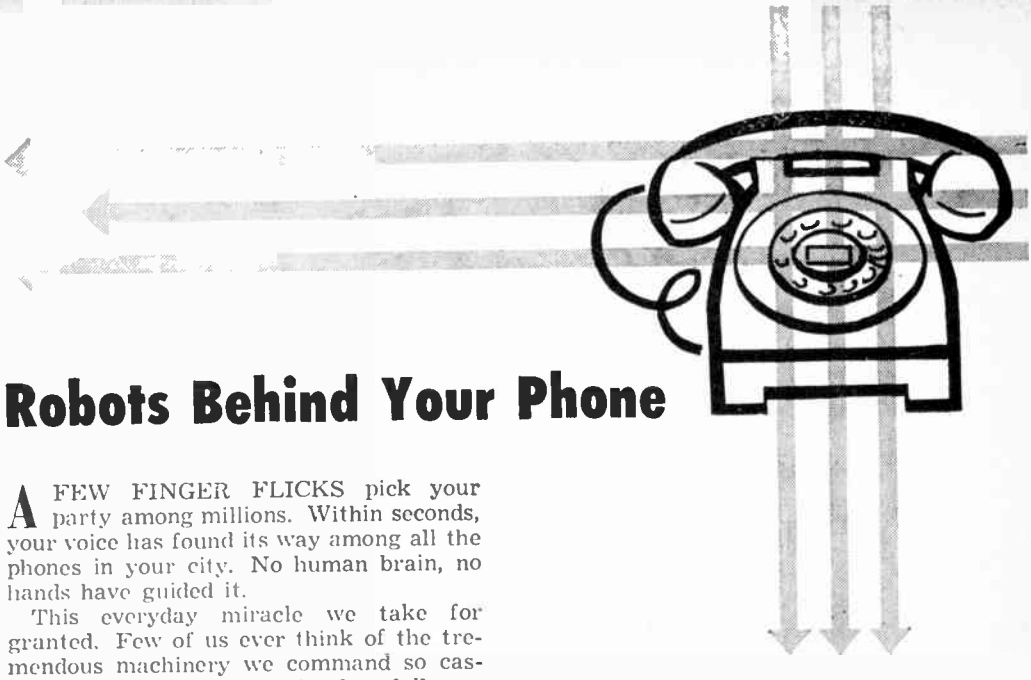
SHERWOOD ELECTRONIC LABORATORIES, INC.
2802 W. Cullom Ave.
Chicago 18, Ill.

FM-AM tuner, Model S-2000, features high sensitivity and automatic frequency control on FM. AM section provides choice of 16-kc. "hi-fi" bandpass, or sharply selective 5-kc. bandwidth for listening to weaker stations. Flywheel tuning and directable ferrite rod antenna are used. Unit is designed to play through external amplifier.

UNIVERSITY LOUDSPEAKERS, INC.
80 South Kensico Ave.
White Plains, N. Y.
Att: Desk PA-8



Enclosure for 3-way speaker system is utility model in unfinished ¾" fir plywood. Model EN-CB uses rear horn-loading. Having over-all dimensions of 40" by 30" by 24", it can be used horizontally or vertically, or as part of a room divider. It may also be used as part of a built-in or wall-to-wall installation. Descriptive brochure is available from manufacturer. Net price, $120.00 (not including speakers shown).



Robots Behind Your Phone

By H. H. FANTEL
Associate Editor

What happens when you dial? Let's follow your call right down the line where "thinking" switches ring in a new era

A FEW FINGER FLICKS pick your party among millions. Within seconds, your voice has found its way among all the phones in your city. No human brain, no hands have guided it.

This everyday miracle we take for granted. Few of us ever think of the tremendous machinery we command so casually. Yet here we have the first fully accomplished case of large-scale automation.

The Girl and the Robot. The easiest way to understand the principle of any telephone exchange is to watch the girl who runs a manual switchboard. Let's see what's behind the "voice with a smile."

When you lift your receiver, a light flashes below your line jack on the board. The girl plugs her headset into your line. "Number please," she asks. You tell her the number and she plugs a "patch cord" between the two phones to be connected. Then (with another switch) she sends a ringing current down the line. Another lamp tells her when your party lifts the receiver and your call is answered. When one of you hangs up, the lamp flashes again and she pulls the plugs out. The lines are free again.

The automatic exchange does basically the same thing. You lift your handset. Immediately, metal arms start groping for your line terminals. Once they have found them, you hear the dial tone. This is the machine's way of saying "number please." The automatic exchange is now "listening" to you.

You dictate the number through the dial. The clicking as the wheel spins back has a precise meaning for rows of robots. Each click sends an electric pulse through the wires; each pulse is a command that stirs whole banks of switching relays into action. They do the actual connecting, ringing, disconnecting, or reporting "busy."

Old Army Game. Some dial telephone systems work like the chain of command in a military organization. You, with your finger on the dial, are Commander-in-Chief. Each of the 10 digits on your dial selects another 10-digit switch at the exchange. Your second flip of the dial picks one of the 10 numbers in the selected switch at the exchange.

Look at the diagram on page 96 showing your phone with its 10-digit dial and ten multi-switches at the exchange. Right there you have $10 \times 10 = 100$ choices. (Strictly speaking, you only have 99 choices unless you are in the habit of talking to yourself. Besides, your phone would be "busy" if you tried it.) Add another row of 10-digit switches and you have $10 \times 10 \times 10 = 1000$ choices, and so on.

Going back to our army comparison, we might say that each succeeding bank of switches represents a lower rank, controlled by the preceding bank of superior "rank." Think of it this way. The Commander-in-Chief at your own phone controls 10 generals at the exchange, who control 100 colonels, who control 1000 majors, who control 10,000 captains, etc. But to keep your ego within bounds, think of what happens when somebody else calls you. Then the whole picture is reversed, and you become a "buck private" on the last row of switches.

Step-by-Step Switching. The first switch link at the exchange is called the line finder. It seeks out your line to send

you the dial tone when you lift the receiver. Unless the exchange is jammed with calls, it works so fast that the dial tone already hums in your phone by the time it touches your ear. The last link that actually puts you through to the number you want is called the *connector*. All the other intermediate links are called *selectors*.

In actual design, these switches are stacked atop one another, ten to a stack. In response to your dial pulses, a contact arm travels like an elevator up and down along these switch stacks to select the right level. Say you dial "4." The contact arm zooms up to the fourth "floor" of the switch. Then it scans horizontally among the 10 available contacts of level 4 to find a free line among them. With this line, it puts you through to the next switching stage (which may be somewhere in another part of town) for your next dial digit until the last one finally completes the connection.

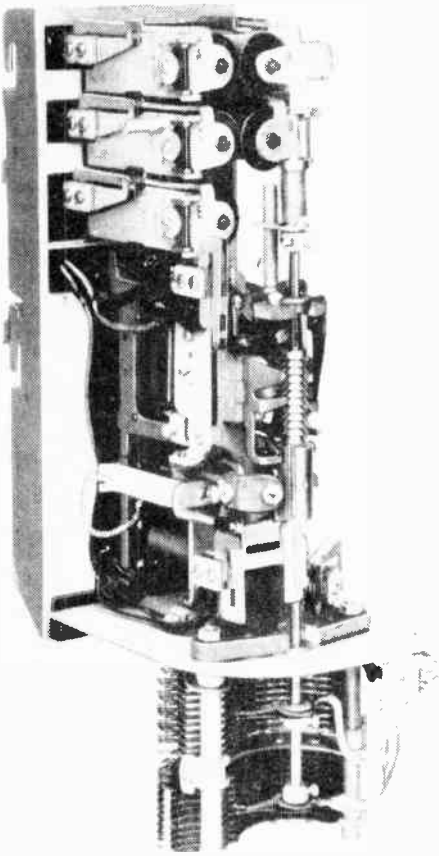
You dial "46" in a step-by-step system for 100 phones. Heavy line shows resulting connection. Each digit works the next row of switches, multiplying the number of choices by ten. Only one route is possible between switch rows of larger systems unless parallel duplicate lines are provided to avoid traffic congestion and frequent "busy" signals. Spare lines have to "stand by" for peak traffic hours. Crossbar system (shown on next page) eliminates need for extensive duplication of facilities.

This system, invented by an undertaker who took a part-time interest in electricity, was called "step-by-step" switching and is still used in many localities.

Traffic Jam. First used in 1892, automatic step-by-step switching was the electromechanical marvel of its day. In later years, however, the telephone system in our larger cities grew to the point where busy lines threatened to bottle up telephone traffic within and between the various exchanges.

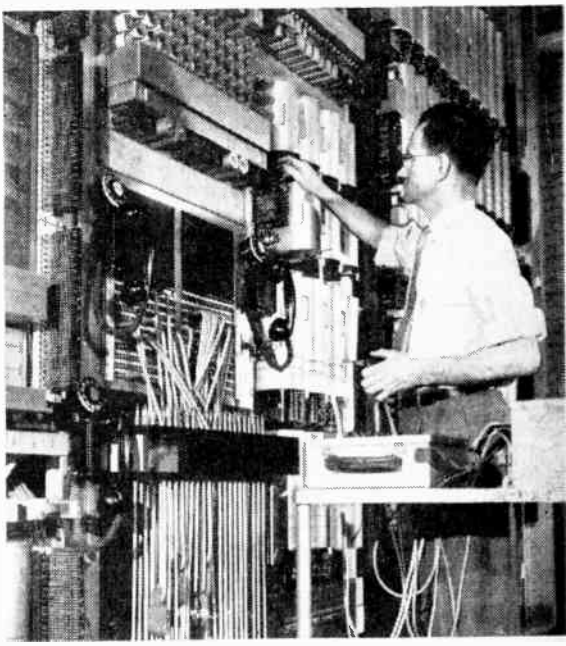
If a trunk between the switch banks was busy, calls had to wait. Behind each busy signal on a main interexchange trunk, calls might pile up like traffic behind a stalled car. To avoid such jams, more and more switch banks had to be added, operating in parallel to provide alternate voice paths. It was like adding lanes to the highway to let the cars flow abreast rather than behind one another.

The extra lanes were filled at peak hours, but at other times, much of this ex-



Actual switch in step-by-step system (left) is more complex than it appears in the diagram on preceding page. Top part contains electromagnets and relays to receive signals and control both upward and sideways motion of contact arms. Beneath the horizontal platform are the actual contacts, built up in sets of ten layers each. Wiper arms climb up to proper layer, then sweep across terminal bank until the correct contact is found.

Technician checks row of switches in protective metal cylinder (below). Manual plug cords in foreground connect to long-distance trunk lines.



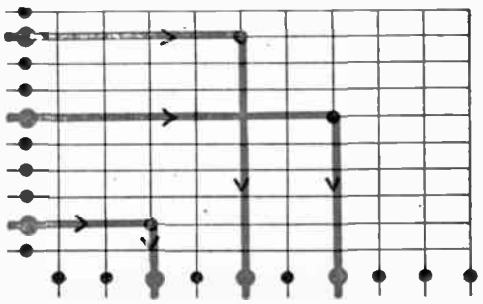
pensive equipment lay idle. A more economical and efficient way of dealing with the problem had to be found.

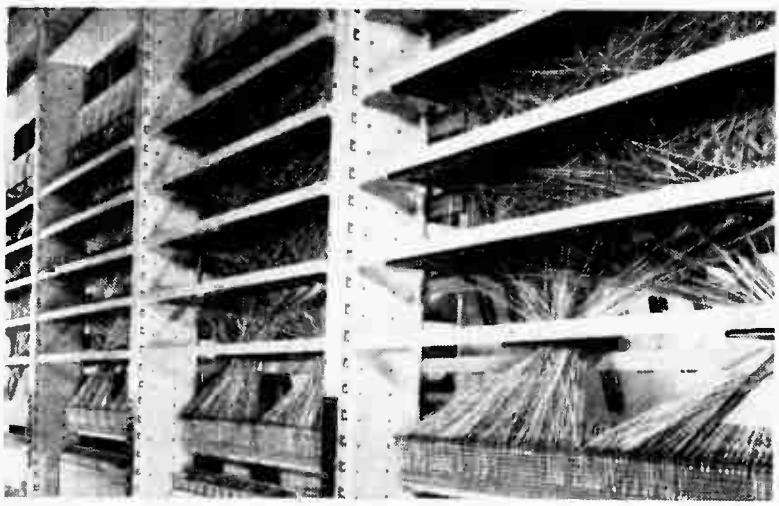
After years of research, Bell Telephone Laboratories came up with the answer. They solved the problem by a new kind of logic applied to the whole switching system. Lines were connected in an interlaced network so that a number of alternate routes existed between any two points. A call could then "sidestep" a busy line section and literally go around it. This is like branching off to a side street when the main highway is blocked. In telephone language, this is "crossbar switching."

The old step-by-step system picked the path between the originating and the terminal telephone in successive stages, one link at a time. The crossbar exchange, before starting the call on its way, "looks at" all possible paths to select one that will not be blocked at any stage.

The Thinking Switch. The crossbar exchange "plans" the best routing of each call for the over-all traffic situation at any given moment. It works like a travel agent selecting a route according to free res-

Crossbar principle permits connections to be made as shown in matrix below. Unlike the step-by-step method, this system always offers a choice of alternate paths from one point to another, somewhat like playing tic-tac-toe. Complex switching systems automatically analyze traffic situation within matrix and pick best possible path for any call at any given moment. Beyond the tic-tac-toe level, Dr. Claude Shannon of Bell Laboratories has employed similar principles to build switching devices smart enough to beat him at chess.





Wire jungle behind switch racks of a crossbar exchange forms vital communications links for the life of a large city. The vast criss-cross pattern of interconnections reflects the multilayer structure and complex social organization of the city which it serves as nerve center and as vocal cords.

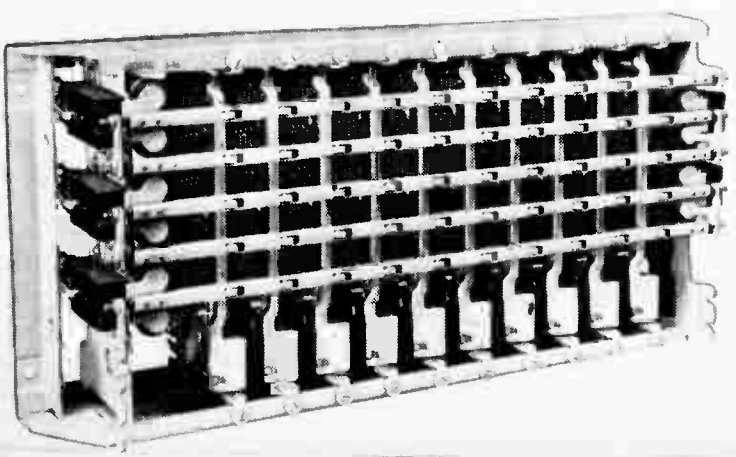
ervation space on various trains. Since the telephone "train" travels at the speed of light, it is faster to take a detour than to wait for someone to hang up.

This job goes far beyond mere switching. It requires judgment and control: the making and carrying out of decisions. Even that is now done without human aid. Within about half a second, a special Control Section marks the points through which the call must go and chooses an instantly available path between those points. Then it feeds this information to the Switching Section, which does the actual connecting.

The Control Section does its "thinking" in terms of open and closed relays. The pattern of "open" and "closed" contacts establishes the possibility or impossibility of a certain route. Information is recorded by closing certain contacts. This is somewhat like punching a number into an adding machine. The keys stick down until the addition is made. In the telephone exchange, the activated relays stay closed and trigger the necessary further action until the call is completed.

Research on the automatic crossbar exchange, completed before the war, opened scientists' eyes to an amazing fact: complex switching networks are able to "think out" alternative possibilities and check their own "conclusions." From here it was only a few more mental jumps to the digital computers which now perform the miracles of modern automation at lightning speed. Yet each such mental jump represents a rare product of inspired imagination, and each theoretical advance had to be backed by years of painstaking laboratory development.

Today, with the far horizons of automation before us, few of us realize that all the human freedom promised by the automatic machinery of the future started behind the dial of the telephone. Think of it the next time your phone rings. —30—



Crossbar switch for 100 lines does the actual work shown in diagram on page 96. Contact is made by automatic tilting of horizontal and vertical bars. This is the basic unit of elaborate switch systems capable of choosing among alternate routes.

How "Hi-Fi" Is Your Living Room?

By EUGENE F. CORIELL
Lt. Col., USAF

The listening room is one component whose fitness for hi-fi is up to you — here's what to do for best results

MANY HI-FI ENTHUSIASTS are being robbed of the full richness of sound their systems are capable of putting out. The thief is nowhere in the system and not part of any of the components. It is the listening room itself! A double-headed monster, this audio criminal blasts you with noises from the outside and—at the same time—plays havoc with reverberation effects, resonances, standing waves, and generally poor acoustics within the room. Here's how to lay low this annoying thief and keep his noise from getting in, as well as to prevent his "inside job" from ever reaching dangerous proportions.

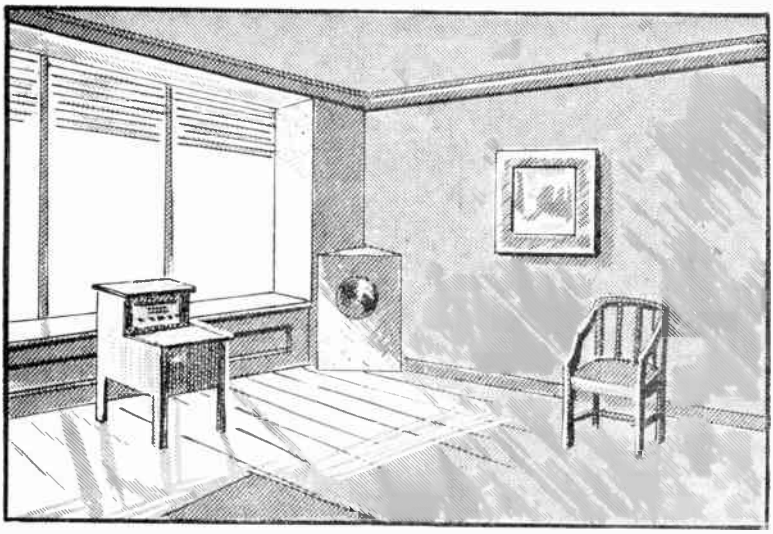
Generally speaking, the outside noise requires prevention and insulation, and the inside job involves absorption and dispersion. These terms may sound formidable, but you don't have to be an architect or an acoustic engineer to come out ahead.

The Noise Menace. Sources of outside noise include traffic, children playing, nearby building construction, and—horrors—the neighbors' hi-fi systems. Also, noises from other parts of the house find their way into the living room. Among these could be the sounds of conversation in different rooms, the refrigerator and other appliances, bathroom fixtures, players in the basement recreation room, radios and TV sets, footsteps, etc.

No music will sound its best in a noisy room. In the first place, extraneous sounds will obviously distract the listener. Also, the higher the noise level, the more it covers up or masks the music. An interesting and sometimes overlooked effect of such masking is that it narrows the range of tones or frequencies that can be heard. The curves in the chart on page 102 clearly show that the ear hears the middle frequencies much better than the highs and lows. This effect is less pronounced at the higher listening levels. For example, the ear sensitivity curve for 50 decibels intersects the 45-db room noise level at 300 cycles and at approximately 6000 cycles. These two points then determine the tonal range that the average listener will be able to hear at this room noise level, although his hi-fi gear was designed for a much wider range.

The curves also show that if the room noise is reduced to 40 db the hearable tonal range is broadened, becoming approximately 190 to 7000 cycles. Still not hi-fi, but we are on the way! If the room noise is reduced another 5 db, to 35 db, which may take some doing, the 50-db curve shows a much wider hearable range—really taking us into the hi-fi region. If the room noise level can't be squeezed down that last 5 db, don't despair. The curves show that increasing the listening level from 50 db to 60 db results in similarly large improvement. More on this later. Another point: low noise levels make it easier to hear the softer musical passages.

Reducing the Level. The first step in reducing the noise level is to prevent or reduce some of these outside sounds. Radios and TV sets can be operated at somewhat less volume. Loud conversation in adjacent rooms can be discouraged, although the attempt to do so may itself prove discouraging. Noisy appliances like refrigerators and washers can sometimes be quieted by repairs or by placing them on isolated mountings or on a sheet of rub-



Very "live" room (left) has little or no sound-absorbing materials on walls, floor, or window. Exposed surfaces combine with polished wood of furniture, glass over hanging picture, and general bareness to create room with long reverberation time. This room is too live; bounce, boom, and random echoes distort what is heard in it.

ber—or even on a piece of carpet. Noisy plumbing can be equipped with a quieter type of mechanism, and pipes—if accessible—can be wrapped with insulating material.

Noises transmitted through piping can often be reduced by inserting a piece of flexible rubber tubing in the pipe near the noise source. Footsteps from upstairs or adjacent rooms can be softened by carpeting, preferably with a pad underneath. Door-slams can be prevented by door-checks, and a gasket of weatherstripping on the door jambs will reduce noise leakage around the door.

Residence doors sometimes have a large crack at the bottom which can be closed to some extent by fastening a heavy piece of felt near the bottom of the door. If you want to be really professional about this, let a carpenter install a "drop-seal." This is a spring-loaded length of felt which is mortised into the bottom edge of the door so that it is flush with the edge when the door is open. Closing the door triggers the felt down against the floor.

Doors with thin panels can be made to transmit less sound by building them up with sound-absorbing tiles or sheets faced with plywood. Sound-absorbing tiles on the ceilings and sometimes on the walls of noisy adjacent rooms reduce the sound level in those rooms and thereby lessen the amount of noise available for leakage into the music room. These steps are not as extensive or expensive as the techniques used in broadcasting studios—but they can help a great deal.

Tackling Outside Noises. Shrubbery and trees around the house offer considerable protection against street noises, as does a high and tight board fence. Support of local noise campaigns will also

Room at top of page has been treated to eliminate some of the unwanted bounce that could make the best loudspeaker sound like a foghorn. Small drapery adorns window, the floor boasts a medium-sized carpet, and an upholstered chair has been placed for comfort as well as good acoustics. Room is still a bit "live."

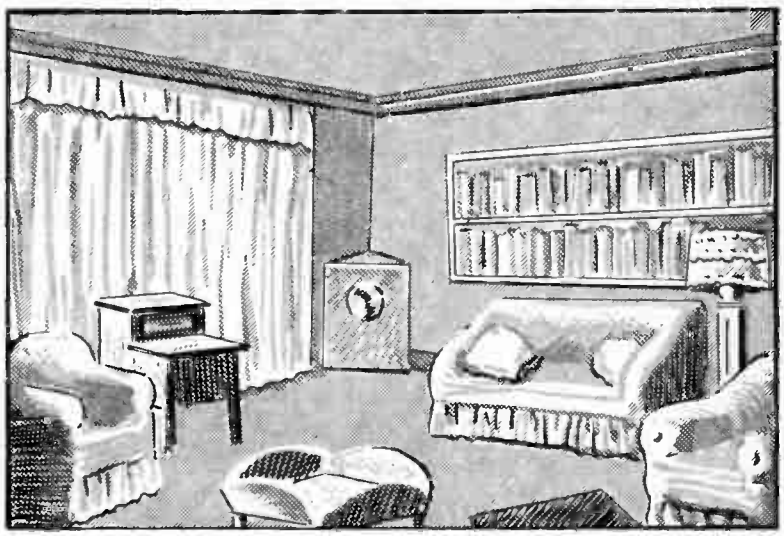
help. These measures are probably all that can be done to reduce the effect of outdoor noises in summer when the windows are open. However, when the windows are closed in winter, weatherstripping will reduce noise leakage around window frames. Double-paned windows, such as sealed "Thermopane," storm windows and storm doors also help. Details on noise reduction in residences are contained in a very clear and interesting booklet entitled "Home Noise And What To Do About It"—available free from the National Noise Abatement Council, 36 West 46th St., New York 36, N. Y.

"Live" and "Dead" Rooms. The second acoustic problem facing the home music listener is the control of sound he *wants* to hear in the listening room—that is, the speaker output. One element of such control is *absorption*. Some rooms are more "live" than others. In such rooms, sound tends to linger. In doing so, it alters the quality of succeeding sounds. An extreme example of excessive liveness is the shower stall where the highly non-absorptive wall tiles bounce the sound around and around before it finally dies away. This phenomenon, known as "long" reverberation time," explains the highly unnatural effects achieved by the bathroom baritone. On the other hand, a room may be so highly absorptive or "dead" that speech and music sound dull and lifeless.

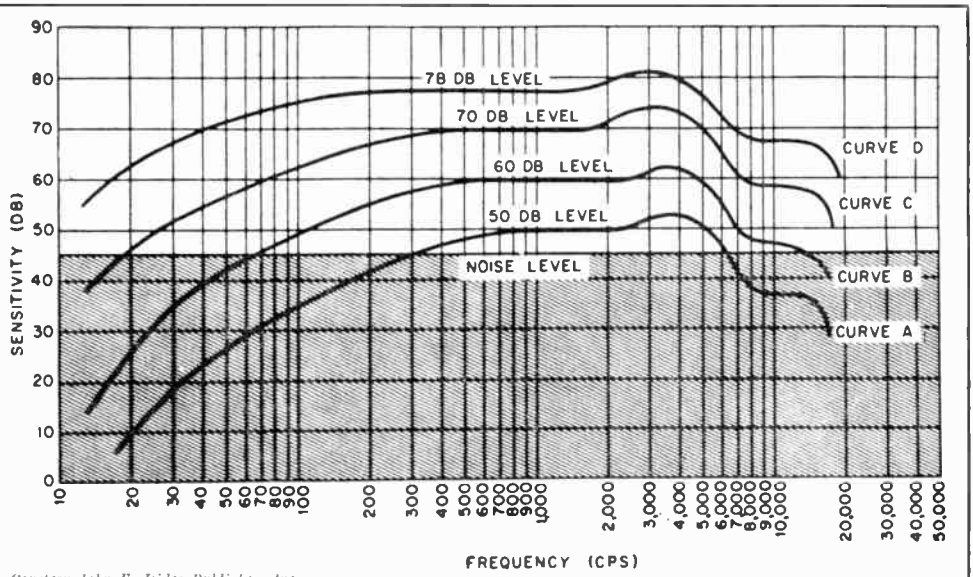
Most rooms are somewhere between totally "dead" and "live," having some absorptive qualities. Carpets, upholstered furniture, drapes, and even people, absorb sound. Just how live the music room should be is, to some extent, a matter of personal preference. If the room is already too dead, a few suitably decorated plywood panels distributed around the room by trial is an inexpensive remedy. Of course, you could take up the rug and expose the relatively non-absorbent floor, or chase your friends and family members out (they might be surprised to learn that they are absorptive, acoustically), but it is probably simpler to use the plywood. Sometimes, drawing back the drapes or repositioning a piece of furniture can tip the subtle balance from too dead to just live enough.

If the room is too live, one solution is to install acoustic tiles on the ceiling, and sometimes on a portion of the walls. Typical tiles of the perforated and fissured types are shown in the photo on page 103. These are highly porous and absorb sound by permitting the sound waves to vibrate the fibers of the material. The frictional resistance of the fibers to vibration transforms the sound energy into heat. These tiles are available in a variety of styles and colors and may be cemented to the existing ceiling or wall, or may be nailed to a light wooden framework of furring strips applied to the original surface. Such work is often within the capabilities of the do-it-yourself fan, in which case the only costs involved are those of the tiles and furring material—which are relatively inexpensive. Another way of reducing room liveness when the finished appearance is not too important—possibly in a basement rumpus room—is to cover some of the ceiling and wall surfaces with egg-crate separators.

Probably the most generally accepted way to sound-treat a room in the home is to add carpets (preferably with pads underneath) and drapes, the latter having the advantage that they can be tried experi-



Same room is now fairly well damped. Note the full drapes on the windows, the wall-to-wall carpeting, the abundance of upholstered furniture with some cushions included for good measure. Rows of books also help absorb unwanted reverberation. These effective steps can be taken without practically rebuilding the house itself.



Courtesy John F. Rider Publisher, Inc.

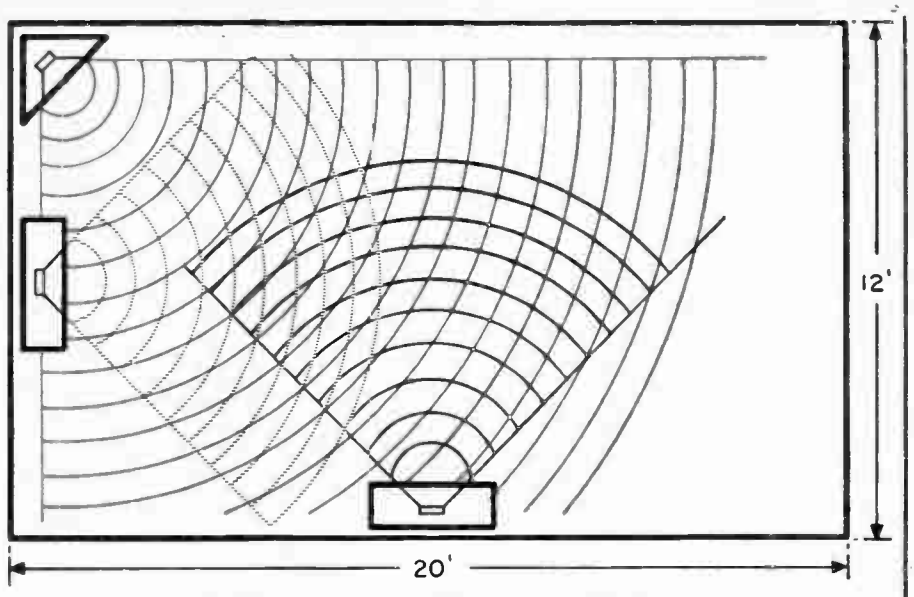
Curves show ear's sensitivity to sounds in audio spectrum when played at various listening levels. The 45-db line represents the noise level in an average city residence. Note how this noise masks highs and lows, thus limiting frequency range heard. For full-range listening, either the hi-fi set's volume must be increased or room's noise level decreased.

mentally in small increments. Drapes and curtains have better absorption at the lower frequencies—which may be desirable to reduce bass boom—when they are hung some distance away from the walls. This distance can be determined by trial and is generally between six and twelve inches. Adding a lining to the drapes increases their effectiveness. For the reader who desires to go into the subject in greater detail, a twenty-five cent pamphlet entitled "Theory and Use of Architectural Acoustical Material" is available from the Acoustical Material Association, 205 West Monroe St., Chicago, Ill.

Remember: a room treated with acoustic tile or other similar material absorbs an appreciable amount of the loudspeaker output. It is therefore possible to operate the speaker at somewhat higher levels without serious annoyance to others outside the music room. This provides greatly improved tonal quality, if the room has not been made too dead. The ear-sensitivity chart shows that we hear much more of the lower and higher freqencies at the 60-db playing or listening level than at the 50-db level. Note that the 60-db curve intersects the 45-db noise level at 65 cycles and 13,000 cycles approximately. Compare it with the 300 to 6000 cycle range hearable at the 50-db playing level. This is one reason why the audiophile turns up the gain on his rig—he cannot hear the deep bass and high treble at low volume settings. The trick is to strike a compromise between the demands of wide-range reproduction and what the neighbors will stand—with somewhere around 75 to 80 db being a good level if you can get away with it.

Dispersion of Sound. Another factor in the control of speaker sound in the listening room is *dispersion*. When sound strikes a wall, some of it is absorbed by the wall, some is transmitted through the wall, and some is reflected from the wall. Even highly absorbent materials reflect sound. When a tone persists in a room due to repeated and sustained reflections between parallel surfaces, we have a lasting tone which is superimposed on succeeding tones, resulting in very unpleasant listening. For this reason, broadcasting studios are often built with no two walls parallel.

Another effect of parallel walls is the presence of live and dead spots—areas where the music sounds unusually loud or soft. This is due to the fact that loudspeaker sound arrives at any point in the room in two ways: from the speaker itself (direct sound), and from reflections of the direct sound bouncing off the walls, ceiling and floor. When the reflected sound arrives in phase with the direct sound, the two reinforce each other. When out of phase, they tend to cancel. The results are live and dead spots respectively. Such effects occur more often in rooms having

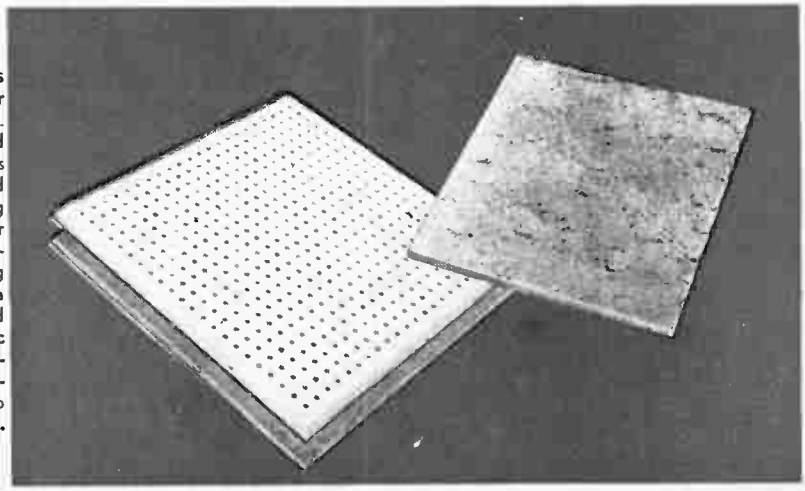


Typical sound dispersion patterns are available from three different positions in a room.

smooth parallel walls because such construction provides relatively few reflection paths, resulting in poor dispersion.

The ideal listening room would have no two surfaces parallel. Also, it would have many irregularities on those surfaces to provide as many random reflection paths as possible, thereby facilitating uniform sound distribution. The hi-fi fan can hardly be expected to throw his living room walls out of square, although some hardy enthusiasts may have done so. But there are some things he can do to achieve good dispersion. He can try relocating the loudspeaker, thereby changing the reflection paths (see diagram above).

If standing waves persist, hang mirrors and pictures, angled downward at the top, sports and hunting trophies and other items having irregular surfaces. You are limited here only by your imagination—or by what the lady of the house will accept. In any case, it might pay to check room acoustics before blaming your hi-fi rig for poor performance. Component manufacturers have—in most cases—licked their problems. Your room acoustics are strictly up to you. —30—



Two materials widely used for "deadening" a room. Left, perforated acoustic tile. This type may be nailed or stapled to nailing strips in wall. Thicker variety may be cemented to existing surfaces. Right, a square of "fissured mineral" acoustic tile. This type, noncombustible, is generally cemented to existing surfaces.

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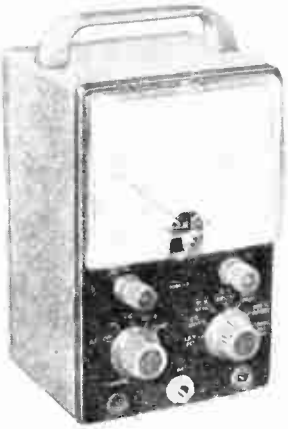

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Features 4½" 50 ua meter and 1% precision resistors.

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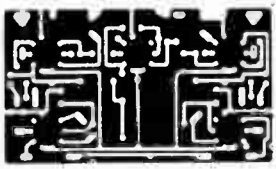

This compact little oscilloscope is just the ticket for use in the ham shack or home workshop. Measures only 9½" H. x 6½" W. x 11¾" D. Weighs only 11 pounds.

Employing etched metal circuit boards, the Model OL-1 features vertical response with in ±3 db from 2 cps to 200 kc. Vertical sensitivity is 0.25 volts rms per inch, peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for direct RF connection to deflection plates. Incorporates many features not expected at this price level. The 8-tube circuit features a type 3GP1 cathode ray tube.

Cathode-follower output for isolation.

No oscillator calibration required.

Covers 160 kc to 220 mc (including harmonics).

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This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument or for use in experimenting in the home workshop. High quality components and outstanding performance. Easy to build, and no calibration required for ordinary use.

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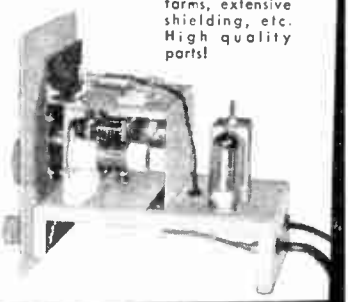
Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts!



This variable frequency oscillator covers 160-80-40-15-11 and 10 meters with three basic oscillator frequencies. RF output is better than 10 volts average on fundamentals. Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from a socket on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters.

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RF Amplifier Power Input	25-30 watts
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Tube Complement:	
5U4G	Rectifier
6AG7	Oscillator-Multiplier
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This CW transmitter is complete with its own power supply and covers 80, 40, 20, 15, 11, and 10 meters. Incorporates such outstanding features as key-click filter, line filter, copper plated chassis, pre-wound coils, and high quality components. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 30 watts plate power input.

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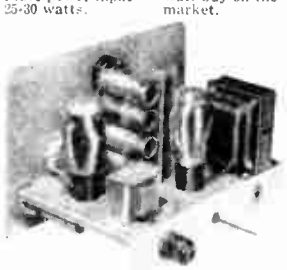
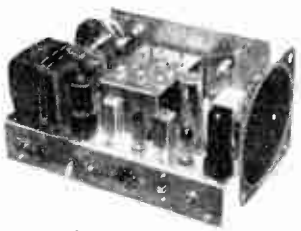
Best dollar-per-watt buy on the market.



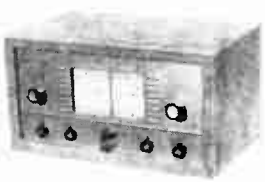
Slide-rule dial-electrical band-spread-ham bands marked.

Slug-tuned coils and efficient IF transformers for good sensitivity and selectivity.

Transformer-operated power supply for safety and high efficiency.



Heathkit COMMUNICATIONS TYPE all band receiver kit



$27.95 MODEL AR-3

Shpg. Wt. 12 Lbs.

CABINET: Fabric-covered cabinet available. Includes aluminum panel, speaker grille, and protective rubber feet. Measures 12-1/4" W. x 6-3/4" H. x 7-3/4" D. No. 91-15. Shpg. Wt. 5 Lbs. $4.60.

The Model AR-3 covers from 550 kc to 30 mc on 4 bands. Covers foreign broadcast, radio hams, and other interesting short wave signals.

Features good sensitivity and selectivity. Separate RF and AF gain controls—noise limiter—AGC—VFO, headphone jack—5½" PM speaker and illuminated tuning dial.

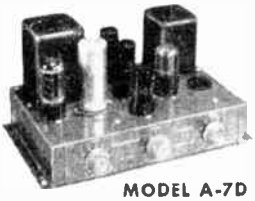
SPECIFICATIONS:

Frequency Range	550 kc to 30 mc on four bands
Tube Complement	1—12BE6 oscillator and mixer
	1—12BA6 IF amplifier
	1—12AV6 second detector, AVC, first audio amplifier and reflex BFO
	1—12A6 beam power output
	1—5Y3 full wave rectifier

HEATH COMPANY *A SUBSIDIARY OF DAYSTROM, INC.*

BENTON HARBOR 5, MICHIGAN

HEATHKIT ECONOMY 7-WATT HIGH FIDELITY



amplifier kit

MODEL A-7D

$16.95 Shpg. Wt.

This is a 7-watt high fidelity amplifier that will produce more than adequate output for normal home installations. Its frequency characteristics are ± 1½ db from 20 to 20,000 cps. Output transformer is tapped to match speakers of 4, 8, or 16 ohms. Separate bass and treble tone controls provided. Features potted transformers, push-pull output, and detailed construction manual for easy assembly.

MODEL A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for low-level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E. Shipping weight 10 lbs. **$18.50.**

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Describes more than 65 interesting "build-it-yourself" projects. Amateur equipment, hi fi amplifiers, and the complete Heathkit line of test instruments. Get yours today!

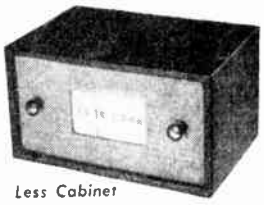
HEATHKIT BROADCAST BAND

receiver kit

MODEL BR-2

Shpg. Wt. 10 Lbs.

$17.50 Less Cabinet



You can build this table model radio and learn about radio circuit and parts during assembly. Complete instructions simplify construction, even for the beginner. Covers 550 to 1600 kc and features miniature tubes, 5½" PM speaker, and built-in antenna.

CABINET: Fabric-covered plywood cabinet as shown. Parts #91-9, shipping wt. 5 lbs. **$4.50**

HEATHKIT HIGH FIDELITY

fm tuner kit

MODEL FM-3

$24.50

Shpg. Wt. 7 lbs.

Tunes from 88 to 108 megacycles and features sensitivity and selectivity not expected at this price level. Cabinet supplied with the kit. Built-in power supply and a stage of audio to insure adequate output. Easy to build from step-by-step instructions and large pictorial diagrams.

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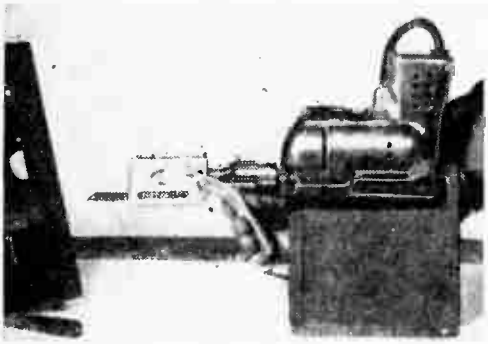
TIPS and TECHNIQUES

HACKSAW FITS ¼-INCH DRILL

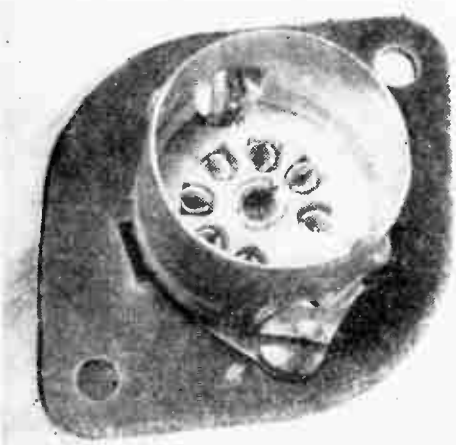
A hacksaw attachment for a ¼-inch drill, as shown, speeds up cutting of wood, light metal, angle-iron and the like. While the drill



shown is attached to a stand, the saw may be held with one hand and the drill handle with the other, making the stand unnecessary. The saw shown has a 2 to 1 reduction drive, and uses short regular blades. —*H.L.*

MOUNTING MINIATURE TUBE SOCKETS

Miniature tube sockets may be mounted neatly and easily in chassis holes cut for larger tube sockets by the method shown in the photo. The socket is mounted on one of the Bakelite or metal wafers furnished with



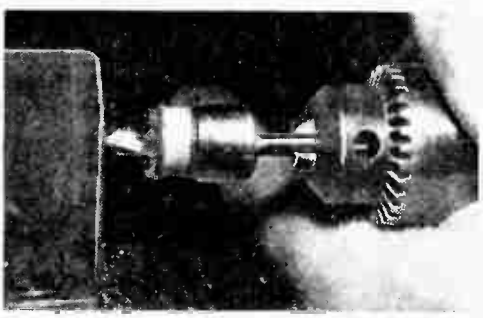
can-type electrolytic capacitors. This, in turn, is mounted over—or under—the chassis hole. It will be necessary to drill two small holes in the wafer to accept the screws that hold the miniature socket. Also, the center hole in the wafer may have to be enlarged slightly to accept the socket body. —*F.H.T.*

REMOVING WIRE INSULATION

A quick and easy way to get the insulation off the end of fine enameled wire so that it can be tinned and soldered is to heat the end of the wire first. Do this by dipping it in a solder pot or holding it in the flame of a match for a few moments. The heat burns the insulation and the charred residue will practically fall off when you scrape it gently with a knife blade or rub it lightly a few times with a small piece of fine sandpaper. Many present-day insulations are so tough that they are almost impossible to remove in any other way. —*F.H.T.*

BRUSH CLEANS WHILE DRILLING

A standard wire brush attached to a drill will clean shavings while the hole is being made. The one shown in the photo was developed at the Martin plant in Baltimore for removing aluminum cladding from duralumin. This permits positive electrical connections to



be made to aircraft structures. If a suitable wire brush is handy, it will prove a good dodge for most drilling.

—*Courtesy, The Glenn L. Martin Co.*

HOLE-DRILLING STUNT

It is always a good idea to center-punch the point where a hole is to be drilled in a chassis. If a center-punch isn't available, however, the hole can be drilled almost as accurately by sticking a piece of ordinary surgical adhesive tape, or friction tape, over the spot where the hole is to be drilled. Then mark the location of the hole on the tape with a lead pencil. The tape will help keep the drill point from wandering until it has started into the metal. Use the smallest drill you have as the starting drill, and then successively larger ones until the desired diameter is obtained. —*F.H.T.*

BETTER CARRIER-CURRENT OPERATION

Anyone who builds or purchases a carrier-current relay or intercom—that is, any unit which uses the a.c. power line to transport control or voice signals on an r.f. carrier—may find that the units will not work properly if there is a nearby r.f. bypass capacitor connected either across the a.c. line or from the "hot" side of the a.c. line to ground. Such bypass capacitors can be found in short-wave

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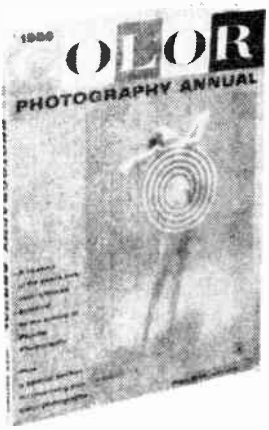

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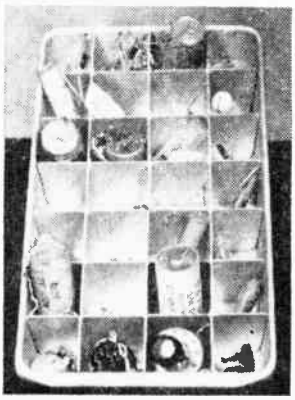
and communications receivers, where they serve to keep line noises from entering the set. And almost all noise filters in general use similar capacitors. Unplugging such filters and any short-wave or communications receiver from the line will often make a carrier-current device perform as it should. —*F.H.T.*

ICE-CUBE TRAYS HOLD PARTS

Tired of chasing small parts all over the workbench and floor? Try keeping them in an ice-cube tray. Surplus ice-cube trays, made of lightweight metal, make very suitable containers for resistors, capacitors, washers, lugs, and miscellaneous small hardware. The tray shown in the photo has 28 small sections and will fit in most service kits or carrying cases. Larger parts may be stored in this manner too, by enlarging the sections in the tray. This can be done by bending back and shearing off the metal dividers, as needed. —*H.L.*



REMOVING METAL FILINGS

Fine metal filings on the workbench can be mighty annoying. Difficult to remove by casual brushing, they can find their way into variable capacitors, causing noise and shorts. Several of these tiny metallic pieces in a loudspeaker can cause noise and distortion. In a wired chassis, they may result in intermittent shorts. Once lodged in your skin, they can be painful for days.

To eliminate this menace, and do a thorough cleaning job on your workbench, first brush off the heavier filings and scraps of metal. Then, wrap a number of turns of Scotch tape around your hand, *sticky side out*. Use this as a "pickup" pad to rub and pat the

top of the bench—you'll find that even the smallest filings will adhere to the tape's sticky surface.

This technique works well with all types of metal filings, whether aluminum, brass, or iron. If the filings happen to be all iron, you can use a small magnet to pick them up. But again, first wrap the magnet with the Scotch tape, and you'll find it a lot easier to clean after the filings are picked up. —*L.E.G.*

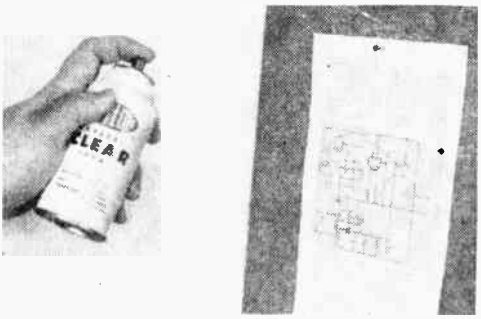
CURING REGENERATIVE HUM

Hum may develop in a regenerative receiver, preselector, or i.f. amplifier operating from an otherwise well-filtered a.c. power supply. This hum can often be eliminated or reduced by moving the supply further away from the receiver. In other cases, it may be cured by connecting a 47- or 100- $\mu\mu$fd. capacitor from each plate of the rectifier tube to the cathode or to chassis ground. Frequently, a single capacitor connected from plate to plate of the rectifier tube will work equally well.

A selenium rectifier will sometimes cause hum or create "hash" in a sensitive circuit. This condition can often be cured by connecting a 100-$\mu\mu$fd. capacitor across the rectifier terminals or from the transformer-connected terminal to chassis ground. —*F.H.T.*

PROTECTING DIAGRAMS

Schematic diagrams, charts, and other printed material may be protected from dirt and smudges by coating them with acrylic



plastic. What's more, once coated, the papers will lie flat and will have more "body" due to the extra thickness of the coating.

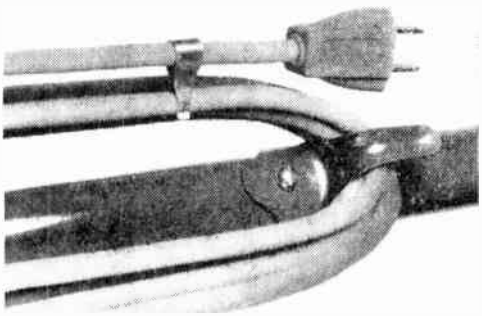
For best results, follow this technique, using the type of plastic that comes in a pressurized spray can. Tack the diagram to a smooth, flat surface. Spray on two thin coats, with the can held well back from the paper (about 12" to 18"). The plastic will be almost dry when it hits the sheet, and will seal the pores of the paper without soaking it. Allow the sheet to dry thoroughly and then apply a second, heavier coat with the can held closer to the paper (10" to 12"). Allow to dry, and coat the reverse side. —*L.E.G.*

CLIP HOLDS COILED POWER CORD

When coiling up a power cord, you generally have to twist its end and insert it between the turns of the cord so that it won't hang loose. Save time and do a neater job by making and using the little metal clip shown in the photo. You simply snap the clip onto the cord near its plug-end. Then, when you coil up the cord, slip the plug-end onto one of the turns of the coil.

The clip is a piece of springy metal about

½" wide, and about 2" long. It has been bent in the shape of a "U" and has two bulges in it to accept the cord. This one was made by removing the U-shaped metal spring from a dime-store plastic clothespin of the snap type. The two bulges were formed by inserting a



¼"-diameter metal rod and pressing with long-nosed pliers against the spring. The two ends of the clip were bent outwards a little, and the sharp edges of the metal were smoothed off to prevent damage to the insulation on the cord. —*A.T.*

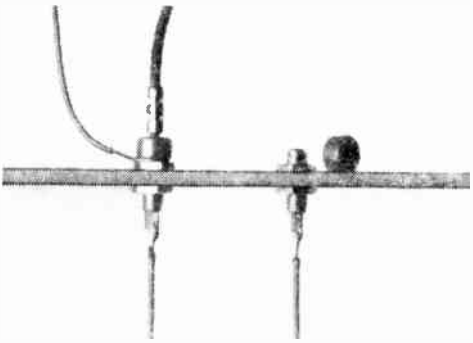
STORED METERS SHOULD BE DAMPED

Meters are often stored in a drawer or a cardboard carton. Such a storage method may seem safe; yet every time the drawer or carton is moved, the meter needles tend to swing back against its stops and may be bent or even damaged.

A good precaution against such injury is to connect a jumper wire securely across the terminals of all stored meters. When this is done, any movement of the needle will cause a small current to be generated in the meter's coil. The direction of the current flow will be such as to oppose any further movement of the needle. This process, which is called "damping," serves as an electromechanical shock absorber. —*F.H.T.*

QUICKLY MADE BINDING POSTS

Want to make quick wire connections to phone tip jacks? One easy way is to mount the tip jacks as shown in the photo. This

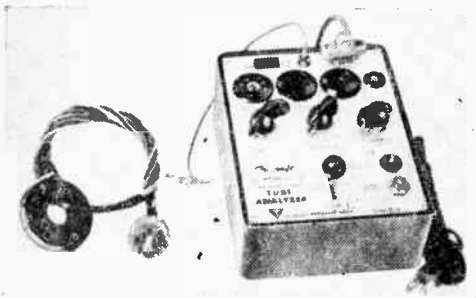


method allows the tip jacks to be used as binding posts without interfering with the insertion of the phone tips. —*A.T.*

TOOLS and GADGETS

TUBE ANALYZER

Compact and rugged, the Model 200 tube analyzer is said to test tubes better, faster and more thoroughly than instruments costing many times more. It will check all standard octal, loktal 7- and 9-pin miniature tubes for



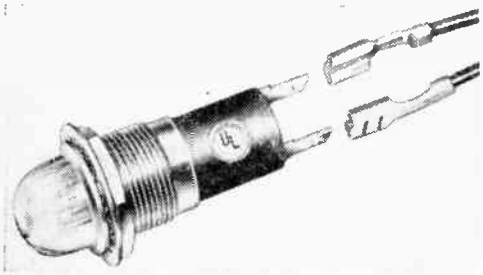
emission gas, shorts, opens, microphonics and filament continuity.

Each element is tested independently with the Model 200. And no circuit changes are necessary to check new tubes as they are developed. Price, $32.95. (*Tricraft Products Corp.*, 1535 N. Ashland, Chicago 22, Ill.)

PILOT LIGHTS WITH SPADE TERMINALS

A series of indicator lights which accommodate bayonet-type miniature lamps is now available from the Dialight Corporation with spade terminals. These terminals are the matching male parts for the convenient "quick connect" type of wire terminals. The connection is positive, with triple spring action.

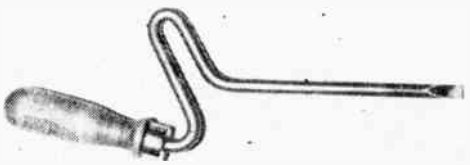
Mounting in an 11/16" clearance hole, this series offers a complete range of choice of



screw and friction lens caps with lenses of varied shapes and colors. The T-3¼ incandescent bulbs which are used may be had in 2- to 55-volt ratings. For commercial voltages, an NE-51 neon lamp can be employed. (*Dialight Corp.*, 60 Stewart Ave., Brooklyn 37, N. Y.)

FAST-ACTION SCREWDRIVER

Featuring a swivel handle and a unique U-bend in the shaft, "Tru-driver" is a new-type, fast-action screwdriver which can be manipulated with a mere twist of the wrist. It is claimed to be ideal for the small assembly line. Jobs that are especially time-consuming can be done up to five times as fast as with the conventional screwdriver.

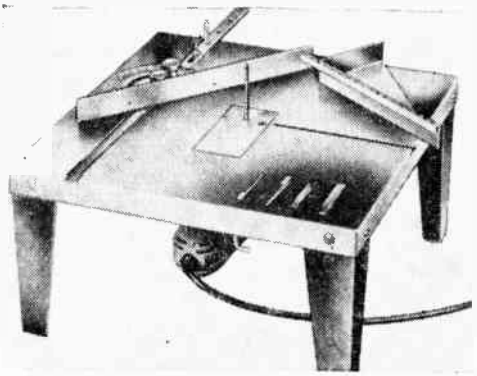


"Tru-driver" is available for either slot or recessed head screws. It has a guaranteed no-slip tip that grips the screw while you turn, lets go when you stop. (*Mayville Manufacturing Company*, Mayville, N. Y.)

ALL-PURPOSE SAW TABLE

Offered as a companion to the Wen Model 505 power saw, the Model 5-T-1 saw table is made of heavy-gauge steel. It comes with a good-quality protractor for measuring and marking angles which can also be used as a T-square. Saw and table are said to be ideal for ripping, angle cutting, squaring cuts, circle cutting, and making tongue and groove joints.

Furnished with the table and its jointer and circle attachments are five straight-shank blades. In operation, the teeth face toward the heel of the bottom plate—just the reverse of their position when the saw is used as a hand tool. There are anchor holes in the base



of the table if you should want to attach it to a workbench. Retail price, $12.50. (*Wen Products, Inc.*, 5804 Northwest Highway, Chicago 31, Ill.)

RUST-PREVENTIVE SPRAY

"Rust Chek" is intended for use on tools, molds, dies, instruments, nested metal parts and machinery. Packaged in a 12-ounce aerosol spray container, a can provides approximately 80 square feet of coverage in the form of a clear, dry, waxy film to a thickness of .0005".

Except in the case of precision instruments where critical tolerances are to be held, the film need not be removed when the protected tool is taken from storage and readied for

use. It works off in the using. In some cases, the film can serve as a lubricant. (*Eastern Aerosol Products*, Newfoundland, N. J.)

"POWER PORTER"

With a series of "Lectric Power Porters," a semi-permanent low-cost wiring system can be set up to handle all workshop needs. The "Porter" is made of U L-approved 8' heavy-duty extension cord equipped with a two-way safety control switch and sturdy twin block outlet with mounting hole that can be easily attached anywhere. The special switch is so designed that one outlet remains hot while the other can be switched on and off as required. Price of one unit is $3.50, postpaid. (*Unilectric, Inc.*, Milwaukee, Wis.)

POWER SUPPLY FOR MOBILE EQUIPMENT

An inexpensive 6/12 volt d.c. power supply has been designed to replace batteries in servicing LPI, low-power input, 10-watt mobile communications equipment. Less than half a cubic foot in size, the Model "H" has a dual range of 6 and 12 volts d.c. output from an a.c. line source. It provides excellent regulation for handling instantaneous current requirements from standby to transmission, and eliminates the inconveniences of recharging, acid spillage and deterioration of batteries. Net price, $66.00. (*Electro Products Laboratories*, 4500 N. Ravenswood Ave., Chicago 40, Ill.

TWO-SET TV COUPLER

The Telco "2-Set TV Coupler" makes it easier and more convenient to operate a pair of television sets from a single antenna. Appropriate for both u.h.f. and v.h.f., it is extremely compact and can be installed anywhere.

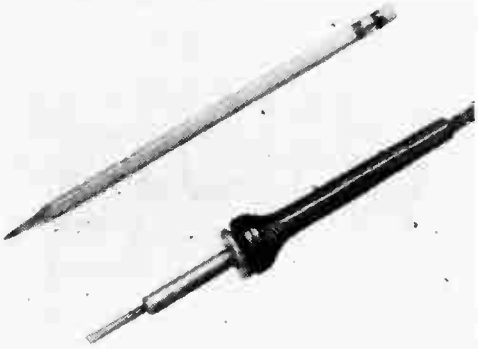
Impedance match for each set is maintained with a minimum of interference or insertion loss, and both sets retain their usual video frequency characteristics. List price, $2.75. (*Television Hardware Mfg. Co.*, division of *General Cement Mfg. Co.*, 919 Taylor Ave., Rockford, Ill.)

MIDGET SOLDERING IRON

In spite of its midget size (over-all length is just 7½"), the new Wall "pencil" soldering

iron is designed and built to survive production line punishment. Weighing only an ounce, and having a ⅛" tip, it incorporates a thermostatic principle — without thermostats — which controls heat so perfectly that fusing and tip-burning are eliminated.

Said to be ideal for delicate precision work on regular radio and TV circuits, printed cir-



cuits, and any intricate electrical work, the "pencil" iron causes no interference with radio, TV or radar, and reaches production heat four times faster than any soldering iron of equal tip size. Handle is kept cool with an exclusive "chimney" feature. (*Wall Manufacturing Company*, Grove City, Pa.)

LOW-COST DEHUMIDIFIER

Complete *except* for a cabinet, which cuts the cost down considerably, the "Dixie Air Dryer" combats rust, rot, mildew, mold, corrosion, warping and dripping pipes caused by dampness. The manufacturer claims that it will properly dry the air in a room or other enclosed space of up to 10,000 cubic feet, or 25′ x 48′ with standard ceiling height.

Moisture-laden air is drawn over refrigerated coils by a quiet, rugged fan. Cooling wrings water from the air which is caught in a pail, or allowed to drip into laundry tubs,

or carried through a rubber hose to a drain. At 90% humidity, the "Dixie" can remove three gallons of water every 24 hours, yet uses only about the same amount of electricity as a 200-watt light bulb. It is priced at only $79.50, f.o.b. Jackson, Mich. (*Adams Equipment Inc.*, Department 923, 511 S. Jackson St., Jackson, Mich.)

—30—

After Class

(*Continued from page 90*)

the oscillator in several different ways: they may be connected so as to form the greater part of the tuning capacitance of the oscillator, or they may be indirectly coupled to an independent oscillator through an impedance-matching network or a matching transformer (Fig. 4).

Applications are varied. The number of applications of dielectric heating to industrial processes increases by leaps and bounds each month. In the wood gluing field, for example, dielectric heaters have firmly established themselves. Since modern resin glues set through a chemical reaction rather than through moisture evaporation, this method of heat application is a "natural." Glue has a much higher loss factor than wood, thus developing most of the heat within its substance without charring the wood even slightly. Edge gluing to make panels out of narrow strips, assembly gluing in the manufacture of cabinets, bonding plywood, and laminating processes to make thick structural members are a few examples.

In the plastics industries, dielectric heaters are well established as tools in heat-sealing and curing. Raincoats, shower curtains, play-pools and plastic covers are now almost universally handled by these "electronic sewing machines." Smaller units, used for one-shot operations, seal plastic bags and containers at unheard-of rates—well over several dozen per minute.

Aside from the highly specialized manufacturing processes, the imagination of the public has been captured by movie and television demonstrations of home "appliances" such as dielectric corn-poppers, coffee roasters, and electronic ovens. Although these are somewhat premature (to put it mildly), the day will come when an oven that can prepare a whopping big Tom Turkey in five minutes will be within the budget of the average American housewife. Some day, too, the curling smoke from outdoor grilles will be replaced by five-second dielectric broilers which will handle hot dogs and hamburgers *faster* than your guests can consume them!

QUIZ

1. What is a dielectric?
2. In what kinds of materials, conductors or insulators, are orbital electrons tightly bound to their atoms?
3. What is heat?
4. In what two ways are dielectric heater electrodes coupled to their oscillators?
5. Why are high-frequency oscillators used in dielectric heaters?
6. What is meant by "loss factor"?

(Answers on page 118)

Transistor Topics

(*Continued from page 61*)

a drop in the cost of transistorized portable and home radios.

Minneapolis-Honeywell has also announced new, lower prices applying to their line of high-power transistors. Prices on some models are as much as 38% lower.

Transistor Testers. As your stock of transistors grows, you'll soon need some method of checking them, not only for sorting the "good" from the "bad," but also to check units which may have been accidentally overloaded in experimental circuits. And if you have any contact with transistors professionally, either in servicing or in engineering, you'll find that a transistor tester is a necessity.

A number of transistor testers are available commercially, but the majority, at this time, are expensive laboratory instruments . . . difficult to set up and time-consuming to use. The three instruments shown on page 60 (bottom) are designed to be quick and easy to use . . . and all handle only junction triodes. All three will test both *n-p-n* and *p-n-p* units.

Lafayette's *transistor checker* (100 Sixth Ave., New York 13, N. Y.) is available as a kit, selling for $7.95, plus postage. It is an easily assembled instrument which provides a check for opens, leakage, shorts, and a static test of current gain. Experimenters and service men should find this instrument quite useful.

General Electric's *transistor tester* is a complete assembled instrument, sold through G.E. distributors in a package which includes five general replacement transistors . . . three r.f.-i.f. units and two audio transistors. A valuable "Transistor Interchangeability Chart" is included in the package, and gives replacement information for popular transistor radio sets. This is a good buy for the service shop for it supplies a tester and basic stock of replacement transistors in a single package. . . . Whole deal is $39.95.

Quantum's *junction transistor analyzer* (Quantum Electronics Corp., 1921 Virginia St., N.E., Albuquerque, New Mexico) is a laboratory-type test instrument which should be of especial value to larger service shops, hearing-aid repair centers, and laboratories. It tests I_{co} and provides an accurate measurement of beta under different I_B conditions. Gain measurements are made dynamically, using a built-in oscillator. The entire instrument is transistorized and self-calibrating. Selling price is $245.00.

That's it for now . . . and let's see some more of your circuits!

Lou

The Transmitting Tower

(*Continued from page 81*)

News And Views

Dave Laird, KN2PXM, (14), 668 Delaware Rd., Kenmore 17, N. Y., says: "I have been on the air for about four months. My DX is not the best in the world—France, England, and Switzerland—but I am happy with it. I think I would do better if I were not using an 80-meter doublet antenna on 15 meters. My transmitter is a Johnson Ranger at 50 watts, my receiver is an SX-99, and I operate on 80, 40, and 15 meters."

John D. High, KN6QWK, P. O. Box 422, Needles, Calif., writes: "I have had my license for about six weeks. I have had about 150 contacts, have 29 states confirmed and am waiting for cards from a few others. My best DX is Massachusetts and Maryland, and I am working on the rest, because I want to work all states as a Novice. I use a Globe Scout transmitter and an HQ-129X receiver, but I have a Viking II transmitter to use when I get my General ticket. My antennas are a 2-element beam on 15 meters and a 127' doublet for 80 and 40 meters."

Dick Harbison, KN4GYB, (16), 2363 Morgan Road, Mobile, Alabama, reports: "In six months of operation, I have worked 21 states with my Johnson Adventurer transmitter and S-38D receiver. Best DX is California. The best of my antennas is my 'beer-can' vertical but I also have a 'Windom' and an 80-meter doublet. I operate 40 meters and would be glad to schedule anyone needing Alabama. I would like to work a few WN7's or W7's. They are pretty scarce around Mobile."

Maurice P. Schwartz (13), 206 South Hamel Drive, Bevery Hills, Calif., offers a bit of sage advice. "Once you get your Novice license and get on the air and work stations, your code speed will constantly increase, even without your knowledge; so when you go for your General, 13 wpm is easy. I can't brag about working all states, all continents, and 20 or 30 DX zones as a Novice. In fact, in eight months as a Novice I worked only 15 states; but I can tell you how much I enjoyed the experience. I used a Johnson Adventurer transmitter as a Novice. Now I have a Johnson Ranger."

Howard Kass, 3041 Ave. W, Brooklyn 29, N. Y., reports hearing 57 foreign amateurs in 29 countries on 20-meter phone on a short piece of No. 20 wire thrown out of his window, 20 feet up, as an antenna on a receiver without bandspread tuning!

Ham wins $100,000! **Leonard Ross, W6SJR,** Tujunga, Calif., is the 10-year old stock market expert who won $100,000 on the NBC television program "The Big Surprise" on March 21, 1956. Lenny received his Novice license at the age of seven and his Technician and General licenses at the age of eight. This made him one of the youngest hams ever licensed in the United States.

Davy Nilsen, K6KIV, 620 So. Irena Ave., Redondo Beach, Calif., gets right to the point. "I use a converted 'Command' transmitter

running about 120 watts and an Army BC-454 receiver. On 80 meters, I have worked 31 states, several Alaskans (KL's) and Canadians. I would like to work South Dakota to give me every state west of the Mississippi. I am on 80 meters, only."

"Doc" Lilien, KN2MRB, (13), 491 Mayhew Court, South Orange, N. J., says: "I use an AT-1 transmitter coupled to a 65' 5" long-wire antenna through an AC-1 antenna coupler, and my receiver is an SX-99. I can copy 25 wpm and have worked 29 states. I need a W7, so let me hear from some of you. I can operate on 80, 40, or 15 meters, but am on 15 meters most."

Dick Mills, W7AMH, ex-WN8OUM, 915 W Alturas, Tucson, Ariz., reports that he, **Harry WN7CKU,** and **Don, WN7CKB,** operate on 3722 kc. and will schedule anyone needing an Arizona contact. Dick also works 40 meters.

Gary Towner, KN9BNJ, (15), 1017 W. 42nd Ave., Hobart, Ind., shows that it is not necessary to work the world to enjoy amateur radio, although he is trying. "My rig is a home-built 10-watter feeding a 30' antenna, and my receiver is an S-38C. Probably because my antenna is so poor, my best DX has been only seven miles, but I've enjoyed trying. Maybe when I get my new vertical antenna up and the power amplifier on the transmitter, I'll be able to get out of K9 land."

Ivan H. Loucks, W3GD, announces the annual picnic of the Maryland Emergency Phone Net at Braddock Heights Park, Braddock Heights, Md., on Sunday, July 22, 1956, from 10:00 a.m. until . . . There will be contests, ladies' and children's programs, rummage sale, prizes. Registration, 50 cents, C. C. Worsley, W3TYJ, 104 Northwood, Silver Spring, Md. Children under 12 admitted free.

Jim Polk, KN2RRL, Box 185, Hunter, N. Y., says: "I have been on the air for a month and have made four contacts. My best DX is 60 miles. This great record is the result of using a very poor receiver—a one-tube regenerative one. I am getting a better receiver soon, and I hope to improve. My transmitter is a 6AG7—6L6 running 25 watts and feeding

DIELECTRIC HEATER QUIZ

(Questions on page 115)

1. A dielectric is a material through which an electric field can act without setting electric currents in motion. 2. Insulators. 3. The energy of moving molecules, alternatively called "kinetic energy." 4. Directly, thus forming a part of the tuning circuit of the oscillator; indirectly, through an impedance matching transformer. 5. The faster the electrons bounce inside the atom under the impulse of the electric field, the greater the energy dissipation; hence the more intense the heat generated. Although low frequencies may also produce dielectric heating, good efficiency is assured when the frequency is high. 6. The loss factor of a dielectric is a number which defines the relative ability of the substance to convert the energy of the electric field into heat; the higher the loss factor, the greater the heat.

a ½-wave antenna on 80 meters. I'll schedule anyone for any reason."

This column marks the end of the first year that the *Transmitting Tower* has appeared in POPULAR ELECTRONICS. Thanks to everyone for your hundreds and hundreds of letters and other indications that you like *our* column. Keep writing and sending your pictures in, and let's see what the next year brings.

Herb, W9EGQ

Tuning the Short-Wave Bands

(Continued from page 57)

Here are this month's station reports. All times are Eastern Standard, based on the 24-hour clock.

Argentina—LRA, 9690 kc., Buenos Aires, can be tuned with French ending at 2115; English, 2115-2125; Italian, after 2125. This xmsn is dual to 6090 kc. *(AB)*

LRU, 15,290 kc., *Radio El Mundo*, Buenos Aires, again in use, is heard at 0600-0730 in a Spanish xmsn. *(RL)*

Australia—VLC17, 17,840 kc., Melbourne, opens in English to South and Southeast Asia at 2300. At 0130 it is noted on 17,800 kc. with English to South Africa. *(BA)*

VLQ9, 9660 kc., Brisbane, and VLH9, 9680 kc., Melbourne, are easily noted at 0300-0500 in the Domestic Service. *(BS)*

DX tips can be gotten from VLC9, Melbourne, every Sunday morning at 0830 on 9615 kc. This follows the 0700 xmsn to Eastern North America. *(WC, NS)*

Belgian Congo—*Radio Congo Belge*, Leopoldville, operates with French and Flemish programs over OTM2, 9380 kc., 50 kw., at 0000-0130, and on OTM4, 11,720 kc., 50 kw. at 0515-0730. OTC2, Leopoldville, signs on at 1830 relaying Brussels. Dutch news is noted following this opening on 9655 kc. *(CM, DK)*

Belgium—In reply to a postcard, Brussels writes that no foreign language broadcasts (including English) are planned. ORU can be heard at 1815-1900 on 9765 kc. and on 11,850 kc. in French. The letter was signed by F. Zoete, Director of Shortwave Service. *(CM)*

Brazil—Sao Paulo, 6215 kc., announces as *Radio Nacional de Sao Paulo* and relays PRG9, 1100 kc. Xmtr is owned by *Excelsior* but is leased to and programmed by *Radio Nacional*. *(RL via WRH)*

British Guiana—*Radio Demarara*, Georgetown, ZFY, can be heard around 0500-0515 with an English program with commercials on 5918 kc. and at 1900-1945 with music; news at 1945 on 3255 kc. Address is *Radio Demarara*, St. Phillips Green, Georgetown, British Guiana. *(VS, LW)*

British Honduras—BHBS, Belize, has English at good level from 2000 to 2230 s/off. It carries news, good music, and sports events on 3300 kc. *(SF, PP)*

Canada—A *new* station is CFJB, 7918A kc., operated by the Royal Canadian Air Force at Goose Bay, Labrador. It can be heard through a variety of QRM at 1900-0200 relaying m.w. CFGB. This one announces as *The Friendly Voice of Labrador* and has a perfect signal when there is no c.w. QRM. *(DX, JW)*

CFRX, 6070 kc., 1 kw., Toronto, has a re-

liable signal Mondays-Saturdays at 0545-0107, Sundays at 0745-0007. (*LS*)

A new S.E. Asia service is reported at 1900-2000 on CKLO in the 49-meter band. Further details are requested. (*WS*)

Ceylon—This one can be tuned on 15,120 kc. in the Commercial Service from Colombo at 2130 with pop music and English, and on 9520 kc. at 1100-1130 with a religious program (*GQ, RR*)

China—*Radio Peking* is operating on 11,715 kc. from 0730 to 1000 s/off. Programs are in Oriental language until 0930, English to the s/off. (*VO*)

Christmas Island—Although not a s.w broadcast station, this rare one can be found in the 10-meter amateur band, around 28,480 kc., afternoons. Call is VE7ASL/VR3. (*ER*)

Cook Islands—Another one worth the patience in tuning for it is ZL1ZA, Rarotonga, on 5050 kc. It can be heard Mondays at 2330-0000 in Island languages and at 0000-0030 (news at 0015) in English. (*BH*)

Ecuador—HCJB, Quito, 11,915 kc., is easy to read evenings at 2100-2330. They send a wood carving of an Ecuadorian Indian to anyone requesting it. (*KD, LW, JM*)

Egypt—Cairo can be heard as follows: on 6215 kc. in Arabic at 1900 with news and Arabic music; on 9790 kc. at 1900-2000 with musical program and Arabic announcements; and on 11,670 kc. until 1800. This latter xmsn may now be only until 1700. (*FW, BA, MA*)

Formoso—An English program for North America can be tuned on BED3, Taipeh, 15,235 kc., in parallel with a 11,815A-kc. outlet. (*CM*)

France—A new schedule carries English on 7240 kc. at 0900-1000, and French at 1500-1530 on 15,400 kc. (*CM*)

French Guinea—*Radio Conakry* is reported operating in French on 6155 kc. daily (except Fridays) at 0715-0815 (Saturdays to 0830) and 1300-1630, on Sundays at 0700-0830 and 1400-1630. (*RR*)

Germany—By this time, *Deutsche Welle* should be operating as follows: 0500-0800 on 15,275 kc. to the Far East; at 0930-1230 on 17,845 kc. to the Near East; at 1300-1600 and 1700-2000 on 11,795 kc. to Africa and South America; at 2030-2330 on 9640 kc. to North America. (*WRH, NV, LN, GI, and many others*)

Postal Chart

Charles Maxant writes that anyone wishing a postal rate chart showing rates and information the world over should write to: Mr. Allen Greever, Post Office Department, Washington 25, D. C. The chart is free.

Greece—*Radio Athens* can be heard on 17,775 kc. at 1300-1330 in English and French and on 15,345 kc. at 1400-1500 in Greek and French. The 15,345-kc. outlet has been noted closing just before 1800. (*CM, JM*)

Haiti—4VEH, Cap Haitien, has been reported on 9625 kc. at 2130-2200 Mondays with "Listener's Box." This outlet is somewhat lower than usual. 4VE, 6100 kc., is under construction. (*BB, FG*)

India—Delhi is operating on two new channels: on 21,580 kc. at 0830-0930, dual to 17,795 kc., in English; on 17,720 kc. at 0730-0740 with Home Service in English and Hindi, dual with 15,325 kc. (*RL*)

Delhi is also reported on a seldom-used channel of 15,380 kc. at 1930-1940 with English news. (*BS*)

Indonesia—*The Voice of Indonesia* operates on 9710 kc., YDF6, and is being noted around 0300 with interviews and commentaries, at 0600-0630 and 1000-1010 with news and announcements. All listings shown are in English. (*RR, NS, FL, JB*)

ABBREVIATIONS

A—About this frequency
BBC—British Broadcasting Corp., London, England
BC—Broadcasting service or station
kc.—Kilocycle
Kw.—Kilowatt of power
mc.—Megacycle
m.w.—Medium wave
QTH—Exact location
s/off—Sign-off of station
s/on—Sign-on of station
V—Verified frequency
xmsn—Transmission from a radio station
xmtr—Transmitter used by station

YDQ3, 7290 kc., Makassar, is heard daily around 0930-1000 s/off with world news and American pop music. (*BK*)

Iran—EPB, Teheran, 15,100 kc., is being received at 1300-1400 with an excellent signal. Program is mostly native music. (*BS*)

Israel—*Voice of Israel* is on at 1415 with Yiddish program; heard at 1500 with Hebrew program. At 1530, *Voice of Zion* is on in French, and at 1615-1700 the same program is on in English (1715 on Sundays). Hebrew news is noted Mondays-Saturdays at 1700-1710 s/off. The frequency is 9008 kc. Address for reports on their English program is: *Voice of Zion*, P. O. Box 754, Jerusalem, Israel. (*SF*)

Italy—*Radio Roma* has English daily at 1915-1935 and at 2125-2145 to North America. News in French can be heard at 1935-1955. Reception reports go to Italian Radio Broadcasting Co. (*Radio Roma*), P. O. Box 320, Rome, Italy. (*RS, NE*)

Jamaica—The Jamaica B/C Co., Kingston, has good programs in English during evening hours, with news at 2200 on 4950 kc. Address here is 32, Lyndhurst Road, Cross Roads, Kingston, Jamaica. (*WB*)

Japan—The Radio Research Labs., Standard Frequency Section, Koganei, verifies with a red, white, and blue QSL card. The schedule is 2500 kc.—0600-0800; 4000 kc.—24 hours daily; 5000 kc.—24 hours on Mondays only; 8000 kc.—2000-1000; and 10,000 kc—24 hours on Wednesdays only. The 5000-kc. outlet probably operates at 1400 on Mondays to 1400 on Tuesdays; the 10,000-kc. outlet is heard at 1400, Wednesdays to 1400, Thursdays. (*TK*)

Liberia—ELWA, Monrovia, is reported on 4810 kc., and is best heard with religious program, Sundays only, at 1700-1815 s/off. (*SF*)

Libya—The Forces B/C Service in Ban-

ghazi has moved to 3305 kc. from 4930 kc. and operates at 2300-0130 (Sundays, 0000-0115). (*Radio Denmark via GQ*)

Malaya—The British Far Eastern B/C Service is heard on 9690 kc. at 0430-0445 and on 15,435 kc. at 0830-0900 with English news and commentaries. The 15,435-kc. outlet closes at 1145. (*BS, FL*)

Mauritius—V3USE, Forest Side, was found on 15,092V kc. at 2200, opening with a march; after announcement, there was music to 2230. French news followed to 2243; dance music to 2300; English news, and a fading signal at 2314 s/off. On Saturdays, there is no English session but the music runs to 2330 s/off. (*GF*)

Mexico—XESC, 15,205 kc., *La Mas Espanola del Mundo*, Mexico City, was noted at 1930-2010. This station has been inactive for a long period but now appears to be carrying the usual programs. Identity is 4 chimes (G-G-E-C) and announcement "XEMC y XESC . . . en la Ciudad de Mexico". The announcer asked in Spanish for reports, at 1910. (*WF*)

New Caledonia—*La Voix de la France dans le Pacifique, Ici Noumea*, Noumea, 6035 kc., carries American pop music but no English. This can be tuned around 0300. (*JB*)

Norway—English is scheduled from *Radio Norway* on Sundays only at 2100-2120 with "Norway This Week." They open at 2000 on LLG, 9610 kc., and LLS, 7240 kc. They have scheduled a new special program for Mondays at 2100-2130. LLN, 17,825 kc., can be tuned Sundays at 0900-0920 in English. (*CM, JM, SF, LW, SW*)

New Guinea—VLT6, Port Moresby, 6130 kc., carries music and news at 0415-0430. (*FL*)

Pakistan—Karachi has English news at 2000 followed by native music and singing in "Pakistan Calling" on 11,885 kc., parallel to 15,255 kc. Close-down is at 2015. (*DX, AB*)

Panama—HOLA, Colon, 9505 kc. (reported on 9480 kc.), is being heard at 0800 and 1700 with English request programs. S/off is at 2200. (*DA*)

Peru—*Radio San Cristobal*, Lima, the only station in Peru on a 24-hour schedule, is transmitting simultaneously on 6102 and 6220 kc. A special nightly program entitled "Bailables Phillips" is on the air every day at 0000-0600. (*WRH*)

Philippines—DZ17, 6080 kc., Navotas, Rizal, is heard at 0815-0830 with English news. The station runs 300 watts and is a rare one to log. (*RR*)

Sarawak—*Radio Sarawak*, 5052 kc., is being heard mornings with a BBC news relay ending at 0810, a message from the Health Office and dance time starting around 0825. This program is mostly popular music, and announcements are all in English. (*JB*)

Spanish Morocco—*Radio Dersa*, EHT-1 (or EA9AH?), Tetuan, 6067 kc., is reported operating at 0600 s/on to 1800 s/off with all-Spanish transmissions. (*RR*)

Sweden—SBP, Stockholm, 11,705 kc., is easily heard at 0000-0030 with English talks, news, and music program to Western North America. (*BV*)

Switzerland—HER3, 6165 kc., Berne, is very strong on the East Coast at 2130-2215 with first transmission to North America, but a re-

porter in Hawaii reports no trace of the signal. Another xmsn to North America is noted at 2310 on HER3, dual with HER4, 9535 kc., and HER5, 11,865 kc. Good music is a feature on these transmissions. (*LS*)

Syria—Damascus, 11,695 kc., signs on at 0000 with "Marching Strings" and has an excellent signal in language until BBC opens at 0015 on 11,700 kc. Damascus can also be tuned in French at 0030-0130 and in English at 0130-0230. (*AB*)

Tahiti—*Ici Radio Tahiti*, 6135 kc., Papeete, is readable from 0015 to 0300 s/off with popular American music and French lyrics. News in French is heard at 0200. An English session is reported Fridays at 0200-0300. (*JB, DA, BH, AN*)

Tangier—A folder-type QSL card from WTAN, *The Voice of Tangier*, British P. O. Box 219, Tangiers, Morocco, lists the following schedule: 0430-0500 (daily); 1200-1230 (Mondays only); 1400-1430 (Thursdays and Fridays only); 1430-1500 (Fridays only); 1530-1600 (Wednesdays and Fridays only); 1600-1630 (Mondays-Fridays); 1630-1700 (daily); 1730-1800 (Mondays-Fridays); through to 1830 (Wednesdays and Fridays). This station operates on 9490 kc. They send a copy of the New Testament on request. (*AB, DA, JM, LW*)

Thailand—HSK9, Bangkok, 11,670 kc., is

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Steve Wilhelm (*SW*), Brooklyn, N. Y.
Gerry Dexter (*DX*), Waterloo, Iowa
World Radio Handbook (WRH)

heard at 0525-0550 with opening announcements in Thai, followed by news and weather in English, and native music. On the West Coast, the signal often fades rapidly after 0600. (*BK, RR, AE*)

Trinidad—*Radio Trinidad*, Port-of-Spain, is now scheduled at 0400-1445 on 5978 kc., and at 1445-2200 on 3250 kc. The station operates in the m.w. at 1223 kc. (*WRH*)

United States—WLWO, Cincinnati, 6010 kc., carries a "Mailbag" session at 1930. KNBH, Dixon, 9510 kc., has the very popular "Music, USA" program at 2200. (*SW*)

Vatican City—English from the Vatican City can be tuned at 1000-1015 or at 1315-1345 on 6190, 7280, 9646, 11,865 kc. or on 15,120 kc. (*CM*)

Yugoslavia—*Radio Yugoslavia*, Belgrade, 6.00 kc., is usually readable at 1715-1730 s/off with an English news period. (*SF*) —30—

Code Reception

(*Continued from page 84*)

on, and *R1* at zero resistance. (2) When this adjustment has been made and checked, tune the receiver to a clear spot on the dial, switch *S1* on, and adjust *R1* until the audio tone has the most pleasing sound. Adjusting *R1* may detune the b.f.o. slightly, but a small readjustment of the knob on the top of *T1* will restore it to resonance. The two unmarked variable capacitors shown with the coils inside the dashed lines are built into *T1*.

No power supply is included as a part of the i.f. oscillator because its requirements are small and, in most cases, the power needed to operate it can be obtained from the receiver with which it is used. If your receiver is of the a.c.-d.c. variety, however, or if you prefer not to dig into its wiring, any small power supply delivering 6.3 volts for the heater and between 200 and 300 volts for the plate, screen, and modulator, may be used instead. (See, for example, page 92, May, 1956).

This little i.f. oscillator will not permit code signals to be heard on a receiver which tunes only the broadcast band. However, it can be used as a code-practice oscillator with such a receiver. And you will be able to hear code stations on any broadcast receiver which also tunes the short-wave bands. —30—

Thin Air, My Foot!

(*Continued from page 52*)

breath of thin air and busied myself with a disgusted frown.

"Well, *where* is it, then?" she countered.

"That's what *I* want *you* to tell me."

Sudden cunning tinted her face. "Isn't it possible you left it *inside* that baffle you

built last week? I heard you using it!"

"Oh, no, you don't!" I chuckled nastily. "Nice try, but I remember returning the drill to . . . its . . . proper . . . place. No, you've had it since then. Where is it?"

Her mouth began trembling. Then, quite without warning, the process of related-objects-thinking went off in my head and I knew exactly what she had done with the drill. Five minutes later, I had excavated the tool from the bottom of the planter where it had been left and carelessly buried.

"B-But how did you *know* it would be there?" asked Friend Wife, her eyes the approximate size of dinner plates. "I can't *imagine* how I could have possibly left it in there. Nor can I see how you knew it was in there, either."

"I hear voices," I admitted, mystically.

"Y-You *do*!" The dinner plates grew into meat platters.

"Yeh, and one of the things they kept repeating and repeating was: *"They ain't nobody but us voices in this thin air!"* I couldn't refrain from slapping my knee and yocking heartily at this bit of humor.

I've had better audiences.

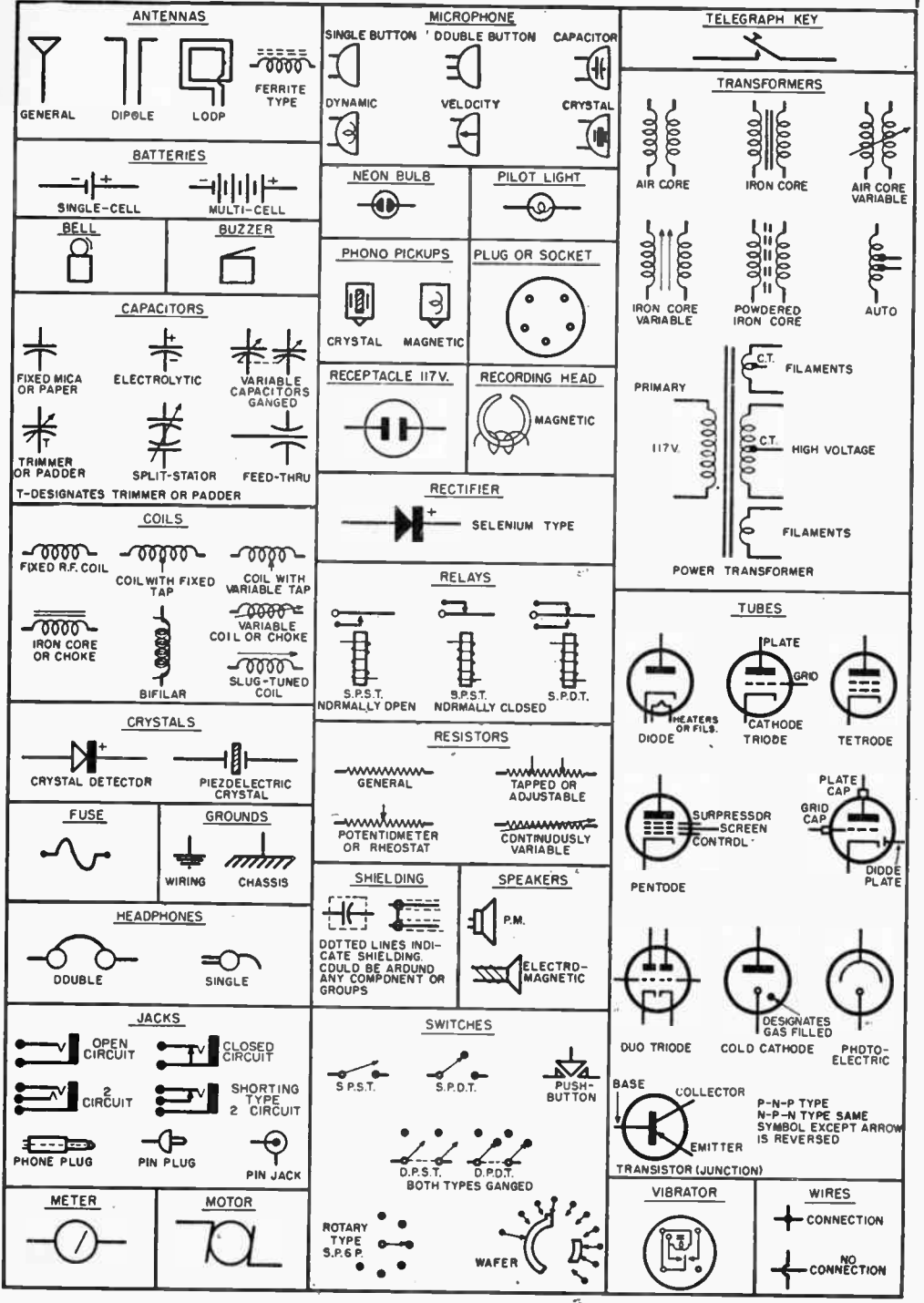
SINCE THEN, the battle to keep tools on hand goes on with the usual percentage of items vanishing, never to be seen again, and the usual number bobbing up in the unlikeliest places.

Like all good, red-blooded All-American types who find themselves gaping into the horrific maw of a seemingly losing battle, I have turned, of late, to the methods of my forefathers. And since Friend Wife appears to be immune to patient, kindly,

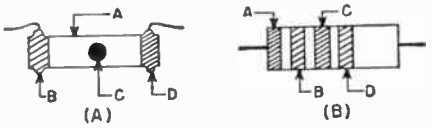
repetitious suggestion, education and dire warning—I'm left with only one as-yet-untried course.

Does anybody know where I might buy an old-fashioned razor strop? —30—

STANDARDIZED WIRING DIAGRAM SYMBOLS



RESISTOR COLOR CODE



RETMA COLOR CODE CHART

COLOR	VALUE	MULTIPLIER
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1000
Yellow	4	10,000
Green	5	100,000
Blue	6	1,000,000
Violet	7	10,000,000
Grey	8	100,000,000
White	9	1,000,000,000

TOLERANCE CODE

Gold—±5% Silver—±10%

No Color—±20%

The ohmic value of a resistor can be determined by means of the color code. There are two standard methods of indicating this value.

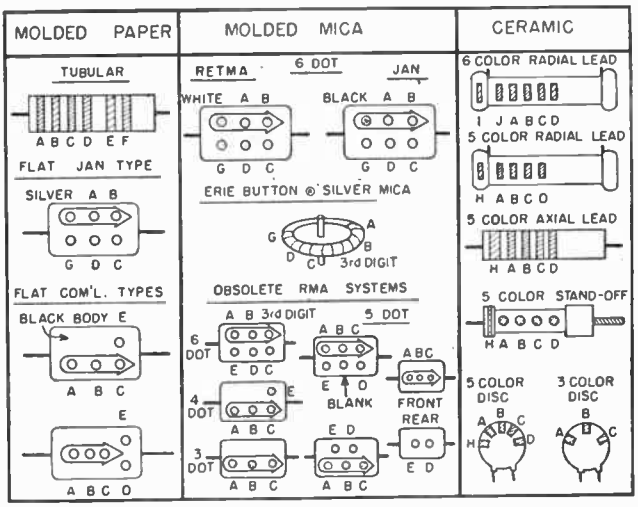
In Fig. A, the body (A) and end (B) indicate the first and second digits of the value while the dot (C) indicates the multiplier to be used. The tolerance of the unit is indicated by the end color (D). For example, if the body (A) is green the number is 5; if the end (B) is grey the second number is 8. If the dot (C) is red the multiplier is 100 or two zeros should be added. The resistor is then a 5800 ohm unit. If the end (D) has no color, the tolerance is ±20%.

In Fig. B, the first two stripes indicate the first two digits; the third stripe the multiplier; the fourth stripe the tolerance. Thus, if stripe (A) is green, (B) is grey, (C) is red, and (D) is silver, the resistor is a 5800 ohm, ±10% unit.

CAPACITOR COLOR CODE

	MOLDED PAPER		MOLDED MICA		CERAMIC	
Color	Multiplier	Tolerance	Multiplier	Tolerance	Multiplier	Tolerance
Black	1	20%	1	20%	1	20% or 2.0μμfd.*
Brown	10		10		10	1%
Red	100		100	2%	100	2%
Orange	1000		1000	3% (RETMA)	1000	2.5% (RETMA)
Yellow	10,000	5%	10,000		10,000	
Green				5% (RETMA)		5% or 0.5μμfd.*
Blue						
Violet						
Gray					0.01	0.25μμfd.*
White		10%			0.1	10% or 1.0μμfd.*
Gold	0.1	5%	0.1	5% (JAN)		
Silver		10%	0.01	10%		*Capacitance less than 10μμfd.
None		20%				

Capacitance is given in μμfd. Colors have same values as on resistors, except as indicated in tables. Colors (A) and (B) are for first two digits; (C) is for multiplier. (D) is for tolerance. (E) and (F) give voltage rating in hundreds of volts; (E) is used only for ratings less than 1000 volts, (E) and (F) for first two digits of ratings 1000 volts or more. Values of colors for (E) and (F) are same as in resistance values. (G) is class or characteristic of capacitor, (H), (I), and (J) give temperature coefficient. (G), (H), (I), and (J) are not listed in the tables, since this information is seldom needed by the average home builder.



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ADVERTISERS' INDEX

JULY 1956

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Superior's New Model TC-55

Streamlined TUBE TESTER

FOR

The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

• **You can't insert a tube in wrong socket.** Separate sockets are used, one for each type of tube base. • **"Free-point" element switching system** Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap". • **Checks for shorts and leakages between all elements.** Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. • **Elemental switches are numbered in strict accordance with R.M.A. specification.** The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Speedy, yet efficient operation is accomplished by: Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

Model TC-55 comes complete with operating instructions and charts and streamlined carrying case.

$26.95

Superior's New Model TV-11

Standard Professional TUBE TESTER

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, 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 TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-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.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ 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.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

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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 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad Scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
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- ✔ Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer 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.

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BAR GENERATOR: The Model TV-50 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: The Model TV-50 Genometer will project a crass-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.

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