POPULAR ELECTRONICS

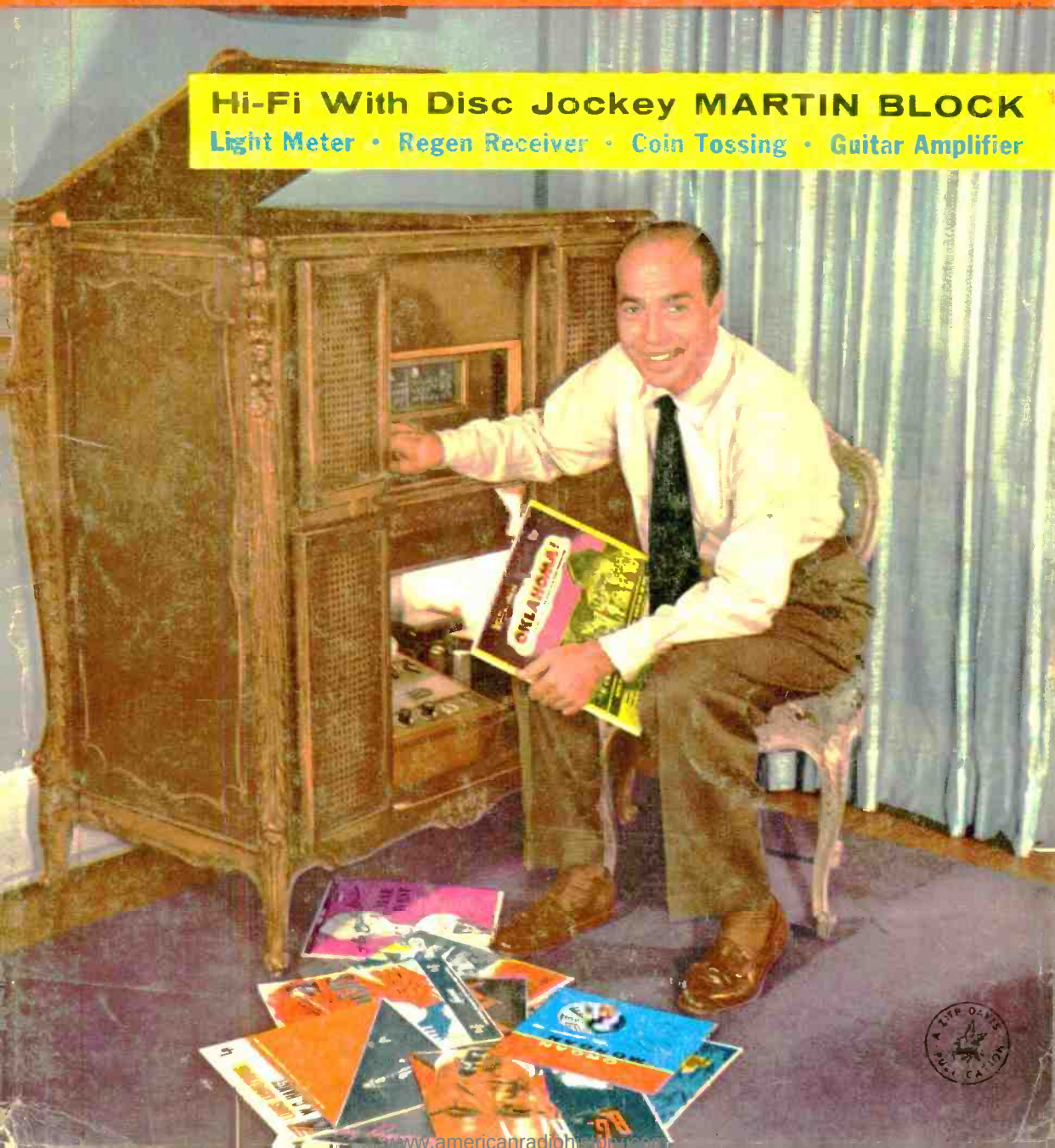
JANUARY 1956

25 CENTS
In U.S. and Canada

HI-FI · AMATEUR RADIO · R/C · SWL · GADGETS

Hi-Fi With Disc Jockey MARTIN BLOCK

Light Meter · Regen Receiver · Coin Tossing · Guitar Amplifier



"For smooth performance when the Joint is Jumpin'. . . I can always count on my Gray viscous-damped Tone Arm."

Reports famous radio disc jockey, Martin Block. Radio Station WABC

Even ordinary vibrations around Mr. Block's studio or home often bounced the stylus right out of the groove . . . not only ruining the performance but also the record.

But today with Gray's viscous-damped suspension principle regulating vertical and horizontal movement of the tone arm—Mr. Block states—"groove jumping and skidding are eliminated even when the joint is jumpin'."

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The utmost in smooth quality of Martin Block's home hi-fi equipment is assured with a Gray 108B Tone Arm.

The Gray All-New 108C Viscous-Damped Tone Arm. Ideal for homes, radio and TV studios.

GRAY RESEARCH and DEVELOPMENT CO., INC.
MANCHESTER, CONNECTICUT

GRAY RESEARCH & DEVELOPMENT CO., INC.
MANCHESTER, CONNECTICUT

Please send me more facts on the Gray 108 Viscous-Damped Tone Arm.

Name.....

Address.....

City..... State.....

POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 64 E. Lake St., Chicago 1, Ill. Entered as second class matter August 27, 1954 at the Post Office, Chicago, Illinois. SUBSCRIPTION RATES: One year U.S. and possessions, and Canada $3.00; Pan-American Union Countries $3.50; all other foreign countries $4.00.

POPULAR ELECTRONICS

Registered U. S. Patent Office

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Cover Photograph by Maynard Frank Wolfe

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366 Madison Ave., New York 17, N.Y.

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SUBSCRIPTION SERVICE:

All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Include your old address as well as new—enclosing if possible an address label from a recent issue of this magazine. Allow at least 4 weeks for change of address.

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COMING NEXT MONTH

POPULAR ELECTRONICS

Shoot to Kill—TV Commercials!

The "Commercial Killer" is a transistorized photoelectric gadget which enables a TV viewer to silence his set with the aid of a flashlight.

Sandwich Box Transmitter

Using a single 6AQ5, this crystal-controlled 7-mc. transmitter is built on a small plastic sandwich box. The coil is wound on a plastic pill carton.

All-Band SWL Preselector

Construction details are given for a high-gain single-tube preselector which can be connected in front of any communications receiver to step up performance.

Choosing a Loudspeaker Enclosure

Part 1 of a series covering design, construction, and operating characteristics of loudspeaker enclosure types, with examples of commercially available units.

Hi-Fi in a Chest of Drawers

A clever method of reconstructing an unpainted chest of drawers to hold a turntable and amplifier installation.

High-Fidelity Audio ■ Kits ■ Radio Control ■ Short-Wave Listening ■ What's New ■ How It Works ■ How to Make It ■ How to Use It ■ Carl & Jerry ■ Tips & Techniques

IN THIS MONTH'S

RADIO & TELEVISION NEWS

(January)

Choosing a Phono Pickup
Do You Need a Preamp-Control Unit?
A Transistor R.F. Frequency Meter
Transistorized TV Antenna Compass & Field Strength Meter
An Improved "3D" Converter
TV Signal-Tracing with a Scope

WANTED: 200,000 TV SERVICE MEN!

VETERANS
NON-VETERANS

GET IN ON THIS 2 BILLION DOLLAR PLUM!

200,000 — That's how many service men will be needed to handle television-radio-electronics industry requirements in the next few years. That's the figure given by the director of product service for CBS-Columbia — a man in a position to know.

2.7 billion dollars to be spent just for *service* and *installation* of TV sets in American homes by 1957! That's the figure given by one of the top men in the entire industry — the president of Radio Corporation of America.

L. C. Lane, B.S., M.A.
President, Radio-Television Training Association.
Executive Director, Pierce School of Radio & Television.

Think What This Means For YOU!

Here is a field still in its infancy — New jobs with top pay and a secure future are being created every day — Here is a chance for you to get into a growing field with unlimited opportunity for advancement — Here is your chance to set up your own business and be your own boss — Here is your opportunity to get in on a *2 billion dollar plum* by becoming a Television Technician.

LEARN BY DOING

As part of your training, I give you the equipment you need to set up your own home laboratory and prepare for a BETTER PAY TV JOB. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to 21-inch. (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply Everything supplied, including all tubes.

EARN WHILE YOU LEARN

Almost from the very start of your course you can earn extra money by repairing sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training with spare time earnings . . . start their own profitable service business.

VETERANS

My School fully approved to train Veterans under new Korean G.I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

LEARN TELEVISION *AT HOME* IN YOUR *SPARE TIME*

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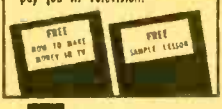

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
Dept. E-1C, 52 East 19th Street, New York 3, N. Y.

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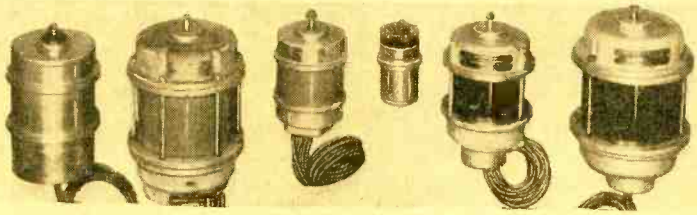
SAVE! NEW SYNCHROS and SURPLUS!

New

NAVY TYPE SYNCHROS

(Also known under trade names such as Selsyn, Autosyn, Etc.)



The function of the synchro is to impart accurately motion from one shaft to another shaft where direct connection is not feasible either because of distance or because of need for torque amplification. Synchros are used extensively for remote-indicating and data-transmission, such as compass repeaters and other systems, and are combined with servomechanisms for hundreds of uses such as aiming guns, pointing searchlights, automatic steering, remote control, etc.

110 V. 60 Cycle Units

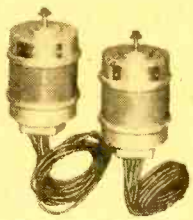
Size & Type	Approx. Wgt. (lbs.)	Approx. Length (inches)	Approx. dia. (inches)	Price New	Size & Type	Approx. Wgt. (lbs.)	Approx. Length (inches)	Approx. dia. (inches)	Price New	Size & Type	Approx. Wgt. (lbs.)	Approx. Length (inches)	Approx. dia. (inches)	Price New
1G	2	3.9	2.2	10.00	5D	5	6.0—6.8	3.4—3.6	15.00	6DG	8	6.4—7.5	4.5	20.00
1DG	2	3.9	2.2	10.00	5CT	5	6.0—6.8	3.4—3.6	15.00	6CT	8	6.4—7.5	4.5	20.00
5F	5	6.0—6.8	3.4—3.6	15.00	6F	8	6.4—7.5	4.5	20.00	7G	18	8.9—9.2	5.8	25.00
5G	5	6.0—6.8	3.4—3.6	15.00	6G	8	6.4—7.5	4.5	20.00	7DG	18	8.9—9.2	5.8	25.00
110 V. 400 Cycle Units:														
5F	5	6.0—6.8	3.4—3.6	9.50	5G	5	6.0—6.8	3.4—3.6	9.50	5DG	5	6.0—6.8	3.4—3.6	9.50

G—Generator; F—Motor (Follower); DG—Differential generator; D—Differential Motor; CT—Control Transformer

SYNCHRO BARGAIN SPECIALS!

For the Amateur, Hobbyist & Experimenter

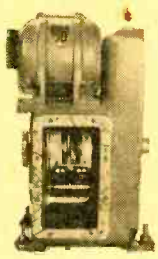
Below are listed synchros removed from equipment and sold as used to provide you added savings.



Size 5 motor & generator combination suitable for TV beam, indicator and other light applications...per set **$17.50**

Size 6 generator & motor for medium size beams and greater torques. per set **$25.00**

2 Size 7 generators (one generator may be used as a motor), suitable for all but the heaviest beams and can be used with suitable gear ratios for these. Provides the maximum of torque. per set **$35.00**

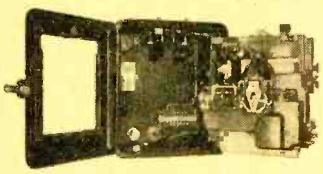


TORQUE AMPLIFIER—NEW—$9.75

For use with synchros size 5-6-7. Provides torque amplification and ease in rotation of input shaft. Rotating power applied to input shaft is reproduced in any direction on the output shaft. Torque supplied entirely by a 1/40 HP 110 V AC motor through gear and planetary drive hookup. Speed varies directly with rotation of input shaft with no noticeable loss of accuracy. Motor requires capacitor of 85-120 mfd. for starting. Designed for use on gun control devices and cost the Gvnmt. hundreds of dollars to mfr. In cast aluminum case. Size: 12" h. x 5⅜" w. x 7½" d. Wgt. 23 lbs. Packed in original wood box. Shpg. wt. 45 lbs.

Brand New **$9.75**

Starting capacitor for above Torque Amplifier. New..... **$1.00**



LEEDS & NORTHRUP MICROMAX RECORDERS

Strip type recorders used for controlling and recording a wide variety of processes. Used originally for temp. range of 350-550 degrees C. May be changed for other applications. Operates on Wheatstone bridge principle using AC galvanometer movement. Original cost several times our price. Units were removed from demilitarized equipment which in many cases was new, but all instruments sold as used and guaranteed. Money back if not satisfied.

Price ea. **$179.50**

EE-1A Instrument Test Set—New—$29.50

Mfrd. by Rex Cole for testing aircraft equipment. Contains AC-DC volt and ohm meter. Variable speed drive with 0-4200 RPM Tachometer, Manifold pressure gauge 10-75 inches of mercury, amplifier test gauge, manifold pressure generator and other items in aluminum portable case, 2' H. x 22" W. x 12" D. Tool kit is included with pliers, screwdrivers, socket wrench access., cables, drives, spares, etc. All sealed in evacuated metal container. These surplus units were purchased at fraction of original cost and are offered to you at this low bargain price.

BRAND NEW **$29.50**

OAV-1 Test Signal Generator—$29.50

Designed to provide a test signal of constant frequency for operation and alignment of IF amplifier stages in the CG-46ACQ type receivers. Covers the range between 150-250 megacycles. Amplitude modulated square wave output is obtained at frequencies of .1, 1, 10, and 100 Kc. depending on the position of the Freq. mod. Pulse switch. A 15 Mc. signal is also provided by a second osc. stage. Power is supplied by internal 115V 60 cycle AC supply connected to source by cord provided. Wgt. of unit 62 lbs.

BRAND NEW, with instruction book..... **$29.50**

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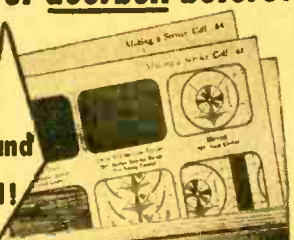
TERMS: Cash/order except rated concerns. All merchandise guaranteed to your satisfaction or money refunded if returned within 10 days. Please include shipping charge, otherwise order will be shipped express or freight collect.

FIX TV AND RADIO SETS RIGHT AWAY

—even if you never fixed a lamp or doorbell before!

McGraw-Hill's Amazing New Low-Cost Instruction Manual Skips Hard-to-Understand "Theories" and "Formulas." Tells How-to-do-it in PLAIN ENGLISH!

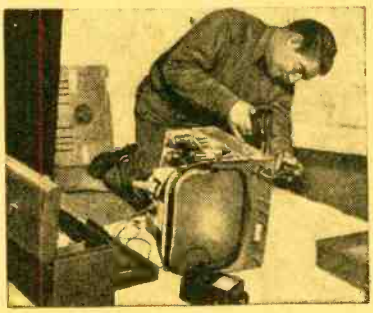


WHY hasn't somebody done this BEFORE? That's what you'll exclaim the minute you start browsing through this amazing new one-volume instruction manual in TV and radio repair.

For here at last a well-known EXPERT has found a way to tell you in PLAIN ENGLISH how to fix almost ANY radio or television set. (And he even tells you where you can go to have the extra-tough jobs done FOR you . . . at reduced professional rates.) Right from the very first chapters you can start doing simple repairs . . . and before you're HALF way through the manual, you can fix HALF the television and radio sets that you encounter. In just a few weeks you can start fixing your own and friends' sets . . . get a service shop job . . . even start your own money-making business at home.

Why It's So EASY to Understand

You get no complicated formulas, algebra, laboratory experiments. Instead you deal *only* with the parts that go wrong in sets—how to recognize the trouble—and what to do about it. "Easy as A-B-C" directions and 700 clear photos, diagrams, and drawings show you exactly WHAT and HOW to fix, step-by-step.



Save Money on Your Own Set

Save $50 to $100 a year just in installing, repairing and servicing your own TV set. Book tells which controls to adjust or tubes to replace if picture is entirely dark — blurred — split — distorted — off center — tilted — wiggles and weaves — too pale — too black — jitters — snow effects — drifts — etc., etc.

The author is Associate Editor of *Electronics* Magazine. He spent FOUR years making this one-volume manual practical and easy-to-understand—even for an "unhandy" beginner.

Here's everything you need to know about *where* and *how* to buy tubes and parts, where and how to get an official circuit diagram for any receiver; how to choose and use basic tools; how to test tubes WITHOUT a tube tester; how to use 58 common TV controls; how to "diagnose" and "cure" common radio and TV troubles; how to fix loudspeakers, phono pickups; how to install and check antennas; and much, much more.

TRY IT FREE ON YOUR OWN SET FOR 10 DAYS

PARTIAL CONTENTS

How to Remove and Replace Tubes • Testing Tubes without a Tester • Using a Table Tester • Power Supply Troubles • How to Test and Replace Resistors, Controls, Switches, Condensers, Coils, Transformers • Loudspeakers • Phono Pickups and Needles • Antennas . . . MUCH MORE.

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"Prepared for people who know absolutely nothing about radio or use of tools."
—Radio Electronics

"Unique in its ability to explain servicing in easy-to-understand terms."
—Electrical South

Tells HOW To "Cash In" ON THE BIG DEMAND FOR RADIO-TV REPAIRMEN

Over 25 million TV sets . . . over 100 million radios! Make nice extra money just fixing sets for friends and neighbors in your spare time . . . or start your own full-time repair business. Book tells exactly how to get started; which tubes to stock; how to make a service call. Actually start fixing sets and making money before you're half-way through book.

SEND NO MONEY

Examine this book for 10 days BEFORE you decide if you wish to own it. Try it out FREE on your own or a neighbor's set. See how simple and easy it makes nearly every repair job. Make it *pay for itself in 10 days* or don't keep it! Mail coupon to: **McGraw-Hill Book Co., Inc., Dept. PEL-1, 327 West 41st St., New York 36, N. Y.**

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LETTERS FROM OUR READERS

Transistor Topics

■ I would be very happy to see your new department entitled "Transistor Topics" every month. I would like to see a section on transistors with both current news and construction projects.

BRUCE DEMO
El Paso, Texas

■ Enjoyed your new department. . . !

IRA GLICKSTEIN, KN2MFU
Brooklyn, N. Y.

■ I, for one, would like to see it as a monthly feature.

HERB MCCOY
New Orleans, La.

■ Keep it going! The more often the better!

RALPH L. SAETTELE
St. Louis, Mo.

■ Please! Please! Please! More Transistor Topics!

A. SAEDARINI
Union City, N. J.

■ Continue on the monthly basis that you talked about.

KARL MUELLER
Dearborn, Mich.

■ Yes, by all means! Transistor Topics is FB.

LAURENCE A. SHARPE
Chapel Hill, N. C.

It is rare indeed to see editors deluged with a quantity of favorable mail such as seems to have been inspired by "Transistor Topics." In response to all those who wrote in—yes, it will continue as a monthly feature. Yes, it will be bigger and better as time goes by.

Low-Frequency DX

■ Don't let your readers forget that they can often pick up bargain receivers covering the low frequencies at auctions and second-hand stores. Many of these receivers are of excellent design. Typical models are the *Philco* 116-x (code 122) and the *Stromberg-Carlson* 150 series. These would be fine for DX'ing between 100 and 400 kc.

OTTO WOOLLEY, WØSGG
Colorado Springs, Colo.

■ I think it would be a good idea to have some long-wave circuits in POP'tronics using modern tubes. There is plenty of good code on the 500-kc. band.

DANIEL F. LILL
Evanston, Wyo.

Any further comments?

Electronic Stethoscope Wanted

■ I imagine that many non-medical readers would be interested in building an electronic stethoscope. I am contemplating a small microphone having

the sound amplified in a hi-fi preamp and amplifier and finally reproduced in a loudspeaker.

G. A. Asche, M.D.
Hope, B. C., Canada

Dr. Asche's suggestion is similar to the "Heart Microphone" (see PE, Oct., 1954, p. 79) marketed by the Altec Lansing Corp. *Probably the microphone adapter designed by* Altec *could be duplicated by our readers. If sufficient interest is shown, we will investigate the subject further.*

Construction! Construction!

■ Your POP'tronics is exactly what thousands of beginners like myself have been waiting for. Please don't change your magazine. Keep it simple and full of projects.

Jack Stroup
Bellaire, Ohio

■ The November issue of PE was the best yet! Am looking forward to more articles like "Reflex Receiver" and "Permanent Electric Clock." Always like construction articles.

Francis Donovan
Medway, Mass.

The above letters from Readers Stroup and Donovan are similar to hundreds of letters requesting more, bigger, or better construction projects in POP'tronics. We are fully aware of the interest our construction projects have created and want to assure our readers that a fair amount of such material will be scheduled for all forthcoming issues.

S-Meters and Preselectors

■ How can I add an S-meter to my Heathkit AR-2?

Arthur Holmberg
Gales Ferry, Conn.

■ Could you publish plans for an SWL preselector that would cover the s.w. and the ham bands?

Gary A. Shapiro
Bridgeport, Conn.

As we informed Art and Gary directly by mail, there are a number of S-meter plans coming up in the February issue. SWL's will also be interested in hearing that an exceptionally novel and simple preselector has been designed by Frank Tooker to appear in that issue.

More on $2 Baffle

■ Can the idea behind the "$2 Speaker Baffle" (November issue, page 79) be used for 12" or 15" speakers instead of for 8" speakers?

William Flynn
Brooklyn, N. Y.

Yes, Bill, it can be used; i.e., the principle can, but don't try to up-ratio the dimensions—it won't sound as good as it could. The theory behind the labyrinth baffle is fairly complex and too involved to discuss here. Maybe we can wrap up a feature on this topic in the near future. The Weems $2 baffle was designed to be cut from a 4' x 4' sheet of Celotex. Several other interesting ideas for low-cost speaker baffles are scheduled for our hi-fi section in the February and March issues. Look for them. —30—

Know how to choose

YOUR LOUDSPEAKER SYSTEM

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WHAT'S THE PE ANSWER?

IMPROVING SHORT-WAVE RECEIVERS

In the September issue of POPULAR ELECTRONICS, I read an article by a Mr. E. D. Morgan concerning a new antenna. This article stated that the antenna would greatly improve the reception of a radio. I would very much like to know if it would help the short-wave reception on a 15-tube superhet and would be sensitive to the one station selected on the dial. Are there any other ways to improve short-wave reception on such a big combination radio?

F. E. ROCKMAN
Vancouver, B. C., Canada

The antenna referred to is a loopstick antenna which is designed to improve reception in the broadcast band but not in the short-wave bands. Short-wave reception can sometimes be greatly improved by the use of a special short-wave antenna. Such antennas are available at most parts supply houses. A preselector would also help; an article on such a unit is scheduled for the February, 1956, issue of POPULAR ELECTRONICS.

CHANGING RECORD PLAYER SPEED

With reference to the inquiry by Mr. Stan Grygatis in the August, 1955, issue regarding conversion of 78-rpm record players to 45 rpm (or 33) and your reply, it seems to me that you have dismissed the subject rather shortly. Is there not a possibility of converting the frequency of the line current from 60 cycles to, say, 25 cycles, which would come out in the proportion of about 78 to 33. I seem to remember having seen instructions for such a conversion in a magazine quite a long time ago, but at that time the cost would have been much greater than that of a new changer.

Next, could you tell me what the actual frequency range of AM broadcasting is as compared with FM, together with their bandwidths, at both the transmitting and receiving ends?

C. R. MEDLAND
Ottawa, Ontario, Canada

Even if it were possible to convert 60-cycle line frequency to a lower frequency economically in order to reduce the speed of a phonograph motor, such a procedure would not necessarily be satisfactory. The inductive reactance of a motor at 25 cycles is considerably less than at 60 cycles, which means that it would draw considerably more current. This could result in overheating and burn out.

The Federal Communications Commission ordinarily limits AM stations to an r.f. bandwidth of 10 kc., which means a top audio fre-

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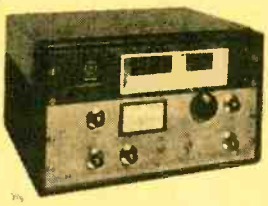

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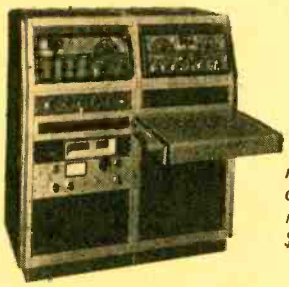

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quency limit of 5 kc. However, some stations are permitted to operate with considerably greater bandwidths, up to 20 kc. in some cases, where such operation does not cause interference with other stations. With a broadband tuner, audio frequencies up to 10 kc. could be received. However, radio receivers generally have a bandwidth of 10 kc. at most, limiting audio response to 5 kc. On the other hand, FM stations are required by the FCC to have systems which broadcast the full audio spectrum up to 15 kc. The nominal r.f. bandwidth of an FM station is 75 kc. FM has two principal advantages over broadcast-band AM. First, the potential frequency response is considerably greater, and second, interference of all kinds is considerably reduced, particularly atmospheric and man-made static.

REACTIVATING LEAKY ELECTROLYTICS

Making purchases of electrolytic capacitors through the post is quite risky, as nearly half of the stuff you receive may turn out to be leaky due to long storage. Is there any method of reactivating such leaky electrolytics?

A. H. PURTI
Jamshedpur, India

It is frequently possible to rehabilitate electrolytic capacitors which have become excessively leaky after long periods of inactivity. The process is known as "reforming" and consists of rejuvenating the insulating film in the capacitor. To accomplish this, a variable-voltage d.c. power supply having good regulation is necessary. With the voltage set very low, the capacitor is connected across the supply and the voltage gradually increased over a period of several minutes until it is equal to the working voltage rating of the capacitor. The voltage is held at this point for several minutes, or until the leakage current has decreased to its normal value. During this process, the leakage current should be checked frequently. If it is allowed to rise too high, the capacitor may be permanently damaged.

REMOVING RECORD SCRATCH

I've seen advertisements on magnetic cartridges, record compensators and scratch filters from about $5.00 and up; this has started me wondering if there is a way to remove scratch from 'poorer' recordings using a crystal pickup phonograph with no tone control. I realize that there isn't too much you can do with favorite songs if they're on old 78's. I would, however, appreciate any information you might have on what (if anything) would help reproduction.

JOE J. SCHEB
Gainesville, Fla.

Record scratch can be made much less annoying in many cases by the use of a low-pass filter with a variable cutoff frequency. The cutoff frequency is set for each individual record to cut out the most scratch while still leaving as much as possible of the program material. Such filters are available from most parts supply houses. Also, a simple tone control can sometimes do wonders in minimizing scratch. —30—

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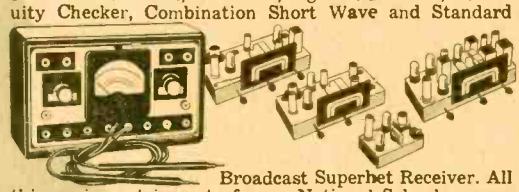

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In many cases, the applications of electronic developments in various fields often go beyond the purposes for which they were originally intended. This has been particularly true of the electronic camera. Designed for use in picking up and transmitting television shows, it is rapidly being taken over by the motion picture industry, where it may soon replace the mechanical camera as a means of making movies.

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The treatment of the subject matter should appeal to the technically minded as well as to the lay viewer. It represents an interesting blend of explanations of equipment, notes on personalities, and a running history of the video entertainment field. The author, himself a television engineer, never loses sight of the human interest inherent in the subject of entertainment achieved by electronic means.

Recommended: for readers at all levels of technical development who are interested in television, cameras, and the increasing application of electronics to photographic work.

"SHOOT TV AND RADIO TROUBLE FAST" by Harry G. Cisin. Published by *Harry G. Cisin,* Amagansett, N. Y. 40 pages. Paper bound. Price, $1.50.

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1B3GT	.65	354	.47	6BA7	.58	6S4	.40	7E7	.70	19T8	.65
1C5GT	.41	3V4	.47	6BC5	.47	6SA7	.45	7F7	.59	24A	.39
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1H4G	.43	5J6	.63	6BF6	.50	6SJ7	.43	7J7	.75	25W4GT	.43
1H5GT	.47	5T4	.69	6BG6G	1.15	6SK7	.45	7K7	.75	25Z5	.37
1J6GT	.47	5U4G	.43	6BH6	.50	6SL7GT	.55	7L7	.75	25Z6	.37
1L4	.45	5U8	.74	6BJ6	.47	6SN7GT	.55	7N7	.50	27	.25
1L6	.55	5V4G	.59	6BK5	.68	6SQ7	.39	12AT6	.37	35A5	.46
1LA4	.57	5Y3	.31	6BK7	.76	6SR7	.42	12AT7	.66	35B5	.50
1LA6	.47	5Y4G	.36	6BL7GT	.75	6SS7	.41	12AZ7	.63	35C5	.50
1LB4	.57	5Z3	.41	6BN6	.58	6T4	.95	12AU6	.41	35L6GT	.47
1LC5	.49	6A7	.57	6BQ6GT	.78	6T8	.68	12AU7	.53	35W4	.34
1LC6	.47	6A8	.45	6BQ7	.78	6U8	.75	12AV6	.35	35Y4	.34
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1R5	.50	6AJ5	.70	6D6	.48	6X8	.73	12BE6	.46	50L6GT	.43
1S5	.42	6AK5	.54	6E5	.44	6Y6G	.55	12BH7	.60	75	.42
1T4	.50	6AL5	.39	6F5	.37	7A4	.45	12BY7	.65	76	.42
1U4	.47	6AQ5	.46	6F6	.38	7A5	.53	12BZ7	.61	77	.38
1U5	.42	6AR5	.46	6G6	.40	7A6	.45	12CU6	.95	78	.38
1V2	.65	6AS5	.48	6H6	.38	7B5	.39	12SA7	.45	80	.34
1X2	.61	6AS6	1.70	6J4	1.79	7B6	.42	12SJ7	.45	84/6Z4	.44
2A3	.55	6AS7G	2.19	6J5	.39	7B7	.41	12SK7	.45	117L7GT	1.09
2A5	.57	6AT6	.39	6J6	.47	7B8	.45	12SN7GT	.56	117N7GT	1.09
2A7	.55	6AU4GT	.65	6J7	.43	7C4	.39	12SQ7	.37	117P7GT	1.09
3A4	.51	6AU5GT	.59	6J8G	.85	7C5	.42	12SR7	.45		
3A5	.50	6AU6	.42	6K6GT	.37	7C6	.43	12V6GT	.45		
3AL5	.45	6AV5GT	.65	6K7	.39	7C7	.45	12X4	.37		
3AU6	.46	6AV6	.39	6K8	.65	7E5	.45	14A7	.42		
3BC5	.54	6AX4GT	.60	6L6	.68	7E6	.55	14B6	.38		
3BN6	.70	6AX5GT	.57								

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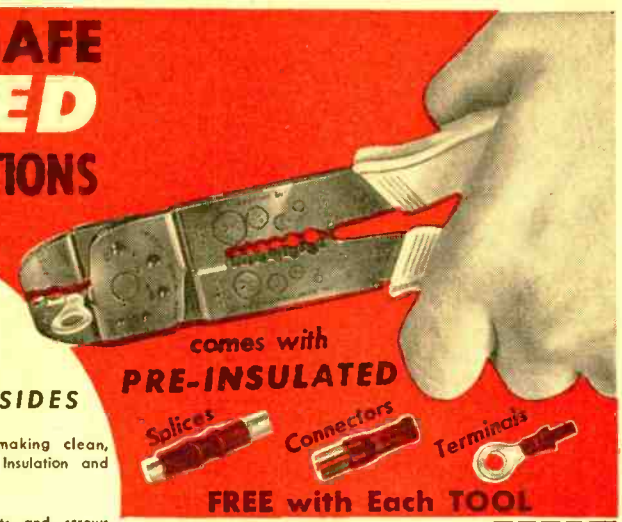

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LISTS HUNDREDS OF NEEDED INVENTIONS

A manufacturer in Chicago is eager to pay good money for new plastic toys or housewares inventions with wide appeal.

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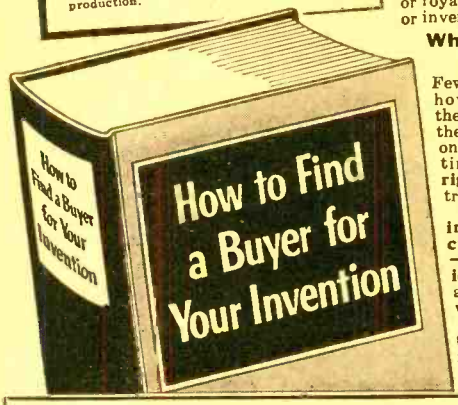
These are just a few of the hundreds of *needed* inventions listed by 140 top manufacturers. Each manufacturer lists the exact type of inventions he is interested in buying, and company executive to write to for immediate action. FOUR complete cross-indexed lists give you this valuable information to guide you:

Cross Index "A" —lists hundreds of needed *inventions* and *types of products* for which improvements are wanted.

Cross Index "B" —gives listing of *materials* each manufacturer uses in current production.

Cross Index "C" —enables you to locate the manufacturers with the *type of equipment* needed for producing your idea.

Cross Index "D" —lists facilities for *developing, producing, and marketing* your inventions.



Why So Many Inventors Fail

Few inventors know how to "cash in" on their ideas. Some spend their entire lives literally sitting on a gold mine without ever getting to the **right man** in the **right firm** who could turn the trick for them, easily—quickly.

The secret of selling your invention—and your shortcut to success as an idea man—is in knowing WHERE your ideas are actually needed, and HOW to contact the man who will say "Yes—BUY!"

That is exactly what the editors of **Science and Mechanics Magazine** have now made it easy for you to do. Their brand-new guide, published after years of exhaustive research, helps you get the **right contact** in the **right firm.** It lists hundreds of inventions urgently needed by top manufacturers. Tells you the actual **name and title** of the man to contact in each firm to make a quick sale!

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using printed circuits. Symptoms of trouble, faults, and corrective measures are all arranged in streamlined fashion for quick reference and quick action on the part of the technician.

Many defects, with apparently different symptoms, all have certain things in common. As a result, one test may often serve to pinpoint several faults. Where this applies, the author has cross-indexed his material, producing a text that is very easy to follow and cutting down on the over-all bulk of the book. It should be pointed out that these are over-sized, double-column pages, each one containing the equivalent of two normal-size pages.

Recommended: as an introductory servicing guide for the beginner; as a "brush-up" or short-cut reminder for the experienced technician.

"OPERATION TV" by Stephen A. Madas. *Vantage Press, Inc.*, New York, N. Y. 81 pages. Cloth bound. Price, $2.50.

Ignoring the extravagant claims on the jacket ("You may be able to fix it yourself and pocket the change . . ."), and getting into the book itself, we feel that this little volume may well fill a gap in the average man's understanding of video technology.

Some insight is provided into the problem of interference, and instructions are given for cleaning the picture tube effectively and safely. This book is not intended as a servicing guide and contains no pictures or diagrams. Its chief value lies in a general explanation of how television works; and it reminds the user that much improvement in reception can be achieved by correct adjustment of visible and accessible controls.

Recommended: for the beginner in TV and the lay viewer.

Free Literature Roundup

AN 8-PAGE BOOKLET titled "Questions and Answers on Electron Microscopes" is available free from the *Research & Control Instrument Div., North American Philips Co., Inc.*, 750 S. Fulton St., Mt. Vernon, N.Y. The booklet covers the operation and application of electron microscopes as well as the subjects of shadow casting, electron diffraction, visual and camera work, and electron and lens theory.

AN ILLUSTRATED FOLDER on "How Magnetic Tape Is Made" may be had upon request from *ORRadio Industries, Inc.*, Dept. 152, Opelika, Alabama. Included is a photo story describing the manufacture of "Irish" brand recording tape. —30—

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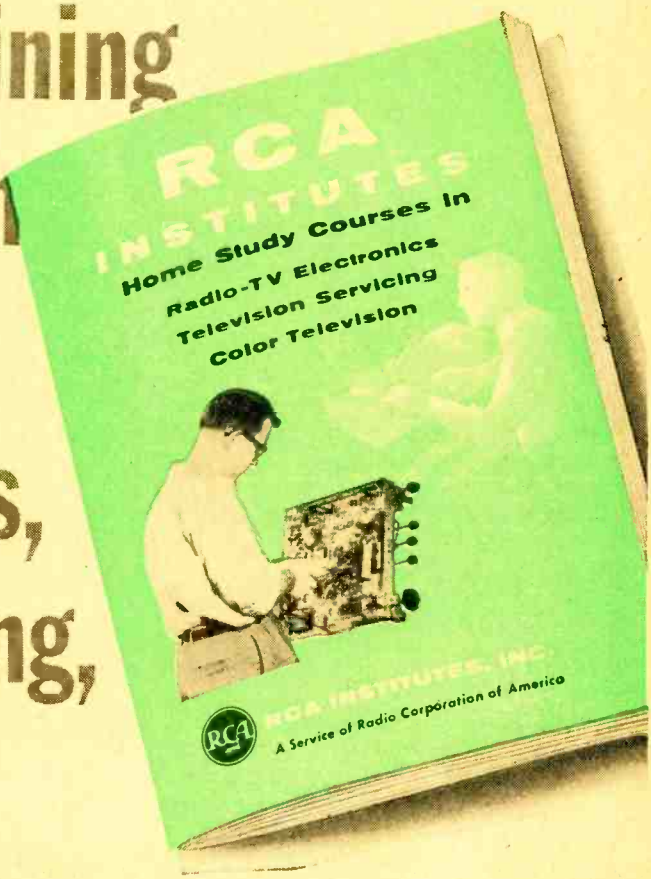

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1L6	.51	6BK7A	.78	12AT6	.41
1LA4	.57	6BN6	.59	12AT7	.68
1LB4	.66	6BL7GT	.77	12AU6	.46
1LC6	.66	6BQ6GT	.80	12AU7	.58
1LD5	.57	6BQ7A	.80	12AV6	.42
1LE3	.57	6BZ7	.90	12AX7	.63
1LG5	.57	6BY5G	.60	12AY7	.90
1LH4	.66	6C4	.39	12BA6	.46
1LN5	.47	6C5	.36	12B4	.70
1N5GT	.55	6C6	.55	12BE6	.46
1R4	.66	6CB6	.51	12BH7	.60
1R5	.51	6CD6G	1.18	12BY7	.64
1S4	.59	6D6	.50	12SA7	.52
1S5	.51	6E5	.46	12SH7	.47
1T4	.51	6F6	.40	12SJ7GT	.50
1U5	.50	6H6GT	.40	12SL7GT	.60
1V	.57	6J4	2.00	12SN7GT	.57
1X2A	.62	6J5GT	.40	12SQ7GT	.40
2D21	1.00	6J6	.49	14A5	.59
2V3G	.80	6J7	.45	14A7	.45
2X2A	.90	6K6GT	.39	14B6	.40
3D6	.45	6K7	.40	14Q7	.52
3LF4	.69	6L7	.44	19BG6G	1.18
3Q4	.55	6N7	.61	19J6	.66
3Q5GT	.63	6Q7	.45	19T8	.70
3V4	.58	6S4	.48	25A7GT	1.50
5T4	.70	6S7G	.47	25AV5GT	.80
5U4G	.49	6SA7GT	.50	25BG6	.98
5V4G	.71	6SC7	.50	25Q6GT	.82
5Y3GT	.39	6SG7	.43	25Y5	.45
5Y4G	.43	6SH7	.45	25Z5	.42
5Z3	.45	6SJ7GT	.45	25Z6GT	.42
5Z4	.54	6SK7	.50	35A5	.48
6A7	.59	6SL7GT	.70	35B5	.48
6A8	.59	6SN7GT	.57	35C5	.48
6AB4	.45	6SQ7GT	.44	35L6GT	.48
6AF4	.80	6V6GT	.48	35W4	.39
6AG5	.52	6W4GT	.40	35Y4	.40
6AH6	.80	6W6	.60	35Z3	.41
6AK5	.80	6W6GT	.53	35Z5GT	.39
6AL5	.42	6X4	.35	50B5	.48
6AL7GT	.70	6X5	.39	50C5	.48
6AS5	.50	6X5GT	.35	50L6	.48
6AS6	2.00	6X8	.75	50L6GT	.45
6AS7G	2.25	6Y6G	.60	75	.44
6AT6	.40	7A4	.47	77	.39
6AU5GT	.70	7A5	.55	78	.39
6AU6	.43	7A6	.47	80	.35
6AV5GT	.75	7A7	.45	83V	.60
6AX5GT	.59	7A8	.46	117L7GT	2.00
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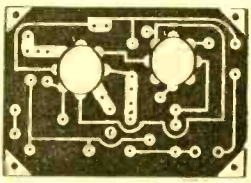
A Printed Circuit is a special insulated board on which has been deposited a conducting material, which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.



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By EDWIN LAWRENCE

Needed Electronic Inventions

If you have a practical solution to any of the problems presented here, contact the National Inventor's Council

A DEATH RAY that will kill at 500 yards! An electronic typewriter which converts speech directly into typed reports! Are these devices from the 25th century or machines from a flying saucer? No. They are only two of the instruments considered worthy of serious work by independent American inventors.

In recent years there has been a tendency for many to think that only large corporations and giant research laboratories could make material contributions to technical development. This is not and has never been true. The American people represent a vast reservoir of inventive talent, creative ability, and technical skill. Individuals, working in basement laboratories and small shops, can still and will continue to make major contributions to science, engineering, and industry. This is as true in the field of electronics as it is in any field, whether engineering, medicine, physics, or chemistry.

In 1940 formal recognition of the part that America's individual inventors and scientists could play in national defense was given when the Secretary of Commerce, with the approval of the President, created the National Inventor's Council. One of the Council's primary functions is to consider suggestions and inventions offered by individuals. It is staffed by a number of eminent engineers, scientists, industrialists, and military men, all of whom lend their specialized services without compensation.

The National Inventor's Council serves in an advisory capacity to the Armed Services and to other government agencies. It acts to consolidate and to make known some of the problems encountered by the military services. In this way the inven-

A typewriter that evaluates the spoken word and processes speech to printed matter would be welcomed. This "invention" may require a new approach before it can be evolved.

tive genius of the public will be directed along lines which will result in needed inventions or in the solution of pressing technical problems. During the years since its organization, the Council has considered literally hundreds of thousands of proposals. A number of these have been acceptable and have resulted in incalculable savings in lives, material, time, and money.

In order to aid in its work, the Council has issued periodically lists of "needed inventions" or "technical problems" to inventors, scientists, engineers, and technicians throughout the nation. These lists have covered practically every field, including medicine, food processing, construction techniques, communications, electronics and transportation.

A number of the more interesting "electronic" problems from recent lists are stated below with additional comments and, in some cases, possible solutions. Read the list carefully. As a POPULAR ELECTRONICS reader, you are one of a great group of Americans who are interested in science and progress. You undoubtedly have many original ideas. Perhaps you can suggest practical solutions to some of these problems and, by doing so, help both yourself and your nation. If you have practical suggestions, or if you would like a complete list of problems, write to The National Inventors Council, Department of Commerce, Washington 25, D. C.

Buried Explosive Detector

A number of mine detectors have been developed and used in the past. Although many of these have performed satisfactorily under ideal conditions, others have failed to operate under specialized circumstances. When a mine detector fails to locate even one buried explosive in a field, that one error may result in the loss of several lives or in the destruction of a valuable piece of equipment. In the past, a number of techniques have been used, including both high- and low-frequency radio waves. It may be that an entirely new approach is needed, possibly one using ultrasonic vibrations. Regardless of the technique used, it should be one which will set off the explosive only at a safe distance from the operator.

Radio-Proof Electric Blasting Cap

Electric blasting caps must be used under some conditions. Unfortunately, many of the present-day blasting caps may be accidentally set off by high-energy radio signals. An inexpensive and efficient electric blasting cap which will not be set off by powerful radio or radar signals is needed.

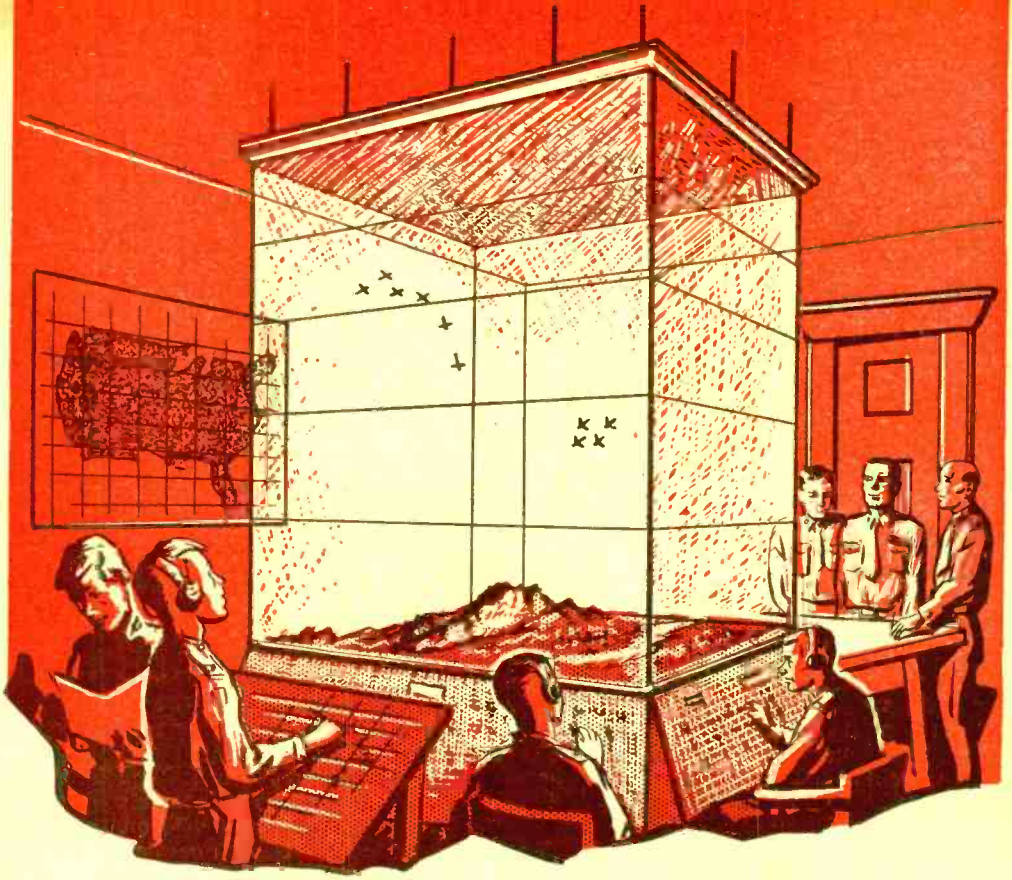
Microwave Oscillator

If you're a ham operator, here's a good problem. There is a need for a microwave oscillator, suitable for both continuous-wave and pulsed operation, with an output of 1 kw. or more. A useful oscillator would be one that will deliver high power signals at 1000 mc. and higher frequencies. One that could deliver high power at 3000 mc. and over would be especially valuable. Most present-day oscillators are incapable of delivering extremely high powers at microwave frequencies for any period of time. However, technical advances are continually being made in this field. Therefore, if you have a potential solution, be sure to check technical literature for the status of other developments in order to avoid any duplication.

Recorder for High-Frequency Range

Some type of recorder is needed for recording signals beyond the range of from 5 to 1000 mc. per second, with either im-

The recording of television programs on wire or on tape is a most promising development.



Three-dimensional radar displays would expedite handling of aircraft near airports as well as improve coastal defenses. Possibly miniature aircraft could be individually activated in a "tank" duplicating area under surveillance.

mediate playback or long-time storage before playback. Wire recorders have not yet been developed with this wide-frequency range. Tape recorders have been developed with frequency ranges adequate for television work, but even these do not encompass the range from 5 to 1000 mc. Perhaps some type of "dielectric" recorder will do the job.

Portable Power Source

There is a continuing need for an efficient, compact electric power source for both field and portable (mobile) work. At the present time, storage and "throw-away" dry batteries are used extensively; but both of these have disadvantages. Storage batteries require frequent recharging and throw-away batteries require frequent replacement. This constitutes a serious problem in front line locations. In addition, where a moderate to large amount of power is required, the weight of a battery power source becomes excessive. Gasoline-driven generators are too noisy for many applications. The recently announced solar and atomic batteries are still in the experimental stage and are far from being suited to field applications at this time. They are also fairly expensive and will probably continue to be so for some time in the future.

One possible solution might be a small sealed gas turbine with an efficient muffler and driving a small generator. Still other solutions might be found in heat- or light-powered electrical energy sources.

The problems of converting light and heat energy into electrical energy have been of long standing. Many experiments have been conducted with self-generating photocells, solar batteries, and similar devices. However, most of the experimental units for converting light into electrical energy have been expensive and have been incapable of delivering really large amounts of power. Thermocouples and pressure-type gas burners have been tried as possible solutions for converting heat into electrical energy but, again, a completely satisfactory solution has not been found.

Regardless of the method used, essential requirements are that the device be reasonably efficient, foolproof, fairly light in weight, of reasonably small size, and extremely sturdy in order to withstand the rigors of field use under combat conditions.

A completely new form of communication is needed by the military. It could be an ultrasonic "carrier" wave. In this drawing, the soldier is using a combination "microphone/earphone" that is plugged into his ear.

A device which generates electrical energy from heat should be capable of using several types of fuel, such as gasoline, diesel oil, kerosene, and alcohol. Any device suggested should operate efficiently under varying atmospheric and humidity conditions and over the temperature range from —65° to +165° F.

Three-Dimensional Information Display

There is a need in the radar display field for a means of presenting three-dimensional information. Radar display units are used to provide a "shadow map" of the covered area, but these are flat and give only two-dimensional information. A "stereo" system in which two cathode-ray tubes are employed is not adequate because it does not permit any degree of accuracy in determining measurements in the three dimensions. A truly three-dimensional display would not only have wide application in military work, but might have wide commercial application in the development of a three-dimensional television system for home use.

Trajectory Indicator

One badly needed device is an indicator to show accurately the path of a missile with respect to target aircraft. Several means may be used for indicating a trajectory . . . photographic, radio, television, radar, or acoustic. However, for military use the system employed should be accurate, fairly easy to use, and capable of indicating the closest approach of the missile to the aircraft, as well as the trajectory. An indicator is needed so that the paths of missiles can be closely checked and improvements can be made in guided missile design to insure greater accuracy. In many cases, it is difficult to tell exactly how close an approach has been made to a target aircraft unless a direct hit is made which destroys both the experimental missile and the expensive target aircraft.

Underwater Target Detection

Some means, other than sonic, is needed for determining the direction and range of an underwater target, such as a submarine. Most of the systems used today depend on the transmission of sound vibrations through the water for their operation. Attempts have been made to use radio and radar-like devices under water but, in general, these have not been too successful. Even though present sonic systems are satisfactory for many applications, they do have some limitations. A supplemental system is also desirable for checking purposes.

Communication System

A revolutionary new method of transmitting intelligence and information is needed to supplement and to replace conventional systems. Present systems, in general, depend on electrical impulses or signals sent over wires (telephone and telegraph), radiated waves (radio and television) and sound waves, or light waves (blinker). The Armed Forces would like a system utilizing completely new concepts. To develop such a system, it will probably be necessary for the inventor to work out a completely new approach utilizing new principles. It may be that a system utilizing an ultrasonic "carrier" wave will offer some possibilities.

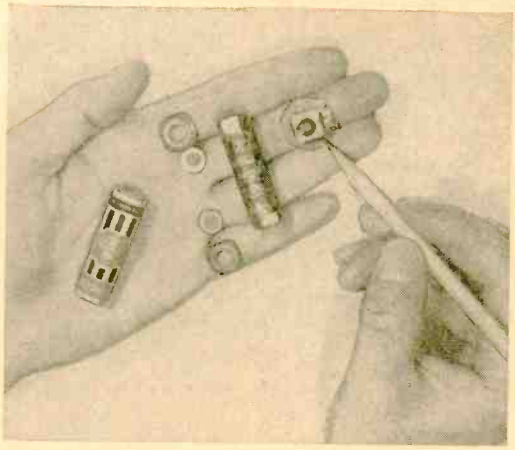
Destructive Ray

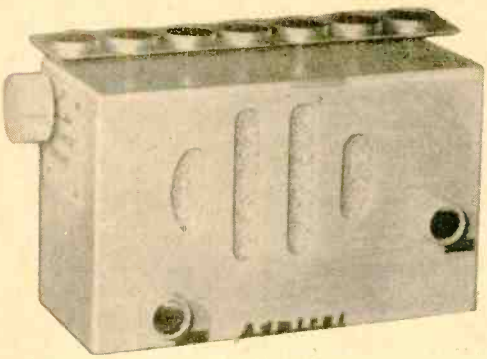
The Armed Forces have been looking for a destructive ray for some time. Although "disintegration rays" and "death rays" have been described frequently in science-fiction, an entirely satisfactory method of producing such rays has not yet been developed. Death rays would be of considerable value in augmenting present weapons, such as mortars, guns, rockets, and flame throwers. However, to be completely useful, the ray should be capable of inflicting damage equal to or in excess of that produced by conventional weapons of similar size and range. It should be portable for field use, usable at distances of at least 500 yards, not require excessive power, and, of course, it should be practical. For example, there would be little point in using a death ray which required careful aiming in order to kill an enemy soldier in the open at 500 yards. A rifle bullet would do the same job and would be a lot cheaper. Several types of "death

(*Continued on page* 122)

Mylar-Encased Battery

THE TINY "wafer cell" battery shown at the right was developed by the *Burgess Battery Company* to simplify construction of high-powered dry batteries. The cell can be made entirely by machine—thus offering a major step towards automation in battery manufacture. It is sealed in a super-thin Mylar pliofilm envelope. Stacking 13 such cells and wrapping the "sandwich" in Mylar produces a battery with an output of 22½ volts. This is an increase of about 30% in battery life and power over earlier styles using carbon center rods. The new battery consists of a sandwich of artificial manganese dioxide mix between tiny discs of flat zinc and carbon.





Solar Battery Operates Radio

A DEVELOPMENTAL transistor radio that derives its power from the sun has been announced by the *Admiral Corporation.* Utilizing printed circuits, transistors, and a solar battery, this radio could conceivably last a lifetime. Eight transistors are employed in place of tubes to insure sensitivity equal to an average home radio receiver. The solar battery consists of seven silicon cells mounted along the top of the receiver case. This battery is used to recharge a standby battery which operates the receiver on cloudy days. Actually, the sun is not necessary to operate the solar battery, since the silicon cells can be activated equally well by a heat lamp or by an ordinary 100-watt light bulb.

Pocket-Size Amplifier Clips to Telephone Receiver

A NEW 3-OUNCE telephone amplifier powered by dime-sized batteries is now available for those who use a telephone in noisy locations and for the hard-of-hearing. The amplifier clips over the common telephone receiver. Produced by *Remler Company,* the unit is self-contained. Batteries are claimed to last several months. The telephone amplifier picks up the conversation by magnetic induction. Volume is adjusted while in use; unit shuts off when removed from phone.

Assembling the Image Orthicon

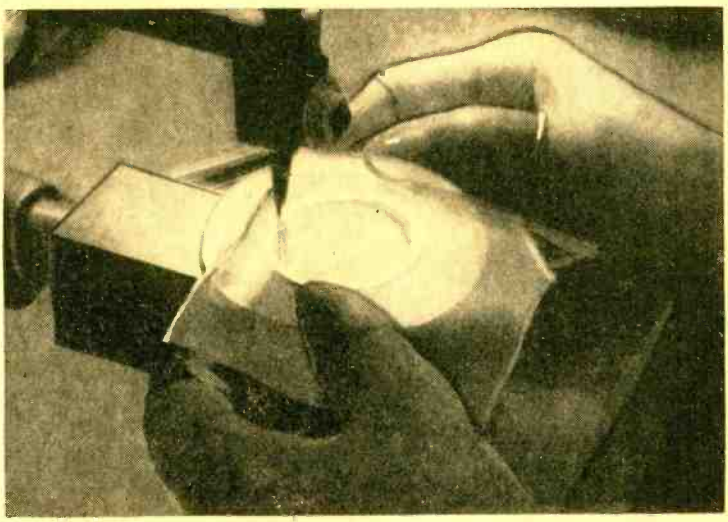
Expert care, precision equipment, and a dust-free atmosphere are required in making TV camera tubes

FACTORY PRODUCTION of image orthicons — the all-important television camera tube—is under way in ultra-modern facilities at the *General Electric* plant, Schenectady, N. Y. Technicians work in nylon clothes and use hospital-clean glass lathes and punch presses, as well as a variety of electrochemical equipment, all behind sealed doors in air-filtered rooms.

This million-dollar investment in camera tube manufacturing involves the assembly of 256 parts to make a single tube. The operation requires exceptionally high dust and lint control standards. In addition, it calls for handicraft skills comparable to those used by artisans of centuries past.

Heart of the image orthicon is the "target and mesh assembly." Difficult to make and install, it consists of a perfect copper mesh of 500 wires to the inch. This mesh must be spaced two-thousandths of an inch

Above, fragile section of glass bubble—about .0001-inch thick —is carefully placed on metal ring. It is then sealed to ring in oven to form delicate "target" of an image orthicon.



Right, precision welding operation joins a 500-wire mesh to the metal ring. The glass bubble, ring, and wire mesh assembly form a critical part of the finished TV camera tube. Mesh cannot touch glass bubble, but must remain spaced from it at .002-inch distance.

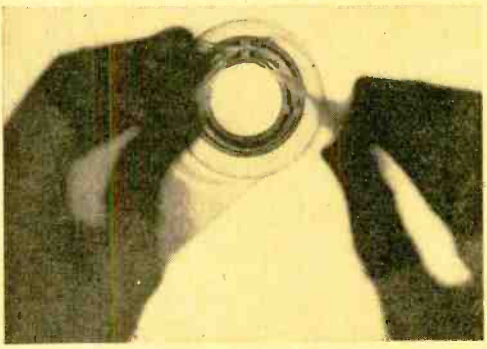
Left, technician receives the glass target and wire mesh assembly after every speck of dust has been removed. Below, the assembly is inserted into the glass tube which eventually becomes the image orthicon. Technician tightens setscrews to hold target in correct position.

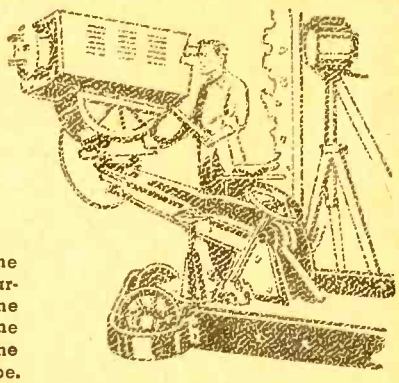
from a delicate glass membrane. The membrane, or "target," must be between one-tenth and two-tenths of a thousandth of an inch thick.

The entire assembly is then inserted into the 13" stem of the tube and fastened in place with screwdrivers that are 18" long. This must be accomplished without either breaking the glass or permitting even the tiniest speck of dust to enter the tube.

Despite the critical nature of this assembly, the *General Electric Company* is managing to produce the tubes in quantity. In addition, *G. E.* is looking forward to mass production of the less expensive—and less critical—vidicon camera tubes. Expected to be employed in large quantities as closed circuit television develops in the next five years, their use is anticipated in military, industrial, commercial, administrative, and home applications. —30—

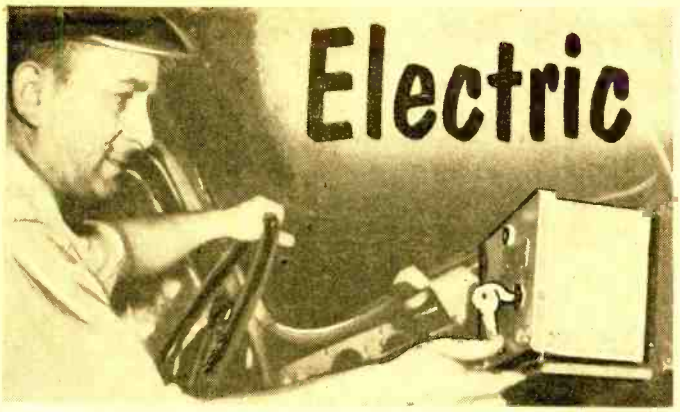
The critical nature of the work is suggested by signs on the door. A sneeze, cough, or unsteady nerves here could cost up to a thousand dollars as technician finishes assembly of camera tube.





Above view of the target is what the assembler sees as she works with thin, 18-inch offset screwdriver fastening the target assembly in place within the glass tube. One slip of the screwdriver could shatter the glass membrane, rendering the tube useless. A speck of dust might not show up until the tube was completed, which would be too late to save the tube.

Electric "Brain"



Alarm box is mounted alongside dashboard. Driver sets alarm by turning key to correct position, then pushing coded buttons below. Timing device allows him a few seconds to leave the cab.

THEFTS OF TRUCK CARGOES are being literally shrieked out of existence with the aid of improved electric alarm systems. Design and circuitry of these devices, first used in 1931, have kept pace with the expanding trucking industry and an accompanying increase in truck cargo thefts, particularly unattended vehicles.

Use of a shock technique is the basic idea behind such alarm systems—not the electrical kind of shock that shoots thousands of volts through the body, but the audio kind that raises a cyclone of screaming decibels in the air. A truck fitted with this type of alarm will—when tampered with—emit a frightening siren-wail. Between the unnerving effect it has on the thief, and the obvious warning it sounds in the area, this alarm technique is credited with reducing or eliminating cargo thefts wherever used. As designed, manufactured, installed, and serviced by *Babaco Alarm Systems, Inc.,* 723 Washington St., New York 14, N. Y., such systems presently act as guardians of truck cargoes valued at fifty billion dollars a year.

"Balanced Circuit" Principle

Practically foolproof, the basic system utilizes the principle of a "balanced circuit." A certain amount of current is permitted to flow through a set of control relays. Decreasing or increasing this current creates an "unbalance," and the relay armatures are activated. Once activated, the armatures set off a "chain reaction" of other relays, self-locking devices, and the alarm siren itself. Unbalance occurs immediately when the vehicle is subjected to any unauthorized movement or tampering. Devices sensitive to pressure, vibration, movement, cutting of wires, etc., flash a signal to a set of control relays (the "brain"), and the alarm sequence is on. Once activated, nothing can stop the alarm except action by someone using the correct combination of key and push-button switching. A different combination is used for each vehicle.

For example, one type of protection circuit uses a relay which is normally energized. This means that the circuit is "balanced" so long as a fixed amount of current flows through the relay's coil to attract its armature. Any decrease in the current will release the armature to provide new contacts which connect the alarm circuit. The decrease in current could result from tampering with—or cutting—the lines.

On the other hand, a relay may be connected to respond to an increase in current. An increase or "overload" could result from short circuits, or attempts to bypass critical networks wired into the system, or vibration actuating the delicately poised contacts of hidden "sensing devices."

Each system is powered by a special battery sealed inside a miniature vault. Special keys and combination switches assure against tampering with the power source.

Ingenious Systems Possible

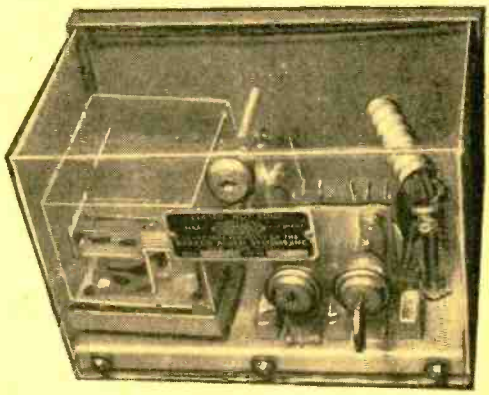
Applying these basic principles, and using relays and other components designed to their own specifications, *Babaco* technicians can wire any unsuspected portion of the truck, including top, sides, and bottom. One system was wired to activate a relay which keyed a c.w. transmitter. When triggered, the transmitter sent out a tone of a certain frequency. This tone, received at a remote listening station, alerted authorities to the situation.

It would seem, at first glance, that such a method of foiling thefts would be least effective on the open road, in country areas. Actually, that is not a very important consideration, inasmuch as 95% of all truck cargo thefts occur within city limits. Reasons for this surprising news are: it is easier to dispose of a cargo in the city; a truck is less apt to appear conspicuous in

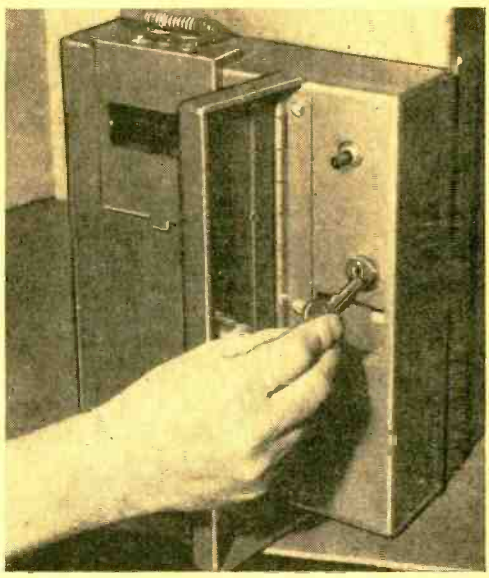
Guards Truck Cargoes

Vehicles shriek for help and can't be moved if thieves try to break in

To enter cab after alarm has been set, the driver must shut off the alarm system. A special key is used; otherwise opening of door would release push button set in jamb and turn on siren. Even if a thief managed to enter the cab, a "parker" device would disable engine, and truck would not move.



Intricate mechanism of alarm's "brain" is shown above. Master key needed for center lock is kept by truck owner. Driver carries key shown at right. Lock at top can be opened only by Babaco. Steel plating guards system (below). To make repairs, or inspect equipment, technician uses special keys, following prescribed sequence.



an area of normally heavy traffic; and the open highway is subject to fast police action in the form of radio calls, pursuit, and roadblocks. In any event, no losses at all have been reported from trucks using the *Babaco* alarms.

Special Features

These systems include refinements that mark advances over the original systems used 25 years ago. A special "seal load" device is available that seals the cargo compartment beyond the driver's control. Any unauthorized attempt to open the cargo doors will set off the alarm. Another new feature is the "parker" device which activates the siren if any attempt is made to open the cargo doors or to move or tow away the trailer section. The "parker" operates even when the trailer is detached from the cab of the truck.

Front page news was made recently when thieves tried to break into a truck carrying $20,000 in cash, toll receipts from the Triborough Bridge and Tunnel Authority in New York City. When the thugs ordered the driver to open the cargo door, which was wired for alarm, the driver indicated that he did not have the keys. The bandits tried forcing the door and the *Babaco* alarm went off. Not only did the siren shriek, but the truck's engine became disabled. Frustrated and frightened, the thieves fled, leaving truck and cargo intact.

Babaco alarm systems are leased, not sold. The cost of installation and the first year's service ranges from $60 to $225. Annual service thereafter runs to about one-half of the initial amount. -30-

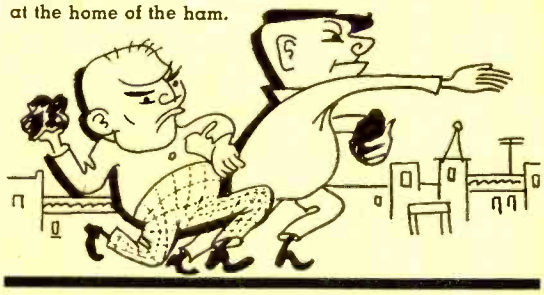
RADIO has become so widely used, and so essential for communication, that any illegal operation or harmful interference must be detected speedily and the violators dealt with. More than 700,000 transmitters are operated in this country, with nearly 975,000 operator permits outstanding. Ninety-eight per cent of the nation's homes contain broadcast receivers. Policing this busy radio activity is a 24-hour-a-day job for FCC monitors. These typical cases were reported by the FCC Field Engineering and Monitoring Bureau in connection with its monitoring and investigative work.

An obliging dentist recently demonstrated an electronic device to induce local anesthesia for tooth extractions. However, the spark-gap oscillator he used could be heard in a mobile unit under power lines about a mile and a half away. Moreover, a neon bulb glowed brilliantly when held within 18 inches of any part of the patient, indicating radiation from the body. Closer physical contact caused actual sparks. All this convinced the dentist that his equipment should be used in a shielded room—whenever he can get patients to try it.

In Kansas City, a 17-year-old radio enthusiast played phonograph records over a home-built transmitter under the mistaken notion that they could be heard only

. . . a neon bulb glowed brilliantly when held close to the patient . . .

They even threw rocks at the home of the ham.



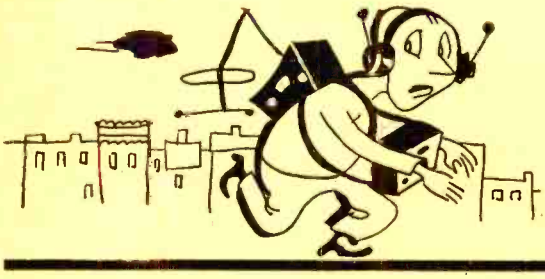
"Kilocycle

on his friend's receiver next door. He was surprised to learn that the signals were going much farther. After being told that his transmissions might obliterate radio messages used for safety purposes, he agreed to abandon his "short-range broadcasting" and direct his efforts toward obtaining an amateur license which would enable him to talk with "hams" the world over.

A young "Marconi" in Ohio requested permission to use an old-fashioned spark coil. He explained that he knew it was unlawful to transmit by radio without a license and for that reason proposed a "wireless" instead of a "radio" station. He was told that "wireless" is just another name for "radio" and that spark coils, which cause great interference, have not been authorized for years.

While moored at a lumber pier at Long Beach, Calif., a cargo vessel caught fire. The night watchman aboard ran to the nearest shore telephone some distance away only to find it out of order. However, the driver of a passing radio-equipped taxicab saw the blaze and reported it by radio to his supervisor, who in turn summoned the fire department. This action saved the fire from spreading to the lumber, and the ship is now back in service after relatively minor repairs.

Despite the mushrooming of Television Interference Committees under FCC auspices to tackle broadcast reception problems at the local level, TV viewers in a certain California community were not



. . . sound calculated to annoy the bugs . . .

Kops"

Comedy and adventure—part of a day's work for FCC monitors

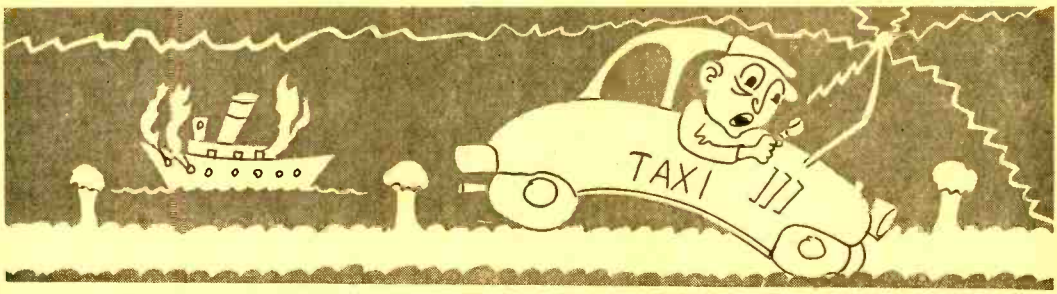
convinced by the local TVI committee that their interference was due to receiver deficiency. They blamed their interference on a local amateur station. They even threw rocks at the home of the ham. But peace was restored when an FCC engineer explained at a subsequent neighborhood meeting that filters connected to poorly shielded TV receivers would overcome the difficulty.

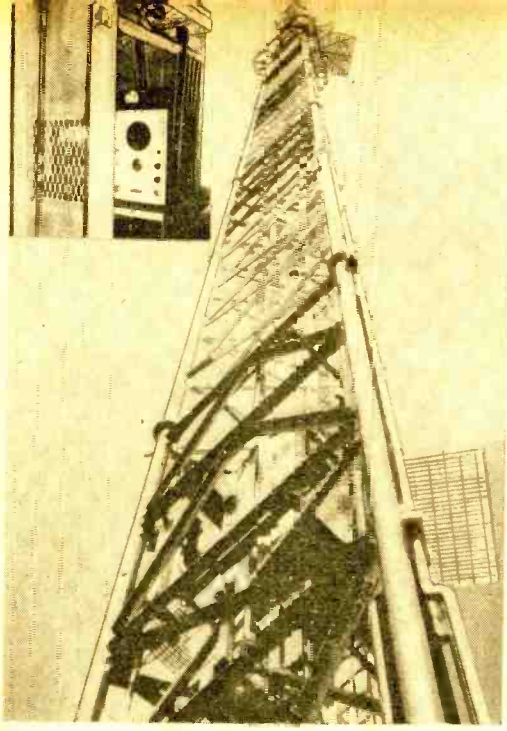
Investigated by FCC field men recently was an alleged "electronic bug killer." A small box was supposed to emit a ray which so affected the antennae of the insects that it would drive them away. The demonstration indicated that there was no release of energy, only of sound which was calculated to annoy the bugs.

While monitoring for interference in Portland, Oregon, an FCC mobile unit observed a strange signal which was traced to an apartment house. It was found to be due to a home-made short-wave receiver which had been discarded for two years. Unknown to the owner, however, the power cord was still plugged in with the switch "on." This combined fire and interference hazard was promptly remedied, but the owner is still trying to determine how much it cost him on his electric bill.

As a practical joke, a licensed amateur sent a "questionnaire" to a prospective ham, asking such questions as: "Are you familiar with the penalty for violation of FCC rules?" The startled recipient promptly filled it out and, assuming it was from the FCC, mailed it to Washington, D.C. The face of the jokester turned red when the prank turned on him. Investigation revealed that he had sold a transmitter to his friend and the latter had gone on the air without a license. Both were warned, and the offender has now obtained a Novice license. —30—

. . . the driver of a passing radio-equipped taxicab saw the blaze and reported it . . .





Inductive Elevator Control

INDUCTIVELY CONTROLLED ELEVATORS have been installed in four TV transmitting antenna towers. Each of the towers is 1000 feet or more in height. They are located at Detroit (WWJ-TV), Tulsa (KVOO-TV), Miami (WGBS-TV), and Milwaukee (WISN-TV). All installations were made by the *Union Switch & Signal Division* of the *Westinghouse Air Brake Company*. Elevators within the TV towers permit workers to tune the antennas and to inspect guy wire anchoring carefully.

The new "TVL" inductive elevator has a 144-kc. transmitter in the car which sends two tones of different frequencies down a special three-conductor cable. One tone controls the ascent of the car, the other controls the descent. Voltage required to operate the transmitter in the elevator car is supplied by batteries. The carrier current receiver is mounted at the base of the tower. Experience has shown that wire control normally used for elevators is unsafe and impractical due to the high winds.

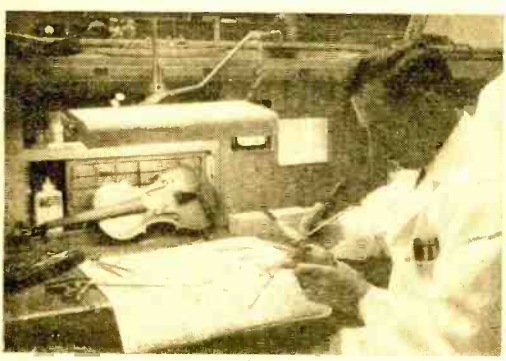
Human Factor in Computers

AN ELECTRONIC "BRAIN" is only as clever as the human brain that operates it. The human brain must have a definite concept of each problem which the machine is required to solve. This fact was emphasized by Claus B. Ludwig of the *International Harvester Company* to businessmen attending the Second Annual Computer Applications Symposium at the Armour Research Foundation.

However, computers relieve humans of monotonous and time-consuming computations, and do the job much faster. Ludwig mentioned that a certain calculation involved 3000 addititons and subtractions, 4000 multiplications, 800 divisions and 1000 logical decisions. All figures were in seven or more digits. A desk calculator with a human operator performed this task in 100 hours. An *IBM* 604 took 12 hours, a *CPC* did it in 4 hours, and an *IBM* 702 computer needed only 20 seconds.

Soundproof Autos?

MONES E. HAWLEY of the *Radio Corporation of America* has predicted that passengers will be able to ride about in soundproof automobiles and airplanes within a few years. Basis of this announcement is the development of an electronic sound absorber at the *RCA* laboratories in Camden, N.J. The electronic sound absorber is a device which consists of a microphone, amplifier, and loudspeaker connected to form a feedback loop. Noise picked up by the microphone is "broadcast" by the loudspeaker with a phase reversal to cancel the "sound" of the noise in the vicinity of the microphone. Scientists at *RCA* are tackling this problem by first mounting the microphone outside the earcap of a set of headphones. Earcap insulation prevents the microphone from picking up sounds coming through the headphones while the feedback loop cancels extraneous noise surrounding the wearer.



Electronic Modeling

THE GENTLEMAN at the left is Ernest H. Grebnau, a highly skilled violin-maker on the staff of the *Stanford Research Institute*. His services have proven to be exceptionally useful to the Institute's Radio System Laboratories. Delicately carved scaled-down models permit evaluation of antennas and other radio equipment without costly test flights. Using wood, metal, plastics and paper, Grebnau must meet tolerances of two or three thousandths of an inch to duplicate in miniature the surfaces of various airplanes.

Santa Fe Railway's "Super Chief" provides its passengers with popular and classical music, radio programs

Music on the Rails

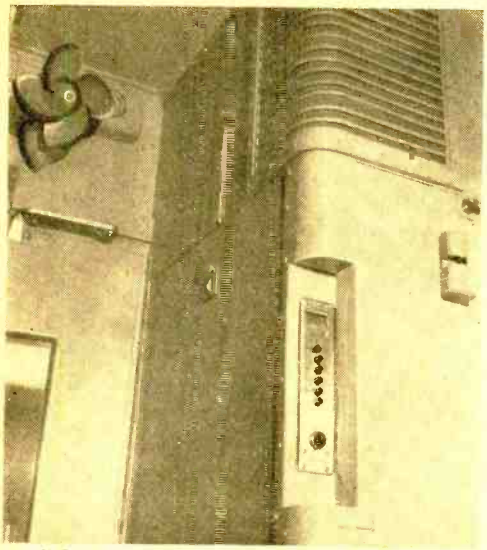
RAILROADS no longer compete with airlines on a price basis. Instead, the airlines offer speed to the man in a hurry and the railroads are selling comfort and relaxation to the man who can take a little more time.

Since trains take longer than planes to carry passengers over the same distances, the airlines have less of a problem in the way of preventing passenger boredom. Many of the new trains have been equipped with music distribution systems. Most consist of a radio receiver with the sound piped to all of the cars. This type of system has limitations since the choice of program is usually left up to a porter and not to the passengers.

The sleek *Santa Fe* "Super Chief," one of the world's most luxurious trains, has been equipped with a music distribution system far more complex and satisfactory than the wired sound systems in many de luxe hotels. The tired business man taking the train can now sit in his private room and enjoy popular music, classical music, or a choice of two radio programs.

Each private room on the "Super Chief" is provided with a built-in loudspeaker and

Power amplifiers in individual cars increase the low-level master signal to speaker level. The radio receivers, magnetic reproducers and main amplifiers are set up in the lounge car.



Program selector switch located in each room enables passenger to tune in one of four different programs, train announcements, or "silence."

push-button control panel which permits the occupant to select any of four programs. In addition, he or she can push a button to get "silence" and another to hear train announcements.

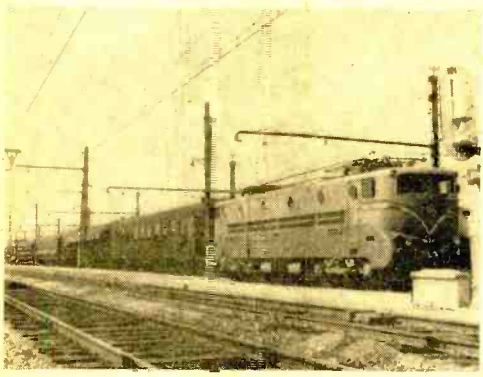
To prevent annoying others in the same car, the loudspeaker in each private room becomes inoperative whenever the room door is opened. Of course, each room has its own volume control. The fidelity of sound reproduction is remarkably good.

Canned music is provided from magnetic reproducers which run for three hours, one delivering classics and the other "pop" tunes. Each car is equipped with its own bank of plug-in amplifiers which are fed at low level from a train line. The radio receivers, magnetic reproducers (which rewind automatically) and main amplifiers are located in a compartment in the lounge car. The canned music is the most popular since radio reception is not always satisfactory in the wide open spaces traversed by the "Super Chief."

Television has been considered for entertaining rail passengers but so far no one has come up with all the right answers. With conventional off-the-air pickup of TV programs, the movement of the train poses many problems concerning reflections and antenna orientation. Train television can be practical using a closed circuit system with filmed programs. And when taped TV programs become a commercial reality, train TV will be even more feasible. —30—

French R/C Train Sets Record

THE FRENCH RAILWAY electric locomotive BB-9003 has established a new record for radio-controlled devices by speeding down

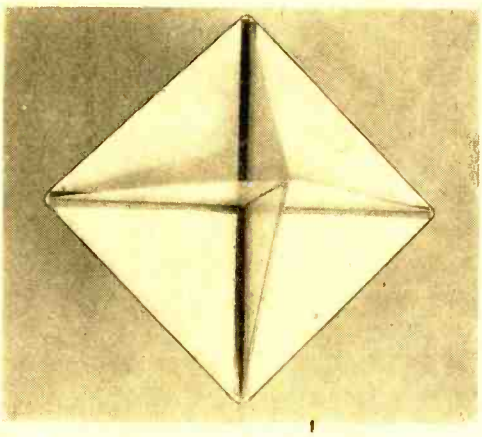


the track at 75 miles per hour. This engine is the sister of the BB-9004 which now holds the world speed record of 205 miles per hour.

During the trial run of BB-9003, all operation was remotely controlled through a relay circuit operating on two meters. Orders were transmitted to the locomotive from a radio transmitter about halfway between the starting and finishing points of the run.

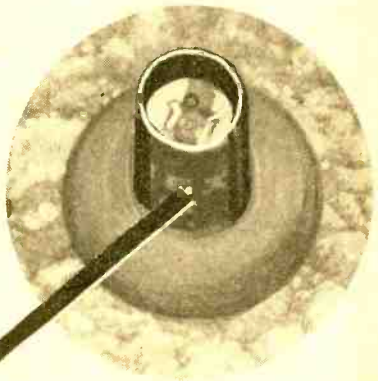
Electronic Red Flag

THE ODD-LOOKING DEVICE below is an "electronic red flag" recently introduced by the *Raytheon Mfg. Co.* It is designed to be mounted on small boats to make them highly conspicuous to larger radar-equipped vessels. Made of aluminum, the "flag" is an octahedral reflector that can be opened or stored like an umbrella. Sold for $14.95,



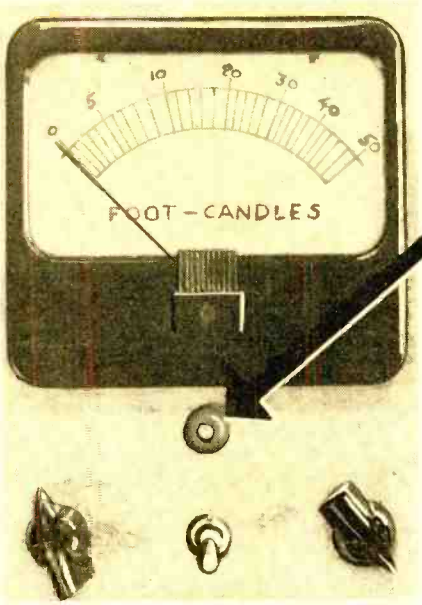
it is available from the *Raytheon* marine sales department in all larger coastal ports and cities.

Transistorized Light Meter



By HARVEY POLLACK

Use this easily built meter to check light intensity in the home, office or workshop



Front-panel view of completed instrument. Right, close-up of photocell in place.

ADEQUATE LIGHTING of the workbench or reading table can assist greatly in relieving eyestrain and fatigue. The eye itself, because of its adaptability to widely varying light intensity, is in general a rather poor judge of proper illumination; accurate measurements with a suitable photometer are much more desirable.

Recent improvements in transistors and the advent of some newly marketed photosensitive devices have made it possible to design the photometer described on these pages. When contrasted with commercially available instruments, it offers these advantages:

(a) *Ruggedness*—the meter movement is a 0-1 milliammeter rather than a delicate microammeter.

(b) *Easy reading*—the use of a 4"-scale milliammeter is desirable if space permits, since quick readings can be taken with very little visual effort.

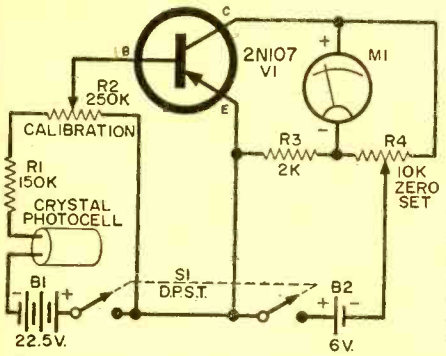
(c) *Low cost*—both the photocell and the transistor are now quite inexpensive, while milliammeters are considerably less costly than microammeters.

(d) *Wide range*—although calibrated for 0-50 foot-candles, a much greater sensitivity of movement is possible.

(e) *Long battery life*—the tiny B battery is never called upon to deliver more than about 100 microamperes, while the current taken from the husky little 6-volt battery seldom exceeds 1.0 milliampere. With this current consumption, batteries may be expected to last out their normal shelf-lives with normal usage.

Construction

Although a detailed constructional procedure is unnecessary since the circuit and wiring are comparatively simple, it is worthwhile to review certain features of the instrument — especially if the reader contemplates layout or size modifications. In planning the purchase of parts, a 0-1 milliammeter of any physical size may be used if the builder is content to sacrifice a measure of easy readability for compactness and portability. A 2½" or smaller movement will permit the construction of a tiny



B1—22.5-volt battery, RCA VS084 or equivalent
B2—6.0-volt battery, RCA VS068 or equivalent
M1—0-1 ma. meter, 4½" face, Simpson No. 29 or equivalent
R1—150,000-ohm, 1-watt resistor
R2—250,000-ohm carbon potentiometer, linear taper (calibration)
R3—2000-ohm, ½-watt resistor
R4—10,000-ohm carbon potentiometer, linear taper (zero set)
S1—D.p.s.t. toggle switch
V1—Type 2N107 p-n-p junction transistor or equivalent
1—Crystal photocell, Clairex Type CL-1 or CL-2 (improved version of CL-1), Clairex Corp., 50 W. 26th St., New York, N. Y.
1—Aluminum case, 7" x 5" x 3", gray hammertone finish
1—Polystyrene sheet, 3/16" thick, 4" x 6"
2—1¼" pointer knobs
Misc. machine screws, wire, solder lugs, rubber grommets, etc.

Catalog price of parts, approx. $20.00

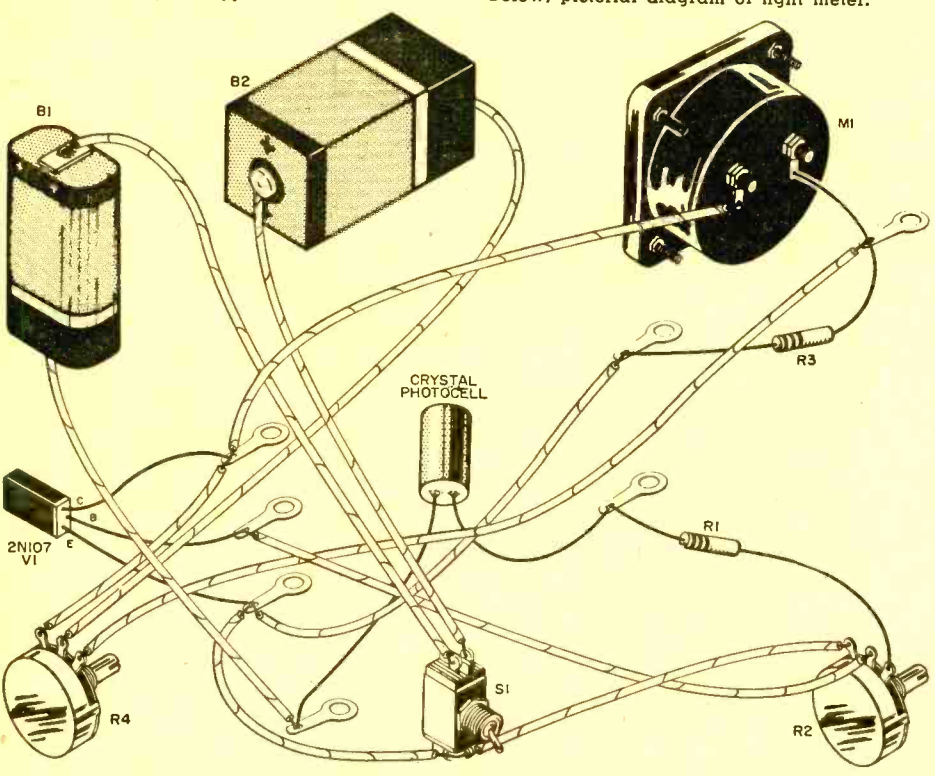
photometer—really pocket-size. It should be realized, however, that this makes it more difficult to calibrate as well as harder to read.

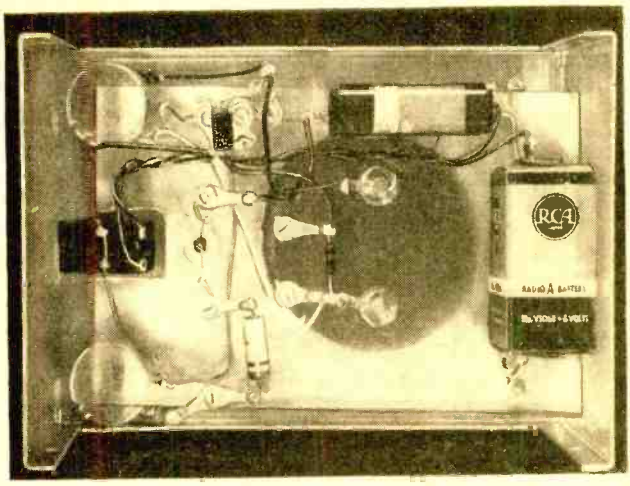
The transistor and other small parts are assembled on a sheet of 3/16" polystyrene. This material—now available in small sheets from any large distributor—is easy to work, makes a neat finished job, and provides good insulation. The plate is held in place by the terminal nuts of the meter movement, while the batteries are secured to the polystyrene by spring clips fashioned from chimney strap steel used for TV antenna installations. If desired, commercial battery clips may be obtained from large supply houses.

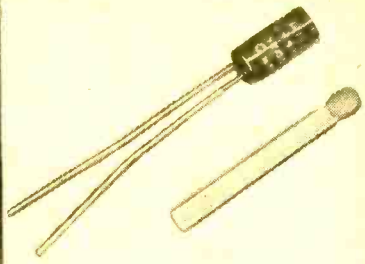
Liberal use is made of solder lugs and machine screws to hold the small components down and, particularly, to avoid the need for soldering to the transistor leads. These wires are looped around the machine screws under the solder lugs before tightening into place, after the circuit leads have been soldered to the lugs. The warnings issued by transistor manufacturers relative to overheating these units during soldering call for extreme caution!

If the panel layout is changed, the photo-

Left, schematic diagram and parts list. Below, pictorial diagram of light meter.







Left, underchassis view of completed instrument. Above, comparison of crystal photocell with paper match gives an idea of small size of cell.

cell must be oriented so that light can reach the tiny window at the end of the unit over as wide an angle as possible.

Testing the Photometer

After the instrument has been completely wired, cover the photocell with a light-tight shield (the author used a Bakelite "wire-nut"), rotate both potentiometer knobs fully clockwise, and snap the toggle switch to the "on" position. The meter should register a small deflection to the right. Adjust *R4*, the "zero-set" control, until the meter reads exactly zero. Now uncover the photocell in the presence of a small amount of light; the meter should show a positive reading and, as the amount of light is increased, should increase its reading. Adjust the illumination by moving the unit closer to or further from the light source until a full-scale deflection is obtained, and then slowly rotate the knob of *R2*—the calibration control—counterclockwise. The meter needle should drop smoothly toward zero.

Restore the calibration control to the full clockwise position. The reading should now return to full-scale. When the photocell is again covered, the meter needle should move back to zero. If consistent restorations of former readings under identical light conditions are not obtained, the transistor is probably faulty. Once these correct reactions have been established, the builder may proceed with the calibration.

Calibration

This is an interesting procedure in itself. Of course, a commercial photometer or "foot-candle meter" enables the user to calibrate simply by comparison, but in the absence of such an instrument, the method described below can provide accurate calibrations with simple "tools."

First, cut a blank scale from a piece of thin white cardboard having a good glossy surface, and cement to the original meter face with rubber-base adhesive. Obtain a 6-volt, double-filament automobile headlamp rated at 32 candlepower per filament in an auto supply store. Either a storage battery or a 6.3-volt, 6-amp. filament transformer will light it to its correct intensity. Provide a clear stretch on the workbench which will permit moving the light source

(*Continued on page* 123)

Distance from Lamp to Photocell		Meter Calibration
Feet	*Inches*	*Foot-candles*
0	9.6	50
0	10.1	45
0	10.8	40
0	11.4	35
1	0.4	30
1	1.5	25
1	3.7	20
1	5.5	15
1	9.5	10
2	6.2	5

Table 1. Distances to use in calibrating the meter with standard lamp.

Location	Foot-candles Recommended
Halls	8-15
Reading room	20-35
Assembly benches	25-50
Clerical desks	20-30
Fine handwork on light objects	40-60
Fine handwork on dark objects	70-100

Table 2. Recommended light intensity for various locations and activities.

Simple

Simplicity of circuit design and all standard components make this handy three-tube amplifier unit easy to build

By LUIS VICENS

WHETHER you're an experienced experimenter or a beginner, you'll enjoy building this guitar amplifier. If you're an "old hand," you'll appreciate the straightforward simplicity of the circuit design and the lack of frills that make a circuit difficult to wire and to trouble-shoot. If you're a beginner who has "cut his eyeteeth" on a crystal receiver or a simple one-tube project, you'll find this three-tube amplifier advanced enough to challenge your interest, yet, at the same time, simple enough to insure success.

Although originally designed for use as a simple guitar amplifier, the unit can be used as a low-cost phonograph amplifier, with a microphone as an inexpensive p.a. system, or as a general-purpose test amplifier in the lab.

Components required are specified in the parts list. All parts are standard and should be readily available at a radio parts distributor or from one of the large mail order supply houses advertising in this magazine.

The chassis layout (Figs. 2 and 3) serves as a guide. Over-all dimensions and exact layout are not critical and modifications can be made to suit individual requirements. Don't crowd the rectifier and power output tubes too close to the electrolytic filter capacitor; excessive heat may damage this component. Locate the input jack *J1*, gain control *R1* and amplifier tubes in such a way that short, direct leads are used in all circuits. And, finally, make sure that the over-all dimensions are not too large for the cabinet.

Construction Details

The chassis used in the model was bent from a flat sheet of aluminum, but a standard commercial chassis will serve as well. When the chassis is completed, mount all chassis parts except the filter capacitor, using small machine screws and hex nuts.

Guitar Amplifier

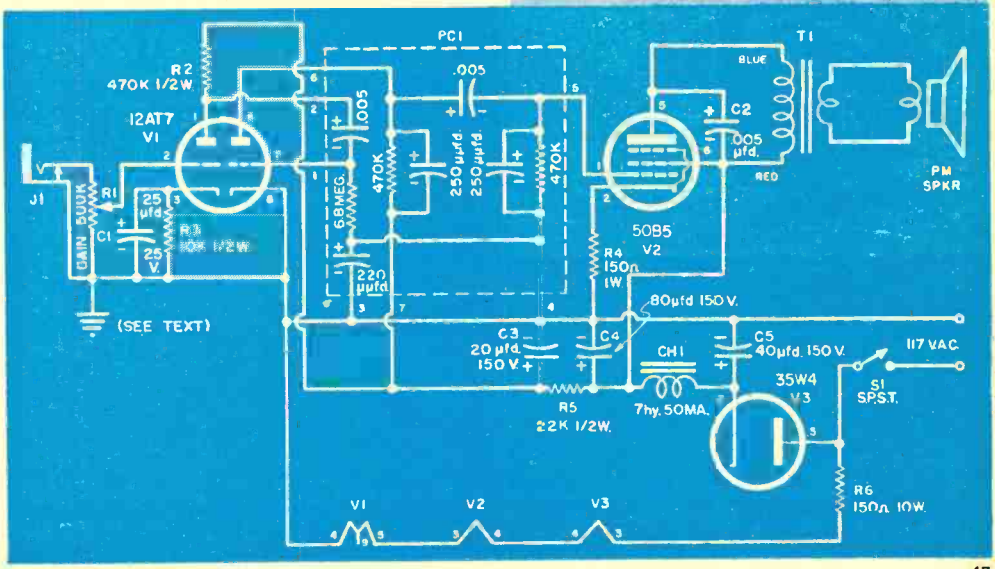
To mount the filter capacitor, first mount either the metal or the fiber mounting plate on the chassis, using machine screws, lock washers and nuts. Both types of mounting plates are furnished with the capacitor. Choose the metal plate if the chassis is to serve as "ground," the fiber plate if a "floating ground" is to be used. With the mounting plate in place, hold the capacitor against the plate so that the small mounting lugs project through the proper holes; give each lug a 45° twist, using a pair of pliers. The mounting lugs also serve as the B— connection to the capacitor.

A wall speaker baffle serves as a cabinet. It is modified by adding four rubber feet to its broader base and mounting a kitchen cabinet drawer pull on top to serve as a handle. Drawer pulls may be obtained at a hardware store. The loudspeaker and output transformer are mounted in this cabinet. Use ornamental head machine screws when mounting the speaker.

A piece of perforated *Reynolds* "do-it-yourself" aluminum serves as a ventilated back cover. This new aluminum alloy is available at most hardware stores and the sheet stock, from which the back cover of the model was made, is soft enough to be cut with ordinary household shears. Special sheet metal shears are not needed. Several perforated designs are available.

C1—25-μfd., 25-volt tubular electrolytic capacitor
C2—.005-μfd. disc ceramic capacitor
C3, C4, C5—Triple-unit elec. capacitor; 20, 80, 40 μfd. @ 150 volts (Sangamo PLT-7385)
CH1—Filter choke, 7 hy. @ 50 ma. (Stancor C-1707)
J1—Closed circuit phone jack
PC1—Printed circuit plate (Erie 1408-02)
R1—500,000-ohm carbon potentiometer, audio taper volume control
R2—470,000-ohm, ½-watt carbon resistor
R3—10,000-ohm, ½-watt carbon resistor
R4—150-ohm, 1-watt carbon resistor
R5—22,000-ohm, ½-watt carbon resistor
R6—150-ohm, 10-watt wire-wound resistor
S1—S.p.s.t. toggle switch (power)
T1—Audio output transformer, 2000 ohms to 4-ohm voice coil (Stancor A-3876)
1—6" to 10" PM loudspeaker, 3.2-ohm voice coil
V1—12AT7 tube
V2—50B5 tube
V3—35W4 tube
1—Small aluminum chassis (about 6"x4"x1½")
1—Polarized plug for line cord
1—Wall speaker baffle
1—Knob
2—7-pin miniature tube sockets
1—9-pin miniature tube socket
1—Line cord
4—Rubber grommets
4—Rubber feet with screws
1—Kitchen cabinet handle
1—Sheet of perforated metal (about 8" sq.)
1—Contact microphone with cable and plug
Misc. wire, solder, machine screws, nuts, hardware, terminal strips, etc.

Fig. 1. Schematic diagram and parts list.



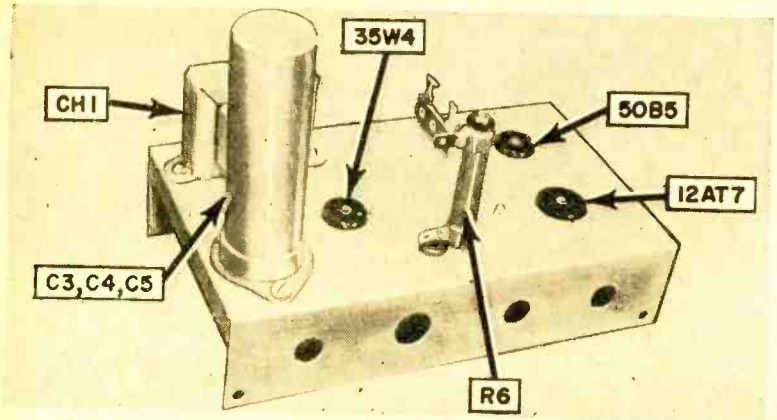


Fig. 2. Above-chassis view of amplifier (at left). Some parts are mounted but not wired.

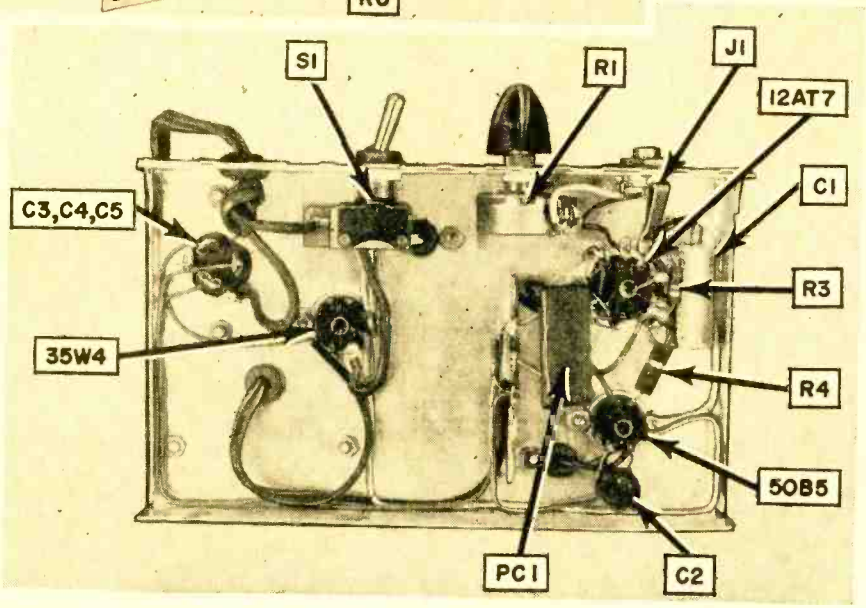


Fig. 3. Below-chassis view of the wired unit. Parts are identified.

Only a few general precautions need be observed when wiring the amplifier. Carefully follow both the schematic and pictorial wiring diagrams, checking one diagram against the other as the wiring proceeds. Keep all signal leads as short and direct as possible. Insulate bare leads with spaghetti tubing. Don't bend the leads of the printed circuit plate too sharply as they may break off close to the plate.

Referring to the schematic diagram, note that one side of the power line serves as the B— lead and connects to circuit "ground." This ground connection may be made to the chassis, *provided a polarized line plug is used, and the grounded side of the line connects to the wider prong.*

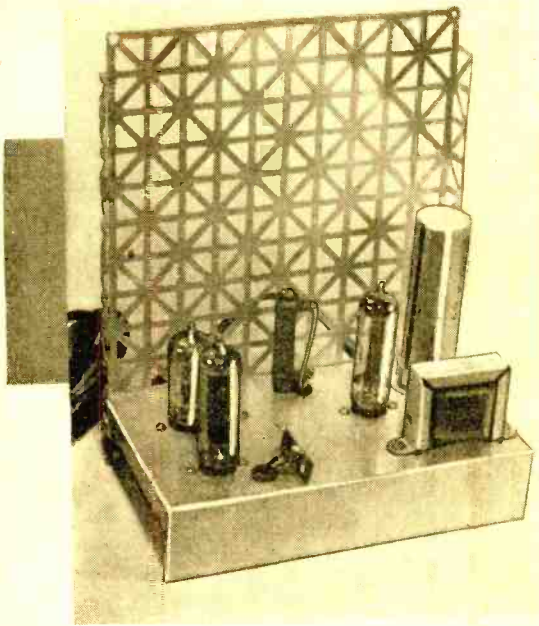
If it is impossible to obtain a commercial polarized line plug, make one by soldering a small piece of wire around the edge of one prong of a standard plug. A small paper clip will furnish a preformed wire for this purpose. See Fig. 4.

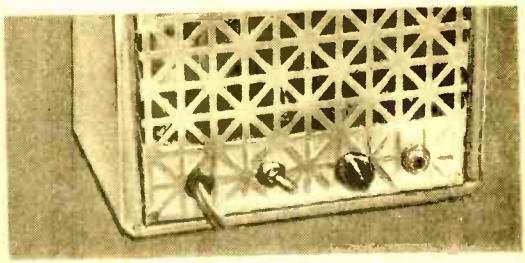
To use a standard line plug without modification, wire the circuit for a "floating ground" and avoid accidental shocks. To install a "floating ground," use the fiber plate when mounting the electrolytic filter capacitor (to insulate its shell from the chassis), and insulating washers when mounting the input jack *J1*, making all "ground" connections to an insulated terminal. Connect this terminal to the chassis proper through a 1-megohm carbon resistor, bypassed by a .01-μfd., 400-volt paper capacitor.

It should be noted that the microphone cable shield will be connected directly to one side of the line in this arrangement, which can present a severe shock hazard. Therefore, use of a standard line plug is not recommended.

Several modifications in the basic circuit are possible to meet the needs of the individual builder. For example, the printed circuit plate may be replaced by individual

Shown at left is the amplifier before it is mounted in its case. Perforated "do-it-yourself" aluminum serves as a ventilated back cover. Below is a rear view of the completed amplifier.





components. The heater dropping resistor may be replaced by a line cord resistor or a ballast tube having the proper resistance.

The toggle switch used as a power switch may be replaced by a volume control type switch mounted on the gain control if care is taken to keep the a.c. leads away from the signal circuits. And the gain control itself may be replaced by a different unit. Although a 500,000-ohm control was used in the model, any value from 100,000 ohms to as high as 2 megohms may be used.

If desired, the PM loudspeaker may be replaced by an electromagnetic speaker, with the field coil connected as a filter choke in place of *CH1*. Coil resistance should be in the neighborhood of 500 ohms.

How it Works

The guitar amplifier consists of a two-stage triode voltage amplifier (12AT7) driving a beam power audio output stage (50B5), with d.c. operating power supplied from a conventional half-wave rectifier (35W4).

In operation, signals supplied by a microphone through input jack *J1* are applied across gain control *R1*, with the setting of this control determining what portion of the total available signal is applied to the grid of the first amplifier stage, half of a 12AT7 dual-triode tube. Bias for the first stage is supplied by cathode resistor *R3*, bypassed by capacitor *C1*.

The amplified audio signal appearing across plate load resistor *R2* is coupled through a .005-μfd. capacitor to the grid of

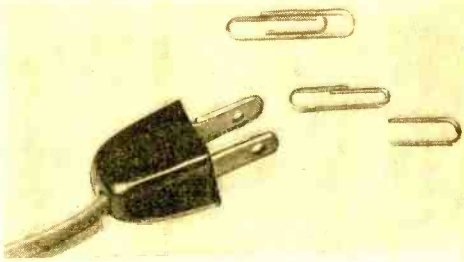


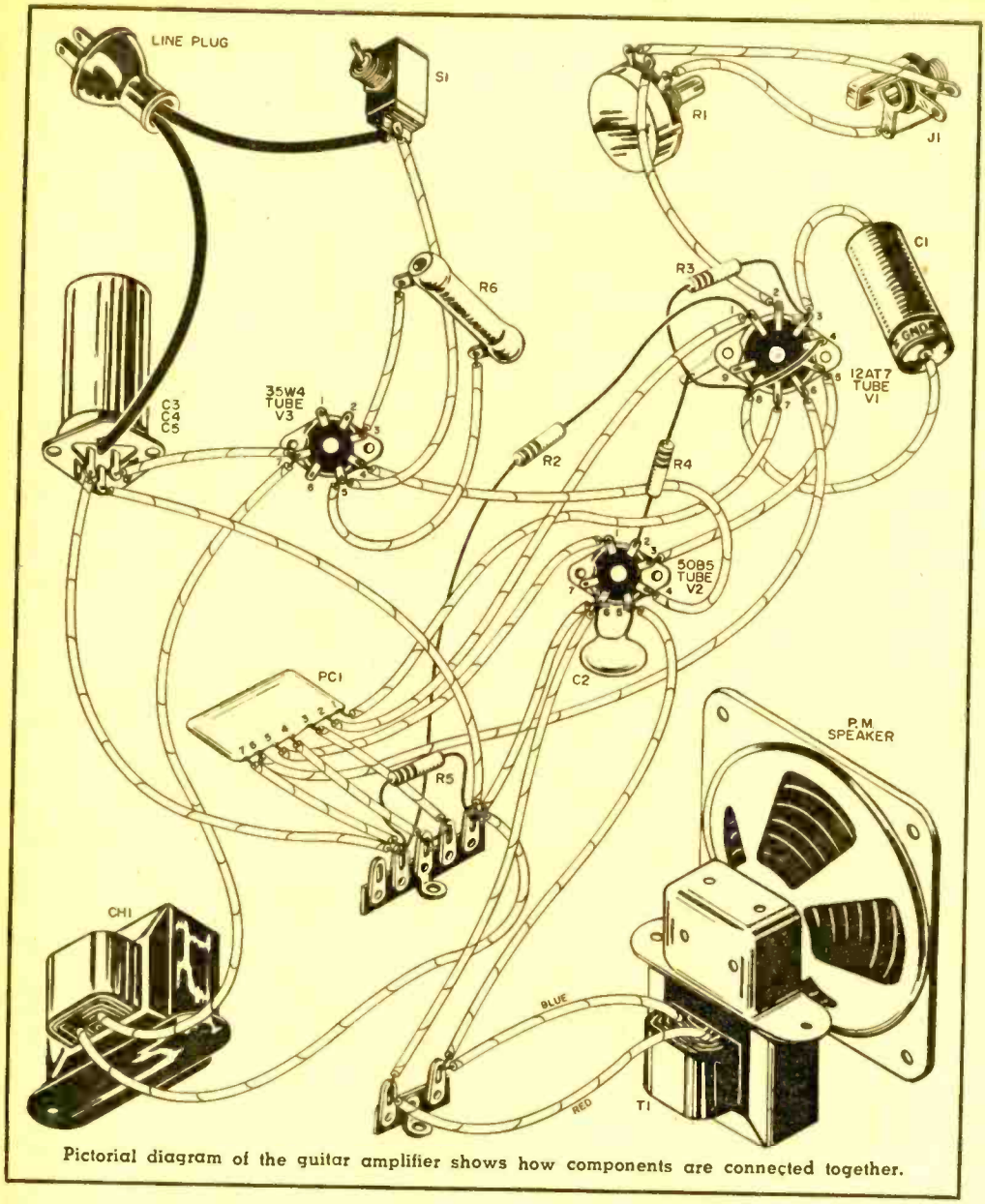
Fig. 4. How to make a polarized plug out of a conventional plug. See text.

the second amplifier stage, the last half of the 12AT7 tube. The small capacitor is part of a printed circuit plate (*PC1*) which also includes the grid resistor for the second stage (6.8 meg.), the plate resistor for the second stage (470,000 ohms), the coupling capacitor to the output stage (.005 μfd.), and the grid resistor of the output stage (470,000 ohms). Three additional capacitors are included on the commercial printed circuit plate and are shown in the schematic diagram, but are not essential to the operation of the circuit. Contact bias, supplied by the large (6.8-meg.) grid resistor, is used on the second stage.

The amplified audio signal appearing across the plate load resistor of the second stage is coupled through a .005-μfd. capacitor to grid of power output stage *V2*.

Capacitor *C2* acts to bypass high-frequency signals and thus to reduce the effects of whatever harmonic distortion may be present in the power amplifier. Transformer *T1* serves to match the high plate impedance to the low voice coil impedance of the PM loudspeaker.

Power to operate the amplifier is supplied by a half-wave rectifier (35W4) and a conventional "brute-force" pi-type filter network consisting of filter choke *CH1* and electrolytic filter capacitors *C4* and *C5*. Additional filtering for the voltage amplifier stages is provided by an *RC* filter consist-



Pictorial diagram of the guitar amplifier shows how components are connected together.

ing of *R5* and *C3*, another electrolytic capacitor.

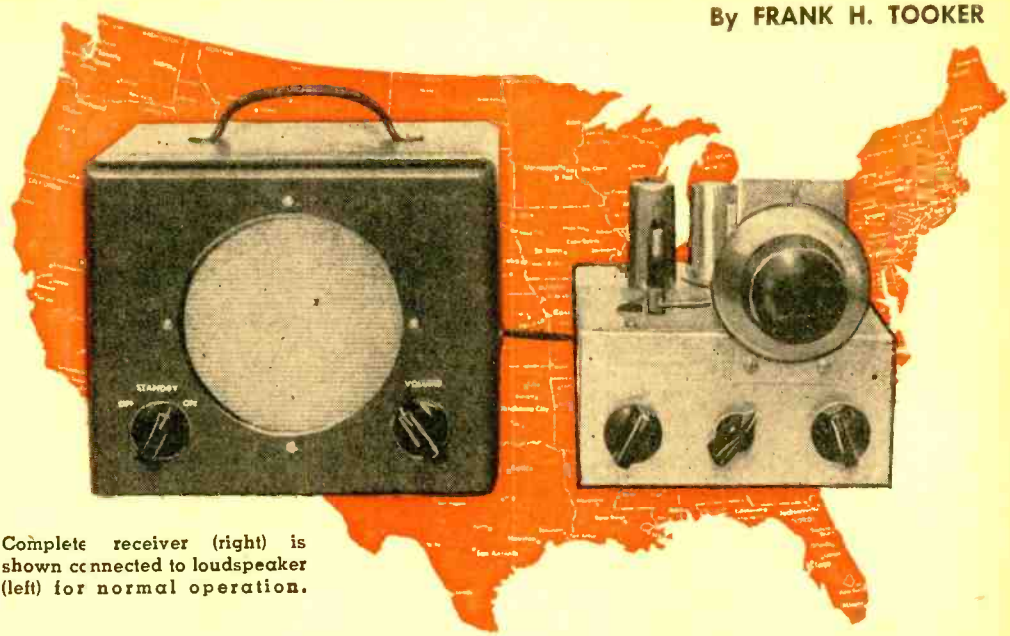
The heaters are connected in series, with resistor *R6* added to permit operation on full line voltage. Switch *S1* serves as the power switch, with a polarized plug insuring that proper power line connection is always made.

Using the Amplifier

The amplifier is complete in itself. Just plug it into a wall receptacle, turn it on, and allow a few minutes warm-up. Only one accessory is required . . . a standard "contact" microphone. This is mounted on the guitar (or other musical instrument) and plugged into jack *J1* of the amplifier. Gain control *R1* may be set at the desired level by adjusting the control while playing a few bars on the instrument.

Don't try to set the gain control at too high a level or there may be a squealing or whistling sound after each note. In most cases, the amplifier should be set slightly in front of and to one side of the musician, but the exact location for best results will depend on individual room or auditorium acoustics. —30—

By FRANK H. TOOKER



Complete receiver (right) is shown connected to loudspeaker (left) for normal operation.

Building a "Regenode" Receiver

Wide reception and exceptional performance will result if you build this novel regenerative and cathode-coupled circuit

BOSTON! PROVIDENCE! HARTFORD! BALTIMORE! WASHINGTON, D. C.! Broadcast stations in these and many more cities now come in at normal speaker volume at the author's home in South Jersey *during daylight hours!* And they all come in with an antenna no more than 20 feet long and only six feet above ground.

What is the secret of this outstanding performance? It is the result of a new concept in regenerative receiver design. The term "regenode" is coined from the circuit which, using modern techniques, is *regen*erative and cath*ode*-coupled. This circuit, plus the use of an extremely high-*Q* coil, and modern, highly sensitive, high-gain television type tubes, has resulted in a receiver of such performance that it will both please and amaze. The circuit is simple, straightforward, and easy to get going. Anyone who can read a wiring diagram and use a soldering iron can build the "Regenode."

The "Ferri-tenna" used at *L1* in the wiring diagram, Fig. 1, does a lot for the "Regenode." It is a coil especially designed to have a very high *Q*—i.e., its radio-frequency losses are low. To utilize the capabilities of *L1* to the greatest extent, it must be connected into a circuit which will not lower its *Q*. A conventional regenerative circuit does not meet this requirement, because the bias rectification process consumes power—and when power is taken from a tuned circuit, its *Q*—or quality factor—is reduced.

To reduce loading of the tuned circuit, *L1-C2-C3,* the "Regenode" uses what is termed a cathode follower, which is shown as *V1A* in the wiring diagram. The two most important qualities of a properly designed cathode follower are: (1) extremely light loading of the circuit to which its input (grid circuit) is connected, and (2) very low impedance output (at the cathode) from which a certain amount of power may be drawn without disturbing the input circuit. Thus, the input circuit (control grid, pin 2) of the regenerative detector, *V1B,* is connected, through a capacitor, *C5,* to the low impedance cathode (pin 8) of the cathode follower, *V1A*. The high-*Q* tuned circuit is connected to the grid (pin 9) of the cathode follower where it will not be adversely affected by the action of the detector.

Regeneration is accomplished in the "Regenode" by feeding back energy from the screen grid (pin 3) of the detector, *V1B*, through *L2* into *L1*. The amount of regeneration is determined by the setting of the feedback control, *R6*, which varies the voltage applied to the screen of the detector. The more the control is advanced, the greater the regeneration, until finally a point is reached where the detector breaks into oscillation. Oscillation is evidenced by a whistle or squeal in the headphones or speaker when the receiver is tuned to a broadcast station. The "Regenode" goes into and out of oscillation very easily. There is no "plop" or "thump" at the point of oscillation heard in many circuits. Hand capacity effects (detuning caused just by moving the hand near the dial or chassis) are non-existent in the "Regenode."

Very low voltages are used with the detector. Normal weak-signal (maximum regeneration) screen potential is about 12 volts and plate potential is around 50 volts. It's unnecessary to measure these voltages while building or adjusting the "Regenode." These values are given merely for the benefit of those who have the facilities to check them—especially those who may want to adapt the "Regenode" principle to other applications.

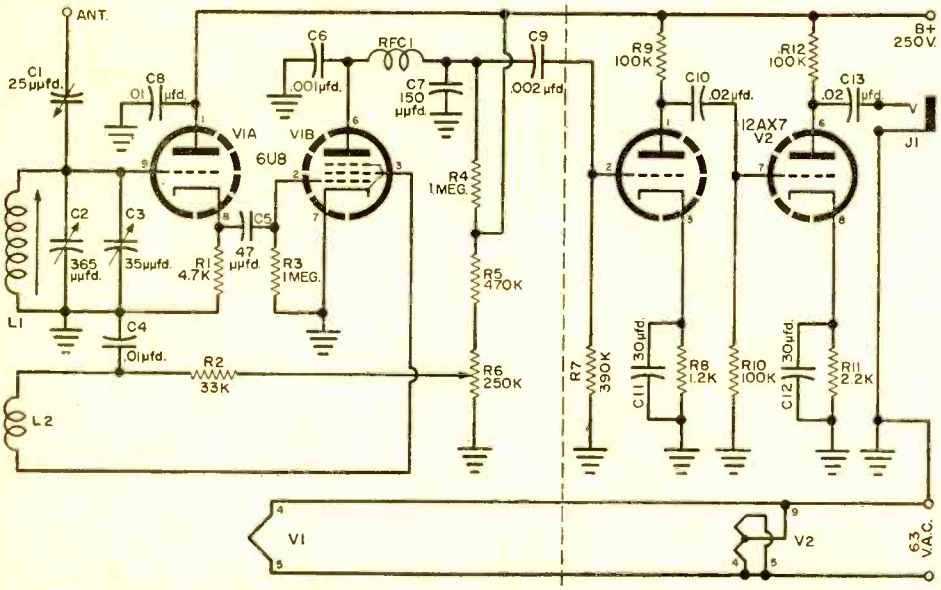
Construction and Adjustment

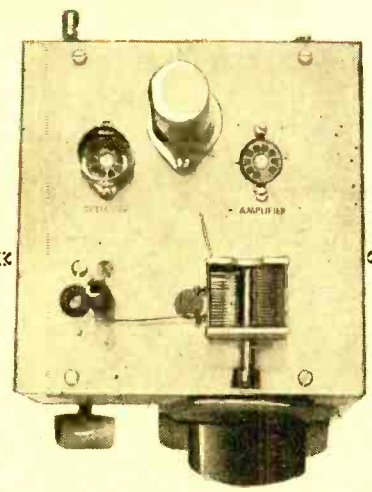
Location of parts and the wiring in this little broadcast receiver are not especially

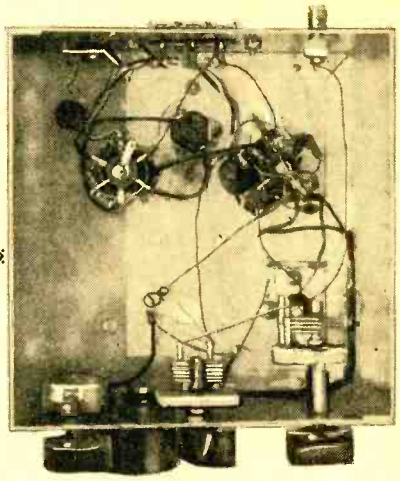
C1—25-μμfd. midget variable capacitor (an insulated coupling extender should be used between the shaft and the knob)
C2—365-μμfd. variable capacitor
C3—35-μμfd. midget variable capacitor
C4, C8—0.01-μfd. ceramic capacitor
C5—47-μμfd. ceramic capacitor
C6—0.001-μfd. ceramic capacitor
C7—150-μμfd. ceramic capacitor
C9—0.002-μfd. ceramic capacitor
C10, C13—0.02-μfd. ceramic capacitor
C11, C12—30/30 μfd., 150-volt electrolytic capacitor, dual unit, Sprague TVL-2422 or equivalent (two 25-μfd., 25-volt units may be used instead)
J1—Open-circuit phone jack
L1—"Ferri-tenna" or "Vari-loopstick" or equivalent
L2—Tickler coil (see text for details)
R1—4700-ohm, ½-watt carbon resistor
R2—33,000-ohm, ½-watt carbon resistor
R3, R4—1 megohm, ½-watt carbon resistor
R5—470,000-ohm, ½-watt carbon resistor
R6—250,000-ohm potentiometer
R7—390,000-ohm, ½-watt carbon resistor
R8—1200-ohm, ½-watt carbon resistor
R9, R10, R12—100,000-ohm, ½-watt carbon resistor
R11—2200-ohm, ½-watt carbon resistor
RFC1—2.5-mhy. radio-frequency choke, National R-50 or equivalent
V1—Type 6U8 tube
V2—Type 12AX7 tube
2—9-pin Vector miniature sockets, or equivalent
1—Noval shield base and shield
3—Knobs
1—Vernier tuning dial
1—Scrap aluminum strip for vernier dial
1—Antenna post
1—Insulated coupling and extender (for C1)
1—3-terminal strip, heavy duty
1—Chassis, 6" x 6" x 2½" (a standard 5" x 7" x 3" chassis may be used if desired)
Misc. machine screws, nuts, ground lugs, decals for lettering (if desired), wire, solder

Catalog price of parts, approx. $18.00

Fig. 1. Schematic wiring diagram, together with parts list.







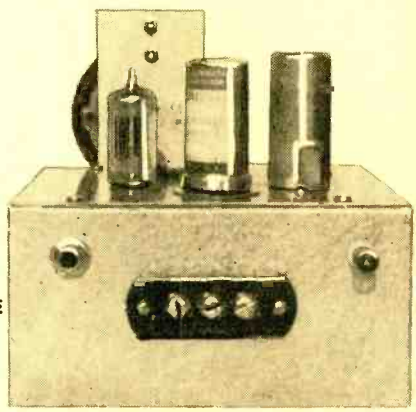
Top, bottom and rear views of the broadcast receiver. The wide-open construction shown here is not specifically required.

critical if large metallic objects are kept about 2" away from *L1*. Keep all leads as short as possible; keep grid leads away from plate leads, especially in the amplifier, and both away from the heater leads. The author used *Vector* sockets to accommodate the various small parts around each stage; however, the more conventional sockets, plus tie points, may be used instead.

Coil *L1*, as purchased, has about a foot of wire wrapped loosely around the form just below the coil proper. Remove this piece of wire and mark carefully the coil terminal to which one end of it is connected, as this is the terminal that should be wired to the stator plates of *C1, C2, C3,* and pin 9 of the cathode follower, *V1A*.

Assemble and wire the receiver except for the tickler coil, *L2*. To make the tickler, wrap two layers of ½"-wide plastic tape around the coil form below *L1*. Put about six turns of wire on the tickler. Use any insulated, small-diameter wire, and close-spaced turns; wind the coil in a counter-clockwise direction, with the first turn toward the chassis, and the sixth turn toward *L1*, and spaced about ¼" below *L1*. Secure the turns to the form with a couple of small strips of the plastic tape.

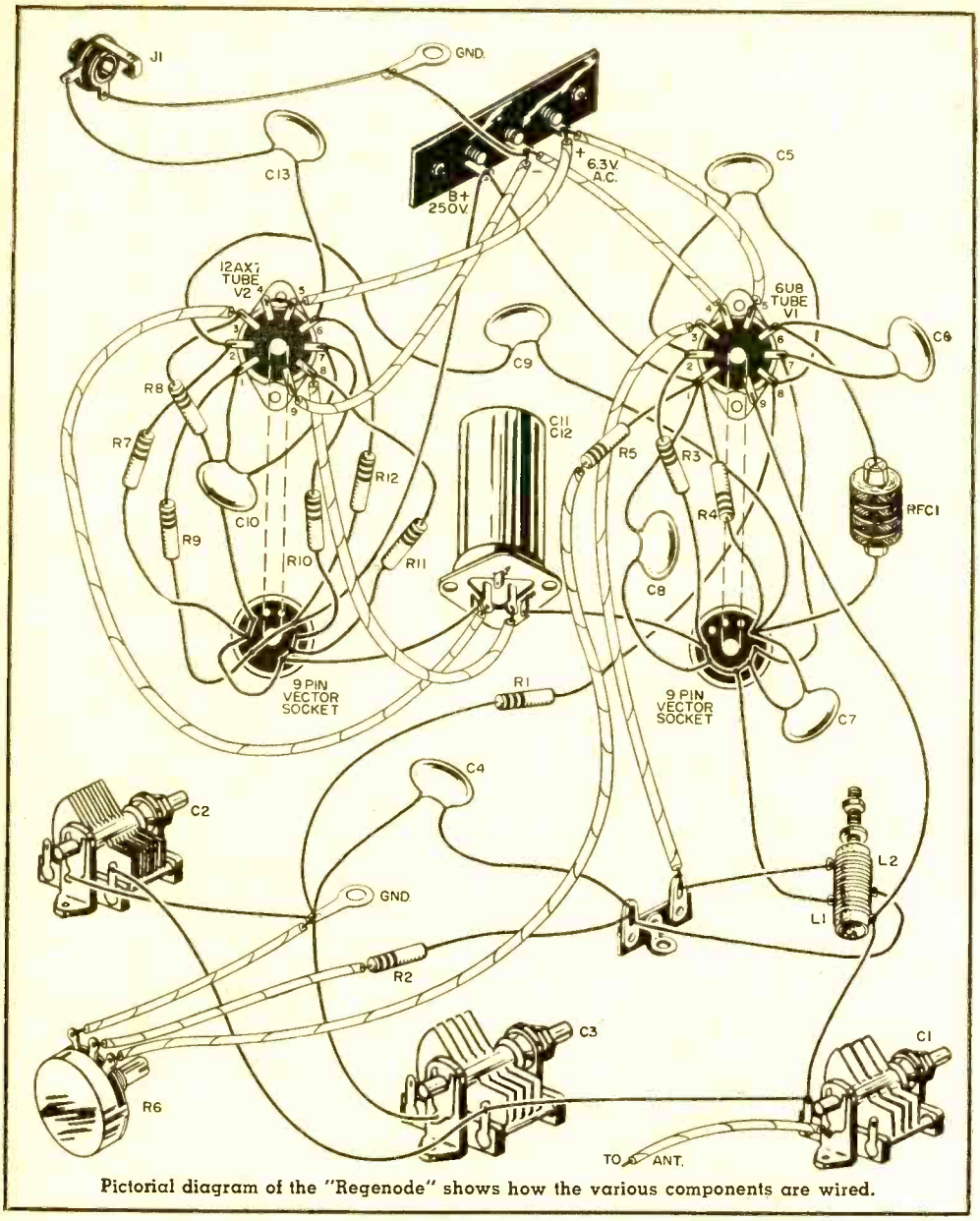
Leaving the tickler coil leads free, connect the lead of resistor *R2*, which would normally go to the tickler, temporarily to pin 3 of the detector. Connect a speaker, power supply, and antenna to the receiver. Advance the regeneration control, *R6*, to about center position, and tune in a local station near the center of the dial on the main tuning capacitor, *C2*. The station should come in clearly. If it is distorted, try a shorter antenna or turn the plates



of the antenna coupling capacitor, *C1*, for less capacity, then retune to the station with the trimmer, *C3*.

When the station is being received clearly, turn *R6* slowly back and forth to find the point where reception is loudest. This is the point of maximum detector sensitivity. Note the position of the dial pointer on the control knob.

Turn off the power supply. Wire the tickler coil into the circuit as shown in the wiring diagram, Fig. 1, with the tickler coil lead nearest the chassis connected to pin 3 of the detector. Turn the set back on again and, as the tubes warm up, a loud squeal should be heard coming from the speaker. Rotate *R6* until the howl ceases. Tune in a much weaker station and rotate *R6* until a whistle just begins to be heard. This is the point of oscillation in the detector. Note the position of the pointer on *R6*—quite likely, it will be considerably below the setting for



Pictorial diagram of the "Regenode" shows how the various components are wired.

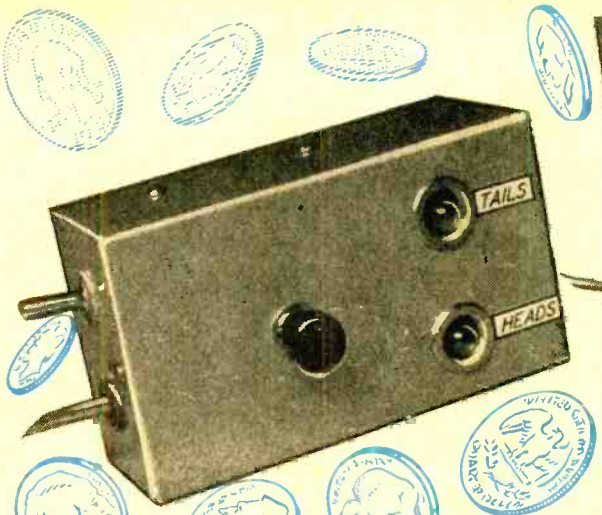
maximum detector sensitivity. If it is, turn off the set, remove one turn from the top of the tickler winding, and repeat the check for the setting of the feedback control. Remove a second turn, if necessary—or even a third turn—until the feedback control setting for the beginning of oscillation coincides with the previously located point of maximum detector sensitivity, when the tuning capacitor, *C2*, is set to a weak station about mid-scale. The setting of *R6* will advance as each turn is removed from the tickler. The author's "Regenode" operates best with four turns on the tickler.

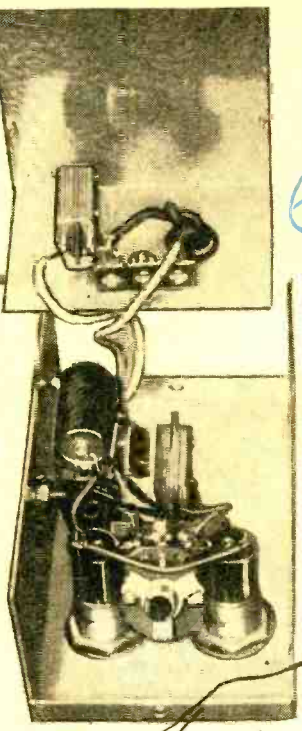
After the tickler turns are adjusted, the core in the "Ferri-tenna" may be turned in or out slightly to make the receiver cover the standard broadcast band.

Using the Receiver

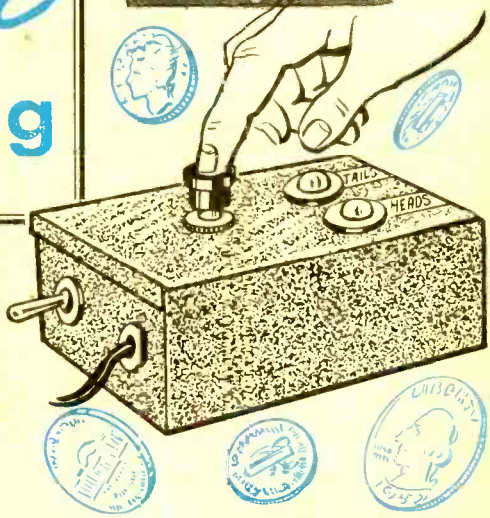
When receiving strong, local stations, it is necessary to reduce regeneration (*R6*) to avoid overloading the detector. Overloading produces severe distortion and is easily recognized.

(*Continued on page* 125)





Electronic Coin Tossing



By JOSEPH BRAUNBECK

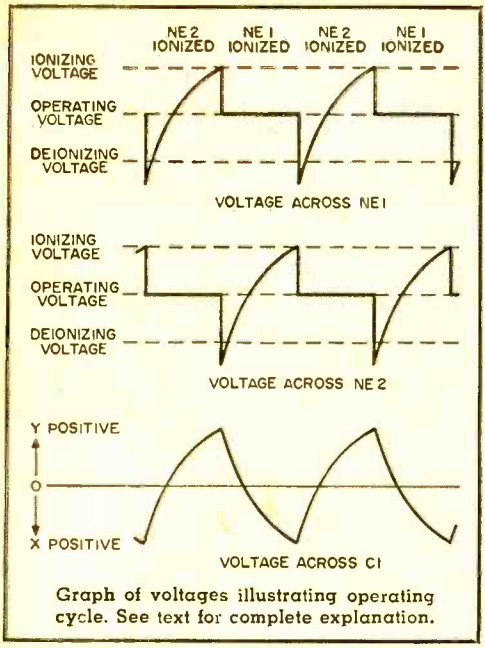
How to make an instrument that simulates tossing of a perfectly balanced coin

TOSS A COIN 100 times; will you get 50 heads and 50 tails? No, say careful investigators of the subject; the most likely result is a few more heads than tails, at least with the most common U. S. coins. Don't blame the people at the Mint; they don't try to make the coins perfectly balanced.

There are times, though, when we may want a perfectly balanced coin—to decide whether to play golf when it looks like rain but the Weather Bureau says "fair," or for some other scientific purpose. Electronics can provide the answer: an equivalent of coin tossing, with an instrument which can be adjusted to simulate a balanced coin.

The "electronic coin" shown in the photographs has two neon lamps and a push button. When power is applied, both lamps glow. When the button is pressed, one goes out.

Actually, when the two lamps appear to be glowing at the same time, they are



Graph of voltages illustrating operating cycle. See text for complete explanation.

flashing alternately. The flashing rate is so high that each appears to be on continuously. Pressing the switch button stops the alternation, leaving on the lamp which happens to be glowing at the time.

The circuit can be adjusted so that both lamps glow for equal lengths of time; then, when the button is pressed, one is as likely as the other to be burning. With the lamps marked "heads" and "tails," pressing the button simulates tossing a balanced coin.

How It Works

Some of our more scientific-minded readers may be interested in the functioning of this device. Those who just want to make and use it can skip the next few paragraphs. The schematic diagram shows that the circuit used is relatively simple. However, it is one which is usually not explained in standard textbooks. The neon lamps *NE1* and *NE2*, potentiometer *R1*, and capacitor *C1* form the oscillator. Capacitor *C2*, selenium rectifier *SR1*, and resistor *R3* constitute a standard half-wave power supply. Neglect resistor *R2* and consider the circuit as it would be with the arm of *R1* connected directly to the power supply. The letters *A* and *B* on the schematic diagram designate the two parts of potentiometer *R1* on either side of the arm.

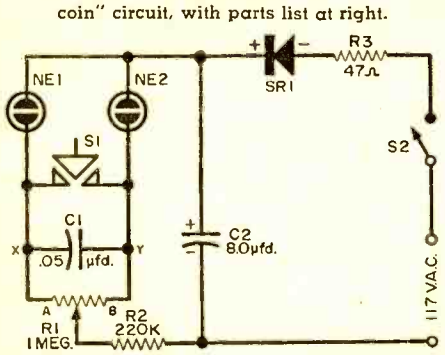
When a small voltage is applied to a neon lamp, the gas will not be ionized and very little current will flow. If the voltage is increased gradually up to a certain critical value (which depends upon the individual lamp), the gas will ionize and much more current will flow. The voltage now can be reduced below the ionizing voltage and ionization will be maintained once it has begun. If the voltage is reduced below a second critical value, however, the gas will deionize. Normal operating voltage for the lamp is somewhere between the ionizing and deionizing voltages.

When power is first applied to the oscillator circuit, the lamps are not ionized and very little current flows. Therefore, there is very little voltage drop across *R1A* and *R1B*, and almost the entire supply voltage is across lamps *NE1* and *NE2*. All of the current through *NE1* flows through *R1A*, and all of the current through *NE2* flows through *R1B*; no current flows to charge capacitor *C1*.

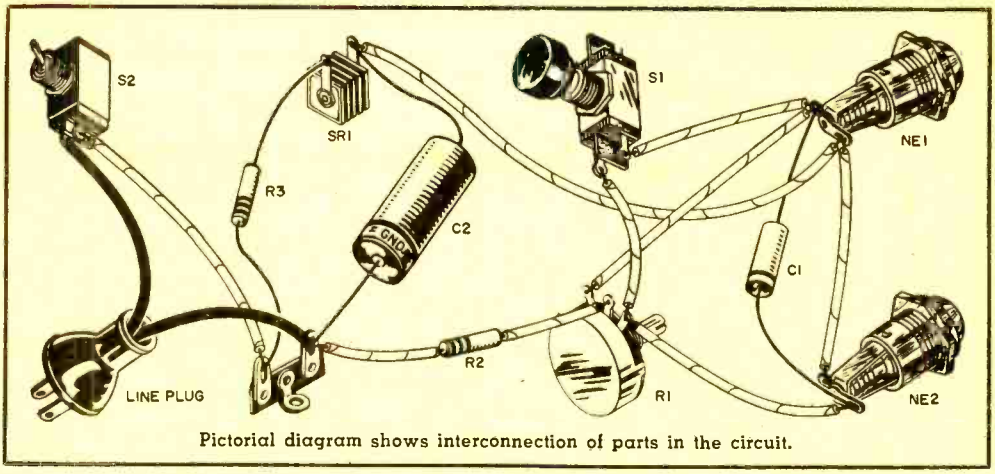
The initial voltage across the lamps is high enough to ionize the gas, but one lamp will ionize before the other; there will be a slight inequality between the two circuits, even if they have been matched as carefully as possible. Assume that *NE1* is the lamp which ionizes first. Current through *NE1* and *R1A* increases, the voltage drop across *R1A* increases, and the voltage across *NE1* drops to the operating value.

The change in voltage across *NE1* also appears across *NE2* and *C1* in series.

Schematic diagram of "electronic coin" circuit, with parts list at right.



C1—.05-µfd., 400-volt paper capacitor
C2—8.0-µfd., 150-volt elec. capacitor
NE1, NE2—NE51 neon lamp
R1—1-meg. potentiometer, linear taper (with screwdriver-slotted shaft)
R2—220,000-ohm, ½-watt resistor
R3—47-ohm, ½-watt resistor
S1—Push-button switch, normally open
S2—S.p.s.t. toggle switch
SR1—20-ma. selenium rectifier
1—Line cord and plug
1—Gray aluminum channel-lock box, 5¼" x 3" x 2⅛" (ICA Type 29410)
2—Neon pilot assemblies for NE-51 (Dialco Series 81410 or 95410)
1—4-lug terminal strip
1—2-lug terminal strip
1—Rubber grommet
Misc. machine screws, nuts, wire and solder



Pictorial diagram shows interconnection of parts in the circuit.

Voltage across a capacitor cannot change until current has flowed for some time (at least a short time) to charge the capacitor. The immediate effect of the decrease in voltage across *NE1* is a decrease in the voltage across *NE2* (and an increase in the voltage across *R1B*). This happens before *NE2* has had time to ionize, so it remains "out." Voltage which is enough to keep *NE1* ionized once it has started is not enough to begin ionization in *NE2*. After the first instant, current flow through *R1B*, due to the increased voltage across it, begins to charge *C1*. The voltage across *R1B* gradually decreases and the voltages across *NE2* and *C1* increase. (In following the rest of the explanation, refer to the graph of voltages in the circuit.)

Operating Cycle

When the voltage across *NE2* becomes high enough, *NE2* ionizes, the current through it increases, the voltage across *R1B* increases, and the voltage across *NE2* drops to the operating potential. This change is reflected through *C1* as an immediate decrease in the voltage across *NE1* and increase in the voltage across *R1A*. *NE1* deionizes. Increased current flow through *R1A* charges *C1* with polarity opposite to that which it had before. The voltage across *R1A* gradually decreases as the voltages across *NE1* and *C1* increase.

The preceding paragraph describes one-half of the normal operating cycle; the other half, which follows, is similar, but with the two halves of the circuit interchanged. When the voltage across *NE1* becomes high enough, *NE1* ionizes, the current through it increases, the voltage across *R1A* increases, and the voltage across *NE1* drops to the operating value. This change is reflected through *C1* as an immediate decrease in the voltage across *NE2* and increase in the voltage across *R1B*. *NE2* deionizes. Then, the voltage across *R1B* gradually decreases and the voltages across *NE2* and *C1* increase. (*C1*, of course, charges with polarity opposite to that in the preceding half of the cycle.)

The cycle described in the two preceding paragraphs is repeated as long as power is applied to the oscillator and switch *S1* remains open. When *S1* is closed, one lamp (say *NE1*) will be ionized and have the normal operating voltage across it. *NE2* may have a higher or lower voltage, but not enough to start ionization. When the switch is closed, *NE2* will have the operating voltage of *NE1* applied to it also. This voltage is high enough to maintain ionization in *NE1*, but not to begin ionization in *NE2*. Therefore, only *NE1* will glow when *S1* is closed.

Series resistor *R2* reduces the supply voltage so that the voltages across *NE1* and *NE2* will range between the ionizing and deionizing voltages. Potentiometer *R1* can be adjusted to vary the resistance in the two lamp circuits, to adjust the length of time each lamp flashes.

Making the "Coin"

All of the components are mounted in a metal box 5¼" x 3" x 2⅛". The positions of the parts are not critical, but they can be placed approximately as shown in the photographs. Oscillator components are mounted behind the front panel; most of the power supply parts are mounted above and behind the oscillator. The power switch and the grommet for entrance of the power cord are at one end of the rear section of the cabinet. A two-lug terminal strip is used to connect the a.c. power cord and a four-lug strip for the mounting and connection of the power supply parts. Proper connections of the parts are shown in the schematic and pictorial wiring diagrams.

(*Continued on page* 124)

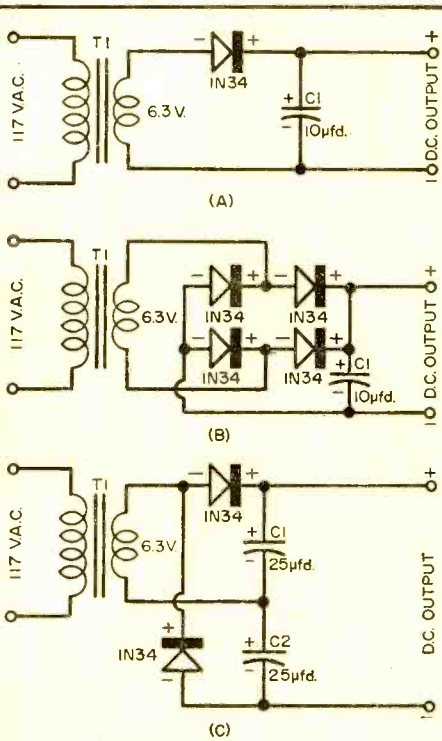
Transistor Topics

IN opening the third installment of this department, we want to express our appreciation for the many letters and cards asking that it be continued and that it be published monthly. Many thanks to all who took the time and trouble to write.

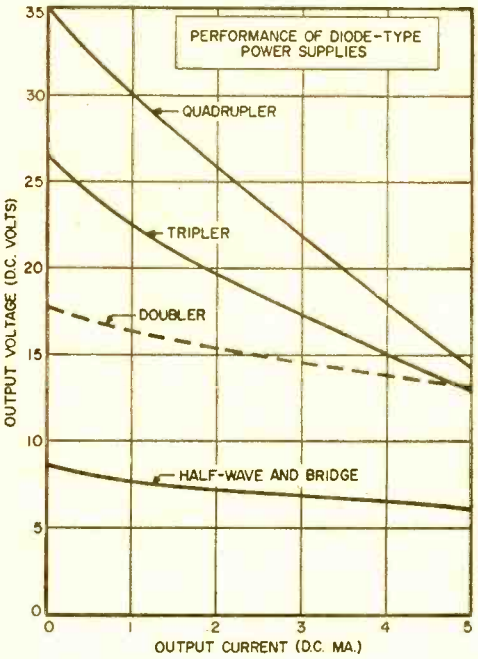
Diode Rectifier Supplies

The material below originated with Mr. Rufus Turner, Contributing Editor of POP-tronics. We have quoted directly from his letter to us.

"Transistors have become so closely associated with battery operation that the mere mention of a power line-operated d.c. supply for a transistor circuit brings forth looks of amused astonishment.



Power supplies for transistor experiments. The circuit in (A) is a simple half-wave rectifier, in (B) a bridge rectifier, and in (C) a simple voltage doubler. All of these circuits employ the common 1N34 crystal diode.



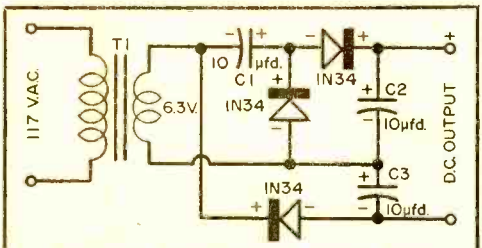
"To be sure, transistors do permit long-life operation of some circuits which, when 'tubed,' cannot be powered by batteries without running into expense. But there also are some places where it seems pointless not to run the transistor from the power line. I saw an example in print recently. The subject was a clever transistorized photo timer. Battery operated, of course, but why? The timer relay switched the a.c. line on and off to an enlarger or print box. Since the power line had to pass through the timer anyway, there seemed little point in ignoring it for transistor bias. Another familiar example is the transistorized burglar alarm that sets off a line-operated signal but is operated from self-contained batteries. You can name others.

"The striking features of the transistor are not lost, as many workers seem to fear, when the a.c. line is used—where sensible—for transistor power. No matter from what source it receives its d.c. bias, the transistor still is tiny, power-thrifty, non-microphonic, cool-running, practically indestructible, and long-lived.

"Because transistor current and voltage requirements are low, an a.c. power supply can be small in size. This is compatible with tran-

sistor dimensions. A midget 6.3-volt filament transformer is entirely adequate. Germanium diodes may be employed as the rectifiers, and miniature electrolytic capacitors used for storage. Where voltages higher than 6.3 are needed, voltage multiplier circuits may be employed.

"The schematics show practical transistor power supply circuits employing germanium

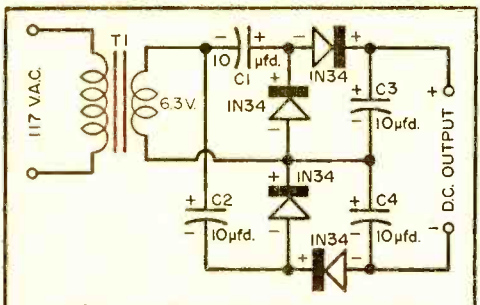


This is a simple voltage tripler using readily available 1N34 crystal diodes.

diodes. In each case, *T1* is a 1-ampere, 6.3-volt filament transformer. The circuits have been tested at a constant a.c. input voltage of 115 volts and their d.c. output characteristics are given in the graph. Except in the case of the doubler, the curves have not been carried beyond the current level at which the d.c. output voltage falls to 6.3, the r.m.s. voltage of the transformer secondary.

"These circuits will be satisfactory, as given, for most low-drain circuits employing one or two transistors at fixed operating voltages. For better voltage regulation (less fall-off of voltage as the current increases) and higher output currents (such as will be required for multi-stage transistor circuits containing bias resistor networks), Type 1N91 miniature germanium rectifiers may be substituted for the 1N34 diodes, and the capacitor values increased. A 1N91 in the simple half-wave circuit with $C1 = 100$ μfd. gives 60-ma. output at 6.3 volts d.c., contrasted to the 5 ma. at 6.3 volts obtained with the 1N34 and 10 μfd. Output of the bridge, doubler, tripler, and quadrupler circuits likewise will be improved.

"The curves in the graph were plotted from data taken in measurements on the circuits exactly as they are shown here and without additional filters. In some transistor applications, especially sensitive amplifiers, filters



Adding another capacitor and crystal diode to the circuit above enables it to operate as a voltage quadrupler.

will be required. These may be of the simple, small-sized, resistance-capacitance type. However, a sharper voltage fall-off must be expected as a result of voltage drop across the filter resistor."

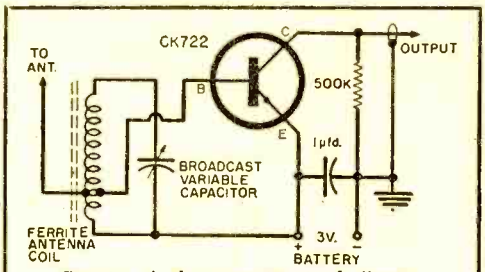
Many thanks to you, Rufus, for the interesting ideas presented above. We hope that our readers will take advantage of your schematics and suggestions. By the way, we have scheduled for early appearance in this column a complete power supply unit for transistor experiments. It is a variable voltage supply with an output of from 2 to 30 volts.

Speaking of power supplies, we might also report that another Contributing Editor is working on several silicon solar battery hookups. Although the price of the "real" silicon battery is still high, we feel that something concerning its use and application should appear in this column.

Another "Radio Add-On"

An additional suggested circuit this month comes from Ed Noll, whose many articles and books on TV servicing and operation are known from coast to coast.

Ed brings to our attention the circuit shown below. It is used much like the original "Radio Add-On" described in the September 1955 issue (page 48). In other words, the output is plugged into the phono jack on a TV receiver. After the base-emitter detector is tuned up, it will bring in a single AM broadcast station. Switching the TV receiver to the phono setting will enable the viewer to hear

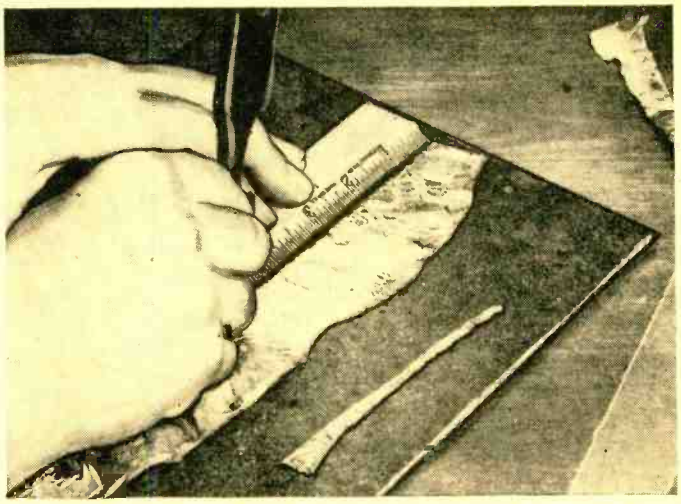


Circuit of the transistorized "radio add-on" unit suggested by Ed Noll. It is similar to that outlined by Homer Davidson in our September 1955 issue.

this station. The advantage is two-fold: better fidelity from the AM station and greater use of the TV receiver during "off-hours."

The circuit is uncomplicated since many ferrite antenna coils are now sold with the tap shown in the diagram. This tap is generally used for an external antenna. In this circuit it provides an additional impedance match between the resonant circuit and the low impedance input to the transistor base-emitter circuit. Don't forget that also in this circuit there is internal coupling in the transistor. The collector circuit provides audio amplification of the rectified and detected signal.

Next month we go back to some receiver plans based on ideas suggested by you readers. Keep your letters coming. —30—



Foil capacitors can be easily made from household "Reynolds-Wrap." Slit two strips of aluminum foil to the desired length and width using a razor blade or scissors. Also cut two waxed-paper strips, about one-quarter inch wider than the foil. The paper will serve as the insulator between the turns of foil.

Roll Your Own Capacitors

By ELBERT ROBBERSON

IN RADIO CONTROL, "walkie-talkie" and other compact construction, builders need not be handicapped because catalog capacitors won't always fit odd slices of available space. Home-made capacitors can be made to fit almost anywhere. One example is the screen bypass capacitor shown in the photographs, wrapped directly on the envelope of the tube. Ordinary household waxed paper and aluminum foil are used, and two strips approximately 1" wide and 12" long provide .001-μfd. capacity. Exact values will depend upon paper thickness and the pressure with which the package is held together, and can be varied by using strips of different dimensions.

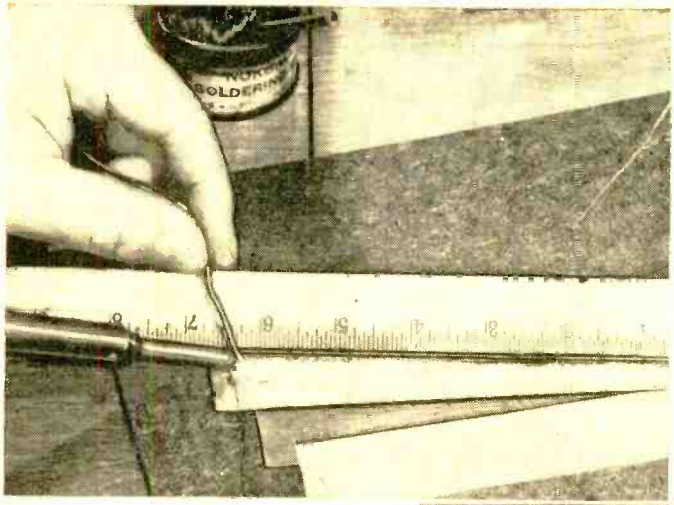
To make the capacitor illustrated, lay a flat smooth piece of foil on a hard surface, such as *Masonite,* and use a metal straightedge to guide the cut. Slit the foil with a sharp razor blade. A couple of tries may be required to find the right angle to prevent tearing and bunching of the aluminum. Cut two strips 1" wide by 12" long.

Next cut two strips of waxed paper, 1¼" x 12¼", to allow ⅛" margin around the foil. Scissors can be used for both cutting operations, but in working on the aluminum, be careful not to wrinkle it or leave jagged points between scissor cuts.

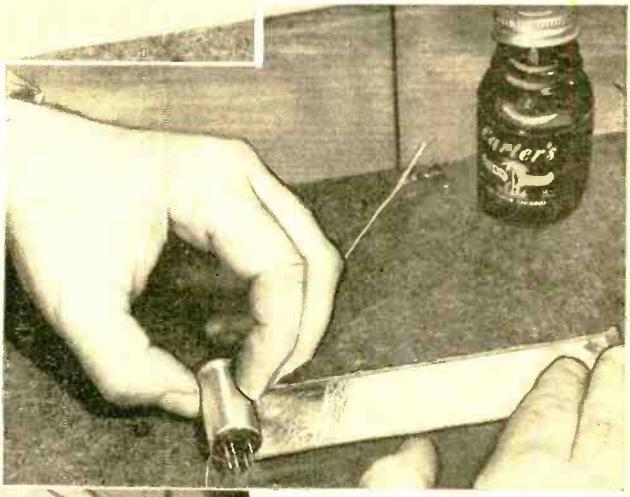
Before assembling the capacitor, leads must be soldered to the foil for the connections. Use fairly active flux, and gently rub the tip of the iron on the foil to remove aluminum oxide. The joint may not be very handsome, but it will carry current and hold together. Just don't leave sharp points sticking up. Clean off excess flux with alcohol.

Lay a flat strip of paper on the hard surface and put a drop of rubber cement on one end. Put a strip of foil on top, aligning it so that the paper projects ⅛" all around, and flatten the end down in the cement, wiping off any excess. Dab cement on the same end of the aluminum strip, then lay another strip of paper on top of it. Repeat the process with another foil and the last paper. Have both wire leads on the cemented end.

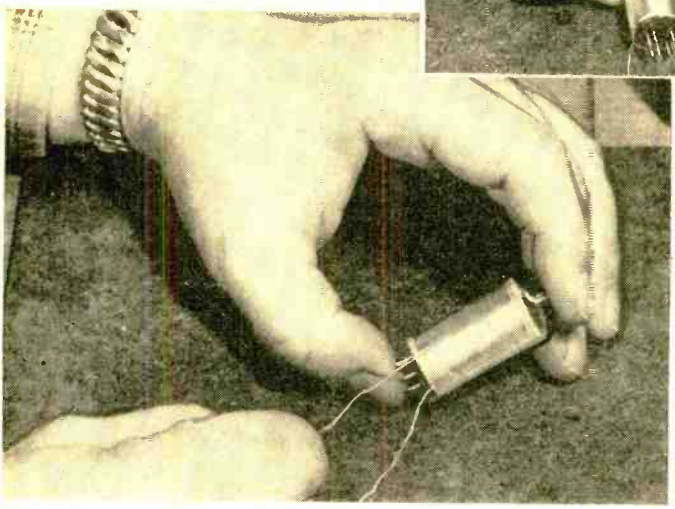
Put a drop of cement on the side of the vacuum tube, and place it on the "stack," pin end of the tube near the capacitor "pigtail" side. Carefully roll it up, and secure the ends with another touch of cement. Hold these cemented ends tightly for about a minute, and then the capacitor will be on its own. The completed home-made capacitor may then be connected for bypass or coupling.



Solder a single strand from flexible hook-up wire to the ends of both aluminum foils. Use very active flux and scrape soldering iron back and forth across the foil to remove any of the aluminum oxide.



Stack the paper and foil alternately, and align so that paper overlaps all way around. Use miniature tube as "former." Hold paper and foil stack to tube with rubber cement, then wind up as shown at right. Secure end of stack by cementing, and then hold in fixed position until dry.

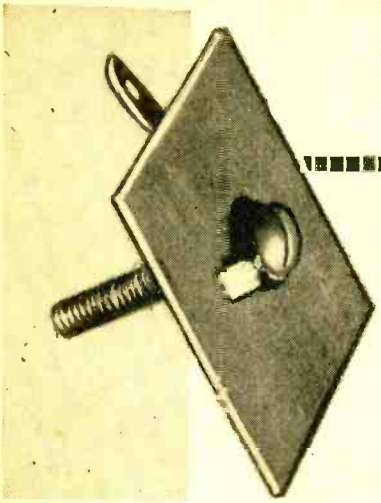


The completed capacitor could be held together with cellophane tape. If the tube is in use, it can be employed permanently as the base for the capacitor. As mentioned in text, this method can be utilized to form two capacitors in parallel, or two capacitors with common ground lead.

In many non-critical circuits, it is possible to form two capacitors around a tube. Just keep leads on opposite sides of the tube to avoid mix-ups, and work the circuit connections out so that a grounded foil is in the center of the wrapping.

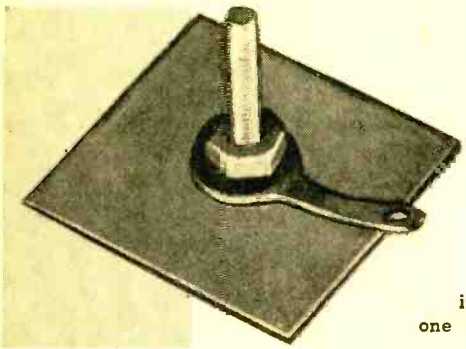
Capacitors can also be made in ribbon form, or wound in flat packages and then folded into almost any shape to fit irregular spaces. Soaking them in melted paraffin after winding will increase their durability and prevent moisture absorption. —30—

Make Your Own



Front view of completed photocell. Bent lug under the screw head contacts the front face of the rectifier plate, while the long lug (protruding from top) contacts the back face.

Back view of cell, showing mounting of long lug, insulating washer, and the retaining nut.

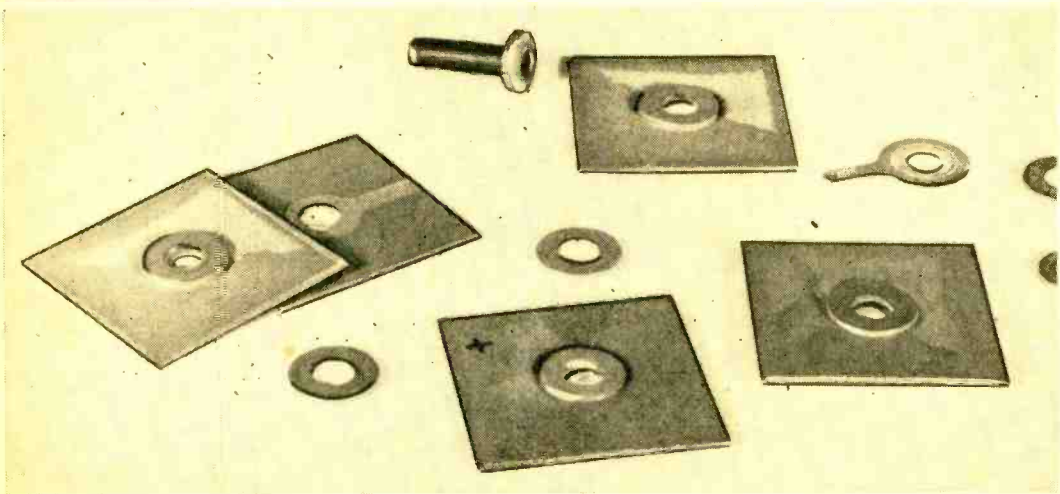


A SINGLE plate taken from the common selenium rectifier makes a surprisingly good self-generating photocell. While a burned-out rectifier will yield at least one or more plates that are in operating condition, a new rectifier will supply six excellent plates. With a rectifier costing about one dollar, this makes the home-made photocell very cheap indeed.

The first job is to pull the rectifier apart. This is done by drilling out the center eyelet which holds the plates together, then separating plates and washers. The next job is to remove the paint from the plates. Soak the plates in lacquer thinner for several hours and then rub their faces gently with a soft rag soaked in lacquer thinner. Hang the cleaned plates to dry for one hour before a fan or blower.

When the paint is removed, it will be seen that one face of the rectifier plate is coated with a rough layer of silvery metal. Underneath this is the sensitive selenium layer. The metal coat is porous enough to allow light to pass through to the selenium. When it is shined on the coated face, the recti-

Dismantled rectifier is shown ready for conversion into photocells. One plate is missing, this being the one used in the finished cell (see illustrations above).



Self-Generating Photocell

By RUFUS P. TURNER

Plate from small selenium rectifier makes inexpensive photocell when wire leads are attached to each face

fier plate will generate a steady d.c. voltage. The coated (front) face becomes negative and the uncoated (back) face positive. The brighter the light, the higher will be the voltage.

In order to use the plate as a photocell, a wire lead must be attached to each face or contact made with the faces in some other way. Since the plate is aluminum, it will not be possible to solder to the back face. And it is not advisable to solder to the silvery-metal front face, because the heat of the soldering iron might burn a hole in the thin coat.

It is best to make connections to the plate mechanically. Figures 1 and 2 show one way of doing this. The seven parts are put together so that the bent lug (B), held by screw (A), makes contact with the coated face. Shoulder-type fiber washer (C) insulates the screw from the rectifier plate as it passes through the hole in the center of the plate. The long lug (E) rests firmly against the back face of the plate. A second shoulder-type fiber washer (F) insulates the screw from this lug. The nut (G) holds the entire assembly tightly together, with the two lugs in contact with the faces of the plate. Connections are made to the screw (negative) and to the long lug (positive). The screw can also be used to hold the cell to the equipment with which is is operated.

This home-made photocell is not as sensitive as the expensive commercial units that are available, but it is very useful in many experiments and devices, such as sun-battery experiments, burglar alarm and light control circuits, exposure meters, etc. Using a plate from a 200-ma. rectifier, an open-circuit voltage of 0.4 volts was obtained in direct sunlight. Direct sunlight also gave a 50-microampere deflection on the 100-microampere scale of a *Simpson* Model 260 volt-ohm-milliammeter which has an internal resistance of 2000 ohms. A 60-watt lamp two feet away from the photocell produces an open circuit voltage of 20 millivolts. These outputs are satisfactory for operating some of the tube-type and transistor-type photoelectric circuits which have been described previously in POPULAR ELECTRONICS.

—30—

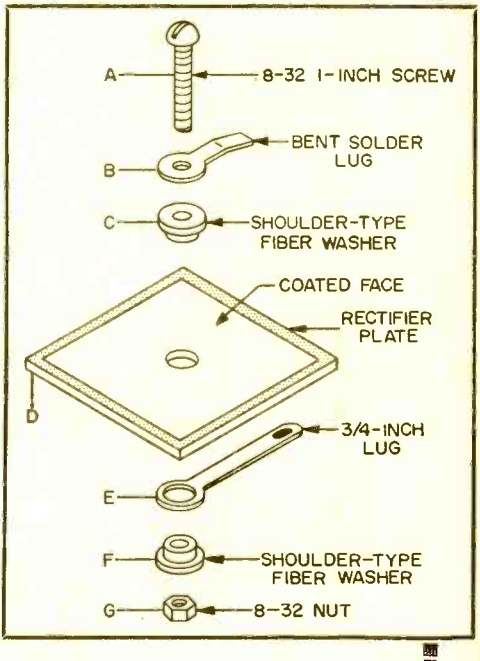


Fig. 1. Exploded view of the photocell.

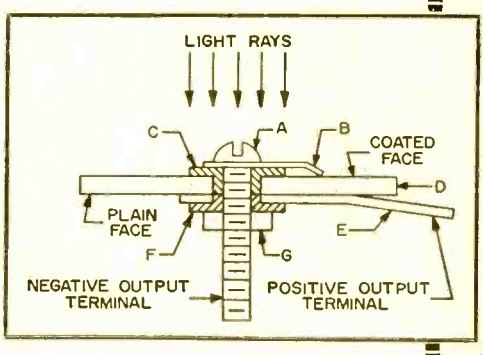


Fig. 2. Cross section of assembled cell.

THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

THE BEST REASON for going to the trouble of obtaining an amateur license and putting a station on the air is to make radio contacts with other amateurs. Naturally, the better your equipment, the easier it will be to do so. However, just as important as equipment in making successful contacts is using good operating procedures. And the less elaborate your equipment is, the more good operating will pay off for you.

In the following paragraphs, we will discuss how to get the greatest percentage of returns to your calls and how to use a couple of important procedure signals correctly.

Calling CQ

To indicate that your station is open for business and is looking for calls from other amateurs, you may transmit the General Call signal, CQ. The usual form for "calling CQ" is: "CQ CQ CQ DE W9EGQ W9EGQ W9EGQ CQ CQ CQ DE W9EGQ W9EGQ W9EGQ CQ CQ CQ DE W9EGQ W9EGQ W9EGQ K."

This is a 3 x 3 x 3 call. Some amateurs change it to a 5 x 2 x 3 call on the basis that such a call takes no longer to send but doubles the percentage of time that CQ is being sent. If conditions are so poor that the calling station's call letters cannot be copied when sent a minimum of twice, it is assumed that a successful contact would not be able to be made anyway.

The greatest misuse of CQ's is in making them too long. Some amateurs apparently work on the theory that if a short call is good a call which is five times as long will be five times better. There are a couple of flaws in this theory.

In the little time that six children, a job, and studying for a master's degree in science allow for amateur radio, Joe Marso, KN2JVE, has worked six states with the above equipment.

As any experienced amateur can tell you, it is surprising how often one hears a CQ from the very first dash when scanning a band for a station call. Too long a call becomes boring, and the listener tunes away looking for someone else, or he decides to call CQ himself. Also, an overly long CQ that started out free of interference is often clobbered (not always accidentally, I am afraid) as it drags on and on. As a result, the listener is seldom sure just when it does end. In spite of appearances, they all end some time.

What makes these marathon CQ's seem so foolish is that they are so unnecessary. No one is rationed as to the number of calls that he can make. Therefore, if one short call does not do the trick, there is no reason why you can't try another.

Good and Bad Sending

Even less useful than overlong CQ's are poorly sent ones. Their effectiveness is often completely nullified because the sender garbles his call letters into a meaningless mess of dots and dashes. Good sending is always important but never more so than in a CQ. Through your "fist," other amateurs judge the kind of an operator you are. Besides, it is no fun to copy poor sending; many amateurs automatically pass over CQ's which are poorly sent.

It is quite easy to fall into the habit of sending your call letters carelessly, for they soon become as familiar to you as your own name. While an illegible signature may get by at the bottom of a letter, it will hardly do at the end of a radio transmission, and will cost you contacts.

Another bad habit of some CQ'ers is to vary their sending speed almost constantly during a call. I had thought that this was an unconscious habit, but I find that some amateurs do it deliberately. One told me that he thought shifting speeds in a CQ helped to attract the attention of both the slow and the fast code operator. There is no doubt that such "roller coaster" sending does attract attention, but does it result in more contacts than an even sending speed? I doubt it.

Good operators call CQ at the speed at which they expect to be answered, and they reply to any call at about the speed at which it was made, unless the speed is greater than they can copy. Sending faster than this is a direct invitation for the other fellow to learn that you can dish it out but can't take it. Conversely, be courteous enough to slow down for the lad whose speed is not equal to yours.

During six weeks of operation, Mickey Hall (15), KN9BBO, made 168 contacts in 30 states. See News and Views for data on this installation.

Presumably, you want him to appreciate your witty sayings, which he cannot do if you send too fast for him.

To CQ or Not to CQ

Many low-power stations get a greater percentage of replies when they answer CQ's than they do when they CQ themselves. On the other hand, some hams get the idea that they are big-time operators if they force the other fellows to call them. Actually, it does not make a bit of difference who calls CQ and who answers. The important thing is to make the contact.

If everybody called CQ only, who would answer yours? And if nobody called CQ, who would you call? The smart thing to do is to mix up your calls between CQ's and direct calls, to fit conditions.

In calling specific stations, a long call is even less necessary than when calling CQ. If your frequency is a kilocycle or so from the other fellow's, a 2 x 2 or a 3 x 2 call ("KN9ADT KN9ADT DE KN9ADK KN9ADK AR") is usually long enough to do the trick. If one such call does not get results, you can repeat the dosage until you raise the station, or the operator answers someone else, or you decide that you are not going to be heard.

When calling a station somewhat removed from your frequency, a slightly longer call may be sent to give the operator time to tune his receiver to your frequency. Even then, a really long call is not required; if he is going to tune to your frequency at all, it will be within a minute after he finishes his call.

On a crowded band, most amateurs listen only around their own frequencies for replies to their CQ's. This makes it very difficult to raise stations more than about 20 kc. from your frequency when activity is high. At times when activity is low, this limit may sometimes be stretched quite a bit. Nevertheless, calling stations halfway across the band from your frequency is not the most efficient way to raise them at any time.

Instead of trying to raise stations far off your own frequency with long calls, you will have much better luck by obtaining a couple of crystals for your transmitter, giving yourself a choice of frequencies. Arrange them so that they can be rapidly plugged or switched into your transmitter. (*E. F. Johnson Co.* manufactures a 10-position crystal selector unit—Model 126-220-1—designed for this purpose.) Practically any transmitter may be tuned to the center of the 3.7-, 7.15-, or 21.1-mc. novice bands and operated on any frequency within the band simply by switching crystals and possibly touching up the final amplifier plate tuning capacitor.

Make a chart of all transmitter dial settings and other adjustments for all available frequencies, and fasten it near the transmitter. With the aid of such a chart, you will be able to shift instantly to the best frequency for calling any station.

A crystal a few kc. in from each edge of the band and one near the center is a good combination with which to start. Also, if you have a favorite frequency, it is frequently helpful to get another crystal within a few kc. of it to permit shifting frequency just enough to dodge interference.

Procedure Signals

In the above discussion, the correct usage of "DE," "AR," and "K" was indicated. These signals and a few others merit a bit more attention.

"DE" stands for "this is" or "from," and separates the call sign of the station called from the calling station, thus: "CQ CQ DE W9EGQ W9EGQ CQ CQ CQ DE W9EGQ W9EGQ K," not "CQ CQ DE W9EGQ DE W9EGQ, etc."

"K," invitation to transmit, is used to terminate a CQ call or transmissions between stations already in communication with each other. This signal has the following meaning:

The new variable-frequency oscillator which was recently introduced by World Radio Laboratories, Council Bluffs, Iowa, should be of interest to all General Class amateurs. Free brochure is available on request from WRL.

"Go ahead with your transmission. I am listening."

"AR," end of message, is conventionally used to terminate initial calls to stations with which communication has not yet been established. Thus, if I were answering a CQ from KN9AQM, I would send "KN9AQM DE W9EGQ AR," reserving "K" for later transmissions. Technically, combining "AR" with another ending signal is usually incorrect, as the following examples will indicate: Incorrect: ". . . What do you think? W9BOS DE

(*Continued on page* 116)

CARL & JERRY

By JOHN T. FRYE

Trapped in a Chimney

"MAN, DID YOU EVER SEE a sweeter flying job?" Carl demanded enthusiastically, as he and his chum, Jerry, squinted at Carl's radio-controlled model plane sailing along against the late afternoon January sky.

"Surely does handle well," Jerry agreed, doing a little jig on the frozen ground to keep warm. It had been a fine winter day with the temperature up in the 40's, but now the mercury was sinking with the sun. The boys were flying their model in a large field just beyond the outskirts of town. At the other end of the field were the ruins of a box factory that had been completely destroyed by fire several years before. Only a tall brick chimney had been left standing.

"Better bring it in for a landing," Jerry suggested. "It's getting late, and I think I can smell snow in the air."

"Okey-dokey," Carl agreed; "but get a load of this tight turn around that smokestack."

As he said this, he stuck his finger in the opening marked "L. Trn." of the telephone dial mounted on the transmitter control box, pulled it down against the stop and released it. Instantly the little plane banked gracefully and turned toward the top of the smokestack.

"Hey!" yelled Jerry, whose depth perception was much better than Carl's, "you've turned too quick!"

By the time he got the warning out, however, and in spite of all the "body English" he tried to put on the little plane, it closed the gap between it and the smokestack—and failed to appear on the other side. At the same instant, the steady snarl of the little motor ceased abruptly.

"Holy cow!" Carl groaned, "it's crashed!"

He set the control box on the ground and started at a dead run across the field. Jerry followed, but Carl's long legs and athletic build gave him such an advantage that by the time his chubby companion came puffing up to the base of the chimney Carl had loped around it twice.

"Hey, that's funny," Carl muttered. "I can't see a thing of it, and there's no place for it to hide, unless—" As though worked by a common string, the heads of both boys tilted back as they stared up at the top of the chimney towering some sixty or seventy feet above them.

"That's where it went," Jerry said with conviction. "It was just skimming the top, and I thought it might clear; but it must have dived right into the top. Well, scratch one model plane."

"That's what *you* think," Carl said determinedly, reaching for a rung of the wide ladder going up the side of the chimney. "I've got at least a gallon of sweat and several acres of lawn mowing invested in that gas motor and the plane controls, and I intend to get 'em back or know the reason why."

"All right," Jerry said resignedly, as he started up the ladder behind his friend; "I'm just stupid enough to go along with you."

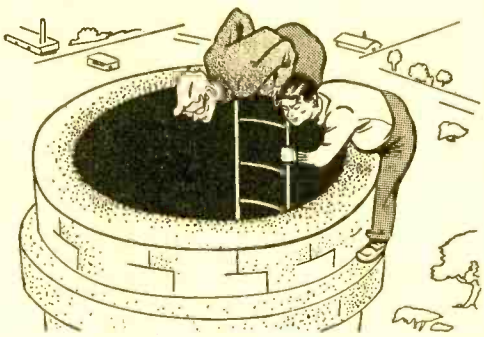
In a few minutes, the boys were standing side by side on an upper rung of the ladder while they leaned over the broad lip of the smokestack opening and stared down its throat. Even at the narrowed top, the stack measured a good eight feet across.

"Heck," Carl said in disappointment; "it's too dark down there to see a thing."

"Hold your horses a minute," Jerry grunted, as he squirmed around on his stomach so that he could reach into a pocket and pull out the flashlight case that contained the booster-battery used in starting the plane motor. He unscrewed the adapter with its two flexible leads from the bulb socket, screwed the bulb back in place, and replaced the lens cap. When the restored flashlight was shone down into the chimney, the white cross formed by the wing and fuselage of the plane could be faintly seen at the bottom.

"You hold the flashlight. I'm going down and get it," Carl announced.

"Oh, no, you don't," Jerry exclaimed, as he threw a fat leg over the edge of the stack



. . . they leaned over the broad lip of the smokestack opening and stared down . . .

and reached for the top rung of the rusty narrow iron ladder that went down the inside of the chimney. "This is my chance to check up on that old business about whether or not you can see stars in daytime from the bottom of a well or chimney, and I'm not going to

muff it. You can tag along if you want to."

Cautiously, the two boys went down the rust-eaten ladder. All went well until they were about ten feet from the bottom, and then suddenly the whole lower section of the ladder gave way under their combined weight and they dropped to the bottom of the chimney. Jerry fell on his back on the layer of soft ashes at the bottom of the chimney, and Carl came down on top of him. The section of ladder broke into several pieces and clattered harmlessly around them. Carl quickly sprang to his feet and looked anxiously down at his friend still lying on his back and staring intently up at the little circle of blue far above them.

"Are you hurt, Jerry? Can't you get up?"

"You CAN see stars, and they're all different colors," Jerry observed softly, in a bemused voice.

"Come on; snap out of it," Carl said, unceremoniously yanking Jerry to his feet. "You don't need to go down a chimney to see the kind of stars you're seeing. Hey! Did you *have* to light squarely on top of my plane?"

"There's just no pleasing some people," Jerry sighed, as he lifted the flattened model from where he had been lying and shook the ashes from it. "Here I break your fall with my very own body, and all you do is gripe about your darn plane. I think we're mighty fortunate. If that ladder had broken loose a little farther up, we'd both have been killed; and it would have been our own stupid fault. Trusting that rickety old iron ladder was not one of our brighter acts."

"You can say that again," Carl agreed, as he stared owlishly about him in the dim light that filtered down from above; "but now the $64,000 question is: how are we going to get out of here? There's nothing to climb on to reach the bottom end of that ladder, and I wouldn't want to trust it again if we could reach it. These chimney walls are too thick to chisel through even if we had tools. The one opening through the wall, that one up there near the bottom end of the ladder where the smoke from the boilers came in, is sealed off solidly with heavy metal plates that sagged down over it when the box factory burned. I've noticed that before from the outside."

"If you were Tarzan, you might go hand over hand up this little cable that runs along the side of the chimney," Jerry observed. "What's it for, anyway?"

"It's a ground lead for the lightning rods on the top," Carl said; "but I'm not Tarzan, and I wouldn't want to trust my weight on it if I were. No, I'm beginning to think we'll never get out of here without help. We've got to cook up some way to let people know we're in here."

"Like yelling?"

"A fat lot of good that'll do. We never saw a soul around here all afternoon; and now that it's getting dark, no one will be around for sure."

"We might build a fire. Then when people saw the smoke, they'd come to investigate."

"A dandy idea *if* we had something to burn, *if* people could see smoke in the dark, and *if* we didn't suffocate long before anyone noticed the imaginary smoke."

"Okay, smarty; you make some suggestions and let me knock them in the head for a while."

"Let's see what we've got in our pockets. Maybe that will give us an idea. All I've got in mine is a cigarette lighter, a dime, a quarter, and this little piece of wire."

"I can do better than that," Jerry boasted. "I've got this flashlight and the booster-battery adapter. Here's a small file I brought along to dress that nick out of the propeller blade. Finally, here's one slightly squashed chocolate bar that was in my hip pocket. We had better cut that up in small portions and eat just a little bit each day to keep up our strength."

"That's out," Carl said flatly. "If we don't get out of here pretty soon, we'll freeze to death anyway; so let's break that in two and

"This thing makes a spark for the motor, and will make a spark for a transmitter."

eat it right away. Maybe it will help us think. All I can think of right now is that Mom is having spaghetti and meatballs for supper tonight, and there's going to be an empty chair at the supper table."

For a little while, the two friends munched their chocolate in silence. Finally Jerry said slowly: "What we really need is some way to send out a call for help. If you had just brought that control transmitter with you, we might have been able to rig up some sort of low-frequency transmitter with the parts, but we surely can't build a transmitter with what we've got here. We don't even have a tube."

"They had transmitters before there were tubes," Carl pointed out. "Don't forget the old spark coil jobs. But that doesn't help either because we don't have any spark coil—"

He broke off abruptly as Jerry leaped to his feet and snatched the broken model plane from the ground.

"Who says we don't?" Jerry gloated, starting to remove the tiny induction coil from the fuselage. "This thing makes a spark for the motor, and it will make a spark for a transmitter."

"This I gotta see," Carl said dubiously. "You've got to have either a.c. or rapidly pulsating d.c. in the primary of that coil to get a continuous spark discharge across the

(*Continued on page* 103)

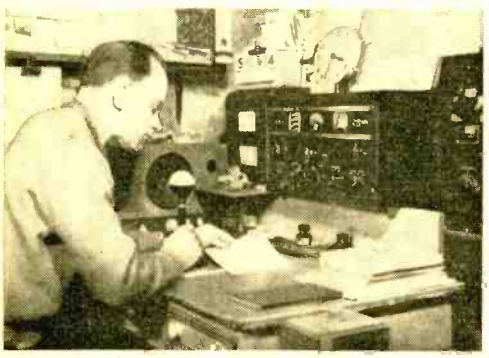
Tuning the Short-Wave Bands

with Hank Bennett

"THIS IS LONDON CALLING in the General Overseas Service on the 19-, 25-, and 31-meter bands. We are closing down the 19-meter transmission. Listeners in North America should now tune to the 25- or 31-meter bands. . . ." Announcements similar to this one can be heard at various times throughout the day, and the person who wishes to continue listening to the station and who is unfamiliar with the term "meters" may find it difficult to locate the band of frequencies covered by the expression "25 meters."

Locating Frequency Bands

Let us take a few moments to examine this frequency business. We have the terms *cycle, kilocycle, megacycle, meter,* and *wavelength,* as well as a few other terms that are less used. The *cycle* is the basic unit of frequency. A *kilocycle* equals 1000 cycles. A *megacycle* is the same as 1,000,000 cycles or 1000 kilocycles. Standard American broadcast-band stations are on even-numbered frequencies ten kilocycles apart. *Wavelength* is the channel on which a station transmits its signal. *Meters* represents another way of expressing wavelength. The higher the kilocycles, the lower the meters.



Ron D. Young, Chelmsford, Essex, England, is one of the top DX'ers in British Empire.

The formula for changing kilocycles to meters is to divide the figure 300,000 (or to be exact, 299,820) by the frequency in kilocycles. The answer will show the wavelength in meters. Reversing the procedure, dividing the wavelength in meters into 299,820 will result in an answer in kilocycles. For example, a station on 6150 kc. would be found to be operating on 48.68 meters. By dividing 25 into 299,820, we find that the London station would appear to be on 11,993 kc., but it is generally known that the term "25 meters" would include the entire range of frequencies from about 11,700 to 12,000 kc. Our listener would almost certainly be able to find his station somewhere in that band; and knowing how to convert meters to kilocycles narrows down his field of exploring quite a bit.

Bands in Operation

Years ago, the radio spectrum was unused and virtually unknown in the region above 200 meters (1500 kc.). As time passed, short-wave stations began operations in the 49-meter band (6000 kc.); in those early days, that was really short-wave! Nowadays, the 49-meter band is devoted pretty much to medium-distance transmissions (daytime) and quite long distances at night and early morning—with such places as Moscow, Andorra, Switzerland, and London being heard evenings, and New Caledonia, the Fiji Islands, and New Zealand in the early morning hours, with regularity and good signals.

Time continued to pass and with it came new s.w. stations on frequencies that were shorter than ever. Stations opened up in the 31-meter band (9500-10,000 kc.), 25-meter band (11,700-12,000 kc.), 19-meter band (15,000-15,500 kc.), and the 16-meter band (17,000 kc.). Today there are even stations operating with full schedules in the 13-meter band (21,000 kc.). During unusual conditions, a listener might even be able to hear one of the few stations operating in the 11-meter band around 25,800 kc. In addition, the 41-meter band is used quite widely by s.w. stations as well as by American radio ham operators. During evening hours, it is sometimes interesting to hear the hams and the s.w. stations battling it out for supremacy of a channel.

In South America and Africa, the so-called "tropical bands" of 60 and 88 meters are heavily used. Those frequencies range from about 4800-5100 kc. (60 meters) and 3300-3500 kc. (88 meters). Many of those stations are easily heard. Lagos, Nigeria, on 4800 kc., is widely reported in late afternoons. One more band in current use in South America is the region around 2350-2450 kc., but these stations are rather difficult to hear. London at one time operated on 2910 kc. and its signal was heard "loud and clear" all over Eastern USA and Canada.

A number of the s.w. stations, when sending out printed schedules to their listeners, list

wavelengths in meters instead of frequencies in kilocycles. Should anyone receive this type of data and not be able to compute the frequency, please write to your Editor and we will try to send you the information that you need.

Greenland's Radio

A letter was received from *Greenland's Radio* in which the following information is given: "Greenland's radio is located in Godthaab, the capital of Greenland. We are on the air weekdays from 1630 to 2000 EST, and Sundays from 1730. Our daily programs consist of news in Danish and Greenlandic, lectures on various subjects, features, entertainment, education, music, etc.

"Although there are approximately 22,000 inhabitants in the whole of Greenland, the great majority live along the western coast. About 3000 radio sets are in operation in West Greenland, most of them being battery-powered since central electric plants are only found in the larger villages. Greenland's radio broadcasts from Godthaab with a power of 1000 watts on the frequencies of 633 kc. and 9526 kc."

Anyone hearing the station and desiring a QSL card should write to: *Greenland's Radio*, Godthaab, Greenland.

Station Reports

Now into the current batch of reports. All times shown are EST, 24-hour system.

Austria—At press time, *Radio Osterreich* is testing a 20-kw. xmtr on approx. 5960 kc. daily at 0300-0400, relaying *Radio Linz*. Reports are very welcome and should be sent to the Austrian DX-Club, Landgutgasse 41/19, Vienna 10, Austria. (*World Radio Handbook*)

Australia—VLC9, 9615 kc., transmits to Eastern North America at 0655-0845 daily; to Western N.A. at 0214½-0315 daily. DX programs are directed to Western N.A. at 2300 on 15,200 kc.; to Eastern N.A. at 0830 on 9615 kc.; to Europe and Asia at 0344 on 17,790 kc. and at 1115 on 7220 kc. and 11,900 kc.; to Africa at 0240 on 11,800 kc.; to New Zealand, South and Middle Pacific Islands at 2300 on 15,200 kc. (*HS, LM*)

Azores—CSA93, Ponta Delgada, 4865 kc., is heard afternoons until 1802 s/off with "A Portuguesa."

Brazil—ZYN7, Fortaleza, 15,165 kc., 5 kw., has been noted on the West Coast with very weak signals at 1850. (*WF*)

A new station is *Radio Guaiba*, Porto Alegre, on 11,785 kc., at 1900. (*RL*)

Bulgaria—*Radio Sofia*, 9700 kc., has an English program to the USA at 2000-2030 with news, variety, and commentary. It is followed at the 2030 s/off by *Radio Moscow* and a musical program. Complete English schedule to USA is 1600-1630 and 1645-1715 on 7670 and 6070 kc., and 1930-2030 and 2300-2330 on 9700 kc. (*KM, RN*)

Ceylon—Colombo can be heard at 1300-1430 on 17,845 kc., parallel to 15,120 kc., with a VOA program in Hindi and English. The xmsn is beamed to East Africa. (*RL*)

Colombia—*Radio Sutatenza*, HJKH, 5070 kc., is usually at good level evenings with various religious programs. It also has other cultural programs. The station is also known as "Accion Cultural Populare" (Popular Cultural Movement or Action). This station was founded by a priest and therefore is primarily interested in cultural goals. (*PM*)

Costa Rica—TIFC, "The Lighthouse of the Caribbean," 9645 kc., operates at 2255-0000 daily. These English programs are of the religious type. (*LM*)

Cuba—An easy one for Spanish listeners is COBC, *Radio Progreso*, Havana, 9362 kc. Usually easy to hear at all hours, especially evenings, this one was noted at 2300-2315 with music, talks, and commercials, all in Spanish. (*FL*)

Czechoslovakia—*Radio Prague*, 9550 kc., has a half hour in English, not beamed to any particular country. News at 1930-1940. A question-and-answer session is tuned at 1940-1955; music to 2000 followed by s/off. (*RN*)

A veteran DX'er, Grady Ferguson is among the best in the Newark News Radio Club. His home is located in Charlotte, N. C.

Denmark—Copenhagen, OZF5, 9520 kc., has English at 2030-2130 and 2200-2300 (repeat). Their DX program is noted at 2115 on Saturdays, in which listener's letters are read and answered by Marianne. (*GF, AE*)

Greece—*Radio Athens* is now using the new frequency of 17,745 to Western Europe at 1300-1330 with French at 1300-1315, English until 1330.

Guatemala—*Radio Cultural* broadcasts daily at 2230-2345 on 9668 and 11,850 kc. in English. The programs are of a religious type, similar to those heard over HCJB. (*LM*)

Calls are TGNC, 11,850 kc., and TGNB, 9668 kc. Each half hour a full announcement of the station and frequency is made in Spanish together with a time check.

Indo-China—*Radio France-Asie*, Saigon, is now on 9805 with an English program at 0900-0945.

Indonesia—A new 20-kw. xmtr has been inaugurated at Jogjakarta for use in the Home Service of RRI. The channel is 7100 kc. A special antenna is being used which makes reception of this station possible in the whole Indonesian Archipelago. (*WRH*)

This one has been noted in the USA.

Italian Somaliland—For Italian DX'ers, *Radio Mogadiscio* is on the air employing 7072 kc. with 300 watts and 4978 kc. with 4 kw. daily as follows: at 0430-0500 in Somali and at

(*Continued on page* 119)

R/C NOTES

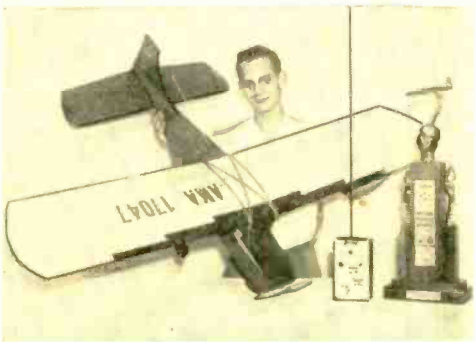
THOSE OF YOU who have hesitated to get into radio control work, saying that it's too complicated, or that "I don't know anything about radio," please look at the photo at the right. It shows E. L. Friend of Las Cruces, New Mexico, who won the single-channel radio control event at the *National Championships* held at the Los Alamitos Air Station in California. The plane shown here is Ed's FIRST radio-controlled model!

Credit for the reliable radio equipment should go to *Babcock Radio Engineering, Inc.*, of Van Nuys, Calif., for it was their BCR-3 receiver and BCT-2 transmitter that enabled a novice in the field to snatch first place away from the experts.

RECENTLY, WE RECEIVED a mimeographed letter from Mr. Irving Megeff of *Electronic Specialty Supply Co.* (*ESSCO*), of New York City, which has an urgent message for the R/C modeler's fraternity. The letter points out that at the time of writing the FCC had on file a total of only 12,500 licenses for R/C and other equipment in the Citizen's band of 27.255 mc. When it is realized that upwards of 60,000 modelers are actively engaged in the use of this band, the neglect of many to register with the FCC gives a black eye to our hobby. But even more important than that, the FCC at present has a totally incorrect view of the use of the Citizen's band by R/C hobbyists. How does this affect us?

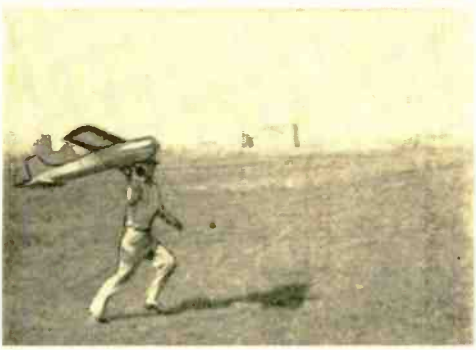
Well, for one thing, the demand for channels by other services is so great that the FCC seems to feel that the small occupancy of the Citizen's band by model control enthusiasts does not warrant an exclusive channel. Consequently, the FCC has issued licenses for mobile services, traffic control services, and others to use this channel despite the fact that it has created a source of interference for the R/C modeler.

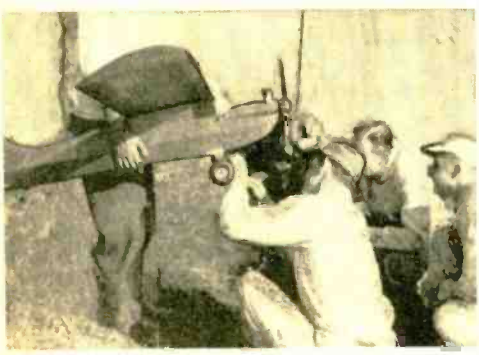
At this point, there is one thing that can be done by all you R/C modelers to



impress the FCC with your claim to the 27.255-mc. band, i.e., send to the FCC a completed Form 505 for the R/C transmitter you use. And ask your friends to do the same.

SHOWN BELOW are some scenes from the recent meet of the R/C³ (Radio Control Club of Chicago). More data on this club will be given in the next issue. —30—





POPULAR ELECTRONICS

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Disc and Tape Review

By BERT WHYTE

WITH THIS issue, we start off a new year of POPULAR ELECTRONICS. It has long been a custom to "summarize" what has happened in the previous year, but I'm afraid space will not permit me this luxury. Suffice it to say that we have covered a lot of ground in our survey of recordings, and by now your library should be quite sizable. But music is a never-ending road and there is still a long, long way to travel. Rather than look back, I'd prefer to give you a preview of what to expect in the coming months.

Preview of 1956

For one thing, you will find a greater emphasis and more space devoted to prerecorded tape. Quite a number of companies jumped on the tape bandwagon in the last months of 1955, and the availability of both monaural and stereophonic tapes virtually doubled overnight. During 1956, more space will be given to "specialized" recordings, such as hi-fi test records that cover frequency response, intermodulation distortion, tracking ability, etc., "gimmick" records with unusual sounds, and—in fact—any recording that is out of the ordinary in content.

Among other innovations will be a listing of the equipment used in reviewing the records that appear in this column, along with occasional descriptions of the acoustical environment involved and the effect on the sound when the acoustics are changed. Whenever possible, and if apropos, technical hints and playback information will be interposed with the reviews. All this, plus the usual features, will—I hope—make *Disc and Tape Review* still more interesting and informative in the months that are ahead.

Record of the Month

SPOTLIGHT ON PERCUSSION

Vox DL180, 12" LP
RIAA curve, $5.95

This is just about the last word in demonstration records for percussion. Sixty-six instruments are covered; you name the percussion device, and it's on this disc! The quality of the record is fabulously good, and there is no reason why it shouldn't be . . . in making this pressing, the usual master-mother-stamper routine is bypassed, and the copy you buy is right off the master. This means that Vox gets about 500 copies from a master and then has to remaster, as the master won't hold up too far beyond that point. So even the most cranky of audiophiles shouldn't gripe at this disc! If you get a chance, listen to the Anchors Aweigh *section . . . the transients on tenor drum, bass drum, cymbals, and glockenspiel will floor you!*

This month we will go back to the practice of reviewing a work from each of three periods of music—in this instance, the baroque, the romantic and the modern eras. For the baroque work, we will investigate Handel's great *Water Music*.

Handel's Water Music

The music derives its name from the fact that it was written for a cruise down the Thames on a Royal barge. Actually, the musicians played the work on a barge which closely accompanied the King's barge. Since these barges were fairly small, the size of the orchestra was somewhat limited and Handel's original orchestration called for what we today would call a chamber orchestra. The complete *Water Music* is rarely played; instead, there is a *Suite* from the *Water Music* which was orchestrated for a much larger orchestra by Sir Hamilton Harty some years ago, and which has attained considerable popularity. Lately there has been a resurgence of interest in the original score and it has been recorded in this form by four companies. Of the four, the versions by the Haydn Society and London are the hi-fi recordings of choice.

On the Haydn label, we find an ensemble listed as the "Hewitt" orchestra, conducted by a "M. Hewitt." Neither the orchestra nor the conductor is familiar to me and I feel fairly certai that this orchestra is what is known in the trade as a "pickup" group . . . or recording orchestra. Assuming this to be the case, then credit indeed must accrue to the conductor, because the performance is wholly admirable, the classical form being rigidly observed but the contours softened by a singular warmth in the playing. One might quibble about the somewhat "draggy" tempi employed and a few other minor falls from grace, but by and large this is a good representation of the score. This opinion is heightened by the excellent sound on the disc. String tone is good and generally clean, little distortion is present throughout the disc, frequency and dynamic range are quite wide. Acoustic perspective is good but could have been more in keeping with the score and the size of the forces employed. I admit the spaciousness lends "liveness" to the sound, but it robs the music of some of its intimacy.

Good as the Haydn recording is, it must bow to the superior sound and the authoritative performance of the London disc. Here is truly one of the few recordings which deserve that overworked term "definitive." Performed by the Boyd Neel orchestra and conducted by Boyd Neel, the *Water Music* is a perfect reflection of the composer's intent. Every subtle nuance of phrasing and every dynamic shading bears witness to the loving care Boyd Neel has lavished on this score. An acknowledged master of Handelian works, Neel brings new clarity and understanding to this work . . . in his hands, all the various sections are smoothly integrated and the music flows with an easy assurance. This is not to say that the short "movements" have lost their individuality, but rather that they are not subjected to crude disjointment by conductors having less insight into the score. In all matters of balance, tempi, etc., Neel wins going away, and so does the splendid playing of his virtuoso orchestra. London has done a magnificent job with the sound on this disc. Acknowledging Neel's insistence on authenticity, they have cloaked the "Handel orchestra" in appropriate acoustics. Here is the way the *Water Music* must have sounded at its premiere . . . intimate, soft-contoured, robust when needed, in perfect balance.

For those who prefer the brevity of the *Suite*, the choice is much wider; and of the total of eight recordings in the LP catalog, four can be designated as hi-fi in sound. Best of the lot, and a very "big boned" and noble-sounding recording is the van Beinum on London, which is coincidentally the best performance. Following closely on the heels of this recording is the von Karajan reading on Angel. There is not quite such a big, robust sound here, but a more finely grained luminous type of sound which is preferred by many people. Performance-wise, this is a fair job by von Karajan but too full of his mannerisms and other deviations to compete with the London disc. The Munch/Boston Symphony and Ormandy/Philadelphia orchestra discs follow in that order on the list, and neither of these discs can compete in sound or performance with the other issues.

Summing up, we can say that the complete *Water Music* is tops in the Boyd Neel/London edition and the *Suite* is best handled on the van Beinum London version. For those who think this is rather "dry" music, it is suggested they play the famous *Hornpipe* section. A more jolly and rollicking tune would be hard to imagine!

Dvorak's Second Symphony

Mention Dvorak's name and almost automatically it will be linked with his *Fifth Symphony*. While it is true that this work has been the mainstay of the Dvorak reputation,

(*Continued on page* 111)

hi-fi

in the home of *Martin Block*

First in a new series shows how famous disc jockey adapted an antique cabinet to house commercial hi-fi components

FAMOUS AS RADIO'S first disc jockey, and heralded as "America's Super Salesman," Martin Block (Make-Believe Ballroom, WABC, N. Y.) enjoys his own, self-assembled hi-fi system. And, says Mr. Block, there's no "make-believe" or mystery to stand in the way of anyone's putting together a system of comparable quality.

Installed in his home, Mr. Block's sound system has facilities for FM and AM reception, record playing, and tape recording and playback. All components, except the loudspeaker, are housed in a Louis XVI style cabinet, whose interior was adapted to accommodate the hi-fi units.

Standard commercial components, readily available at most distributors, were used. The installation comprises equipment manufactured by such representative organizations as *Altec-Lansing, Ampex, Fisher, Gray, McIntosh, Pilot,* and *Rek-o-kut.*

Mr. Block's excursion into hi-fi was a natural result of his love of music and his interest in electronics. Between his radio show and his own music collection, he has probably heard as much music as any man alive. What's more, he's even written the lyrics for many hit tunes (*I Guess I'll Have to Dream the Rest, This Is No Laughing Matter,* etc.). And the electronics art could hardly present a problem to a man who has operated two of his own amateur radio stations (EX-W6ZOW and EX-W2MGE).

Martin Block is credited with having originated the art of disc-jockeying back in 1935. At that time, he

Martin Block pauses to pet his spaniel, "Blackie," who maintains a neutral attitude toward hi-fi.

Antique furniture piece, containing tuner, amplifier, tape recorder, and turntable, harmonizes with general decor of house. At left, Block listens to his speaker system, an ALec 604C 15-inch coaxial mounted in a 606A enclosure.

was covering, for radio news broadcasts, the famous Hauptmann trial. To fill in time between announcements, Mr. Block decided to play recorded music. He felt he had nothing to lose by telling his listeners that the music heard came from a beautiful crystal ballroom. Then Block began talking to the musicians as if they were actually at his side. Station WNEW and many new sponsors liked it; the audience loved it, and "Make-Believe Ballroom" was born.

The popularity of the program, combined with Block's persuasive selling technique, raised the disc jockey to pre-eminence in the profession he had, in effect, created for himself. In a few years, his name became synonymous with the tops in popular music. Recording companies saw to it that he got first play on new releases.

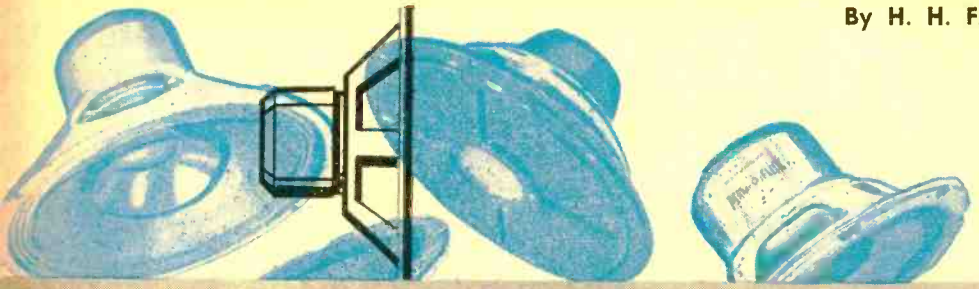
Block moved recently to his new spot at WABC, the *American Broadcasting Company's* key station in New York. During his twenty years as a "dee-jay," Block has had his own record outfit, and his own music publishing house. He's written a monthly column on music, and made movie shorts. His non-musical interests include sports cars, golf, and such gadgets as a personal "earplug" radio and an electric toothbrush.

Perhaps unexpected, but interesting, is the added news that Mr. Block is also a lover of serious music, and a confirmed home "do-it-yourself" audiophile in his own right. Details of his installation are highlighted in the accompanying photographs and captions. —30—

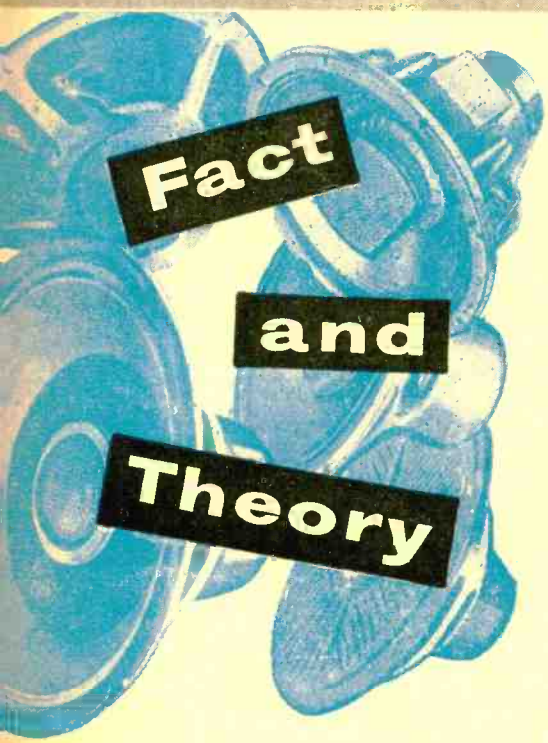
Top of cabinet hinges open to permit access to Rondine DeLuxe turntable and Gray 108C arm. Below this assembly are located Fisher 50R FM-AM tuner and Pilot PA-913 control preamplifier.

Bottom half of cabinet houses Ampex 600 tape recorder so mounted as to be readily removed when necessary. A McIntosh 30-watt power amplifier sits behind the Ampex tape recorder.

By H. H. FANTEL



LOUDSPEAKERS



What every hi-fi enthusiast should know: the principles, problems, and representative types of loudspeaker designs.

THE FUNCTION OF a hi-fi system is to reproduce musical sounds. Regardless of the medium used—broadcast, record, or tape—the sound that emanates from the system should be identical to that of the sound entering the system. Anything more or less than this is not truly "high fidelity."

The actual sound source in a hi-fi system is the loudspeaker. It is literally the voice of the system. As such, it combines elements of electronic as well as musical instrument design. At this point, hi-fi leaves the logical realm of electronics and enters a tricky border region where electronics, mechanics, acoustics, and musical esthetics overlap.

With these different elements affecting loudspeaker performance, there can be nothing cut-and-dried about hi-fi speaker design, just as the manufacture of fine musical instruments can never be reduced to an exact routine. No two loudspeakers sound exactly alike—even if their measurable characteristics are identical. Nor do two pianos or violins sound alike, regardless of their similarity. The fact that two loudspeakers sound differently does not necessarily mean that one is better than the other. It is simply that loudspeaker designers give audio fans their chance to choose among different "types of sound."

Design Principles

A loudspeaker is an electromagnetic motor, pushing air out with each forward stroke and sucking air in with each backward stroke. These alternate movements

are the mechanical equivalent of the electrical signal fed into the loudspeaker. The moving loudspeaker cone imparts corresponding vibrations to the surrounding air. In this way, the loudspeaker reconverts the electrical signal into audible sound.

Shown at the right are the necessary parts which go into making up a typical, modern high-quality loudspeaker. A coil connected to the amplifier output is slipped over the pole piece of a strong permanent magnet and held in a floating suspension, allowing it to move back and forth along the magnet. The magnetic force induced in the voice coil by the audio signal acts against the constant field of the permanent magnet, pushing the voice coil back and forth in rhythm with the audio signal. The cone, rigidly attached to the voice coil, then imparts this motion to the air. All these parts are assembled within a rigid and preferably non-resonant framework.

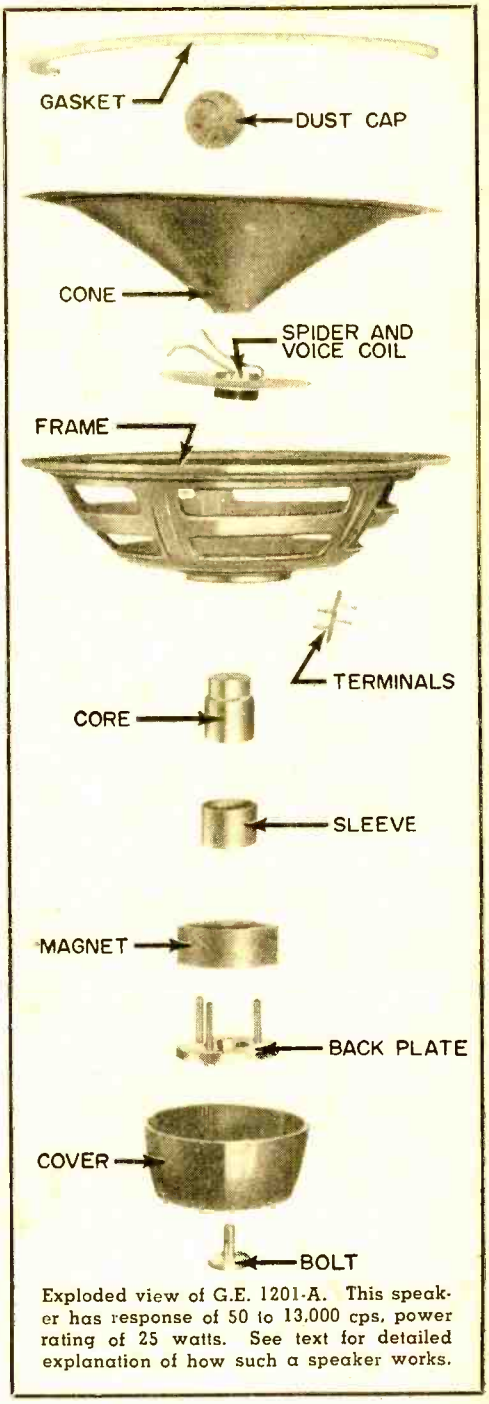
To call this mechanism "simple" would be misleading, although the operating principles are simple. The trick is to achieve precise correspondence between the highly complex audio signal and the actual cone movement over the widest possible frequency range. In musical terms, this means freedom from distortion and proportional loudness throughout the audio spectrum. It requires good engineering, careful selection of materials, painstaking workmanship and testing. Skill and ingenuity are the main ingredients of a good loudspeaker.

The objectively measurable factors affecting loudspeaker performance are: power rating, damping, frequency response, directivity, and efficiency. These are the black-on-white specifications that distinguish good loudspeakers from poor ones.

Power Rating

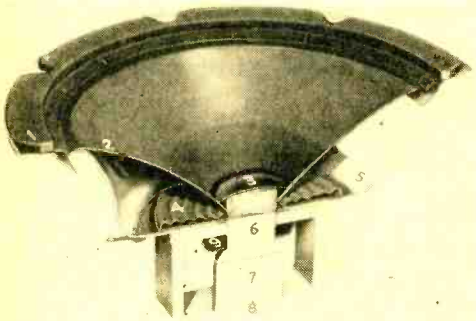
The amount of audio power a speaker can deliver depends chiefly on the magnet. Most modern speakers use the same magnet material, Alnico V, an alloy named after its component metals: aluminum, nickel, and copper. Since the magnet material is identical, loudspeaker magnets can be compared in terms of their weight. Generally, the heavier magnet means higher power rating. The larger magnet provides a greater field of uniform magnetic force, permitting the voice coil to travel further on each excursion. If a high-amplitude signal pushes the voice coil beyond the uniform magnetic field, the acoustic output of the speaker is no longer proportional to the input; and the result will be distortion.

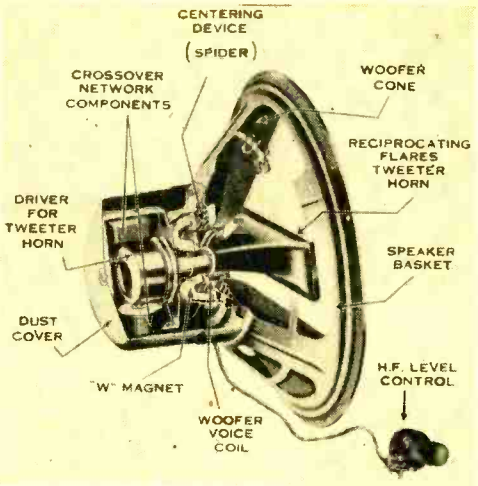
Essentially, the power rating tells the wattage a speaker can absorb (i.e., how loud it can play) without distortion. Yet sheer loudness is not the only advantage of a high power rating. Even at moderate volume level, music contains elements representing fairly strong power peaks. The energy content of deep sounds, like those from kettledrums, string bass, tuba, low organ pipes, etc., is considerable. To visualize these sounds, remember the large



Exploded view of G.E. 1201-A. This speaker has response of 50 to 13,000 cps, power rating of 25 watts. See text for detailed explanation of how such a speaker works.

At right, cutaway view of University 6201 shows all elements of a compactly designed 12-inch woofer-tweeter combination. Response is 45 to 15,000 cps; power rating, 25 watts. Below, cross section of Permoflux 8W81, a high-quality 8-inch model. Flared cone is stiffened at apex for better highs, slotted at rim for improved bass. Response is 45-14,000 cps; power, 15 watts.





physical forces involved in producing them. Effective, life-like reproduction of such musical notes requires wide excursions of the loudspeaker. Insufficient magnet size tends to blur the clarity and reduce the impact of bass notes.

The power rating of a speaker should at least equal and preferably slightly exceed the power rating of the amplifier. Yet, while reserve speaker power might result in somewhat clearer sound, it must be kept in mind that the amplifier power will remain the limiting factor.

Damping

The damping or transient response of a speaker is largely a function of magnet size relative to the mass of the cone. Damping means the ability of the magnet to control the movement of the cone so that it neither overshoots its mark nor keeps jiggling after a sharp and sudden excursion. Good damping keeps the speaker motion strictly equivalent to the signal waveform. It prevents the speaker from distorting waveforms by unrelated movements of its own cone.

Musically, the exact reproduction of waveforms through effective speaker damping means clarity of sound, clear definition of instrumental timbre, and transparency of orchestral texture. The characteristic tonal flavor of any musical instrument depends on its overtone structure, and on the initial transients in the formative phase of its tone: plucking, tonguing, striking, etc. A properly damped speaker retains these elusive aspects of music with dramatic realism.

Speaker damping is tested in the laboratory by measuring the square-wave response of the speaker. For the average audiophile, a more telling and more casual test is to play (in an acoustically "dead" room) some music with extremely sharp transients, such as drums and other percussion, crashing piano chords, or sudden entrances of full orchestra. If the speaker is well damped, the initial phase of these sounds comes through clearly and without a disturbing "hangover" blur that occurs when the speaker keeps oscillating randomly after the initial wide-amplitude excursion. In orchestral music, the texture of even the heaviest sound remains amazingly transparent in a well-damped speaker.

Fortunately, speaker damping is greatly aided by negative feedback in the amplifier, which, in effect, puts dynamic brakes on the speaker whenever it gets out of step with the signal by letting inertia take it for an unscheduled trip. A good feedback amplifier thus makes it possible to obtain good damping even from speakers with moderately sized magnets.

Frequency Response

To do its job as the reproducing unit in a hi-fi system, a speaker must sound the whole frequency range from the lowest thud of the bass drum to the silver tinge of the piccolo. The various musical instruments are shaped and dimensioned for their own limited range, which seldom exceeds two and a half octaves with any degree of efficiency. But the loudspeaker must be "Jack" of all their trades and master of the whole audible gamut. To cover such a wide band of frequencies, the loudspeaker designers must play tricks on the laws of resonance.

The physical requirements for producing high tones are different from those for producing low tones. Sound sources are most efficient at or slightly above their own

resonance, dropping sharply in efficiency below the resonance point. High tones are best emitted from small, light bodies, rigid enough to follow the rapid reversals of high-frequency oscillation without bending and flapping. Bass sources should be large and heavy, so that their natural resonance will be down toward the lowest frequencies they must reproduce. They should be compliant enough to follow the wide-amplitude motions which are characteristic of low frequencies.

The dilemma posed by these conflicting requirements has been solved in two ways: (1) by special cone treatment and suspension to extend the frequency range of a single cone; (2) by using separate speakers for bass ("woofers") and for treble ("tweeters"), and possibly a separate mid-range speaker.

Single-Cone Wide-Range Speakers

Just as the electronic circuit designer juggles inductance and capacitance to get his required bandwidth, the acoustic designer creates a wide-range loudspeaker cone by special combinations of mass (= inertia) and compliance/rigidity. Flaring the shape of the cone also extends the frequency range since it results in high rigidity at the apex (for treble) and relatively greater compliance at the rim, where the heavy bass motions are carried out.

These are ingenious and precisely calculated compromises with the laws of acoustics. Such single-cone speakers often provide very good audio quality at a cost much lower than that of an only slightly superior woofer and tweeter combination. A good speaker of this type is not recommended where the primary goal is extreme frequency response but where the listener derives his main enjoyment from good balance between highs and lows without distortion.

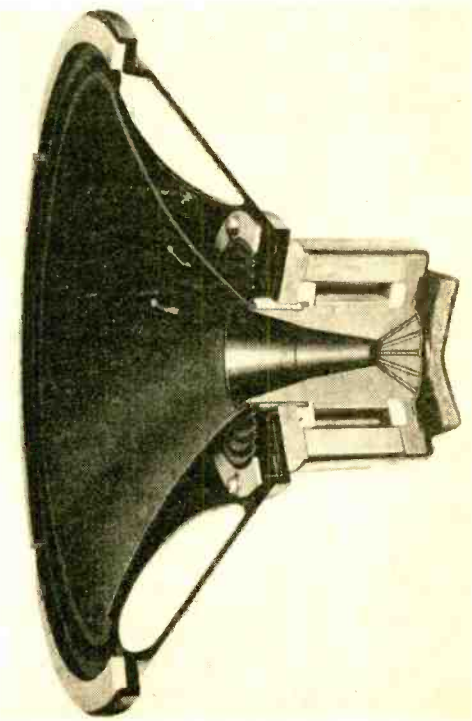
An example of this type of design is the *Permoflux* speaker shown on page 78. Its flared cone is relatively rigid at the center so as to follow the rapid treble oscillations without flapping or the cone breaking up into distorting ripples due to limpness. At the same time, the slotted cone suspension gives sufficient compliance at the outer cone region for the longer and slower bass excursions.

Many single-cone speakers use different cone materials concentrically within the cone. In fact, the most significant difference between various makes of otherwise similar speakers lies in the shape and materials of their cones. This largely accounts for the characteristic sound of a certain speaker. For instance, *Jim Lansing* and *Electro-Voice* single-cone speakers use aluminum foil at the cone apex for better treble radiation. The rigid, lightweight aluminum center is surrounded by an outer ring of heavier and more compliant cone material whose lower resonance and flexible suspension make it a suitable bass radiator. In effect, "division of labor" takes place between different areas within the same cone, the inner part for treble and the outer part for bass. Where different materials are used for the center and periphery, it is referred to as a "mechanical crossover."

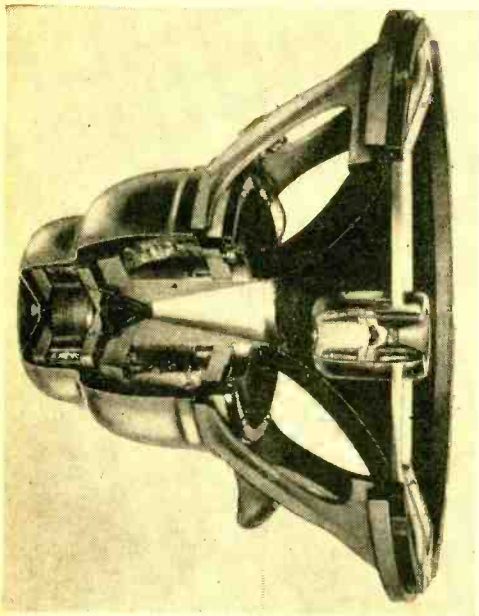
The physical separation of cone areas oscillating in different frequency ranges also reduces the danger of intermodulation on the cone. This insidious form of distortion occurs when the low bass frequencies are superimposed on the high frequencies in the same way that an audio signal is superimposed on an r.f. carrier in amplitude modulation.

Speaker Size

The size of a speaker is naturally related to its frequency response. Larger, heavier loudspeaker cones have greater mass and



Tannoy "dual concentric" speaker uses separate voice coils for bass and treble units. Tweeter horn blends geometrically into curvature of bass cone. Shape achieves wide-angle radiation of frequencies, and response is 40-20,000 cps. Twelve-inch unit handles 15 watts of power; 15-inch unit, 25 watts.



Cutaway view of Jensen G-610 shows three independently driven speaker elements all nested within single 15-inch frame. Crossover frequencies of 600 and 4000 cycles are achieved by separate network. Tweeter and mid-range units have their own level controls. This "triaxial" handles 35 watts.

therefore a lower resonance than smaller, lighter cones. Since all oscillating systems, electrical as well as mechanical, operate best within the region of their natural resonance, the larger speakers are more efficient in the bass while the smaller speakers function better at higher frequencies. To produce effective low bass (i.e., to recreate in audio power the equivalent of the electrical amplitude of the sound pressure of the original instrument), large amounts of air must be moved.

A large cone, say, a 12" or 15" cone, naturally moves more air at a given amplitude of voice coil travel than a smaller cone. Consequently, a large speaker provides more effective bass radiation. A 15" cone, however, would be too heavy for good treble response, and therefore should only be used as a woofer to operate in conjunction with a separate treble unit. Yet a wide-range 12" or 10" speaker, or even a well-designed 8" speaker, if properly baffled, often provides very adequate sound over most of the musically significant range, sacrificing only those extreme highs and lows which contain marginal musical data.

But the economy and good over-all quality of these single-cone speakers will hardly reconcile the more hard-bitten audiophile to the partial loss of his beloved frequency extremes: that deep velvet in the bass and that sheen in the treble. For these he must turn to coaxial speakers or separate multiple speaker systems.

Coaxial Speakers

The problem of obtaining wide-range response from a single speaker is neatly sidestepped (at added cost to the customer) by using separate speakers for treble and bass. Sometimes a third speaker is added to the system to cover the middle range. Since bass and treble speakers are known by such picturesque names as "woofers" and "tweeters," it has been seriously suggested that mid-range speakers should be called "squawkers."

A coaxial speaker is a two-way system with the tweeter mounted within the woofer. The two units operate independently, each having its own magnet and voice coil, each fitted with a cone or metal diaphragm suited to its own frequency range. Compared to equivalent systems consisting of separate speakers, the coaxial speaker offers space economy and convenience in mounting. The buyer also has the assurance that treble and bass elements are properly matched for smooth coverage of the entire range.

Structural details of woofers and tweeters will be discussed in another article on multiple speaker systems. At that time, crossover networks which divide the audio-frequency band to channel the high frequencies to the tweeter and the low frequencies to the woofer will be described.

Directivity

Low frequencies spread evenly in all directions. There is an increasing tendency for high tones to emerge from the apex of the speaker as a narrow beam, like a focused searchlight. This leaves wide areas of aural "shadow" at either side of the treble beam. Flared loudspeaker cones tend to be particularly directive with considerable high-frequency loss for listeners located too far off the center line.

To spread the entire frequency spectrum evenly throughout the listening area, several devices are used, such as domed metal diaphragms or various types of perforated frequency diffusers at the cone apex, flared tweeter horn shapes and multicellular tweeter horns. By means of such devices, most quality speakers now attain a high-frequency dispersion angle of 90° or more, i.e., more than 45° to each side of the center line. This means practically uniform dispersion of frequencies throughout the listening room from a single speaker if the speaker is placed in a corner looking diagonally into the room.

Graphs of the speaker's radiation pattern

are sometimes included on the data sheet. But for a simple, rough check of directivity, simply walk in front of the speaker from one side of the room to the other. No great treble loss or other change in tonal balance should be noticeable within the normal listening sector. The walls of the room must not be too reflective or reflected high frequencies will be heard.

Efficiency

Speakers differ greatly in efficiency—the quantity of sound (loudness) produced from a given wattage. Efficiency is determined by many factors, such as the strength of the permanent magnet field and the mass inertia of the cone. Chiefly, however, it is a function of the ratio between the resistive and the inductive reactance components that make up the voice coil impedance. Only the inductive reactance component produces the magnetic interaction resulting in movement of the voice coil. The resistive component simply burns up audio energy, converting it into heat.

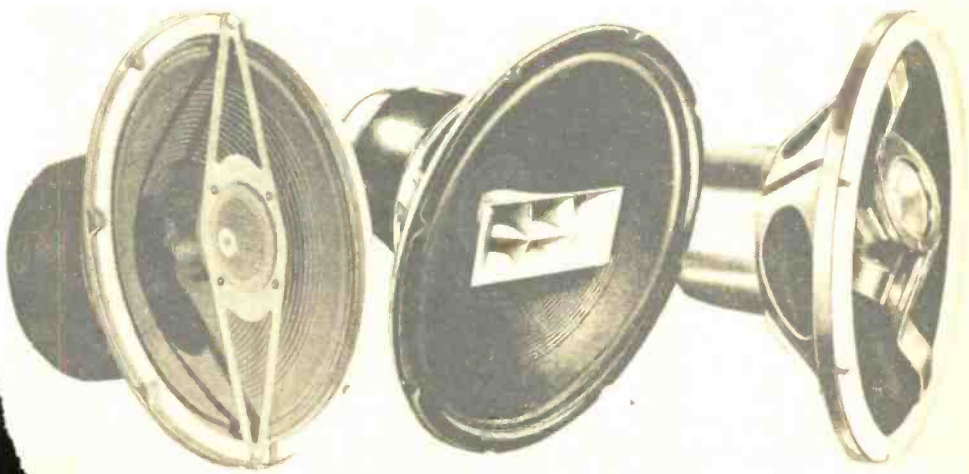
Since the total voice coil impedance is usually only about 4 to 16 ohms, the parasitic resistive component accounts for a large share of this total impedance, thus reducing the efficiency of the speaker. Some speakers overcome this difficulty by using an up-ended lightweight aluminum ribbon as a voice coil. The ribbon offers more conductive cross-sectional area and hence less resistance. Thanks to its light weight, such a voice coil further improves efficiency by providing less mechanical inertia to oppose the rapid reversals of motion at high frequencies.

An efficient speaker produces a given degree of loudness with less amplifier gain, permitting the amplifier to be operated at low power levels for minimum distortion. Voice coil diameter is often stated on the data sheet. As a general rule, a larger diameter means greater efficiency since the voice coil then acts against a larger periphery at the inner cone rim.

The Final Factor

At the outset, the loudspeaker was described as an unpredictable hybrid of musical art and electronic technology. And where music enters the picture, it throws the monkey wrench of subjective tonal impressions right into the neatest engineering calculations. Therefore, let your own ears and tonal taste be final arbiters in the choice of a loudspeaker. After all, a loudspeaker is not a piece of impersonal, calibrated equipment guaranteed to jiggle your eardrums with a flat decibel curve through all audible frequencies. Rather, it is a many-voiced companion in your home, to bring you music for many years and for many moods. —30—

Three different approaches to coaxial speaker design and dispersion of highs. Stromberg-Carlson RF-471 (left) has cone tweeter mounted in front of 12-inch woofer. Flat tweeter cone disperses highs uniformly over wide angle. Woofer cone is corrugated to reduce tendency to "break up" into subharmonic vibrations. Response is 30 to 14,000 cps; power, 30 watts; impedance, 8 ohms. Jensen H-530 (center) uses multicellular horn with matched driver. A 15-inch woofer is employed, and separate crossover network and tweeter level control are provided. Power is 30 watts; impedance, 16 ohms. Lorenz LP-312-2 (right) uses two plastic cone tweeters facing in different directions from 12-inch woofer. Plastic is said to avoid metallic quality in high-frequency range. This German-made speaker has reported frequency response of 20 to 17,000 cycles. Power is 20 watts; impedance, 16 ohms.



Audio Audit

This year will usher in exciting new developments in hi-fi, better components and systems, and many kits for home builders

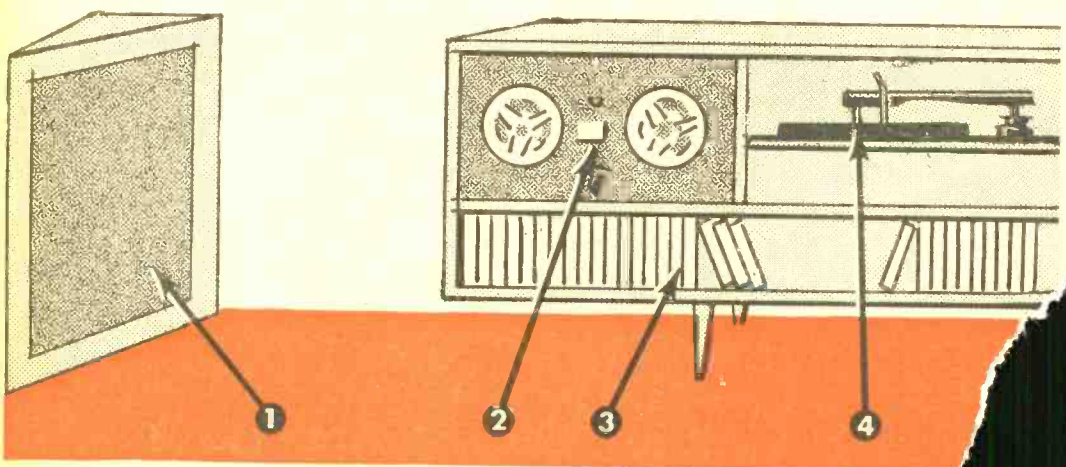
By NORMAN EISENBERG
Feature Editor

TO THIS fan, most of the "pooh-pooh" attitude on high fidelity (emanating, naturally, from the sidelines) was blown away in one big blast by the enthusiastic crowds at the recent "Audiorama" held by the *Audio Fair* at the Hotel New Yorker. Attendances at this show and similar ones in other large cities, as well as the exhibits themselves, have demonstrated that hi-fi is not a passing fad like miniature golf or four-button jackets, but is here to stay and grow.

Behind the fanfare is the inescapable fact that the public wants hi-fi, and that the hi-fi industry is sparing no effort to satisfy the public's demand for better equipment that is reasonably priced and engineered and styled for home use.

On the basis of what was observed and heard at more than 200 exhibits at audio shows, the coming year should prove to be one of the most exciting and gratifying for music lovers, record and tape collectors, and audio hobbyists of all inclinations. Some of the developments on the way are: new, low-cost speakers as well as full-range electrostatic reproducers, better amplifiers and tuners at lower prices, low-cost tape mechanisms, tone arms with no tracking error, new lines

Better hi-fi components expected this year: 1. SPEAKERS and ENCLOSURES include many corner types, with kits available for 12" units to 4-way systems. 2. Higher response is expected from TAPE RECORDERS using 7.5-ips speed. 3. RECORDING TAPES will be stronger, more sensitive; PRERECORDED TAPES, lower in price. 4. PHONO EQUIPMENT will feature extended range pickups, improved tone arms. 5. RECORDS will boast wider ranges, cleaner surfaces. 6. Superior AM and FM reception will be had from TUNERS



of cabinets and enclosures, and kits galore for building a variety of components. Even the "packaged" or "ready-made" radio-phonograph combinations—long scorned by the dyed-in-the-wool audiophile—have attained a level of sound quality that earns for them a respectable place in the hi-fi roster. And exciting new developments can be expected all along the hi-fi component "chain"—from program sources and pick-ups to reproducers and cabinets.

Playing of records will be facilitated by new developments in all phono components. Pickups with extended frequency responses, flat to well above the limits of audibility, are making their bows. New variable reluctance, dynamic (moving coil), and ceramic types all show improvements. Better methods of affixing the stylus to the pickup, and of mounting cartridges for changeover from 78 rpm to LP, are in evidence.

Tone arms that resemble cutting assemblies, both in structure and groove-tracking, are here. These new playback units, easily fitted to any standard turntable or changer, permit a pickup to travel across the record in a perfectly straight line. Tracking error, and its attendant distortion and record-wear, is virtually a thing of the past.

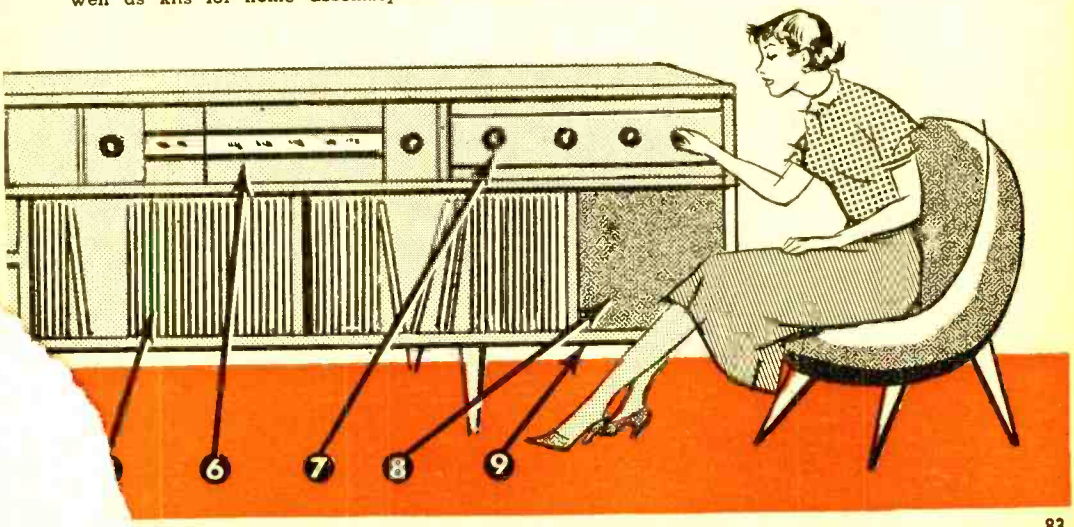
In turntables as well as in record players and changers, existing models have undergone marked improvements, and recently introduced models—from abroad as well as domestic—show signs that the designers and engineers have really stayed up nights solving motor operation, noise, and mounting problems.

Low-priced prerecorded tapes, and equipment on which to play them, appear due for a boom. There are many attractive subscription plans to enable enthusiasts to purchase tapes at savings; if at all successful, this relatively new facet of the industry should mushroom considerably. Tape decks, designed for playback only, and known sometimes as "tape phonos," are beginning to rival record players in terms of price and ease of installation in the home.

Tape Recorders, Tuners, and Preamps

Tape machines, for home recording as well as for playback, are generally easier to use than earlier models. They are smoother running and invariably boast better frequency response at the popular 7½-ips speed due to improved heads. Stereophonic sound for the home, (foreseen in an article in POPULAR ELECTRONICS, May, 1955), is no longer a dream but a reality—now that prominent manufacturers are producing recorders for this purpose. A trend towards making tape recorders as physically attractive as other hi-fi units is also apparent. More and more, the recorder is evolving away from a specialized piece of audio equipment toward a device for home enjoyment. This is seen in the type of installation suggested by many exhibitors, as well as by the console-furniture design—resembling that of a conventional phono or TV set—instituted by others. Hobbyists who delight in projecting slides for visitors

of higher sensitivity. 7. Separate or combined, PREAMPLIFIERS and POWER AMPLIFIERS will feature more versatile controls and higher power outputs, respectively. 8. Many new SMALL SPEAKERS and ENCLOSURES, intended for direct listening, monitoring, or for stereophonic setups, will be available. 9. CABINETRY, for housing system, will show use of new wood grains, ingenious shapes for attractive placement. Finished units as well as kits for home assembly will offer wide choice of components and housing.



A few of the 30,000 hi-fi enthusiasts who visited "Audiorama" in New York City. Show lasted 4 days, occupied several floors in large hotel.

will have the assistance of a new gadget which automatically synchronizes the action of the slide-projector with a recorded tape to provide narration for the pictures.

New lines of FM and AM tuners show advances in circuitry and physical design that just beg to be grabbed and installed in one's listening room. Provisions for "binaural" listening and recording are built into many receivers. Increased sensitivity will make for wider acceptance of these units in fringe and rural areas, where music lovers can pull in big-city stations relatively far away. In addition to regular factory-wired units, many tuners are available in kit form, and more for the "do-it-yourself" enthusiasts may be anticipated.

The rising interest in the diverse applications of audio techniques possible in the home is reflected in a crop of new preamplifier-equalizer-control units. More than mere boosters for low-level phono pickups, the new preamps are the nearest thing to studio "patch panels" yet devised. Equalization for tape playback has been added on many, and mixing facilities are available. Multi-channel selection is provided so that any number of separate program sources may be permanently plugged in, with a simple flick of the wrist selecting the desired signal for listening or for recording.

In addition to switching and control facilities, control preamplifiers will reflect—more than ever before—the eye-appeal inherent in units designed specifically for home use. Sleek styling and compactness, even miniaturization, will be more and more pronounced.

Power Amplifiers Up to 100 Watts

Keeping pace with the enhancement of program sources already described are developments in power amplifiers. These may be summed up as representing bigger and better sound without the need for larger chassis or higher prices. A "wattage race" among manufacturers has pushed the rated output of amplifiers for home use up to figures like 30, 60, or even 100 watts! These output figures are not as astronomical or absurd as they may appear at first glance. For the home enthusiast who wants to drive several speakers throughout his house, who wants to cut his own discs, or who can afford the power reserves that make for completely smooth "Cadillac-like" performance, the high-rated output amplifier is quite in order. Tube developments and increased attention to feedback networks and output transformer design will provide these powers without distortion or hum, and covering frequency bands from 10 to 100,000 cycles.

Kits Build "Dream Sets"

Even more pronounced than in the field of tuners is the trend toward partially-wired kits for preamps and power amplifiers. More and more manufacturers, as well as distributors, are making exceptionally fine units in kit form. Many of these kits, available at comparatively low prices, would have been considered "dream sets" by audiophiles a short while ago.

Preamps that are built as part of a tuner, as well as preamp-power amplifier combinations, will continue to be popular where space is at a premium, power output requirements are moderate, and complete simplicity of operation is important. No sacrifice of quality will accompany these space-saving and budget-minded units.

Part of the story of these lower-priced units that possess greater stability and fidelity is the increasing use of printed circuits for important sections of tuners and amplifiers. As in the case of television receivers, the printed circuit technique in component manufacturing has proven to be a cost-cutting quality-assuring measure.

Loudspeakers and Enclosures

Perhaps the most spectacular innovations will manifest themselves in the area of loudspeakers and enclosures. As is pointed out in another article elsewhere in this issue, the loudspeaker is the "most personal" of the hi-fi components, being the close and immediate instrument through which music is heard. The amplifier may be the heart of the system, but the speaker is certainly its mouthpiece. Novel developments —reflecting wide diversity of design theory and approach—characterize these units. The electrostatic reproducer, long confined

Left, demonstration of stereophonic sound for the home attracted thousands of listeners. Two-channel tape playback unit reproduces tape through two independent, but perfectly balanced, amplifier and loudspeaker channels. Units are priced to be within the reach of many hi-fi enthusiasts. An intent fan, seated at far left, is Martin Block, noted disc jockey, whose own hi-fi system is described in this issue (p. 73).

Just as the language of music is international, so is the enthusiasm and exchange of ideas and techniques in musical performance and hi-fi reproduction. Right, the distinguished British audio authority, Gilbert A. Briggs, explains the details of construction of one of his new loudspeakers to New York audience at audio show. Representatives of all hi-fi organizations were on hand to discuss hi-fi with visitors.

to tweeter units only, has bowed in as a full-range speaker system. Mid-range and bass units are to be added to tweeters for complete coverage of the spectrum. Price-wise, these units compare with the $100-$200 loudspeaker class; but it is reported that electrostatic speakers, even the bass units, require no enclosure for best operation! Here is another really new development that may have far-reaching results.

Other loudspeaker proponents, contending that the electrostatic full-range speaker is still an experiment, are going ahead with improved versions of conventional-type reproducers. Noticeable among these are newly designed attempts at miniaturization of enclosures, with engineers playing all sorts of electro-acoustical tricks with the insides of cabinets as well as the cones and driving units of speakers themselves. Eight-inch, wide-range speakers may set a new vogue for low-cost installations. Domestic types as well as imports from abroad—both single cone and coaxial—continue to surprise us with their new "gimmicks" for attaining big sound at low cost and in small areas. The interest in small speakers is reflected by lines to be marketed soon by some of the oldest names in the "big speaker" field, as well as by organizations hitherto confined to the production of other components.

More and more, enclosures of all sizes are being made in a wide variety of angled shapes for corner placement, as well as in semi-circular and completely circular shapes!

Advances in Housing

The subject of speaker enclosures goes naturally with that of other cabinets for housing the entire system, since the combination—in many cases—presents the finished appearance of the installation with which one lives. Here, too, the situation is phenomenal when one thinks of the faltering and hesitant steps in this direction made a few years ago. As a rule, most hi-fi enthusiasts are interested in all-around comfortable living. Good sound in their homes is another aspect of modern living that goes with enjoyable surroundings and visually satisfying furniture and decorations. The ruling motto in modern design has been "form follows function." This principle has, for years, helped designers turn out award-winning automobiles, exquisite fountain pens, and epoch-making homes. It seems, at last, to have overtaken

(*Continued on page* 122)

Record Pressing Method Reduces Surface Noise

MASS PRODUCTION of records which boast a minimum of surface noise and whose sound quality closely resembles the hi-fi performance of the master disc is foreseen as a result of a new pressing process developed by *Custom Records, Inc.*, 41 East 42nd St., New York 17, N. Y.

Known as the "sintrafused" process, the new method uses a pressing machine

that weighs less than 80 pounds and operates at relatively low temperatures and pressures. Four records a minute can be made, with only nominal supervision by one technician.

The key to "sintrafusing" — and the factor which permits economies in production — is the use of vinylite in its powdered or "uncompounded" form. In this state, vinylite has been heated just to the point of cohering.

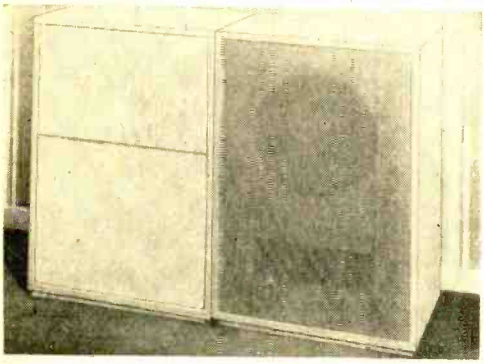
Conventional disc pressing methods carry the vinylite several steps further in the milling process to the point where it becomes a relatively hard mass. In this state, very high temperatures at 2000-psi pressure are required to press the vinylite into a record. According to *Custom Records, Inc.* engineers, such pressure causes a granular "flow" from the center of the disc to its outer rim. This "flow" is said to deteriorate the chemical structure of the vinylite as well as contribute to surface noise, record wear, and loss of high frequencies.

The new process sidesteps these difficulties by using the vinylite in its earlier stage of formation. Being more "powdery," it is more malleable. Less than 500-psi pressure at maximum temperatures of 300° F is needed to press a record from a wafer of uncompounded vinylite. This reduction in heat and pressure also means less wear on the grooves of the stamper, which may be used for more pressings of consistently higher quality.

Custom Records, Inc. has begun to produce 45-rpm discs using this process. Wider use of the method is seen for all speeds and sizes of records, and in small production units in this country and abroad, since the setting up of such operations would be facilitated by the light, compact, and relatively inexpensive pressing equipment.

Kits for Building Equipment Cabinets and Speaker Enclosures

CABINETS FOR HOUSING hi-fi systems, including the loudspeaker, may be assembled from "River Edge" kits, now marketed by



British Industries Corp., 80 Shore Rd., Port Washington, N. Y. An equipment cabinet, selling for $26.70 net, has an adjustable shelf to permit installation of any size or combination of tuner-amplifier components. The top lifts to provide access to the record player compartment, which is roomy enough for a changer or professional turntable and arm assembly. Dimensions are 33" high, 23" wide, and 16" deep.

A matching bass reflex speaker enclosure, for 12" or 15" speakers, sells for $24.00 net. As an alternate type enclosure, a kit is available for building a horn-loaded corner unit. Selling for $23.94 net, this enclosure is suitable for use with 12" or 15" woofers, and almost any size or shape of tweeter. Kits include pre-cut plywood, glue, hardware, and grille cloth.

Selecting Your "Phonogenic Music"

At "live" concert given in pre-symphonic (and pre-hi-fi) days, music was played by relatively small ensemble for limited audience. Today, electronics makes possible much wider audiences who are discovering that, via their hi-fi systems, they can enjoy a new type of "chamber music," recorded under ideal conditions and aptly suited for reproduction in the living room.

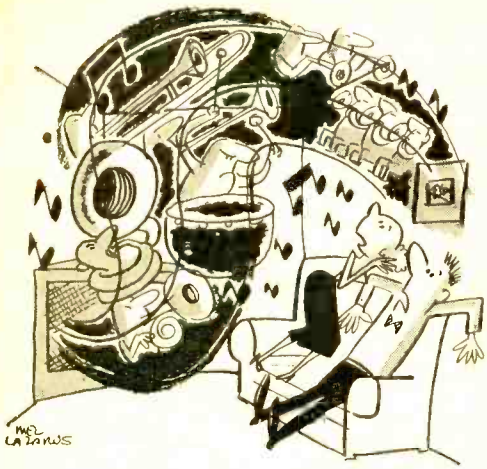
By H. H. FANTEL

Although your sound system can reproduce any type of music, there's a special kind practically made to order for hi-fi

THE MOST IMPORTANT component of any hi-fi system is "the listener" with his tastes, moods, and living room acoustics. This is the "load" at the output to which the musical input must be matched.

To Betty and Joe, their new phonograph was an instrument for exploration. With it, they discovered not only new kinds of music, but also new ways in which music and hi-fi go together. Like most new owners of hi-fi systems, they had to discover by trial and error what records gave them the most pleasure in repeated listening.

Being fond of classical music, they had bought some symphonies. But the concentrated attention required for serious listening sessions seemed too heavy a diet for everyday consumption. They wanted their



. . . the heavy sound of a full symphony was rather overpowering in their small room.

music to be rich in ideas and exciting in sound, but more casual in mood. Besides, the heavy sound of a full symphony orchestra, even though it came through beautifully on their new system, seemed rather overpowering in their small living room.

They started off into the byways of recorded music, passing up the display counters at the record store and the helpful suggestions of the sales clerk trying to push his overstocked warhorses. Instead, they scanned the catalogs for unusual instrumental combinations, intriguing titles, and were always willing to take a chance on composers they had never heard of. To keep within their budget, they made a habit of sampling lots of records before buying any of them.

Soon they hit on a kind of music seldom heard in concert or on the radio, neither "symphonic" nor "popular," and just about perfect for playing on a wide-range system in apartment-sized rooms at medium volume level.

Typical "Phonogenic Music"

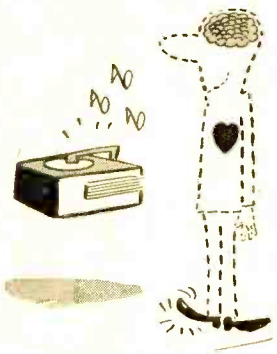
Their first find was *Acadian Songs and Dances* (Decca DL 9616) from the *Louisiana Story* film score that won Virgil Thomson an "Oscar" some years back. These "Cajun" tunes, some sad and some jaunty, are the kind of music that leaves one whistling. Yet their polished style makes any classicist happy. There is imaginative detail sparkling at every turn. For home consumption, it can be listened to casually (after a hard day's work) and it's guaranteed to perk one up; but it will also repay attentive listening with both ears wide open. Using a small orchestra, the music stays at a volume well below the eviction level, but clever orchestration and close microphoning make the instruments come tangibly alive.

Going further in this direction, Betty and Joe headed straight for the works of Aaron Copland, whose specialty is cross-breeding folk music with symphony. Like most hybrids, the resultant strain has plenty of vitality. *Rodeo,* for instance (Capitol P-8169), puts a square dance with a rip-roaring hoe-down right in the middle of what is basically a symphonic poem. Surprisingly, it fits. Neither barn nor concert hall draws the short straw (or the truncated baton) in this match. After the stomping, twirling, and bronc-busting are served up in an honest, lean musical style, there are quiet stretches of lonesome riding. Copland paints his prairie with hollow, haunting harmonies that bring the open spaces and the wide sky right into a living room.

Similar in style and concept is Copland's *Billy the Kid* (Victor LM 1031). Toward the end, there is a cracking gun duel that whacks a bullet through Billy and the sharpest transients this side of a square wave through a rig.

From Concert Hall to Living Room

All these pieces have one thing in common: transparent texture. Of course, any music gains by faithful reproduction. But this kind of music, where the individual instruments stand out, is a "natural" for the phonograph. The microphone can get "inside" the music and pick up details that are inevitably lost in massive orchestrations. It "puts the players in their places," giving



Brubeck and Mulligan record jazz that can be listened to with feet, heart, or brain . . .

an almost three-dimensional illusion of space. There is plenty of dynamic range and often exciting percussive transients—but no sustained avalanches of sound to push Betty and Joe's valiant 10-watt system way beyond the distortion level. After all, there aren't many sound systems (not to mention the recording itself) that can take a full orchestral onslaught unflinch-

Bowles and Wilder straddle the fence . . . letting their pieces fall where they may.

ingly—not even the hard-muscled rigs costing a long-term mortgage. Massive orchestral music sometimes makes stunning audio demonstrations, but it simply wasn't written for the phonograph . . . nor for home listening.

Heavy orchestral sound was conceived for great concert halls, where it had to reach listeners a block away and four flights up in the balcony without benefit of any electrical amplification. Music of this kind came into existence in the last century when big cities mushroomed from small towns and large auditoriums were built for the growing audiences. Orchestras themselves had to keep growing until their heavy 100-man sound matched the size of the big halls.

Today, audio is reversing the trend. Realizing that most music nowadays reaches the listener through electronics, composers are beginning to veer away from heavy, massive orchestration to make their scoring compatible with the microphone.

Old music, written before the appearance of large orchestras, is equally "phonogenic." In terms of tonal texture, very old music and very new music come off best through the loudspeaker. So Betty and Joe found themselves reaching both into the past and into the future of music. For instance, Bach's *Brandenburg Concertos* become an almost transparent tonal fabric in good performance and recording. Excellent recordings of *Concertos No. 1, 2* and *4* have been made by London, Westminster, Vox and Bach Guild. This is music of supreme inspiration, with contagious rhythm and breakneck solos.

"Progressive Jazz" and the Classics

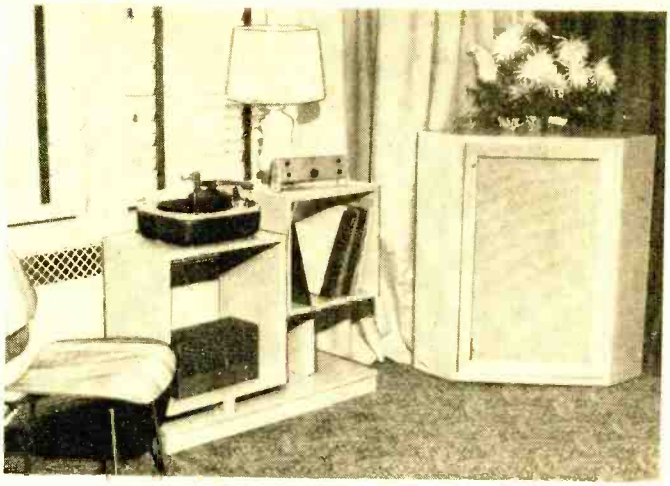
In the shotgun wedding of old and new music (with hi-fi holding the gun), one can find in "progressive jazz" some of the same qualities as in the *Brandenburg Concertos*. Men like Mulligan and Brubeck yield nothing to Bach in contrapuntal trickery. Brubeck on Columbia CL-6321-2 and Gerry Mulligan on Pacific LP 2 represent a kind of jazz that can be listened to with feet, heart, or brain, depending on one's disposition. Or the receptive organs can be switched occasionally to get at the music from different angles. That, incidentally, is a good idea for listening to any sort of music.

Old music and "progressive jazz" alike owe their current vogue to their hi-fi aptitude. Before the 19th century, all music (except church music) was written to be played and heard in the home rather than in the concert hall. Now that electronics is bringing music back into the home, the tonal dimensions of this older music again fit the modern listening situation. The accent here is on detail rather than mass, on phrase rather than force. That makes it easier on the sound equipment, acoustics of the room, and, last but not least, one's ears. As far as musical value is concerned, names like Mozart, Haydn, Handel, Bach,

Each collector, with his own taste, must find his own way through the LP forest.

Vivaldi, and Corelli light up a panorama of old treasures, rediscovered through modern recording.

Jazz parallels this trend. Owing its phenomenal rise largely to the phonograph, jazz has been traditionally platter-conscious. Its ears always cocked to the cue of opportunity, jazz dissolved the large, brassy bands of the swing era with the coming of hi-fi. Instead, the small instrumental combo came into its own. The early spade work done by Benny Goodman in his quintet and sextet recordings has now spawned about a dozen fine jazz groups. Here again, the accent is on detail and transparency, and the microphone is the principal audience. The artistic honesty of these jazzmen puts them above the tempta-



Is this hi-fi system complete? Record changer, pickup and stylus, preamplifier-equalizer, power amplifier, loudspeaker and enclosure are all here, properly connected and attractively placed. Only the listener is missing. This "component," perhaps the most important in the entire system, differs in every home, as does the music chosen. Putting yourself, and your musical tastes, into the hi-fi picture is an exciting and gratifying adventure.

tion of latching on to some commercial gimmick and running it into the ground. In fact, the searching of these jazz groups for individual and musically significant styles gives the entire musical development of our age a much-needed shot in the arm. It has already been mentioned how the best of them, like Mulligan and Brubeck, move in the direction of closing the gap between "classical" music and jazz.

Classical composers, partly prompted by audio and the trend toward home listening, are bridging this gap from the other side. Paul Bowles and Alec Wilder are expert straddlers of the fence between jazz and classical music, letting their pieces fall where they may. In his *Concerto for Two Pianos, Winds and Percussion* (Columbia ML-2128), Bowles uses unique timbres that bring out the fine points of any hi-fi set. Reedy woodwinds whisper beneath a gay chatter of pianos. Syncopation is tapped out on milk bottles and wood blocks. A bass clarinet with a mellow growl is in charge of the bottom, and a big gong, softly struck, spreads tonal clouds beneath the luster of the trumpet. But this is not a mere stunt. Bowles' work has musical integrity, a contagious mood of good fun in the spirit of a Mozart "Divertimento."

Another Bowles work, full of hi-jinx and bubbling good humor, is *Music for a Farce* (Columbia ML-4859). Here, too, the handling of the small orchestra seems tailor-made for hi-fi.

Alec Wilder specializes in short pieces for a group of woodwinds, harpsichord, drums, and double bass. The sound of this combination ranges in varying nuances from velvet to rasping file. The music itself keeps changing between a captious kind of bounce and a tender lyricism that always stays clear of mush. Items like *Walking Home in Spring, Her Old Man Was Suspicious, A Little Girl Grows Up,* and *Footnote to a Summer Love* are a fair sampling of what some critics count among the most delightful and original music written in America today (Columbia ML-4271, CL-6181, or Mercury 25008). Again, the tonal values fit nicely into the record groove.

Chamber Music

From Wilder and Bowles, it was only a short step across the border into the realm of chamber music. To their surprise, Betty and Joe found nothing forbidding in this territory. With Poulenc's *Sextet for Piano and Winds* (Capitol P-8258) and Prokofiev's *Second String Quartet* (Capitol P8151) as their first destinations, the climate here seemed refreshingly crisp. For a balmier mood, they bought Ravel's lush *Quartet in F* (Philharmonia LP 104 or Columbia ML-2202), one of the most hauntingly beautiful pieces in the whole chamber music literature, which evokes from the four instruments of the string quartet a color palette so rich and varied that much orchestral music seems grey in comparison.

Since taste is a personal matter, no record list can or should be more than a hint. Each collector must find his own way through the LP forest. His trophies will be worth the hunt. In mapping the trail of Betty and Joe's explorations, their reasons for picking certain areas in preference to others were explained. But no music is exclusive of any other music. The hi-fi fan has a basic advantage. His innate appetite for any kind of organized noise keeps him spinning records of all kinds, always ready to go off on new tangents. Of course, there are train whistle records and other audio stunts. But the most fascinating sounds, after all, occur in music. Hi-fi and music go together, for the enjoyment of each is compounded by the other. —30—

AFTER CLASS

USING LOAD LINES

THE PRACTICAL usefulness of the average plate characteristic curves of vacuum tubes as they appear in tube manuals and reference handbooks is restricted to *static conditions* in which there is no plate load or input signal. These curves enable the user to investigate the inter-relationships between plate current (*Ip*), plate voltage (*Ep*), and grid voltage (*Eg*), and to find any one of the three if the other two are known. Different tubes have, of course, different "families" of curves.

As soon as a load is inserted in the plate circuit, however, the entire picture changes. Since a load is necessary in practical designs—which may be a relay coil, a resistor, a choke, or the primary of a transformer in amplifier applications—it becomes very difficult to predict the behavior of a given tube unless a *load line* is constructed on the average plate characteristic graphs and properly used.

Need for a load line is evident from a consideration of the effects that take place in a circuit such as that of Fig. 1. Imagine that it is desired to find the bias voltage (*Eg*) needed to produce a plate current (*Ip*) of given value in the load resistor (R_L). The tube is a 6J5 and the plate supply voltage is known. The plate current depends upon the supply voltage, the magnitude of R_L, and the effective d.c. plate resistance of the tube which, in turn, is determined by the amount of bias applied to its control grid. Since the bias—the factor we want to find—is unknown, it follows that the plate resistance of the tube is also an unknown quantity. With this missing from the data, the plate current cannot be stated. Thus, we encounter an impasse.

The construction of a load line, in one graphical step, sweeps away all the unknowns. It immediately makes possible the precise determination of the tube's plate resistance, voltage drop from cathode to plate, and the plate current, by what amounts to simple inspection. It solves problems which would otherwise demand tedious calculations.

To illustrate the principle which underlies the load line, the following typical circuit constants may be assumed: $Ebb = 240$ volts; R_L=20,000 ohms; and the tube is a 6J5. The construction of the load line is easier to grasp if it is divided into three distinct steps:

(1) Let us first consider the tube as an *open circuit;* the circuit may be said to be open if the control grid bias is made so negative that the tube is cut off and no plate current flows. Under such circumstances, there can be no voltage drop across R_L (voltage drops take place only when current flows), and the full plate supply voltage must then appear across the tube as its plate voltage, *Ep;* i.e., $Ep = Ebb$. In our example, when $Ip = 0$, $Ep = 240$ volts. This locates point A on the horizontal axis. (See Fig. 2.)

(2) Next, imagine that the bias is made so positive that the tube acts as a perfect conductor (*short circuit*) having zero internal resistance. In this case, the voltage drop across the tube (its plate voltage, *Ep*) would have to be *zero* while the full plate supply voltage appears as a drop across R_L. With R_L the only resistance left in the circuit, the plate current must now be:

$$Ip = \frac{Ebb}{R_L} = \frac{240}{20{,}000} = .012 \text{ amp.} = 12 \text{ ma.}$$

Thus, a second important point, B, on the vertical axis is determined.

(3) Let us stop for an instant and examine the results thus far. Having assumed the two most extreme conditions—the tube first as an open circuit and then as a short circuit—we have found, in the first case, a plate voltage of 240 volts across the tube at zero plate current, and a plate current of 12 ma. with zero plate voltage for

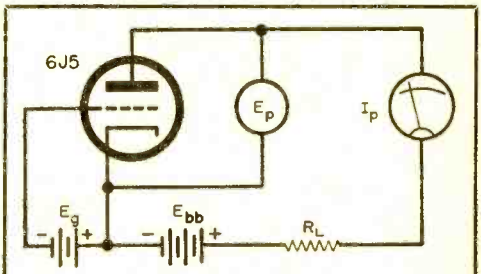


Fig. 1. Basic circuit of a typical amplifier stage using a 6J5 triode.

the second assumption. Since the plate load is resistive, it follows Ohm's law at all times, so that for any other assumptions which involve a partially conducting tube between the two extremes, points must be located along a straight line connecting A and B. This is an outcome of the *linearity* of a resistor in which current and voltage are always directly proportional to each other. Thus, points A and B are the terminals of the straight *load line* shown in Fig. 2, which is unique for a 6J5 having a 20,000-ohm plate load and a supply voltage of 240 volts.

The examples that follow show how this load line is used.

Problem: Find the grid bias which permits 5 ma. of plate current to flow in a 6J5 having circuit constants as given. *Solution*: The load line intersects the 5-ma. line on the —4 volt bias curve. Hence, a bias of —4 volts is just right if the plate current is to be 5 ma. Moreover, if the intersection is brought down to the voltage axis (C), it is seen that the plate voltage of the tube is now 140 volts. This means that the voltage drop across the plate load resistor must be 100 volts. Note how, by mere inspection, the load line provides information on the magnitude of the plate current, the actual plate voltage, and the fall of potential along the load resistor.

Problem: If this tube is run at zero bias, what is its actual plate voltage? *Solution*: Locate the intersection of the load line with the zero bias curve. This occurs at a plate current of 8 ma. Moving down along the vertical line at the intersection, we cross the plate voltage axis at 80 volts—the true plate voltage; the remaining 160 volts is the drop across the load resistor.

Problem: A relay having a 10,000-ohm coil is used as a plate load in series with a 10,000-ohm resistor. If its pull-in current is 2 ma., what grid bias is required to activate its armature? *Solution*: The relay, together with the series resistor, constitutes a plate load of 20,000 ohms for which this load line has been drawn. The load line crosses the 2-ma. marker halfway between the —8 and —10 volt bias curves. Thus, a bias voltage of —9 volts will be just right for pull-in. With these circuit constants, the voltage across the tube is 200 volts and the potential applied to the series combination is 40 volts.

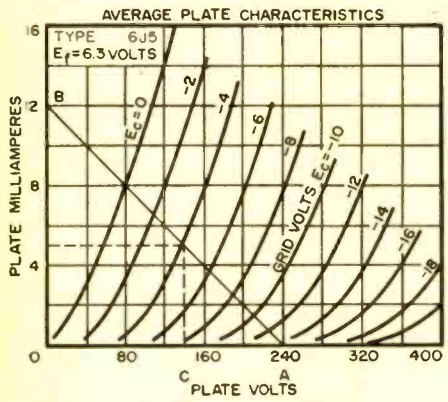


Fig. 2. A set of average plate characteristics for a type 6J5 tube with a load-line representing a 20,000-ohm load superimposed.

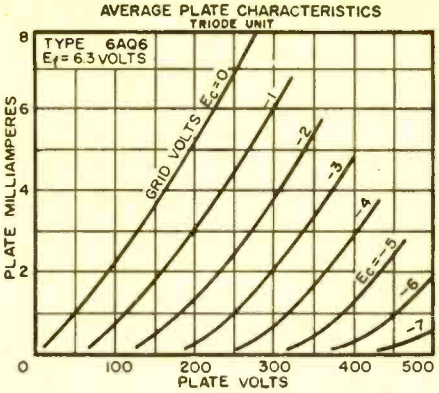


Fig. 3. Average plate characteristics of triode section of a 6AQ6 for use in quiz.

Load lines are very useful in predicting stage gain on the basis of static curves since they permit the determination of output voltage swing as compared with input voltage variations. (See *After Class*, December, 1955). Using the methods outlined above, simply draw the appropriate load line for the particular tube and load resistor, and find the voltage drop across the plate load resistor for the two extremes of signal input. The difference between the output potentials is the output swing which may then be compared with the input swing to determine the gain.

QUIZ

Answer the following questions for a circuit using the triode section of a 6AQ6 double-diode high-mu triode having a 300-volt plate supply and a load resistor of 50,000 ohms. Curves for the 6AQ6 are given above in Fig. 3.

1. Find points A and B for the construction of the load line (Fig. 2 indicates which points these are).
2. What grid bias is required to obtain a 50-volt drop across the load resistor?
3. What plate current in ma. flows during the quiescent period when the drop across the tube is 150 volts?
4. What grid bias in volts is needed to bring about the conditions described in question No. 3?
5. What is the voltage drop across the plate load resistor when the tube operates at zero bias?

(Answers appear on page 100.)

MEN WITH MECHANICAL SKILLS:

CAN YOU MEET THIS CHALLENGE?

Mechanics Creed

Upon my honor I swear that I shall hold in sacred trust the rights and privileges conferred upon me as a certified mechanic. Knowing full well that the safety and lives of others are dependent upon my skill and judgment, I shall never knowingly subject others to risks which I would not be willing to assume for myself, or for those dear to me.

In discharging this trust, I pledge myself never to undertake work or approve work which I believe to be beyond the limits of my knowledge; nor shall I allow any superior to persuade me to approve aircraft or equipment as airworthy against my better judgment; nor shall I permit my judgment to be influenced by money or other personal gain; nor shall I pass as airworthy aircraft or equipment about which I am in doubt, either as a result of direct inspection or uncertainty regarding the ability of others who have worked on it to accomplish their work satisfactorily.

I realize the grave responsibility which is mine as a certified mechanic to exercise my judgment on the airworthiness of aircraft and equipment. I, therefore, pledge unyielding adherence to these precepts for the advancement of aviation and for the dignity of my vocation.

If you are a man who takes real pride in a job well done, the Air Force offers you a challenging and rewarding career. The safety of our country, and the lives of its defenders, depend on your accuracy and devotion to duty. Act today and put your skills to work tomorrow—in the U. S. Air Force.

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THE U.S. AIR FORCE

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Airman Recruiting Information Branch
Box 2202
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Please send more information on my opportunities for enlisting in the U. S. Air Force. I am between the ages of 17-34 and reside in U.S.A. or possessions.

Name_____

Address_____ Age____

City_____ Zone____ State____

Build YOUR OWN HEATHKITS

INTERESTING—EDUCATIONAL

Heathkits are fun to build with the simplified easy-to-follow Construction Manual furnished with every kit. Only basic tools are required, such as soldering iron, long-nosed pliers, diagonal cutting pliers, and screwdriver. All sheet metal work has already been done for you. No cutting, drilling, or painting required. All parts furnished including tubes. Knowledge of electronics, circuits, etc., not required to successfully build Heathkits.

New PRINTED CIRCUIT VACUUM TUBE VOLTMETER KIT

New charcoal gray baked enamel panel with highly readable white lettering.

New peak-to-peak meter scale—new color harmony—new control knobs.

New printed circuit board for faster, easier construction—exact duplication of Laboratory development model.

The VTVM is the standard basic voltage measuring instrument for radio and TV servicemen, engineers, laboratory technicians, experimenters, and hobbyists. Because of its extremely high input resistance (11 megohms) the loading effect on the circuit being measured, is virtually negligible. The entire instrument is easy to build from a complete kit, with a detailed step-by-step Construction Manual. Featured in this instrument is an easy-to-wire foolproof printed circuit board which cuts assembly time in half

CIRCUIT AND RANGES: Full wave AC input rectifier permits 7 peak-to-peak voltage ranges with upper limits of 4000 volts peak-to-peak. Just the ticket for you TV servicemen. Seven voltage ranges, 1.5, 5, 15, 50, 150, 500 and 1500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, and 4000 volts. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, center scale zero position, and a polarity reversal switch.

IMPORTANT DESIGN FEATURES: Transformer operated—1% precision resistors—6AL5 and 12AU7 tubes—selenium power rectifier—individual AC and DC calibrations smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting—new knobs—test leads included. Easily the best buy in kit instruments.

Model V-7

$24.50

Shpg. Wt. 7 lbs.

New easy-to-read open panel layout. Off-on switch incorporated in selector switch

Heathkit HANDITESTER KIT

The Heathkit Model M-1 Handitester readily fulfills all requirements for a compact, portable volt-ohm-milliammeter. Its small size permits the instrument to be tucked into your coat pocket, tool box or glove compartment of your car. Always the "handitester" for those simple repair jobs. Packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges, full scale 10, 30, 300, 1000 and 5000 volts. Ohmmeter ranges 0–3000 ohms and 0–300,000 ohms. DC milliammeter ranges 0–10 milliamperes and 0–100 milliamperes. Uses 400 microampere meter—1% precision resistors—hearing aid type ohms adjust control—high quality Bradley rectifier. Test leads are included.

MODEL M-1

$14.50

Shpg. Wt. 3 lbs.

Heathkit MULTIMETER KIT

Here is an instrument packed with every desirable service feature and all of the measurement ranges you need or want. High sensitivity 20,000 ohms per volt DC, 5000 ohms per volt AC. Has the advantage of complete portability through freedom from AC line—provides service ranges of direct current measurements from 150 mieroamperes up to 15 amperes—can be safely operated in RF fields without impairing accuracy of measurement.

Full scale AC and DC voltage ranges of 1.5, 5, 50, 150, 500, 1500, and 5000 volts. Direct current ranges are 150 microamperes, 15, 150, and 500 milliamperes and 15 amperes. Resistances are measured from .2 ohms to 20 megohms in three ranges and db range from −10 to +65 db. Ohmmeter batteries and necessary test leads are furnished with the kit.

MODEL MM-1

$29.50 Shpg. Wt. 6 lbs.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 5, MICHIGAN

New Heathkit 3" OSCILLOSCOPE KIT

PRINTED CIRCUIT

Ideal for individual home workshop, ham shack, or as extra instrument for outside servicing.

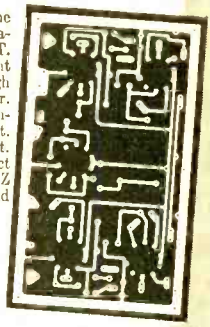
Compact size, light weight, portable — perfect for service work or field operation.

New, modern styling, gray panel with white lettering, light gray knobs and case — contrasting red and black terminal posts.

New printed circuit for constant circuit performance, rugged component mounting — assembly time cut in half!

USE: This brand new Utility Scope was designed especially for servicemen and radio amateurs, and is adaptable for use in all general Scope applications. Perfect for modulation monitoring, etc. Use it to tackle alignment or adjustment problems. Equally valuable in breadboard work. A must for ham shack or for outside servicing.

DESCRIPTION: Front panel controls of the Model OL-1 are "bench tested" for ease of operation and convenience. Sharp focusing 3" CRT. Printed circuit for ease of assembly and constant performance. Assembly time cut in half! High quality electronic components used. Sensitive hor. and vert. amplifiers with broad freq. response; cathode follower for isolation. Push-pull hor. and vert. output to deflection plates. Int ., 60 cycle, or ext. sync. Sweep freq. range 10–100,000 cycles. Direct connection to deflection plates. Provision for Z axis input. Uses 3GP1 CRT, 4–12AU7 hor. and vert. amplifiers, 1–12AX7 sweep gen., 1–6X4 LV rect., and 1–1V2 HV rect. The Heathkit Model OL-1 is a real standout value at only $29.50, and is another example of the famous Heathkit combination; quality plus economy.



Measures only 11¾" x 6¾" x 19½" and weighs only 11 pounds.

Model OL-1

$29.50 Shpg. Wt. 15 lbs.

Heathkit SIGNAL GENERATOR KIT

New, modern panel and knob styling — professional appearance and professional performance.

Broad frequency coverage — fundamentals from 160 KC to 110 MC in 5 bands — up to 220 MC on calibrated harmonics.

Cathode follower output for good isolation — fixed step and continuously variable attenuation.

USE: This instrument is "serviceman engineered" to fill the requirement for a reliable basic service instrument at moderate cost. Frequency coverage extends in five bands from 160 Kc to 110 Mc on fundamentals, and dial is calibrated to 220 Mc for harmonics. Pre-wound and pre-aligned coils make calibration unnecessary for service applications.

DESCRIPTION: The Heathkit Model SG-8 Signal Generator provides a stable modulated or unmodulated RF output of at least 100,000 microvolts which can be controlled by both a continuously variable and a fixed step attenuator. Internal modulation is at 400 cycles, or can be externally modulated. AF output of 2-3 volts is also available for audio testing. Uses dual purpose 12AU7 as Colpitts RF oscillator and cathode follower for stable, isolated, low impedance output, and type 6C4 tube for 400 cycle oscillator. Operation of the SG-8 is well within the frequency limits normally required for service work. Modern styling features high definition white letters on charcoal gray panel with re-designed control knobs. Modern professional appearance and Heathkit engineering know-how combine to place this instrument in the "best buy" category. Only $19.50 complete.

Output selection — internal modulation, pure r.f., or audio output.

MODEL SG-8 **$19.50** Shpg. Wt. 8 lbs.

Heathkit ANTENNA IMPEDANCE METER KIT

MODEL AM-1

$14.50 Shpg. Wt. 2 lbs.

The Model AM-1 Antenna Impedance Meter makes an ideal companion unit for the GD-1B Grid Dip Meter or a valuable instrument in its own right. Perfect for checking antenna and receiver impedance and match for optimum system operation. Use on transmission lines, halfwave, folded dipole, or beam antennas. Will double as monitor or relative field strength meter. Covers freq. range of 0–150 Mc and impedance range of 0–600 ohms. Uses 100 microampere meter and special calibrated potentiometer. A real buy at only $14.50 complete.

Heathkit GRID DIP METER KIT

MODEL GD-1B

$19.50 Shpg. Wt. 4 lbs.

Amateurs and servicemen have proven the value of this grid dip meter many times over. Indispensable for locating parasitics, neutralizing, and aligning filters and traps in TV or Radio and for interference problems. The Model GD-1B covers from 2 Mc to 250 Mc with 5 pre-wound coils. Featuring a sensitive 500 microampere meter and phone jack, the GD-1B uses a 6AF4 or 6T4 tube. An essential tool for the ham or serviceman.

ACCESSORIES: Low freq. coverage to 355 KC with two extra coils and calibration curve. Set No. 341A for GD-1B and set No. 341 for GD-1A. Shipping weight 1 lb. Only $3.00.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 5, MICHIGAN

New Heathkit VFO KIT

MODEL VF-1

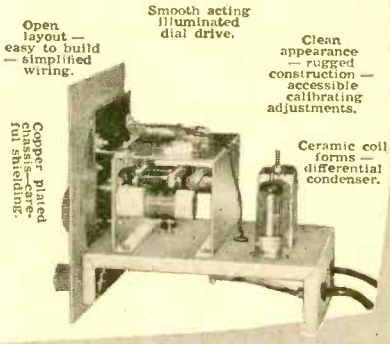
$19.50

Ship. Wt. 7 lbs.

- Smooth acting illuminated and precalibrated dial.
- 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.
- 7 Band coverage, 160 through 10 meters—10 Volt RF output.
- Copper plated chassis—aluminum cabinet—easy to build—direct keying.

Here is the new Heathkit VFO you have been waiting for. The perfect companion to the Heathkit Model AT-1 Transmitter. It has sufficient output to drive any multi-stage transmitter of modern design. A terrific combination of outstanding features at a low kit price. Good mechanical and electrical design insures operating stability. Coils are wound on heavy duty ceramic forms, using Litz or double cellulose wire coated with polystyrene cement. Variable capacitor is of differential type construction, especially designed for maximum bandspread and features ceramic insulation and double bearings.

This kit is furnished with a carefully precalibrated dial which provides well over two feet of calibrated dial scale. Smooth acting vernier reduction drive insures easy tuning and zero beating. Power requirements 6.3 volts AC at .45 amperes and 250 volts DC at 15 mills. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter Kit. The VFO coaxial output cable terminates in plastic plug to fit standard ¼" crystal holder. Construction is simple and wiring is easy.



Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

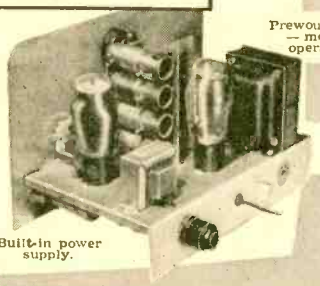
$29.50

Ship. Wt. 16 lbs.

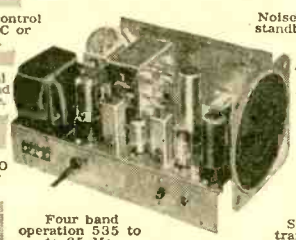
SPECIFICATIONS:

Range 80, 40, 20, 15, 11, 10 meters.
6AG7 .....Oscillator-multiplier.
6L6 .....Amplifier-doubler
5U4G .....Rectifier.
105-125 Volt A.C. 50-60 cycles 100 watts. Size: 8⅛ inch high x 13⅛ inch wide x 7 inch deep.

Here is a major Heathkit addition to the Ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, A. C. line filtering, good shielding, etc. VFO or crystal excitation—up to 35 watts input. Built-in power supply provides 425 volts at 100 MA. Amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual.



Heathkit COMMUNICATIONS RECEIVER KIT



SPECIFICATIONS:

Range.....535 Kc to 35 Mc
12BE6 .....Mixer-oscillator
12BA6 .....I. F. Amplifier
12AV6 Detector—AVC—audio
12BA6 ....B. F. O. oscillator
12A6.....Beam power output
5Y3GT .....Rectifier
105-125 volts A. C. 50-60 cycles, 45 watts.

MODEL AR-2

$25.50

Ship. Wt. 12 lbs.

CABINET:

Proxylin impregnated fabric covered plywood cabinet. Shipg. weight 5 lbs. Number 91-10, $4.50.

A new Heathkit AR-2 communications receiver. The ideal companion piece for the AT-1 Transmitter. Electrical bandspread scale for tuning and logging convenience. High gain miniature tubes and IF transformers for high sensitivity and good signal to noise ratio. Construct your own Communications Receiver at a very substantial saving. Supplied with all tubes, punched and formed sheet metal parts, speaker, circuit components, and detailed step-by-step construction manual.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 5, MICHIGAN

Heathkit ECONOMY SIX-WATT AMPLIFIER KIT

MODEL A-7B

$15.50 • Shpg. Wt. 10 lbs.

Here is an outstanding amplifier value. This economically priced amplifier is capable of performance usually associated only with far more expensive units. Can be nicely used as the heart of an inexpensive high quality home music system. Features inputs for tuner and phono (Model A-7C accommodates a microphone by using an additional preamplifier stage). Separate bass and treble boost and cut tone controls for just the degree of tonal balance you want. The entire kit can be built in a few pleasant hours for years of enjoyment.

Technical features, frequency response ± 1½ db 20–20,000 cycles. Full 6 watts output. Push-pull beam power output stage. Output transformer impedances 4, 8, and 15 ohms. Tube lineup, 12J5GT, 12SL7, 2—12A6, 5Y3GT, and 12SJ7 (A-7C only).

All parts including tubes are supplied along with a prefabricated and painted chassis. Detailed step-by-step Construction Manual eliminates necessity for specialized knowledge.

MODEL A-7C incorporates a preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance cartridge or microphone. **$17.50**

NEW Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2

$17.50 • Shpg. Wt. 10 lbs.

less Cabinet

Here is the ideal radio kit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit deserves your attention. Circuit is transformer operated, eliminating shock hazard usually associated with "economy" AC-DC circuits. New high gain miniature tubes and IF transformers—powerful ferrite core built-in rod type antenna—chassis mounted 5½" PM speaker—optional operation either as receiver or tuner and phono input. Covers broadcast band 550—1600 Kc. Uses 12BE6, 12BA6, 12AV6, 12A6, and 5Y3 tubes.

CABINET: Proxylin impregnated fabric covered plywood cabinet available. Includes aluminum panel, flocked re-inforced speaker grill and protective rubber feet. 91-9, Shpg. Wt. 5 lbs. **$4.50**

MODEL FM-2

$22.50 • Shpg. Wt. 8 lbs.

Heathkit FM TUNER KIT

Here is an FM tuner kit designed for simplified construction to operate either through the "phono" section of your radio or with a separate amplifier. AC transformer operated—8 tube circuit—slide rule type tuning dial—88–108 megacycle coverage—three double tuned IF stages—factory adjusted front end. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

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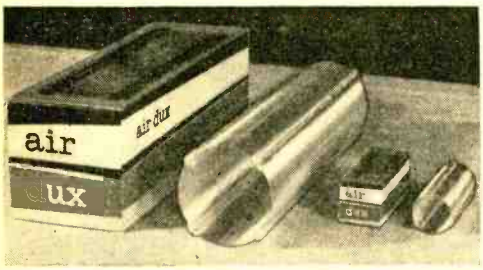
ON PARCEL POST ORDERS insure postage for weight shown.

ORDERS FROM CANADA and APO's must include full remittance.

TOOLS & GADGETS

AIR-WOUND INDUCTORS

Said to incorporate the first major advancements in air-wound inductors in eight years, the "Air Dux" line of amateur and industrial inductors is complete and versa-

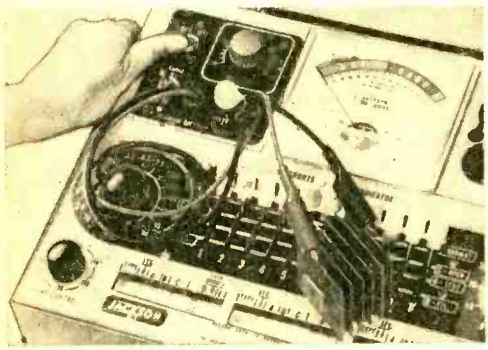


tile, and will fulfill virtually every coil need. Sizes range from ½" to 3" in diameter, with lengths of from 2" to 10". Each diameter size is wound in various pitches for different inductance values.

The coils are wound on low-loss polystyrene rod, and each coil is available in three different wire finishes—formvar, tinned or silver-plated. For further information and free brochures, write to *Illumitronic Engineering*, 680 East Taylor St., Sunnyvale, Calif. A free inductance calculation chart is also available for ease of calculating specific coil needs.

TUBE TESTER AND ACCESSORIES

Plug-in accessories are featured with the new Model 49 tube tester announced by *Jackson Electrical Instrument Company*, 16-18 South Patterson Blvd., Dayton 2,



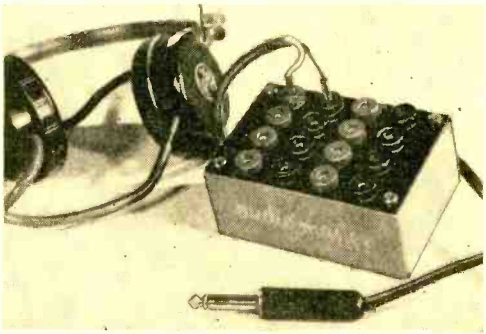
Ohio. All of the accessories use the basic meter and power supply to perform additional tube and component tests. To date, they include a high-resistance shorts tester, a selenium rectifier checker (shown in photo), and a heater current tester.

The basic tube tester, which sells for $49.95, features lever-action switches numbered to correspond with the pin numbers of tubes under test. A large 4½" meter indicates tube condition on a colored "good-bad" scale, which is also marked in per cent of normal quality. The instrument is housed in an all-metal carrying case finished in "Jacksonite," a new scuff-resistant finish.

EARPHONE AGGREGATE BOX

The "Earphone Aggregate Box," developed by the *Audio-Master Corp.*, 17 East 45th St., New York 17, N. Y., distributes sound to individual headsets. It is housed in a compact metal case and covered with a Bakelite top, making it easy to manipulate. A 10' extension cord completes the unit.

As many as eight headsets can be employed for individual earphone listening, in conjunction with any record or transcription player, tape recorder or radio receiver



which has a detachable loudspeaker or a special jack for earphone use. The "Earphone Aggregate Box" is recommended for libraries, schools, and other allied institutions.

HAMMER FINISH SPRAY

Designed for use on panels, racks, chassis and instruments, "Hammer-Koat" is the newest in the extensive line of *G-C* "Spray-Koat" products. A smooth air-drying hammer finish, it is now available in three colors: brown, blue and silver. It comes in a 12-ounce can listing at $2.75 (net, $1.83). Literature may be obtained from *General Cement Mfg. Co.*, 919 Taylor Ave., Rockford, Ill.

"TOOL OF THE MONTH" CLUB

The *Tool of the Month Club* offers its members the opportunity to obtain quality tools at exceptional discounts. Here's how it works. You join the club by sending a letter to *Tool of the Month Club, Inc.*, 44 Dickerson St., Newark 3, N. J., stating that you would like to become a member. For a typical value, enclose two dollars, postpaid, with your letter and you will receive a 26" Atkins carpenter's saw, worth $3.95 retail.

With this purchase, you agree to buy at

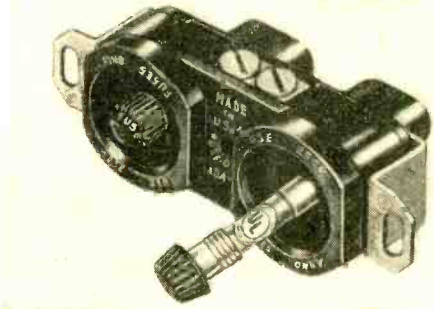
least six tools in your first membership year. Thereafter, the purchase of only four tools per year continues your membership, and a useful gift accompanies every second tool you buy. Membership may be cancelled at any time after you buy six tools.

Your selection is made from a *Tool of the Month Club* catalog featuring over a hundred tools, including power tools. As a member, you buy only the tools you want. All are unconditionally guaranteed.

"FUSE-O-LET" DUPLEX OUTLET

"Fuse-O-Let" duplex outlet Model FL-101 is said to make old-style outlets obsolete, to fit all standard outlet boxes, and to provide maximum safety and positive protection both at home and in industry. UL-approved, it eliminates fire hazard by preventing overloaded outlets and protecting hidden wiring.

Costly repairs are minimized through the use of "Fuse-O-Let" because fuses can be sized for maximum protection of motors, appliances, TV sets and expensive instruments. They can be quickly, easily and



safely replaced at particular outlets without cutting off the main current supply.

Individually boxed with 6-amp. fuses, "Fuse-O-Let" retails for $1.00 complete. Descriptive literature is available from the *Alvin Manufacturing Company,* 1800 Eddy St., Chicago 13, Ill. —30—

LOAD LINE QUIZ

(Questions on page 92)

1. Point A falls on 300 volts on the plate voltage axis; point B is the 6-ma. marker on the plate current axis. 2. —3 volts. 3. 3 ma. 4. —0.3 volts, approx. 5. 170 volts, approx.

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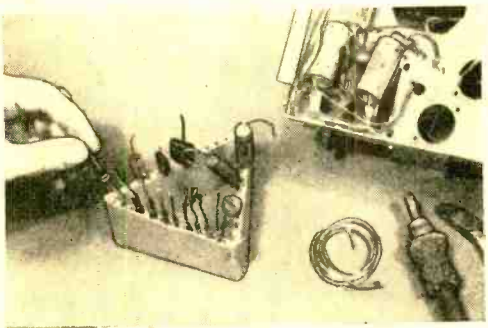
TIPS and TECHNIQUES

PARTS HOLDER SPEEDS ASSEMBLY

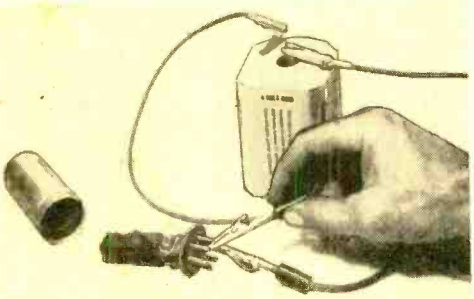
Easily formed from a piece of corrugated cardboard, this simple parts holder keeps the desired resistors and capacitors in posi-



tion for rapid identification and use. Select the components needed for the job at hand and insert the wire leads in the corrugations.

VIBRATOR USED AS BUZZER

Discarded vibrators from auto radios, obtainable free for the asking from most radio repair shops, can be used for high-frequency buzzers. With a pair of pliers, bend back the crimped edge of the can that houses a



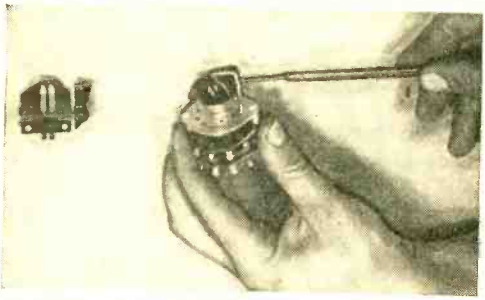
vibrator. Then the assembly may be removed from the can. As burnt contact points are a common cause of vibrator replacement, it will be necessary to polish the contact faces with fine sandpaper, and perhaps adjust the contact spacing.

If the vibrator is to be used as a circuit interrupter (as in the signal generator described in PE, August, 1955), it may be

reinserted in the original can and socket-mounted. To use the vibrator as a straight buzzer, remove the padding from the can to allow better transmission of the buzzing sound.

FILE TANG BECOMES HEX WRENCH

A hex-socket setscrew without a wrench to fit it may be worse than no setscrew at all. The tapered tang of a triangular file is



hex-shaped and will serve as a suitable wrench in an emergency. Cut the file tang at a point which will fit the particular socket setscrew. The file tang is soft and may be cut with a hack saw.

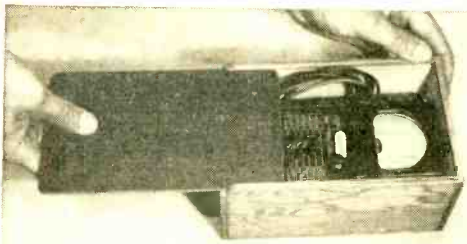
SEWING NEEDLE TESTS CIRCUITS

To save time while trouble-shooting, try soldering a medium-size sewing needle to a phone tip jack. It can be attached to your test probe and pushed through the wire you want to check. You won't have to feel

your way to the end of the wire or take off covers that have numerous screws holding them in place. To keep the needle from being damaged when not in use, push it into a cork or gum eraser.

PROTECT YOUR VOM

The plastic cases of multitesters are tough, but they can crack rather easily when they strike hard objects. Mounting a



multitester in a simple plywood box will provide protection from both shock and dust.

Construct the box of ¼" plywood, leaving room for the test leads as well as the

multitester. Wood screws, passing through holes drilled in the back of the multitester case, fasten the case to the box. A cushion of rubber or felt between case and box aids in protecting the instrument. Avoid overtightening the hold-down screws to prevent cracking the plastic case.

A groove dadoed into the top of three sides of the box provides a means for holding a sliding lid. Such a lid may be made of pressed wood.

NOISY TUBES MAKE GOOD RECTIFIERS

Radio tubes having low or noisy output will serve as rectifier tubes for experimental radio and electronic circuits. Most tubes can be used as rectifiers simply by connecting the grid terminals to the plate, and feeding the a.c. input—either direct from the power line or from a transformer—to the plate.

RUBBER BAND STOPS NOISE

Handles on some small portable radios have a tendency to vibrate when sets are played fairly loud. This undesirable noise can be eliminated by placing a heavy rubber band around the case, holding the handle tightly, to stop the vibrations. —30—

Carl & Jerry

(*Continued from page* 67)

secondary. Where are you going to get that?"

"Fire up that lighter of yours, and just watch and see," Jerry said, as he busied himself with the coil and the booster-battery adapter for the flashlight.

In a few minutes, Jerry had a haywire arrangement of wires, flashlight case, and induction coil spread out on the ashy floor. Two bits of the wire from Carl's pocket had been used to form a small spark gap across the secondary of the induction coil. One terminal of the flashlight battery was connected to one end of the induction coil primary, but leads from the other side of the battery and the other side of the primary were left free.

At Jerry's direction, Carl used the rest of the wire to connect one side of the spark gap to the lightning arrester cable. The other side he stuck in the ground several feet away. Finally, Jerry connected one of the loose primary wires to the blade of the file and pressed the end of the other wire against Carl's quarter. When the quarter was drawn rapidly across the serrations of the file, the rapid making and breaking of the primary circuit of the induction coil produced a ragged blue spark discharge across the small gap.

"It works!" Jerry exclaimed. "What shall I say? Had we better start out with SOS or use the amateur emergency call, QRR?"

"Better use SOS," Carl advised as the lighter flickered out. "More people are familiar with that. Then go ahead and say something like, 'Please send help to the old

box factory chimney. We are imprisoned within it and—' "

"All right, Charles Dickens; cut it short," Jerry interrupted. "This quarter-and-file keying arrangement is not exactly a bug, you know. I'm going to send 'SOS box factory stack' over and over and let 'em take it from there."

With this, he started drawing the coin across the file in short and long strokes to form the respective dots and dashes. "Z-z, z-z, z-z; z-z-z-z-z, z-z-z-z-z, z-z-z-z-z; z-z, z-z, z-z," hissed the little spark, and its light cast a flashing, eerie, blue glow on the intent faces of the two boys. By now it was almost completely dark inside the chimney, and Jerry "keyed" the transmitter entirely by sense of touch. Needless to say, the sending was not exactly machine-like.

After a quarter of an hour or so, the batteries grew so weak that the spark would no longer jump the gap. The bits of wire were pushed closer together and the message repeated until even this smaller gap was too much for the failing batteries.

"That's it, I guess," Jerry announced. "After resting a few hours, the batteries will recover enough to let us make one more short transmission; we'll save that for daylight."

"What frequency do you suppose we're sending on?"

"Just about all frequencies. A spark gap emits a very broad band of frequencies, and there are no tuned circuits in this rig to peak it up."

"Well," Carl said disconsolately, "it looks like nobody heard it anyway—"

"Listen!" Jerry interrupted.

Faintly, but unmistakably, there came the sound of a wailing police siren. It came closer and closer and then stopped abruptly. A few minutes later, the boys heard muffled voices outside the chimney.

"Help! Help! Here in the chimney!" they shouted in unison.

Seconds later, a strong spotlight was shone into their upturned faces from the top of the chimney, and a dangling rope was let down to them. By means of this rope, the boys were hoisted up one at a time until they could reach the bottom end of the broken ladder, and then were helped on up and out of the chimney.

"I might know it would be you two," the police sergeant said coldly, as he surveyed the begrimed but happy boys. "Every time something weird happens in this town, you jokers are mixed up in it."

"Who picked up our message?" Jerry asked eagerly.

"Who didn't!" the sergeant growled. "For the past half hour they've been ringing the police station phone off the wall. A few of the calls were from hams, Boy Scouts, and ex-Army or -Navy operators who actually picked up the message on the broadcast or short-wave bands; but dozens of calls were from irate TV viewers who were just plain mad because someone was clobbering Milton Berle on their sets—and on the very night when Marilyn Monroe was a guest star, too. Right now, you two are probably the most hated pair in this whole town!" —30—

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14BP4 or A	$15.95	16JP4 or A	$18.75	17CP4	$20.85	21FP4	$28.25
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0Z4	.44	6AG5	.50	6T4	.89	12SL7GT	.59
1A4P	.30	6AG7	.75	6T8	.85	12SN7GT	.53
1A7GT	.45	6AH4GT	.65	6U8	.73	12SQ7	.35
1AZ2	.65	6AH6	.65	6V3	.77	12V6GT	.44
1B3GT	.63	6AK5	.57	6V6GT	.44	12X4	.38
1B4P	.88	6AL5	.38	6W4GT	.38	14A5	.90
1C5GT	.45	6AN4	1.25	6W6GT	.55	14A7	.44
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1E7GT	.40	6AS6	1.50	6X8	.75	14E7	.59
1H4G	.35	6AT6	.38	6Y6G	.49	14F7	.59
1H5GT	.45	6AU4GT	.70	7A4	.44	14F8	.69
1L4	.47	6AU5GT	.80	7A5	.53	14N7	.69
1L6	.53	6AU7	.85	7A6	.44	19BG6G	1.10
1LA4	.55	6AV5GT	.65	7A7	.44	19T8	.64
1LA6	.55	6AV6	.38	7B4	.43	24A	.35
1LB4	.55	6AX4GT	.65	7B5	.40	25BQ6GT	.75
1LC6	.81	6AX5GT	.59	7B6	.44	25CU6	1.10
1LH4	.55	6B8	.75	7B7	.44	25L6GT	.45
1LN5	.51	6BA6	.45	7B8	.44	25W4GT	.42
1N5GT	.53	6BA7	.55	7C4	.44	25Z5	.39
1R5	.58	6BC5	.50	7C5	.44	25Z6GT	.35
1S5	.41	6BE6	.48	7C6	.44	26	.48
1T4	.49	6BF5	.42	7E5	.59	27	.29
1T5GT	.57	6BG6G	1.10	7F7	.59	32L7GT	.53
1U4	.55	6BH6	.52	7F8	.69	35	.32
1U5	.41	6BJ6	.49	7H7	.69	35/51	.33
1V2	.63	6BK5	.75	7J7	.69	35A4	.44
1X2	.65	6BL7GT	.69	7K7	.69	35B5	.48
2A7	.50	6BN6	.60	7N7	.54	35C5	.48
2X2A	.55	6BQ6GT	.75	7X7	.69	35L6GT	.45
3A4	.55	6BQ7	.80	7Y4	.39	35W4	.35
3A5	.55	6BY5G	.60	7Z4	.39	35Z4	.35
3AL5	.48	6BZ7	.80	12AT6	.38	35Z5GT	.35
3AU6	.48	6C4	.35	12AT7	.65	37	.30
3BC5	.56	6CB6	.50	12AU6	.42	39/44	.35
3BN6	.65	6CD6G	1.10	12AU7	.52	50A5	.44
3CB6	.56	6CU6	.90	12AV6	.38	50B5	.48
3Q4	.45	6C6	.45	12AV7	.73	50C5	.48
3Q5GT	.55	6F6	.40	12AX4GT	.67	50L6GT	.45
3S4	.52	6H6	.42	12AX7	.69	75	.40
3V4	.52	6J4	1.50	12AZ7	.65	76	.40
4BQ7	.92	6J5	.38	12B4	.65	77	.40
4BZ7	.97	6J6	.50	12AB6	.45	78	.40
5AQ5	.52	6K6GT	.36	12BA7	.59	80	.35
5J6	.60	6L6	.65	12BE6	.45	84/6Z4	.41
5U4G	.45	6S8GT	.74	12BH7	.59	117L7GT	1.39
5U8	.68	6SA7	.44	12BY7	.84	117N7GT	1.29
5V4G	.56	6SC7	.50	12CU6	1.09	117P7GT	1.29
5X8	.78	6SF5	.60	12K7	.49	117Z3	.38
5Y3	.29	6SH7	.43	12Q7	.44	117Z6GT	.60
5Y4G	.35	6SJ7	.43	12SA7	.43	807	1.49
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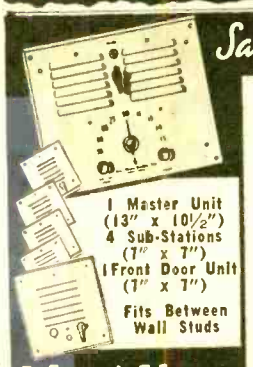

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It had to come! A combination music-radio-intercom system for homes! Musi-Kom is the system home builders all over the country are installing in new homes, available now, for the first time as a do-it-yourself item. This attractive, functional, built-in-the-wall system allows you to send and receive messages from the master unit to all rooms . . . to enjoy radio programs or recorded music in every room . . . to answer the front door from the master unit . . . and contains this sensational "baby-sitter" feature that all parents love, simply adjust the controls as instructed and every sound from the baby's room will be heard throughout the house! Any handyman can install in a few hours in a house under construction, takes less than a day in homes already built. **No radio or electrical knowledge is necessary.** Kit is pre-assembled, ready to operate as soon as you install and plug it into an AC-DC outlet. Kit consists of one master unit, four sub-stations and one front door speaker plus all necessary wire, rough-in forms, complete, easy-to-follow instructions and sells for the amazing price of only $99.50. Thousands now in use. Not a toy but a precision built system that will save time and footsteps and add tremendous pleasure to your home life PLUS adding hundreds of dollars in value and sales appeal to your home. Write for FREE literature and name of nearest dealer or order direct. Send cash, check or M. O. Examine 15 days. Money cheerfully refunded if not satisfied.

HOME MUSIC SYSTEMS, INC., Dept. PE, 644 Madison, Memphis, Tenn.

Superior's New Model TC-55

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.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. 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
The Model TC-55 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. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

Superior's new Model TV-11

TUBE TESTER

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Subminiatures, 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.

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.

★ 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.

$47.50 NET

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

ALSO TESTS TRANSISTORS!

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only **$72.50 NET**

ABOUT TESTING PICTURE-TUBES...

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture-tube tester. Sounds fine—but—it simply doesn't work out that way!

We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a makeshift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensable instrument.

Incidentally, the Model TV-40 is the ONLY low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electro-life testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

C.R.T. TUBE TESTER

Tests ALL magnetically deflected tubes...In the set...out of the set...in the carton!!

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (ion trap need not be on tube). Throw switch for quality test...read direct on Good-Bad scale. Throw switch down for all leakage tests.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only

$15.85 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

The FIRST Pocket-Sized

Superior's New Model 770-A

VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER

71% MORE SCALE AREA!!

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

Features

- Compact—measures 3⅛" x 5⅞" x 2¼"
- Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter
- Housed in round-cornered, molded case
- Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications

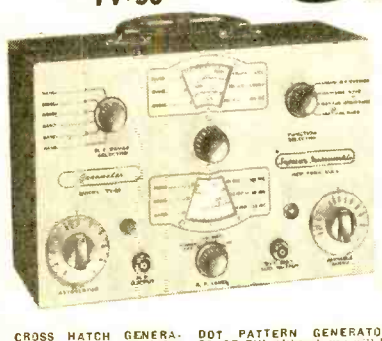
6 A.C. VOLTAGE RANGES: 0-15/30/150/300/-1500/3000 Volts. 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts. 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm. 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps. 3 DECIBEL RANGES: —6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

The Model 770-A comes complete with self-contained batteries. Test leads and all operating instructions. Only

$15.85 NET

Superior's New Model TV-50

GENOMETER



A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- ✓ R. F. Signal Generator for A.M.
- ✓ R. F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: 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.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

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 cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one additional which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 180 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 6 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only

$47.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try any of the instruments on this or on the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

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Dept. D-193, 3849 Tenth Ave., New York 34, N.Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name .....
Address .....
City ..... Zone ..... State .....

- ☐ Model 270-A ..... Total Price $15.85 $3.85 down payment. Balance $4.00 monthly for 3 months.
- ☐ Model 670-A ..... Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.
- ☐ Model TV-40 ..... Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TC-55 ..... Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-11 ..... Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-50 ..... Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-12 ..... Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.

AMA-TOURING

with Roger Legge

THERE HAS BEEN a remarkable improvement in DX conditions on the higher frequency bands during the past several months. The sunspot numbers have been increasing even faster than predicted, and the opening of the 21-mc. and 28-mc. bands has been more rapid than expected.

The 21-mc. band opened in September for transmissions from Africa and Latin America, and occasionally from Europe. Since October, this band has been open for Europeans almost daily, from about 0700 EST until 1300 or later. The 21-mc. band has replaced the 14-mc. band as the best band for reception from Europe and Africa. It has also opened for reception from Asia, mainly on the West Coast.

The 28-mc. band opened in October for Africa and Latin America, providing good DX conditions for the first time in several years. This band has also provided DX from Europe in the eastern United States and from Oceania in western states, although reception from these areas has been somewhat irregular.

This QSL card is from the Canadian Arctic.

Now is the time to watch the 21-mc. and 28-n.c. bands for many countries that are difficult to hear on the 14-mc. band.

Canadian Arctic Stations

Amateur stations on many of the islands in Northern Canada are providing interesting reception from that area. They are located at isolated weather stations in the Arctic area, and most of the operators are there for a year. Amateur radio gives them a means of contacting their families and friends. The following stations are active in the Canadian Arctic:

VE8MA Eureka Sound, Ellesmere Island
VE8MB Resolute Bay, Cornwallis Island
VE8MC Mould Bay, Prince Patrick Island
VE8MD Isachsen Island
VE8ME Clyde River, Baffin Island
VE8ML Alert, Ellesmere Island
VE8PX Resolution Island
VE8RT Frobisher Bay, Baffin Island
VE8SP Nottingham Island

These stations are heard mainly on the 14-mc. band, generally between 14.10 and 14.20 mc., and around 14.31 mc.

During the summer and fall months, a number of W and K stations were heard operating portable from the VE8 area, but most of these appear to have returned further south by now, except for W9RJV/VE8 on Resolution Island.

K2MEA, who operated from Frobisher, Baffin Island, advises that he sold his transmitter to VE8RT and VE8SA, and that he is now back in the United States. WØCFJ, who also was at Frobisher, is now operating portable VO6 from Goose Bay, Labrador.

A. J. Smyth, formerly chief operator of VE8PF, Padloping Island, writes that the weather station there is operated by the Air Services Section of the Canadian Department of Transport. VE8PF handled traffic for many parts of Baffin Island, and also for KG1AG, the Greenland Icecap Survey Team. About 5000 messages were cleared between W9NZZ and VE8PF during the past year.

Phone DX on All Bands

Reports on the DX stations that you are hearing will be appreciated, including frequency and times heard, and any other information of interest regarding them.

Here are the reports for this month. All times are 24-hour EST. All stations are phone unless stated otherwise.

ASIA & OCEANIA

Antarctica—VP8BD, Grahamland, was heard on 21.19 mc. at 1900-2030. (*Don Kenny, Calif.*)

Australia—The VK's are coming through on the 28-mc. band at 1700-1900, including VK4HD, 28.47, and VK4XJ, 28.49 mc. (*Kenny*)

Reception on the 14-mc. band continues around 0700-0900. Stations heard were: VK2JZ, 14.11; VK3AHC, 14.20; VK3OC, 14.175; VK5CE, 14.14; VK7CK, 14.11. (*Kurt Meyers, Ohio*)

VK3ATN was heard on 7.10 mc. at 0700.

Caroline Islands—KC6CG has been noted on 14.20 mc. at 0900. (*Curt Swenson, Minn.*)

Fiji Islands—VR2CG was heard on 21.17 mc. at 1500. (*Kenny*)

Israel—4X4DK was picked up on 7.07 mc. at 2100 contacting Latin Americans. 4X4DK, 21.265, and 4X4GB, 21.15, are heard around 0700-0900 with good signal strength. (*RL*)

Japan—The KA's are coming through now on the 21-mc. band. Heard at 1730-1830 were: KA2GS, 21.22; KA8AB, 21.15; and KA8SD, 21.10. Only a few of the KA's have remained active since handling of third party traffic was eliminated. In addition to the ones listed above, these include: KA2CY, KA2KS and KA2LZ. (*Kenny*)

Midway—KM6AX was heard on 21.26 at 1650. He stated that except for a midday schedule with the Pacific Islands his operation is irregular. (*Kenny*)

New Zealand—ZL's observed on the 28-mc. band around 1930 are: ZL1IX, 28.30; ZL1UP, 28.37; ZL2CY, 28.41; ZL3JN, 28.01 mc. (*Kenny*)

Okinawa—KR6CR was heard on 21.10 mc. at 1820. (*Kenny*)

Portuguese Timor—CR10AY has been picked up on 14.18 mc. at 0745. (*Herbie Krueger, Texas*)

AFRICA

Algeria—FA8IH was heard on 21.19 mc. at 0700.

Angola—CR6BX is now on 21.25 at 1530 and on 28.36 at 1300. (*Emmet Riggle, Ohio; RL*)

Bechuanaland—ZS9G has been observed on 28.37 mc. at 1330.

Belgian Congo—OQ5AU was heard on 21.20 at 1400. (*Howard Hodge, Conn.*)

OQ5FC, on 14.125 mc., was heard at 0930. (*Kenny*)

Canary Islands—EA8AI is noted on 14.165 at 0730.

French West Africa—FF8AK, Dakar, was picked up on 21.18 at 1530. (*Hodge*)

Gold Coast—ZD4BV has been heard on 21.21 mc. at 1650 (*Meyers*)

Italian Somaliland—I5PP was observed at 0830 on the 14-mc. band. (*Krueger*)

Kenya—VQ4AO is coming through on 14.185 at 1700. (*Malcolm Ringel, Georgia*)

VQ4EO was heard on 21.125 at 1530. (*Riggle*)

VQ4RF continues to be very active, operating around 21.20 mc.

Liberia—EL3A apparently operates mainly on Sundays. He is heard around 1300-1500 on about 21.22 mc.

Morocco—CN8MM, 21.19 mc., was noted on the West Coast at 1315. (*Kenny*)

South Africa—The ZS's are being heard well on the 28-mc. band at 1100-1400, including: ZS1B, 28.39; ZS1BK, 28.30; ZS1KK, 28.16; ZS6CV, 28.22; ZS6ID, 28.45; ZS6JZ, 28.32; ZS6LR, 28.30; and ZS6NK, 28.35.

Southwest Africa—ZS3BC was picked up on 21.18 mc. at 1420. (*Hodge*)

Tanganyika—Heard at 1200-1400 are: VQ3DQ, 21.185; VQ3ES, 21.16; and VQ3SK, 21.14 mc. (*RL*)

Tangier—KT1WX was observed on 21.21 mc. at 1050. (*Kenny*)

Uganda—VQ5EK and VQ5FS were both heard on 21.235 at 1330, causing interference to each other. (*RL*)

Zanzibar—VB1EX is now on 21.295 at 1445. He stated that he would try to be on more in

order to give the fellows a chance to contact this rare country. (*Krueger*)

EUROPE

Austria—OE5JK was picked up on 14.21 at 1500. (*Ringel*)

The 21-mc. band provided signals at 0730-0830 from: OE5AQ, 21.44; OE5CK, 21.165; OE6DK, 21.365; and OE6WK, 21.165.

Czechoslovokia—OK1OO has been heard on 21.145 at 1400.

Finland—OH2OP is noted on 21.42 at 0800.

Germany—DJ1BZP has been putting through very good signals on 7.06 mc. around 2000-2300. DL1AU, 7.095, and DL4UZ, 7.075, were also heard at that time.

Last-Minute Flashes!

The 21-mc. band continues to provide more good DX stations, including: CR9-RH, Macao, on 21.20 mc. at 0800; CT3-CN, Madeira, on 21.10 mc. at 1230; EA9AZ, Spanish Morocco, on 21.15 at 1300; ET2AB, Eritrea, on 21.20 at 1500; FB8BC, Madagascar, on 21.15 mc. at 1300; FY7YE, French Guiana, on 21.15 at 1000; HA5KBA, Hungary, on 21.15 at 1000; JA3BB, Japan, on 21.15 mc. at 1700; VQ2SK, Northern Rhodesia, on 21.14 mc. at 1400; VS6AE, Hongkong, on 21.15 mc. at 1000; ZB1EB, Malta, on 21.16 mc. at 1300; ZD1SW, Sierra Leone, on 21.22 mc. at 1300; ZD9AD, Gough Island (south of Tristan da Cunha), on 21.15 mc. at 1300; ZS9G, Bechuanaland, on 21.23 at 1700; 4X4FQ, Israel, on 21.26 mc. at 1330.

On the 14-mc. band, additional stations reported are: CR7AD, Mozambique, on 14.145 mc. at 2330; ET2US, Eritrea, on 14.18 at 1430; FC9UC, Corsica, on 14.15 at 0930; VK1DC, Macquarie Island, on 14.15 at 2400; VP8AQ, South Shetland Islands, on 14.11 mc. at 1900; VQ8AL, Mauritius, on 14.15 at 1500; VU2VH, India, on 14.15 at 0930; 9S4BC, Saarland, on 14.13 mc. at 0900.

The 28-mc. band continues to improve, with the following reception reported: CR6BQ, Angola, on 28.34 at 1330; CR7AD, Mozambique, on 28.37 at 1400; GD3ENK, Isle of Man, on 28.46 at 1300; VQ2AT, Northern Rhodesia, on 28.42 at 1330; VQ4AU, Kenya, on 28.10 mc. at 1330; ZD1TZ, Sierra Leone, on 28.12 mc. at 1500.

(Contributors: *Howard Hodge, Conn.; Emmet Riggle, Ohio; George Chatfield, N. Y.; Rodney Johnson, Va.*)

Greece—SVØWM was observed on 14.19 at 1800. (*Ringel*)

SVØWT was heard on 28.25 at 1000.

Isle of Man—GD3ENK has been fairly active. He is heard on about 21.27 mc. around 0800.

Northern Ireland—GI3HAJ, 21.30, and GI5AJ, 21.23, were picked up at 0800.

Norway—LA5YE was heard on 21.23 at 1300 and on 14.15 at 1400.

Trieste—I1BLF was noted on 21.445 mc. at 0800.

AMERICAS

Alaska—KL7AZN has been observed on 14.25 mc. at 2100. (*Ringel*)

KL7ALZ, 21.26, and KL7RE, 21.26, were heard at 20.15. (*Kenny*)

Bolivia—CP5EK is now on 21.24 at 1515 and 2100, using single sideband. (*Hodge, Kenny*)

British Honduras—VP1HA has been the most active station from this country. He is heard on 14.19 around 2000.

Guatemala—TG9AD has been active on all

Patsy Nikodem, of West Allis, Wis., became interested in short-wave radio when she picked up an amateur station on the amplifier of her electric guitar.

bands. He was heard on 7.07 at 2100, on 14.17 at 1500, on 21.17 at 0800, and on 28.28 at 1600.

Martinique—FM7WF was picked up on 14.11 at 0715. (*Johnny Lewis, S. C.*)

FM7WN is coming through on 14.20 at 0700 and on 21.15 at 0900. (*Ringel*)

FM7WQ was heard on 21.16 at 1615. (*Kenny*)

Nicaragua—YN5AV, a rarely heard YN district, was picked up on 14.15 at 2200.

Panama—HP3FL has been observed on 27.50 mc. at 1330. (*Swenson*)

Turks and Caicos Islands—VP5GB, a new one in the Turks Islands, was heard on 14.195 at 1100. QSL's should be sent to WØOUZ.

C.W. DX Reports

Robert Winn, reporting from Germany, lists c.w. DX heard as follows: SP6WM, Poland, 7.023 mc. at 1640; UC2KAB, Bielorussia, 7.029 at 1640; YI2AM, Iraq, 14.06 at 1815; ZA2G, Albania, 14.085 at 2030; and ZD2NWW, Nigeria, 14.02 at 1705. –30–

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Disc and Tape Review

(*Continued from page 72*)

it is obvious that there were four previous symphonies. For our romantic period this month, I have chosen the *Second Symphony* of Dvorak. This vigorous work has never been played much, but in the past few years a new appreciation for it has grown and it is programmed much more frequently. As a consequence of this activity, the record companies forgot their apathy towards the

work and now we have three recordings in the LP catalog. Unfortunately, only one of the three discs can qualify as being hi-fi in sound quality, and this—unhappily—is not the best performance.

Topping the list, and a first-class recording in all aspects, is the Schmitt-Isserstedt reading on a London disc. Here we have sound of supercharged realism . . . one of London's best engineering efforts, and a prize example of how spectacular the sound can be in the classical repertoire of the romantic period. The sonorities generated by the celli and contrabassi in this recording are tremendously "weighty" and of extraordinary richness. The brass is clarion-clear, first strings are generally quite smooth, woodwinds have a particularly bright, "breathy" intonation, and percussion is very sharp and accurate. Couple all these virtues with a spacious acoustic perspective, which imparts "liveness" to the recording without sacrificing inner detail, and add such plus factors as super-wide frequency and dynamic response and low distortion, and you will realize why this is a superior recording. Performance-wise, Schmitt-Isserstedt gives a good account of himself, and if his reading is unspectacular and close to the vest, it is at least honest. As they say in trade parlance: "He dots all the i's and crosses all the t's."

Far and away the best performance is that by Kubelik on the HMV label. This boy really knows his way around Dvorak's music, a fact which is easily and audibly apparent. His reading has a great depth of feeling . . . a very warm and seemingly effortless essay of the score in which one almost overlooks the correct tempi, the superb balance, carefully modeled phrasing, and other evidences of loving care. Alas, the HMV sound, while fairly wide-range stuff, leaves much to be desired. Distortions crop up frequently, string tone is edgy in places, brass does not have that bright punch which is characteristic of the London recording, and the acoustics are somewhat cramped. Still, it isn't altogether objectionable and it *is* the best performance.

The third recording is the least satisfactory, that of Schrader and the Berlin Philharmonic on the Urania label. Schrader doesn't come off too badly in the performance department, a general lack of inspiration and a tendency to let the orchestra run away with the score being his chief faults. But the sound is a real "weirdie." Some of it isn't the most objectionable I have ever heard, but other parts are just plain miserable! I suspect that this recording was taken from an FM German broadcast, and with all due regard for the general excellence of most German equipment, I don't think the FM transmitters or receivers can compare with our stuff. In any case . . . muddy bass, screechy strings and strident brass are to be found here.

For the best deal, I'd put my money on the London recording . . . although the Kubelik performance has undeniable attractions.

El Amor Brujo

For our modern period work this month, we turn to the music of that masterful Spanish composer, Manuel de Falla. His *El Amor*

Brujo is probably his best-known work, and it is from this music that the famous *Ritual Fire Dance* was derived. There are five recordings of *El Amor Brujo* in the LP catalog, and three of these are worthy of the hi-fi label.

The Westminster recording is the best-sounding of all, but the performance is not of a very high caliber. The soloist lacks the luster and assurance of the artists in several of the other recordings. As a hi-fi vehicle, this quasi-oriental Spanish-flavored work is a natural. There are many opportunities throughout the score for spectacular sound, and the Westminster engineers make the most of them. Blaring brass, sizzling strings and crashing percussion are all there . . . in fact, it's just a bit too jazzed up for my taste.

For those who would like to have their *El Amor* sans vocal as a straight orchestral selection, there is the London recording. This is a good recording, with generally smooth strings and clean brass and percussion. However, for those who want the very essence of this work, we must turn to the Stokowski recording on Victor.

The Stokowski recording just barely qualifies as hi-fi in sound, because of restricted range rather than any obvious faults or distortions. Performance-wise, this is it . . . a most stirring demonstration of Stokowski's particular affinity for modern scores. It has dash and fire and dazzle, and some sensuously beautiful sound. Most important of all, the vocal sections are handled in incomparable fashion by Nan Merriman. Here is a gal who can really sing, and strangely enough, even though the vocalists on some of the other recordings are native Spaniards, Miss Merriman has the more authentic sound, better diction, and infinitely better expression. The *Fire Dance* section as played by Stokowski is one of his orchestral tour-de-forces. It is a pity that the only fault on this disc should be something as basic as the orchestra. Yes, the Hollywood Bowl Symphony does nobly, but I'm afraid that an orchestra which has a great deal of transient personnel will always have some trouble with ensemble playing. There were some ragged attacks and other little flurps in evidence, a most unusual situation with a Stokowski-conducted orchestra. Be that as it may, he managed to get them through the *Fire Dance* in fine style, and there is no doubt in my mind that if you want the most thrilling recording of *El Amor Brujo* this Stokowski disc is the one to buy.

That takes care of the classical menu for this month. We'll keep plugging away at the standard repertoire next month.

Jazz Corner

Worthy of mention this month is an item called *Rugolomania* with Pete Rugolo and His Orchestra (Columbia CL689, 12" LP, RIAA curve, $3.98). The devotees of Pete Rugolo must be a vocal lot. At least it would appear that way from the number of Rugolo discs which Columbia has been issuing lately. And I can see the point, for this boy has a real talent. Having endeared himself to countless numbers for his clever arrangements when he was with Stan Kenton, he is now on his own

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1LC6	.49	6AV5GT	.60	6J5	.49	12AV6	.42	35B5	.48
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1S5	.43	6AX5GT	.60	6K6GT	.39	12AX7	.61	35W4	.33
1T4	.51	6BA6	.56	6K7	.40	12AZ7	.61	35Y4	.42
1U4	.51	6BA7	.58	6L6	.78	12B4	.72	35Z3	.41
1U5	.43	6BC5	.48	6Q7	.40	12BA6	.46	35Z5GT	.33
1X2	.65	6BC7	.75	6S4	.41	12BA7	.58	37	.59
3A5	.65	6BE6	.46	6S8GT	.65	12BE6	.46	43	.55
3Q4	.53	6BF5	.48	6SA7	.45	12BH7	.61	45	.55
3Q5GT	.61	6BF6	.48	6SK7	.45	12BY7	.65	50A5	.49
3S4	.48	6BG6G	1.18	6SJ7	.45	12H6	.50	50B5	.48
3V4	.48	6BH6	.51	6SN7GT	.60	12J5	.40	50L6GT	.50
5R4	.95	6BJ6	.51	6SQ7	.40	12K7	.40	50X6	.53
5U4G	.43	6BK5	.75	6T8	.71	12Q7	.48	75	.44
5V4	.49	6BK7	.78	6U8	.76	12SA7	.45	77	.55
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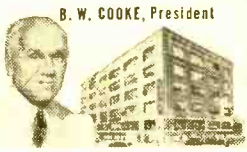

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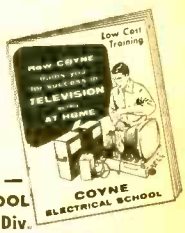

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and free of any restraining influences Kenton may have imposed. I say that in the light of the contents of this particular disc, in which he certainly gives his talents free rein on some of his own originals and with such standards as: *In a Sentimental Mood, Little White Lies, Everything I Have Is Yours,* etc.

Rugolo has whipped up some very fancy arrangements here, featuring certain outstanding soloists. But most unusual of all, much of the instrumentation used in the arrangements is generally found in a symphony orchestra! He makes free and effective use of such things as the French horn, oboe, alto flute and tuba. Some solo work spotlights these instruments and the boys that play them are no slouches.

For lovers of the hi and the fi, there is plenty of good red meat here! The brass is exceptionally crisp and clean with the difficult-to-record French horn especially well reproduced. Some of the reeds are recorded a little "close-to," and are quite "breathy," but this certainly helps in maintaining the illusion of "liveness." I still feel Columbia overdoes things a bit with the echo chamber, although that's a matter of taste and on this disc it does no particular harm.

There is still some pre- and post-echo with Columbia discs. We can't really howl here, however, since most of it results from Columbia's attempt to give you more for your money by putting more music on the disc. All in all, this is one of the best-sounding "cool" discs to come out recently, and a good buy. —30—

The Transmitting Tower

(*Continued from page* 65)

W9EGQ AR K." Correct: ". . . What do you think? AR W9BOS DE W9EGQ K."

A third ending signal is "SK," end of work. Sent at the conclusion of a contact, it is supposed to mean: "This was my last transmission. I do not expect you to reply." In actual practice, it usually means something like: "This was my final transmission, but I know that you will make a final transmission—also ending with SK—to which I will reply, to which you will reply, etc., until three to six 'final' transmissions later, we will finally conclude our contact."

The confusion results from sending the "SK" too soon. All these preliminary "sign off" transmissions should be terminated with "K." Only when the contact has actually been concluded should each station send "SK," thus: "SK W9BOS DE W9EGQ." "SK W9EGQ DE W9BOS."

When "SK" is used in this manner, there is never any doubt about when a contact is ended, and it is safe to call either of the stations involved without interfering with its "final" transmission. It would be especially helpful in DX work. When conditions are favorable for foreign amateurs to contact the United States, there are always many stations waiting for them to finish each contact, so that the others can call them. As "SK" is generally used, it is practically impossible to tell when a contact ends. As a

result, it is a rare DX contact that is not finished in interference from a couple of stations jumping the gun with their calls.

Speaking of DX brings up the ending signal "KN." When used instead of "K" at the end of a transmission, it means: "Go ahead, the addressed station. I will ignore all other calls." I doubt that there are many Novices so overwhelmed with calls that they need to use "KN." However, most DX stations use it to reduce the number of unwanted calls.

To conclude this discussion, most amateurs add "CL" before leaving the air. It means: "I am closing my station."

HELP WANTED

Each month, the names of prospective amateurs requesting help are listed in this section of the *Transmitting Tower*. To have your name listed, address your request to: Herb S. Brier, W9EGQ, c/o POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y.

William B. Iber, 72-24 67th Place, Glendale 27, L. I., N. Y.

Eddie James, 2433 Montreal Rd., Tucker, Georgia.

Anthony K. Carbone, 24 Governor Winthrop Rd., Somerville 45, Mass.

Mike G. Russo, 102 Fellows St., Roxbury, Boston 19, Mass.

News and Views

Many amateurs and SWL's will probably be interested in the new G.E. Ham News QSL cards. They are replicas of a portion of a standard log sheet, with a space for the call letters of the sender. The usual QSL information is written in the form of a standard log entry. The cards are available in packets of 300 for $1.00 per packet, postpaid. In the United States, Canada, Alaska, Hawaii, or the Panama Canal Zone, send orders with remittance to: Tube Department, *General Electric Company,* Schenectady 5, N. Y. From other countries, order from: Lighthouse Larry, *International General Electric Company,* 570 Lexington Ave., New York 22, N. Y.

"Saul" F. Broudy, W3WHK, 1123 E. Phil-Ellena St., Philadelphia 19, Pa., writes: "I am 12 years old and in the eighth grade and have been a ham for a couple of years—Novice, Technician, and now General. I still have my Novice rig, a *Heath* AT-1 transmitter, running 30 watts, and an S-53A receiver. The antenna is a 'long wire.' In the last six months, I have worked 26 states and three Canadian provinces. Best DX is Kansas, but when I get up my new antenna, I'll do better.

"I'll be glad to work anyone on 80 or 40 meters who needs a Pennsylvania contact. Also I wonder if there are any YL's (young ladies—girls) my age around. If they are, they must be pretty scarce. Keep up the good work in the *Transmitting Tower*. 73."

Bernie Nickles, KN4BPY, reports from 187 Frankfort St., Versailles, Ky.: "I got my license last January after what seemed an awful long wait and built the little one-tube transmitter described in POPULAR ELECTRONICS

last February. So far, I have received QSL (confirmation) cards from 16 states and Canada. My receiver is a *National* SW-54, and my antenna is a dipole fed in the center via 300-ohm TV 'twin lead' transmission line. I do not have much time to operate, because I am taking the *DeVRY* Electronics Course. 73."

"Mickey" Hall, KN9BBO, 213 Cleveland St., Gary, Ind., reports: "I do not think that enough Novices realize how important a really selective receiver and a good antenna are in obtaining good results. More than anything else, they should start out with the very best receivers they can get.

"I have a *Hallicrafters* SX-96 receiver and a *Johnson* Adventurer transmitter, running 50-watts input. My antenna is an 80-meter, ½-wave doublet fed with 72-ohm twin lead and supported between two 40′ telephone poles. In a month and a half of operation on the 3.7-mc. band, I have worked 30 states. The best time to work DX around here is about 3:30 a.m., and my best DX is California. 73."

Mike Wenninger, W9ASK, 513 Forest Ave., River Forest, Ill., writes: "In August, I visited an old friend of mine in Des Moines. He does not have his license yet, but he has an AT-1 transmitter and an S-38C receiver, waiting for the day. We put up a 40-meter off-center-fed antenna, and I operated from there as a "portable" station. In 13 hours of operation on 80 and 40 meters—using an old broadcast antenna for 80—I worked eight states and Hawaii. I wish I could do that well from here. I have never worked Hawaii from home! 73."

Duane Bentley, KNØCFS, Route 1, Belgrade, Nebr., says: "My ham career began with the February, 1955, issue of POPULAR ELECTRONICS, and my call arrived last month. I use a *Heath* AT-1 transmitter and AC-1 antenna coupler, and a *Hallicrafters* SX-99 receiver. I have worked nine states so far. I use my receiver as a monitor when I transmit. This works fine, unless the other fellow is off my frequency. Then I sometimes lose him while retuning. I wonder how other Novices handle this problem. 73."

Stan Wilson, W9IFZ, Rt. 1, Washington, Ind., says: "I have had my 'General' for eight months now. I am operating on 20 meters, running 70 watts to a home-brew 6AG7-6146 rig. My receiver is an NC-98, and the antenna is a vertical ground plane. I have just finished working all states, and I have worked 11 countries in four continents. Some day, I hope to make DXCC (have confirmed contacts with amateurs in at least 100 countries) and work all continents. 73."

Steve Aug, K2EOF, 175 West 93rd St., New York 25, N. Y., has kindly passed on some information on a few of the many N. Y. C. amateur radio clubs.

"In my opinion, the New York Radio Club is the best one in the city. I say this partly because I am a member of it. The club is open to all, and it has members from all parts of the city; so a Novice or a prospective one is likely to find a neighbor among the members. Meetings are held on the second Monday of the month. Contact George Doherty, W2ATT, 606 W. 115th St., New York 25, N. Y., for additional information.

"Kern Bowyer, W2GHH, 1 Midland Gardens, Bronxville, N. Y., a friend of mine, is vice-president of the Westchester County Amateur Radio Society. He may be contacted for additional information about this society.

"We at the NYU Radio Club have radio code and theory classes, but we must, unfortunately, limit them to NYU students only. I believe that this is the situation at other colleges and high school clubs, enrollment limited to their students only. However, if prospective Novices will contact me at my home on weekends or c/o NYU Radio Club, New York University, University Heights 53, N. Y., I shall attempt to put them in contact with members who can help them. 73."

I hope to have a bit more information about radio clubs in New York City and in other cities next month, along with other amateur news. In the meantime, let me hear from you. 73.

Herb, W9EGQ

Tuning the Short-Wave Bands

(*Continued from page 69*)

0500-0545 in Italian (7072 kc.); at 0830-1000 and 1100-1200 in Somali, 1200-1300 in Italian on 4978 and 7072 kc. (*WRH*)

Jamaica—ZQI, Kingston, 4950 kc., is noted at 2245 with music, 2300 with news. Some heavy QRM makes this one rough to hear at times. If unable to locate on this channel, try 3360 kc. (*BG*)

Liberia—ELWA, Monrovia, 4830 kc., was noted on the west coast at 0230 with a musical program and at 1745-1815 s/off in the east. They also operate on 11,800 kc. at 1130-1330. (*JP*)

Monaco—3AM4, Monte Carlo, 7349 kc., can be heard in English on Wednesday at 1705-1805 with a religious program. Their QSL card shows the xmtr building with mountains in the background, and the Monaco Flag. Power is 30 kw. (*TL*)

New Zealand—ZL3, Wellington, 11,780 kc., is heard at 0000-0100 with music and talks or stories. They operate parallel to 15,220 kc. but reception is on the lower channel. Closing at 0100, they re-open at 0115 on 9520 kc. (ZL18) and 6080 kc. (ZL7) with a good classical musical program. (*JB*)

Still being noted at 0400-0415, their programs are now popular and light music. (*PM*)

Philippines—DZH7, Manila, 9370 kc., "The Call of the Orient," with 10 kw., is noted at 0900-0915 daily with English news; at 1000-1030 with an English program of varying subjects; at 1200 s/off with announcements in English and singing of the "Prayer Song." They announce that they will return at 1600 on same channel. Final announcement is "This is the *Far East Broadcasting Company* in Manila. We salute you from the Philippine Republic . . . good morning, good afternoon, good night, wherever you are, from the Philippine Republic, more than 7000 islands at the place where the Pacific Ocean meets the China Sea. . . ." Then the National Anthem and a silent xmtr at 1205. (*BV*)

Poland—*Radio Warsaw*, 9540 kc., carries English at 1930-2200. Their address is *Polskie Radio*, Warszawa, UL, Noakowskiego 24, Poland. (*AE*)

Portugal—Lisbon, *Radio Nacional*, 15,110 kc., can be tuned with an English program at 0930-1030. (*SG*)

Sarawak—A rare treat for most anyone's log is *Radio Sarawak*. It is being heard on 5052 kc. with English news at 0805. Careful tuning and some patience are needed as they are often jammed until news time.

Switzerland—A high-frequency station is HER7, Berne, on 17,784 kc. They have an English program at 0900-0930 (quiz show on Sundays). (*SG*)

Tanganyika—Dar-es-Salaam, 5050 kc., has increased power from 250 watts to 20 kw. It is being heard by our readers in England from 1230 tune-in and by 1300 has a good signal. The *BBC* news relay is heard at 1300. (*BB*)

Thailand—HSK9, Bangkok, 11,670 kc., is found at 0555 in language. At 0615, a woman announces for the station, followed by English news. At 0620, a program of Thai music is heard. They close at 0655, reopen at 0800 with a relay of the Home Service. (*GF*)

USA—A new call sign being heard is WBOU, on 17,785 and 11,870 kc.

USSR—Last July, we stated that—to our knowledge—the only Russian stations that verified were the Moscow xmtrs, in their English service to North America. A letter from the s.w. station, *Deutsche Welle*, Koln, Germany, signed by Horst A. C. Krieger, DX-Editor, states: "*Radio Moscow* never verifies with a QSL card or letter in the usual way as do other stations. Nevertheless, it seems as if local stations in USSR do verify directly provided that you write to them direct. To date, only one example is known and that is *Radio Tashkent*, Uzbekian, which verified my reception report after some weeks had passed."

Venezuela—*Radio Rumbos* has an English session on Monday and Friday at 1700-1800 on 4970 kc. This station usually puts a strong signal into Eastern N. A. (*LM*) —30—

SHORT-WAVE CONTRIBUTORS

Bernard Brown (*BB*), Derby, England
S. George (*SG*), Ottawa, Ontario
Harwood Shepard (*HS*), Auburn, N. Y.
Louis Marcarelli (*LM*), Medford, Mass.
Grady Ferguson (*GF*), Charlotte, N. C.
William Flynn (*WF*), Berkeley, Calif.
Roger Legge (*RL*), McLean, Va.
Kurt Meyers (*KM*), Columbus, Ohio
Robert Nelson (*RN*), Newburgh, N. Y.
Paul Mathieu (*PM*), Southbridge, Mass.
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1F4	6AC7	6SD7GT	7X7	25Y5
1F5G	6AG5	6SF5	12AT7	25Z5
1H5GT	6AK5	6SJ7GT	12AU6	26
1H6G	6AK6	6SH7GT	12AU7	27
1L4	6AL5	6SK7GT	12AV7	32L7GT
1LA4	6AQ5	6SL7GT	12AX4GT	35/51
1LA6	6AU5GT	6SN7GT	12AX7	35A5
1LC5	6AU6	6SQ7GT	12AY7	35B5
1LC6	6AV5	6SS7	12BA7	35C5
1LD5	6AV6	6U7GT	12BD6	35L6GT
1LH4	6AX4GT	6U8	12BE6	35Y4
1LN5	6AX5GT	6V6GT	12BH7	35Z5GT
1N5GT	6B4G	6V7	12F5GT	39/44
1P5GT	6BA6	6W4GT	12J7GT	41
1Q5GT	6BD6	6W6GT	12Q7GT	42
1R5	6BE6	6X5GT	12S8GT	43
1S5	6BF6	7A5	12SA7GT	45
1T4	6B66G	7A6	12SC7	45Z5GT
1U4	6BQ6GT	7A7	12SG7	46
1V	6BY5G	7A8	12SK7GT	47
1V4	6C4	7AD7	12SL7GT	50AX6
1X2A	6C5GT	7B6	12SN7GT	50L6GT
2A7	6C6	7B7	12SQ7GT	56
2X2	6C8G	7B8	12X4	57
3A4	6CB6	7C4	12Z3	58
3B7	6CD6G	7C5	14B6	70L7GT
3C6	6D6	7C6	14B8	77
3Q4	6B8G	7C7	14Q7	78
3Q5	6F6GT	7E5	14W7	117L7GT
5U4G	6G6G	7E6	14X7	117Z3
5Y3GT	6J6	7E7	24A	117Z6GT
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Audio Audit

(*Continued from page 85*)

the audio field, and with gratifying results.

As the trend catches on, both on the part of the industry and that of the consumer, more advances can be expected along these lines. The use of newly discovered—and rediscovered—beauty in natural wood grains such as birch, walnut, and oak rivals the traditional finishes of mahogany, maple, and blonde. Combining these textures with skill into structures that are intended to look good as well as "sound" good is rapidly becoming a facet of the electronics art all in itself. And if prices for completely assembled and finished units are relatively high (good furniture has never been cheap), the "do-it-yourself" enthusiast will find on the market the widest assortment of prefabricated kits yet made available.

Audio Shows Themselves

This "Audio Audit" would not be complete without a word on audio shows themselves. The great majority of exhibits are entertaining as well as informative. But a few still resemble a barker's demonstration at a carnival side show. Some restraint and exercise of good taste should be blended with the showing of the fine equipment. The "selections" played in certain quarters could stand some improvement: less drumbeats and automobile horns, and more music. Weird sounds that shock may earn a smile at first hearing, or prove a point in the laboratory. But after all, the main purpose of hi-fi is to reproduce music. And whether it be Bach or Bartok, Armstrong or Brubeck, good, solid music should prevail.

Which exhibit sounded best? That's any man's choice. More and more, authorities in the field are emphasizing the purely subjective factors in an individual evaluation of this or that hi-fi system. It is now generally agreed that almost any combination of matched components can provide a system that will make *somebody* happy. Technical specifications being the same for a group of similar components, the deciding factors would include one's personal attitudes toward styling, space requirements, listening room acoustics, intended use, overall impression made both visually and aurally, and—of course—price. —30—

Needed Electronic Inventions

(*Continued from page 32*)

rays" have been developed, but experiments thus far indicate that the equipment would be bulky, difficult to control, of a limited range, and would require fantastic amounts of electrical power.

Speech-into-Writing Translator

Not only the military, but industry and business as well, could use a lightweight unit capable of translating ordinary speech into the written word. It would be valuable for speeding up communications and for intercepting radio and wire transmissions. All the approaches tried thus far have indicated that the apparatus required would be complicated, bulky, and expensive, and would do a far from satisfactory job. An "ideal" unit should not be appreciably larger than a present-day tape recorder. A person could speak into a microphone and the speech would be translated into a written or typed message, either on a flat sheet, or on a continuous strip of tape. It may be that a new approach utilizing transistorized, subminiature circuitry will result in a satisfactory solution. However, because of the differences in voices, the various accents people use, and the differences in the spelling and meaning of words that are pronounced similarly, the problems of developing such a device are many.

Most of the "needed inventions" described above have been either new systems or relatively complex pieces of equipment. But the lists issued by the National Inventor's Council also contain a number of relatively simple components and new chemicals and materials. —30—

Transistorized Light Meter

(*Continued from page* 45)

over a few feet to vary the illumination on the photocell. Now darken the room.

Zero the meter as described above with *R2* rotated fully *counterclockwise*. Then place the light source at a distance of 9.6 inches from the cell window, remove the light shield, and gradually advance the calibration control until the meter reads full-scale. Check the zero adjustment by replacing the light shield and readjust both *R4* and *R2* until the meter reads zero with no light on the cell and full-scale at the 9.6" spacing.

Now refer to Table 1. Increase the spacing between light source and cell as shown, marking the scale with the corresponding number of foot-candles for each new distance. Subdivisions of 5 foot-candles may be drawn in after the calibration is complete, spacing the smaller index lines proportionately with relation to the main divisions.

Extension of Range

The range of the instrument may be extended to 100 foot-candles or more by starting the calibration closer to the light source

with an adjustment of *R2* that permits a full-scale deflection for this higher illumination intensity. To find the correct distances for 100 foot-candles, 90 foot-candles, etc., the following equation may be used if only one of the two filaments of the 32 + 32 CP lamp is connected:

$$d = \frac{5.66}{\sqrt{\text{F.C.}}}$$

where d = distance in feet between source and photocell, and F.C. = desired illumination in foot-candles.

To increase the distance between the source and the photometer for the higher values of illumination, both filaments may be connected in parallel to obtain a light emission of 64 CP. In this case, the equation becomes:

$$d = \frac{8}{\sqrt{\text{F.C.}}}$$

Theory of Operation

The CL-1 photocell (or the improved CL-2 version) is a photo-resistive type whose d.c. resistance diminishes with increasing light. When the cell is dark, the resistance is very high, so that the current from *B1* through the cell, *R1, R2,* and thence through the base-emitter circuit of the transistor is quite small. Under these conditions, the current in the collector circuit is also small and the meter may be adjusted to read zero by varying *R4*.

R3, R4, and the resistance of the collector circuit form a Wheatstone bridge, an arrangement that allows the user to set the meter at zero even with some current flowing through the collector circuit. Then, when the current increases, the balance of the bridge is upset, the meter reads and provides an indication of the extent of the change.

The transistor (2N107) is connected as a d.c. amplifier with a gain which ranges from 12 to 20 times depending upon the particular transistor. Flexibility of this photometer circuit is such that almost any transistor in good condition may be used, provided that it is a junction type. The 2N107 is a *p-n-p* arrangement but an *n-p-n* may be substituted if both battery polarities are reversed in wiring. —30—

Electronic Coin Tossing

(*Continued from page* 57)

Observe the polarity of the selenium rectifier and the electrolytic capacitor; they may be connected as shown or both may be reversed. Do not reverse the connections of only one of the two parts or the capacitor will be damaged.

After checking the wiring and inserting the neon lamps, plug the unit into an a.c. power outlet and turn on the power switch *S2*. If one lamp fails to light with the push button up, replace it. If the new lamp also fails to light, check the lamp socket, potentiometer *R1*, and the wiring.

If both lamps fail to light, first temporarily short out the series resistor, *R2*. Then, if necessary, check potentiometer *R1* and the wiring. Finally, check the power supply. Voltage across capacitor *C2* should be approximately 150 volts.

If it was necessary to short out *R2* to make both lamps light, replace it with a resistor of smaller value. However, do not use so small a resistor that both lamps remain on when the push button is depressed.

Adjust potentiometer *R1* so that one lamp remains on as often as the other when the button is pressed several times. Press the button ten times and count the number of times each lamp remains lit. If you do not get five "heads" and five "tails," turn the potentiometer a fraction of a turn in either direction and check again. Readjust until both lamps remain on equally often. For the most accurate adjustment, use a long series of trials (fifty, for example, instead of ten). After the "electronic coin" has been used for a time, check the adjustment of *R1*, and recheck it periodically; changes in power line voltage and in the actual values of the components may affect the balance of the circuit. —30—

Building a "Regenode" Receiver

(*Continued from page* 54)

The setting of *C1* when receiving very weak stations will depend upon the length and type of antenna used. A long antenna will require little capacity, while with a shorter antenna the receiver works best over most of the dial with the plates of *C1* fully meshed.

If headphone reception is preferred, it is recommended that a 12AU7 tube be plugged in to replace the 12AX7 shown in the wiring diagram, and that the grid resistor, *R10*, be replaced by a 250,000-ohm volume control. For even better reception with headphones, change *R11* to 1000 ohms, replace *R12* with a 20- to 35-henry, 15-milliampere choke, and use a 0.1-μfd. capacitor at *C13*. The 12AU7 and the 12AX7 have identical socket pin connections. Those who already have a suitable amplifier may wish to build only the detector, that is, only that part of the receiver that is to the left of the dotted line in the wiring diagram. —30—

GLOSSARY OF ELECTRONIC TERMS

This glossary, which is being published in serial form, started in August, 1955. It consists of a selected group of definitions taken from the booklet "A Dictionary of Electronic Terms," published by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. The complete dictionary, containing over 3500 terms, is available from Allied at 25 cents a copy.

oscillator—(1) Any non-rotating device for setting up and maintaining oscillations of a frequency determined by the physical constants of the system. Examples are vacuum tubes, sparks, or arc generators. (2) In a superheterodyne receiver, that stage which generates a radio-frequency signal of the correct frequency to mix with the incoming signal and produce the intermediate-frequency of the receiver. (3) In a transmitter, the stage that generates the carrier frequency or a frequency equal to some definite multiple of the carrier frequency. (4) A test instrument that can be set to generate an unmodulated or tone-modulated r.f. signal at any frequency needed for aligning or servicing radio receivers and amplifiers. (5) A test instrument for generating an audio-frequency signal, at any desired frequency for test purposes. (6) In early radio, a form of generator of radio frequencies that was coupled to an antenna as a radio transmitter. (7) In the very high and ultra-high frequencies, a generator that is coupled to some form of radiator as a transmitter.

output impedance—The impedance as measured between the output terminals of a radio device, receiver or amplifier at a definite frequency or at a predominant frequency in the audio range which the device is to handle. For maximum power transfer, the load impedance should match or be equal to this output impedance.

output transformer—The iron-core audio-frequency transformer used to match the output stage of an audio-frequency amplifier to its loudspeaker or other load.

overload—A load greater than a device is designed to handle.

overtone—One of the harmonic frequencies at which a vibrating body can freely vibrate in addition to its lowest fundamental frequency. The first harmonic is the fundamental; the second harmonic is the first overtone.

oxide-coated cathode—A cathode coated with oxides of alkaline-earth metals to improve electron emission at moderate temperatures. Usually barium and strontium.

paper capacitor—A fixed capacitor consisting of interleaved strips of metal foil separated by an oiled or waxed paper dielectric.

parallel connection—A shunt connection. A method of connecting two or more components into a circuit side by side so that one line terminal is connected to one end at each component (these ends are thus connected together); and the other line terminal is connected to the other side at each component.

peak inverse anode voltage—The maximum instantaneous anode voltage in the direction opposite to the forward anode voltage. Often applied to the maximum voltage which a rectifier can tolerate without internal arcing between electrodes.

peak load—The maximum load consumed or produced at or in a stated period of time.

peak voltage—Maximum voltage which can be applied to electrolytic capacitors for a period not to exceed about 30 seconds. Also called **surge voltage.**

pentode—A vacuum tube having five electrodes. Ordinarily, these will be the cathode, control grid, screen grid, suppressor grid and anode.

per cent ripple—The ratio of the r.m.s. ripple voltage to the algebraic average of the total voltage of a rectifier.

period—Time required for one complete cycle of an oscillating or recurring quantity.

permeability—Measure of the ease with which a given material can carry magnetic lines of force; expressed as a multiple of the permeability of air which is 1.

phase—The position at any instant which a periodic wave occupies in its cycle. If amplitude is depicted perpendicular to a time axis, phase may be represented as a position along the time axis. If the time of one period is represented as 360°, the phase position is called a **phase angle.** Phase angle is also shown as the angle of a rotating vector moving through 360° in one period or cycle. This angle is measured with respect to some fixed direction or to some other rotating vector.

phase inverter—A vacuum-tube stage containing one or more tubes connected between single-ended preceding stages and a succeeding push-pull stage; converts single-ended input to push-pull output.

phase shift—Change in the phase relationship between two periodic quantities.

phono cartridge—A small unit containing a crystal, magnetic coil, ceramic element, etc. Cartridges are fitted into tone arms of record players. The mechanical movement of the styli in the record grooves is transmitted to the crystal or ceramic elements, producing a stress which generates a small voltage. This voltage in turn is fed into the amplifier, and subsequently emerges as audible sound. In the case of magnetic coil cartridges, the movement of the needle traveling in the record groove moves an armature in the magnetic field back and forth, varying the amount of magnetic flux linking the coil and inducing a voltage in the coil. This voltage is then fed into the amplifier in the same fashion as crystal and ceramic cartridges. See also **crystal cartridge.**

phonograph—A device for converting mechanical vibrations into sound waves. **Electrical Phonograph**—A phonograph in which the motor derives its power from an electrical source. **Mechanical Phonograph**—A phonograph utilizing a hand-wound type of mechanical motor.

phosphor—Any substance which becomes luminous as a result of exposure to radiant energy or bombardment by atomic particles. The effect may cease with the exciting stimulus (fluorescence) or may persist (phosphorescence). In the electronic art, the term "phosphor" is used most commonly to denote those substances (such as zinc silicate) employed for the coating of cathode-ray screens. These phosphors are

produced in a wide variety of colors and a wide range of persistencies.

photocell—See **photovoltaic cell.** Sometimes incorrectly referred to as a phototube.

photoelectric cell—(1) A general term applying to any cell whose electrical properties are affected by illumination. (2) A type of photoemissive cell consisting of a vacuum or gas-filled tube having a photo cathode from which electrons are emitted when the surface is exposed to light.

phototube—A two-element glass vacuum tube whose cathode emits electrons when light falls on it, the electrons being attracted to the anode when a positive potential is applied to it. Commonly used in sound motion picture projectors and light-operated relay circuits. Also frequently but incorrectly called photocell.

photovoltaic cell—Photronic cell or barrier-layer cell. A light-sensitive cell capable of generating a voltage when exposed to visible or other radiation. Copper-cuprous oxide or silver-selenium are common types.

pickup—A mechanical device that converts some form of intelligence into a corresponding electrical signal. Also called **transducer.**

pie winding—A method of constructing coils from a number of individual washer-shaped coils called **pies.** Also called pi (π) winding.

piezoelectric—Literally, pressure electricity. Property of some crystals which have the ability to generate a voltage when mechanical force is applied, and the converse ability to produce a mechanical force by expanding or contracting when a voltage is applied.

pilot lamp—A small lamp used to illuminate the tuning dial of electronic equipment or to indicate when the equipment is turned on.

pin connections—Connections made to pins of a vacuum tube. The following abbreviations are used to identify pin connections: **NC**—no connection; **IS**—internal shield; **IC**—internal connection (but no electrode connection); **P**—plate; **G**—grid; **SG**—screen grid; **SU**—suppressor; **K**—cathode; **H**—heater; **F**—filament, **RC**—ray-control electrode; **TA**—target.

pitch—(1) The property of a tone which is determined by its frequency. The higher the tone, the higher the pitch. (2) The distance between two adjacent threads of a screw.

plate—(1) The common name for the principal anode of a vacuum tube. (2) One of the conductive electrodes of a capacitor. (3) One of the electrodes of a storage battery. (4) Colloquialism for a piezoelectric crystal.

plate resistance—The ratio of a small change in plate voltage divided by a small change in plate current, in vacuum-tube circuits. The symbol is **Rp.**

plate voltage—The direct voltage between the plate and the cathode of a vacuum tube.

plug-in coil—A coil having as its terminals a number of prongs arranged to fit into a socket mounted on the radio chassis.

polarity—(1) An electrical condition determining the direction in which current tends to flow. Applied to direct current sources; also to components when connected in d.c. circuits. (2) The quality of having two opposite charges, one positive and the other negative. (3) Quality of having two opposite magnetic poles, one north and one south.

potentiometer—(1) A popular term for a variable resistor. Radio pots (potentiometers) usually have a ring-shaped resistance unit with an adjustable arm. Laboratory models are larger, straight and tubular. The device may be connected as a variable resistor (one end and movable contact) or as a voltage divider (both ends and movable contact). (2) A standard instrument of high precision used for measuring d.c. potential (and thereby current or resistance). Measurement is by a null method so that no power is transferred to or from the unit under investigation by the instrument.

powdered iron core—A core consisting of powdered magnetic material mixed in a suitable matrix and pressed into the required shape.

power—Rate of doing work. Energy per unit time. May be expressed in horsepower (550 foot-pounds per second). More often in the electrical field, it is expressed in watts (joules per second) or in kilowatts (thousands of watts).

power amplifier—(1) An audio- or radio-frequency amplifier designed to deliver a relatively large amount of output energy. (2) The last stage of an amplifier as distinguished from previous stages usually classed as voltage amplifiers. Here, signal currents appear, so power (EI) is amplified.

power output—The power in watts delivered by an amplifier to a load, such as a speaker.

preamplifier—An extra stage of amplification at the front end of an amplifier or receiver. Also a separate booster unit employed with amateur receivers or television sets for strengthening weak signals. Typical example: a preamplifier used to increase the output of low-output magnetic cartridges in phono players.

pre-emphasis—The increase of the relative strength of higher audio frequencies as, for instance, at a transmitter of the frequency-modulated type. After de-emphasis at the receiver, the net result is an increase in signal-to-noise ratio. Used in disc recording to subdue record scratch.

preselector—A tuned-radio-frequency amplifier or antenna tuning device inserted between the radio receiver input terminals and the antenna lead-in to increase the amplitude of the incoming signal.

printed circuit technique—A method by which circuit connections and many of the components are printed or painted on a plane surface with conductive or resistive media. Permits building extremely compact circuits.

push-pull circuit—Two-tube amplifier circuit in which the grid and plate of one tube is operating 180° out of phase with the grid and plate of the other tube, as against parallel operation in which the grids are connected together and the plates are connected together. Push-pull operation generally results in higher output efficiency. Even-order (2nd, 4th, etc.) harmonics are cancelled out. Hum in the plate supply circuit is balanced out. Push-pull circuits are used at both audio and radio frequencies.

push-pull transformer—An iron-core a.f. transformer designed for use in a push-pull amplifier circuit. If it is the input transformer, it will have a center-tapped secondary winding. If it is the output transformer, it will have a center-tapped primary winding.

(To be continued next month)

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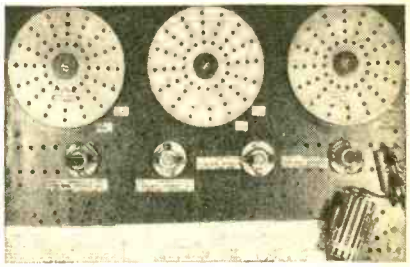

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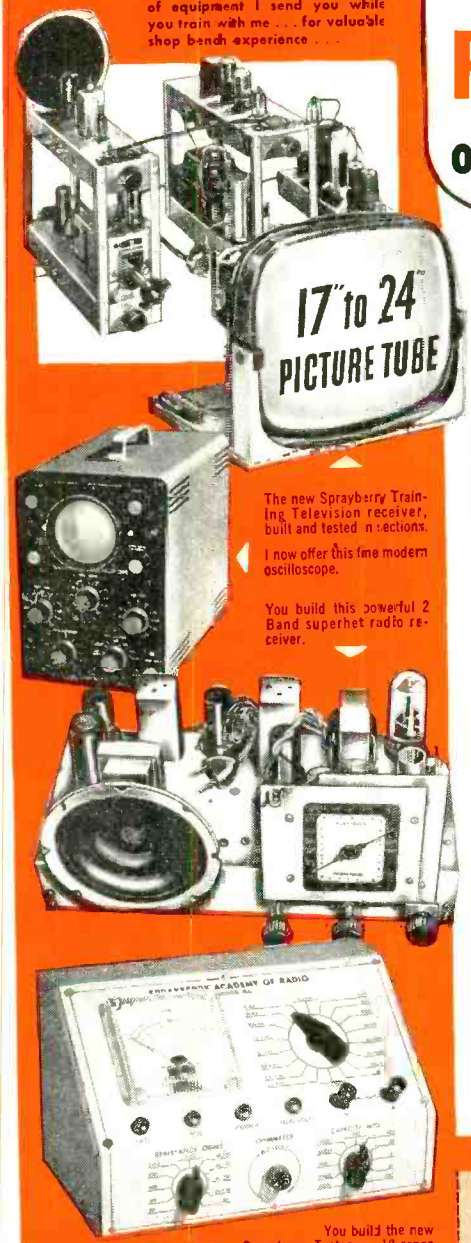

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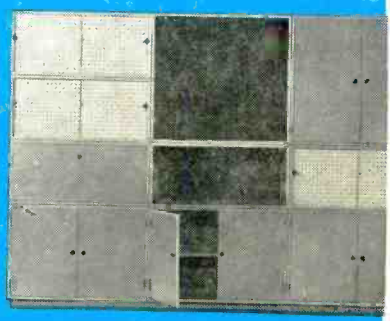

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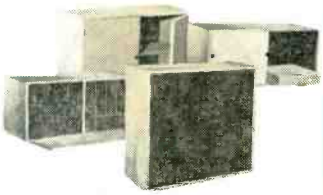

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