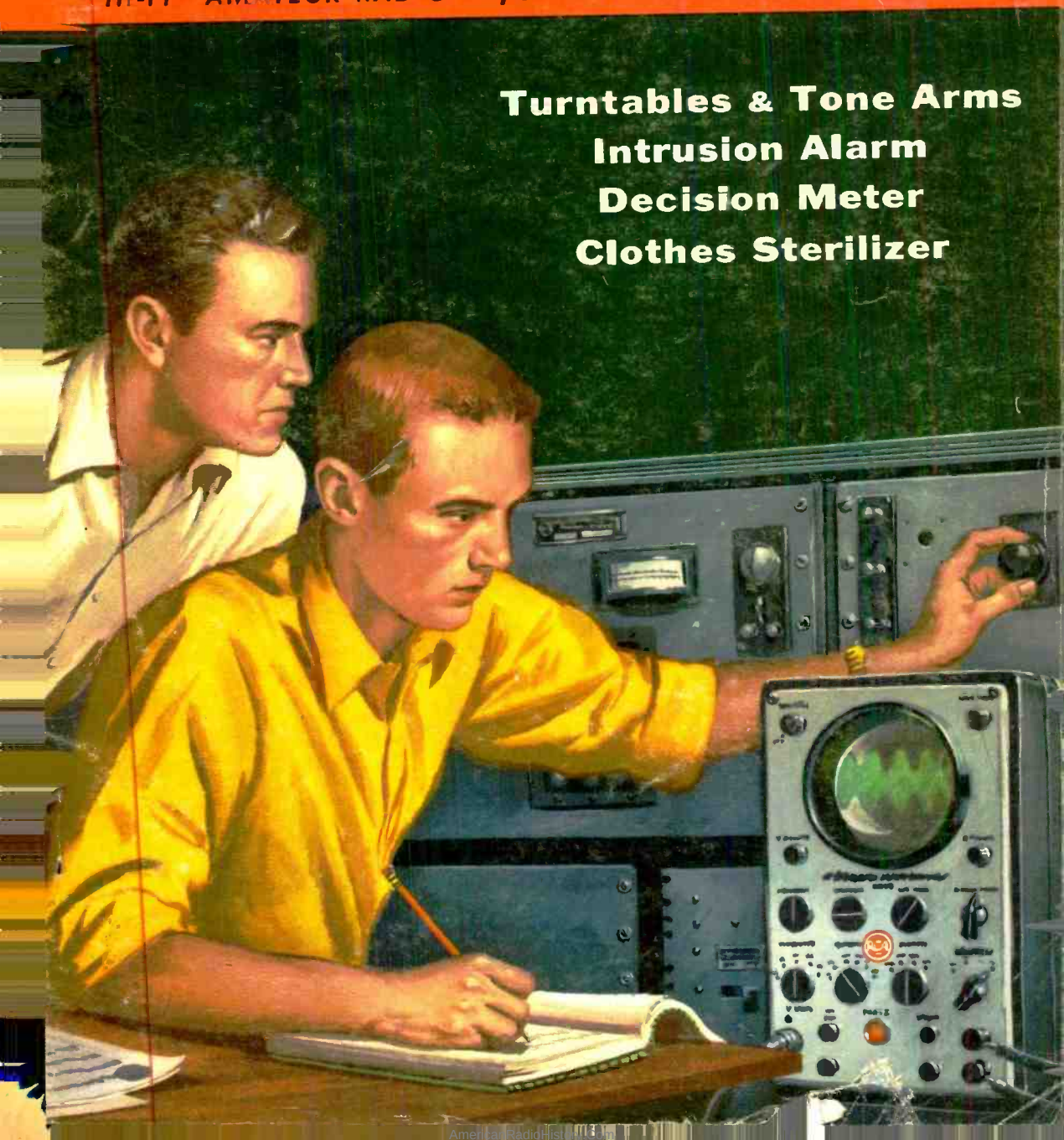
POPULAR ELECTRONICS

OCTOBER 1955

25 CENTS
In U.S. and Canada

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

Turntables & Tone Arms
Intrusion Alarm
Decision Meter
Clothes Sterilizer



Q. Each the best! What'll you have?

Model T . . . "The Crest"

$32.50 manual?

Compact, rugged 3-speed unit with automatic start and stop; balance-mounted tonearm; 4-pole motor and other basic record-playing features of famed RC80 changer.

Model RC80 . . . "The Triumph"

$49.50 changer?

Experts choice, and your best buy in fully automatic 3-speed record changers. Gentle, precision pusher platform; interchangeable removable spindles; rumble-free 4-pole motor and many exclusive Garrard features.

Model 301 . . . "The Professional"

$89.00 turntable?

Performance certified! Each transcription unit with its own written inspection report. All 3 speeds variable; special 4-pole motor with exclusive floating, rumble-free, dynamically balanced turntable.

All prices net, less cartridge.

A. Suit your preference and your pocket with a GARRARD

The World's Finest!

A quality-endorsed product of the British Industries Group: Garrard, Leak, Wharfedale, RJ, Genalex, Multicore components. Write today for 16-page illustrated booklet, "Sound Craftsmanship" to: British Industries Corporation, Dept. PE10, 164 Duane St., New York 13, N. Y.

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

CONTENTS

POPULAR ELECTRONICS Audio and Hi-Fi Section

DEPARTMENTS

(Also see page 6)

Cover Painting by Ed Valigursky

OCTOBER 1955

VOL. 3-NUMBER 4

EDITOR
OLIVER READ, W1ETI

MANAGING EDITOR
O. P. Ferrell

TECHNICAL EDITOR
H. S. Renne

FEATURE EDITOR
Norman Eisenberg

ASSOCIATE EDITORS
M. C. Magna
Charles Tepfer

ART EDITOR
A. J. Reich

CONTRIBUTING EDITORS
H. Bennett — R. Legge
H. S. Brier — H. Pollack
J. T. Frye — R. P. Turner
L. E. Garner, Jr.

ART DEPARTMENT
Frank Sayles (Director)
J. A. Golanek — M. Whelpley

ADVERTISING DEPARTMENT
NEW YORK (MU 7-8080)
L. L. Osten—Adv. Dir.
Wm. G. McRoy—Adv. Mgr.
T. Suito
CHICAGO (AN 3-5200)
James Weakley
LOS ANGELES (Mich. 9856)
John E. Payne

ZIFF-DAVIS PUBLISHING COMPANY

W. B. ZIFF (1898-1953) FOUNDER

Also Publishers of
RADIO & TELEVISION NEWS

Editorial and Executive Offices
366 Madison Ave., New York 17, N. Y

PRESIDENT
B. G. DAVIS

VICE-PRESIDENTS
H. J. MORGANROTH — M. FROELICH

SECRETARY-TREASURER
G. E. CARNEY

CIRCULATION MANAGER
M. MICHAELSON

BRANCH OFFICES
Chicago (1), 64 E. Lake St.
Los Angeles (14), Statler Center, 900 Wilshire Blvd.

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.

CONTRIBUTIONS:

Contributors are advised to retain a copy of their manuscripts and illustrations. Contributions should be mailed to the New York Editorial Office and must be accompanied by return postage. Contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to whatever adaptations and revisions are necessary to meet the requirements of this publication. Payment covers all author's, contributor's and contestant's rights, title, and interest in and to the material accepted and will be made at our current rates upon acceptance. All photos and drawings will be considered as part of material purchased.

Prepare now
IN SPARE TIME AT HOME
for great opportunity field of...

TELEVISION
RADIO-ELECTRONICS

The future is YOURS in TV-RADIO!

A fabulous field—good pay—fascinating work—a prosperous future! Good jobs **or** independence in your own business!

Modern Training by Coyne
RIGHT IN YOUR OWN HOME

Coyne brings you the first **truly lower cost,** MODERN —QUALITY Television Home Training; training designed to meet Coyne standards. Not an old Radio Course with Television "tacked on." Here is MODERN TELEVISION TRAINING including working knowledge of Radio. Includes UHF and **COLOR TV.** No Radio background or previous experience needed. Personal guidance by Coyne Staff.

The Institution Behind this Training

Famous for over 55 years, COYNE ELECTRICAL SCHOOL occupies this entire 5-story building. Coyne's modern resident training of men for Television, Radio, Electronics and Electricity has produced thousands of successful graduates.

B. W. COOKE, President — FOUNDED 1899

COYNE
ELECTRICAL SCHOOL
A TECHNICAL TRADE INSTITUTE OPERATED NOT FOR PROFIT
500 S. Paulina Street, Chicago 12, Dept. 75-HT6
MAIL COUPON NOW FOR DETAILS FREE

LEARN TO
EARN IN SPARE TIME AT HOME

COYNE offers a most practical, Home Television Training. Simple, easy to follow step-by-step instructions, fully illustrated. **Practical Job Guides** to show you how to do actual servicing jobs—**make money early in course.** Keep your present job while training.

Low Cost—Easy Terms

We save you money because we don't send you—AND CHARGE FOR—a long list of parts or "put together kits," which you may not want or do not need. With Coyne Television Home Training you pay only for your training, **no costly extras.**

Let us show you that this is not only the newest, most up-to-the-minute Training in Television-Radio-Electronics—but also **it costs you much less than other leading home training courses.** Send coupon today for details including Easy Payment Plan.

SEND COUPON FOR FREE BOOK

and full details, including Easy Payment Plan. **No obligation, no salesman will call.**

COYNE ELECTRICAL SCHOOL
Television Home Training Div.
500 S. Paulina St., Chicago 12, Ill.
Dept. 75-HT6

Send Free Book and details on Television Home Training. This does not obligate me and no salesman will call.

*Name*_____

*Address*_____

*City*_____ *State*_____

ITEMS OF INTEREST

NEW PRODUCTS

COMING NEXT MONTH

POPULAR ELECTRONICS

Reflex Receiver
By using the same tube for both r.f. and a.f. amplification, excellent performance can be obtained with a minimum of components.

Introduction to Puzzle-tronics
"Three Jealous Husbands" and other intriguing puzzle circuits are discussed.

Easily Built Chassis Rack
How to build an inexpensive chassis rack which will enable easy wiring and allow ready access to a chassis from both sides.

Your Career in Electronics (Part 3)
The third and final article in this series covers the advantages of correspondence schools that teach electronics by the home study method.

Experiments with Simple Solar Batteries
Practical applications of readily available selenium-type self-generating photocells are demonstrated.

The Permanent Electric Clock
A 6-volt automobile clock that does not require house current (117 volts, a.c.) but will operate on six volts, a.c., taken from a filament transformer.

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

(October)

Industrial TV
A Review of New Record Players
High-Fidelity Bugs
A Modern FM Carrier-Current Receiver
Tape Recording—The Tape
The Electronic Decimal Counter

LETTERS FROM OUR READERS

Kit for Metal Locator

■ Where can I get a kit of parts to build the metal locator featured in your June, 1955, issue?

W. T. HENSLEY
El Paso, Texas

The various parts may be purchased at most dealers. A complete kit is available from Thrifty TV Supply, *13647 Burbank Blvd., Van Nuys, Calif.*

Saturable Reactors

■ In our plant, we are getting equipment which employs saturable reactors in increasing numbers. Can you furnish me with sources of information, such as books, on these devices?

J. KATONA
Ontario, Canada

As far as we can determine, there is no book solely devoted to the topic of saturable reactors. Much of the theory behind the construction and operation of these reactors is available in textbooks written by Terman, Henney, etc.

Parts for the Theremin

■ I am interested in constructing the Theremin described in your April, 1955, issue, but have been unable to locate a source for some of the required parts.

R. P. MCCLINTOCK
Kansas City, Mo.

The Allied Radio Corp., *100 North Western Ave., Chicago, Ill., and the* Hudson Radio Co., *48 West 48th St., New York, N. Y., report that they have all the necessary parts immediately available.*

Code Oscillator with Speaker

■ I would appreciate seeing soon a circuit for a code oscillator (a.c. only) with a 4" speaker and a plug for headphones, plus a fine pitch and volume control.

BEN KOENIG
Brooklyn, N. Y.

Full construction details on this type of unit will be published in the very near future.

Spark-Coil Signal Generator

■ In the "Letters from Our Readers" department of your July, 1955, issue, I noticed that Mr. V. A. Burton, of Encinitas, Calif., asked about a spark-coil signal generator for locating metal pipes. I have used this type of device in the Navy for locating pipes, cables, etc. As far as I can recall, it was a Model "T" Ford coil with a timer that would send a series of dashes (— — — —, etc.). When used on a pipe, a coil was placed around the pipe and connected to the Ford coil. When used on cable, the Ford coil was connected di-

rectly to the cable, with one wire to ground. The receiver was a simple coil of wire about two feet in diameter, with about 100 turns (more or less) of No. 22 wire, connected to an amplifier and thence to a headset.

I'm sorry I cannot remember the details of its construction, but I have seen such devices on the market for sale as war surplus items. I hope this information will be of some help to Mr. Burton.

Now, can anyone come to my rescue and tell me how to replace the paper cones in loudspeakers?

A. J. CIARROCCA
Coraopolis, Pa.

Receiver Diagrams

■ Is there any possibility of your printing a diagram showing how to build one's own receiver?

ANDREW NOWAK, JR.
Buffalo, N. Y.

Starting in our November issue, we will be publishing more month-to-month diagrams and construction data on simple radio receivers.

"World Radio Handbook"

■ I would appreciate it very much if you would forward the address from which the "World Radio Handbook" is available.

GERALD E. MORRIS
Denver, Colo.

The "World Radio Handbook" is available from Gilfer Associates, *Box 239, Grand Central Station, New York 17, N. Y. Price of the current issue is $2.00 per copy.*

Request for Theremin Reprint

■ May we have permission to reprint the Theremin article (April, 1955, issue) in a future issue of "The Braille Technical Press?" We would, of course, credit POPULAR ELECTRONICS and the author.

R. W. GUNDERSON, Editor
The Braille Technical Press,
New York, N. Y.

Permission to reprint the Theremin article in "The Braille Technical Press" is granted, and thank you for your interest.

Buying Geiger Tubes in Canada

■ A great many experimenters here in Canada and the United States will want to build the instruments described in your Geiger counter issue (July, 1955). I would like you to pass the following information on to all your readers, especially those in Canada.

A leading electronics supply store in Toronto *(Alfa & Aracon Radio Co., Ltd.)* has advised me that in order to purchase a Geiger counter tube the person wishing to make such a purchase must write a letter to the Canadian Government, to the attention of the dealer with whom he is doing business, stating the following: (1) the type of electronic instrument in which the Geiger counter tube will be used; (2) the use to which the completed instrument containing the Geiger counter tube will be put.

I was also told that to buy a Geiger tube from

Prepare Now... in spare time at Home... for a New,

PROFITABLE, INTERESTING FUTURE in TELEVISION RADIO - ELECTRONICS

RADIO CHIEF OF ILE DE FRANCE FRENCH LUXURY LINER PRAISES D. T. I.

Radio Chief—Jean Desmas Says:

"Your Training Organization in Chicago is known not only throughout Europe, but also in many parts of the world as one of America's finest Television, Radio and Electronics training centers."

JACK DEMPSEY

Former World's Heavyweight Champion TELLS WHY HE'S PROUD TO BE WITH D. T. I.

- *I have been greatly impressed with D.T.I.'s wonderful spirit of friendliness and sincere determination to help its students make good in Television-Radio-Electronics.*
- *I admire its remarkable 24 year record of helping men build brighter futures.*
- *I also admire the business policy of its management and the thoroughness of its large faculty of instructors.*
- *Never have I heard young men praise a school as enthusiastically as do the students and graduates of D.T.I. They are its best boosters.*

Prepare At Home Or In Our Chicago Laboratory!

See for yourself how readily you may prepare at home, or in our modern Chicago laboratories, for a good job or business of your own in one of America's most promising, fast-growing fields—TELEVISION-RADIO-ELECTRONICS.

If you train at home you get (1) the use of a 16-mm. movie projector and 16 reels of animated movies to help you learn important points faster . . . easier, (2) modern, well illustrated lessons and (3) sixteen shipments of electronic parts enabling you to get valuable practical experience from over 300 projects—including building and keeping the electronic equipment shown below. And upon completing training, you have the optional privilege of building and keeping a big 21 INCH TV Set. (D.T.I. offers another home training in Television-Radio-Electronics, but without the TV set.) Get the full story. Mail coupon today!

LAUD D.T.I.'s HOME MOVIES IN CONGRESS

D. T. I.'s remarkable home training benefit of visual training MOVIES has been praised from the floor of the House of Representatives in Washington, D.C. and recorded in the Congressional Record.

If subject to military service, the information we have for you should prove very helpful. Mail coupon today.

"One of America's Foremost Television Training Centers"

DeVRY TECHNICAL INSTITUTE
CHICAGO 41, ILLINOIS
FORMERLY
DeFOREST'S TRAINING, INC.

MEMBER OF NATIONAL HOME STUDY COUNCIL

MAIL COUPON TODAY!

DeVRY TECHNICAL INSTITUTE
4141 BELMONT AVE., CHICAGO 41, ILL.
Dept. RE-10-L

I would like your valuable information-packed publication showing how I may get started toward a good job or my own business in Television-Radio-Electronics.

Name_____ Age_____
(PLEASE PRINT)

Street_____ Apt._____

City_____ Zone_____ State_____

D. T. I.'s Training is Available in Canada

the United States the above procedure would still have to be followed, and that the Canadian Government would forward the letter to the U. S. Government after okaying it.

In other words, no Geiger counter tubes may be purchased in Canada without the written permission of the Canadian Government. Please pass this information on, because you have a very large number of readers here in Canada, and I would like to have them all know the score on this.

PAUL J. KAPITAN
Mimico, Ontario

Subscription TV: Pro and Con

■ Subscription or "Toll-TV" is, to my mind, an excellent way of permitting better programs to be telecast. If, as the proponents of the new system say, we would be treated to first-run shows and important sports events, then it would certainly be worth the additional few dollars a month such entertainment would cost. There's no good reason why people living outside New York City should not be privileged to see Broadway stage shows.

M. J. RASKIN
Oklahoma City, Okla.

■ I read your review of the book "Pay As You See TV" (August, 1955, issue) and it stirred me to let you know what one reader thinks of this idea. Briefly, I think it's horrible. We're paying now for the TV shows we see: we pay for the initial cost of the TV set, we pay for the installation and the antenna, we pay for upkeep and maintenance of the set, we pay additional money on our monthly electric bill, and we pay every time we buy one of the products that is advertised on any show. If any further paying is required to watch a TV program—I'll nail boards over the screen and stick to my radio and the local movie houses for entertainment.

HANK DORFMAN
Newark, N. J.

Transistor to Act Like Thyratron

■ I would like to know if there is any kind of a transistor that can be made to behave like a thyratron.

MARTIN J. BRIEHL, JR.
Bellevue, Ohio

A point-contact transistor can be made to operate in a fashion similar to that of a thyratron. The cost of point-contact transistors is, of course, quite high.

Loudspeaker Repairs

■ I would like to know something about repairing loudspeakers. Would this be a profitable business? Also, I do not fully understand how transistors work. I would appreciate any information you can give me on these two things.

HERMAN DOMINEY
Corpus Christi, Texas

Loudspeaker repairs that you can make at home were described in our April, 1955, issue. In most cases, any repairs more involved than those, such as replacing a cone, would probably be so com-

A dramatic demonstration of a new idea to help you understand music better and enjoy it more...

MUSIC-APPRECIATION RECORDS

Will you accept WITHOUT CHARGE

A COMPLETE PERFORMANCE—WITH AN ILLUMINATING ANALYSIS ON A SEPARATE RECORD—OF

Tchaikovsky's

FIFTH SYMPHONY

MAX RUDOLF, *conducting*

THE STADIUM CONCERTS SYMPHONY ORCHESTRA

NOTE: Because of the length of the symphony, the Tchaikovsky recording is on two records—a 12" disc with the performance on both sides, and a 10" disc with the analysis on both sides.

ON ONE SIDE there is a full performance of a great musical work, featuring artists and orchestras of recognized distinction. You listen to this performance, and then...

ON THE OTHER SIDE is an analysis of the music, with the main features played separately and explained, so that you can learn *what to listen for.*

YOU WILL RECEIVE SEPARATELY A GLOSSARY OF MUSICAL TERMS

SPONSORED BY THE BOOK-OF-THE-MONTH CLUB, this new idea is designed for those who enjoy good music but who are aware, too often, that they do not listen to it with complete understanding. There is no doubt about the reason: most of us are not primed about *what to listen for.* MUSIC-APPRECIATION RECORDS meet this need—for a fuller understanding of music—better than any means ever devised.

YOU TAKE ONLY RECORDS YOU WANT . . . A new MUSIC-APPRECIATION RECORD is issued every month preceded by an announcement written by Deems Taylor. After reading this descriptive essay you may take the record or not, as you decide. *You are not obligated to take any specified number of records.*

TWO TYPES OF RECORDS . . . These are high-fidelity long-playing records of the highest quality—33⅓ R.P.M. on Vinylite. They are *twelve-inch* discs priced at $3.60. An Analysis-Only Record – a *ten-inch* disc—is also provided for those who may want it alone, and is priced at $2.40. (A small charge is added to cover postage and handling.)

TRY IT ONE MONTH—NO OBLIGATION TO CONTINUE . . . The *Tchaikovsky* recording will be sent to you at once—*at no charge.* You may end the subscription immediately after hearing this recording or any time thereafter.

PLEASE RETURN ONLY IF YOU HAVE A 33⅓ R.P.M. RECORD PLAYER

MUSIC-APPRECIATION RECORDS R68-10
c/o Book-of-the-Month Club, Inc., 345 Hudson Street, New York 14, N. Y.

Please send me at once the Music-Appreciation recording of *Tchaikovsky's Fifth Symphony,* without charge, and enroll me as a Trial Subscriber to MUSIC-APPRECIATION RECORDS, with the privilege of canceling at any time. I understand that, as a subscriber, I am not obligated to buy any specified number of records, but may take only those I want. Also, I may cancel my subscription after hearing the first recording, or any time thereafter at my pleasure, but the gift offer is free in any case.

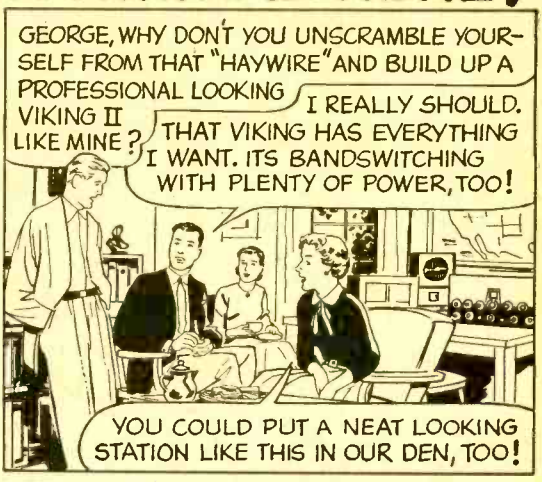
Mr. }
Mrs. } .....
Miss } (PLEASE PRINT)

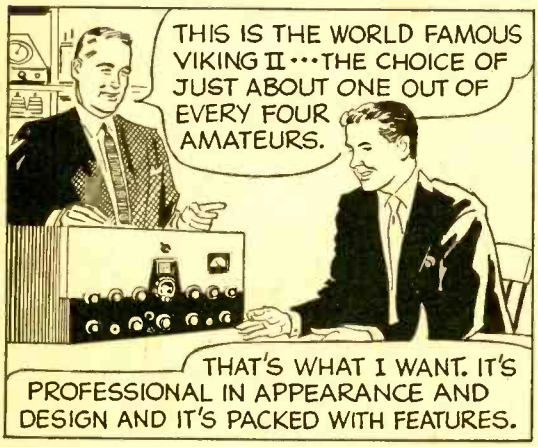
ADDRESS.....

CITY..... Postal Zone No. (if any) ..... STATE..... MAR 40

Thanks for that 5 by 9 plus, Algiers!

WE'RE USING A VIKING II HERE!





VIKING II TRANSMITTER KIT

- 10 Thru 160 Meters
- 180 Watts CW Input
- 150 Watts Phone Input

Available wired and tested, with tubes . . . or as a complete kit, the Viking II is today's most popular amateur transmitter.

Cat. No. **240-102.** Complete with tubes, less crystals, key and mike. **$279.50** Amateur Net

Cat. No. **240-102-2.** Wired and tested with tubes, less crystals, key and mike. **$337.00** Amateur Net

MAIL TODAY

E. F. JOHNSON COMPANY
308 Second Ave. S. W., Waseca, Minnesota

Please send me a copy of Catalog No. 714, containing a complete written and pictorial description of the Viking II.

NAME _____

ADDRESS _____

CITY _____ STATE _____

NOW...Start Fixing TV and Radio Sets RIGHT AWAY

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

Prove It on Your Own Set

Save up to $50 a year just by 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—snows—drifts—etc., etc.

PARTIAL CONTENTS

Tools Needed • How TV and Radio Sets Work • How to Remove and Replace Tubes • Testing Tubes without a Tester • Using a Tube Tester • Power-Supply Troubles • How to Test and Replace Resistors, Controls, Switches, Condensers, Coils, Transformers • Tuning Devices • Loudspeakers • Phono Pickups and Needles • How to Install and Repair Antennas . . . and MUCH MORE. . . .

TELLS HOW TO "Cash in" ON THE BIG DEMAND FOR RADIO-TV REPAIRMEN

Over 25 million TV sets . . . over 100 million radios in this country! Shortage of skilled repairmen! You can make nice extra money just fixing sets for friends and neighbors in your spare time . . . or start your own full-time repair business, with steady profits. Book tells exactly how to get started; how to plan your workshop; which tubes to stock; where to get information; how to make a service call. You can start fixing sets and making money. Author tells how tough jobs can be done so you STILL make money, before you're halfway through book.

Trouble Shooting Chart Tells Where to Look for Bad Tube IF:

No picture; no raster; no sound.
No picture; raster OK; no sound.
No picture; no raster; sound OK.
No picture; raster OK; sound OK.
Picture wiggles and weaves, lacks blacks, or is very black; raster OK; sound OK.
Picture jittery, double image; raster OK; sound OK.
Snow on all channels; raster OK; sound weak.
Snow on all channels, raster OK; sound OK.
Picture and raster do not fill screen; sound OK.
Picture drifts up and down but not sideways; raster OK; sound OK.
Picture muddy and gray; raster OK; sound OK.
. . . PLUS 29 OTHER COMMON TV TROUBLES.

. . . even if you have never fixed a LAMP or DOOR BELL before!

Why hasn't somebody done this BEFORE?" That's what you'll say the minute you start browsing through this amazing new and complete one-volume instruction-manual in radio and TV repairs.

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 professional rates.) Right from the very first chapters you can start doing simple repairs . . . and before you're HALF way through the book, you can fix HALF the television and radio sets that you encounter. Surprisingly quickly you can fix your own and friends' sets . . . get a service shop job . . . even start your own money-making business right in your own home.

Why It's So EASY to Understand

No electronic formulas . . . no algebra . . . no laboratory experiments. Instead you deal *only* with the things that go wrong in sets—how to recognize and spot 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.

The author is Associate Editor of *Electronics* Magazine. He's a long-recognized expert—not only on radio and TV—but also on making technical subjects easily understood by the average reader. He has spent FOUR years making this one-volume instruction manual so practical and easy-to-understand that even a man who never fixed a door bell before will have no trouble.

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

SEND NO MONEY

Examine this big 556-page book for 10 days BEFORE you decide if you wish to own it. Try it out FREE on your own set. See how easy it makes your handling of repairs. Take 10 days to prove it PAYS FOR ITSELF, or don't keep it. Just mail coupon to: **McGraw-Hill Book Co., Inc., Dept. PEL-10, 327 West 41st St., New York 36, N. Y.**

FREE 10-DAY TRIAL COUPON

McGRAW-HILL BOOK CO., Dept. PEL-10
327 West 41st St., New York 36, N. Y.

Please send me, for 10 days' FREE EXAMINATION, your one-volume "Television and Radio Repairing" by John Markus. If not delighted with it, I may return book, pay nothing. Otherwise, I will keep book and send only $1.95 plus postage; followed by 3 monthly installments of $2.00 each.

Name .....

Address .....

City ..... Zone .... State .....

☐ **SAVE MONEY.** Check here if enclosing full price of $7.95 WITH this coupon. Then WE will pay delivery. Same 10-day return privilege—full refund guaranteed. PEL-10

plex and costly that it might be a better idea to buy a new speaker. As a rule, repairs on expensive speakers are made by the manufacturer. Apart from this, such highly specialized work is, in itself, not much of a field either in terms of the number of people in it or the money to be made.

As for transistors, try the Sylvania *booklet, "Transistors and Their Applications," available for 25 cents from* Sylvania Electric Products Inc., *1740 Broadway, New York 19, N. Y.*

Phono Playback Equipment

▪ Your article on pickups (June, 1955, issue) was fine, and clarified a few points for me on this subject. How about following it up with a piece on turntables, arms and phono motors? Frankly, there seems to be so much "meat" in this area that I don't know which way to turn in making a selection for my own home system.

RALPH W. RAWLINS
Scranton, Pa.

See our article entitled "What You Should Know About Record Players" in the September, 1955, issue of POPULAR ELECTRONICS. *This story discusses automatic record changers and manual or "single-play" record players. Each of the units described has been found to meet basic requirements for use in a home hi-fi system.*

Starting on pages 75 and 80 of this issue, you will find articles which discuss separate tone arms and turntables that are available to the home audio enthusiast, and which—when properly assembled—provide the ultimate in record-playing equipment.

"Gag" Record Titles

▪ Carl Kohler's story "Scheme and Variations" (July, 1955, issue) was tops. It describes the situation in my own household exactly. By the way, were the titles of jazz records used in the story real, or were they "gags"?

BUD STERNMAN
Omaha, Nebr.

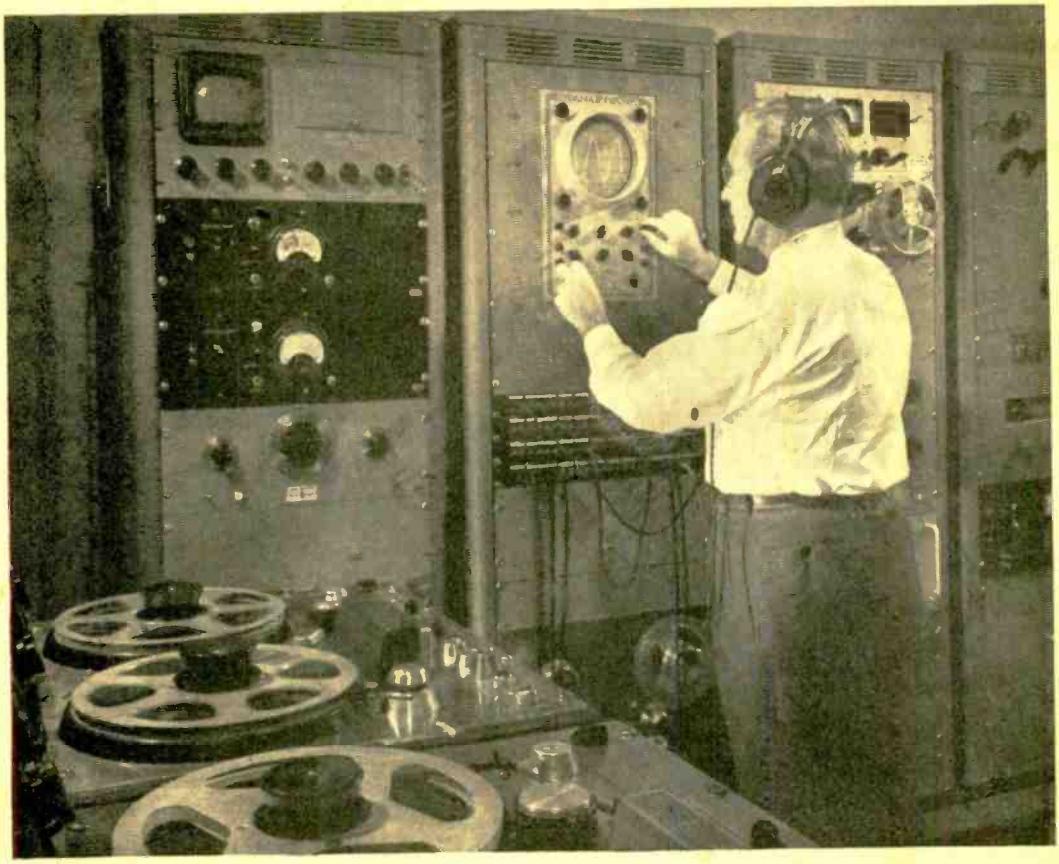
Thanks for the applause. The titles were, as you put it, "gags"—but, we believe, vaguely reminiscent of the extravagant characteristics of some recent discs.

Electrostatic Reproducers

▪ The little items in your August, 1955, issue on electrostatic tweeters (pages 40 and 89) were very interesting. Can you tell me anything about an electrostatic woofer? In other words, what's the word on a full-range speaker system using only electrostatic reproducers?

SIDNEY PEARL
Rochester, N. Y.

Frankly, we too would like to know "what the word is" on these units. Rumors have it that sooner or later the electrostatic principle will be applied to speaker systems that cover the entire audio range. Rumors further have it that such systems will be commercially available, to home users, at prices that compare with the better speaker systems currently on the market. Until we see and hear such systems, however, the entire thing is still in the rumor stage. —30—



"SCOTCH" BRAND JUGGLES ATOMS

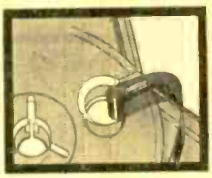
to produce the finest long play magnetic tape!

Years ago "SCOTCH" Brand pioneered modern magnetic tape—and solved a knotty technical problem at the same time. The problem? How to produce recording tape with a uniform, magnetically-responsive oxide surface for finest recording results.

"SCOTCH" Brand does it by making its own oxide coatings. It's a difficult job and *only* "SCOTCH" Brand does it — splitting atoms to transform unmagnetic oxide into a *super*-magnetic coating sensitive enough to record even a whisper! But this extra work is worth the effort, as you'll hear yourself. *Today*—listen to a reel of new "SCOTCH" Brand Extra Play Magnetic Tape 190. It offers you 50% more recording time on a standard-size reel, *plus* complete fidelity and purity of sound.

New!* "LOOP-LOK" *reel for easier threading!

Saves time...saves tape! It's "SCOTCH" Brand's exclusive "LOOP-LOK" reel. Just loop tape around the new-design center pin for instant threading. Tape locks tight without necessity of wasteful wrap-around, yet releases fast at end of reel. Enjoy this "SCOTCH" Brand feature at no extra cost!



SCOTCH BRAND *Extra Play* **Magnetic Tape 190**

with 50% more recording time

WHAT'S THE PE ANSWER?

Delayed Audio Signals

Could you give me any information as to how to effect a delay of an audio signal without distorting it, whether by a special circuit or otherwise?

LEON COTTRELL
San Diego, Calif.

Delay networks are commercially available which will delay an audio signal by any desired amount. A tape recorder with an extra playback head can also be employed for recorded material. This extra head is located behind the regular playback head, the spacing being determined by the amount of delay required. For example, with a tape speed of 7½ ips, a spacing of ¾" will provide a delay of 1/10 second. This scheme is sometimes used to produce artificial reverberation effects.

If the original signal is being recorded on tape, a delayed signal may be obtained by locating a playback head behind the recording head as indicated above.

Surplus Conversions

Would you mind telling me if it would be worthwhile to convert a surplus oscilloscope for use in my home workshop? It is a BC-929, and uses a 3BP1 C-R tube, two 6SN7's, two 6H6's a 6G6, 6X5, and 2X2. The power transformer and what appears to be a choke are missing. Also, do you know where I might get a schematic or some conversion data on this scope?

R. A. SHIPP
South Gate, Calif.

In general, we do not recommend conversion of surplus equipment unless the changes required are minor. Several companies sell kits which are nearly as cheap as surplus equipment, have a professional appearance, and usually perform much better.

There is at least one advertiser in our sister publication, RADIO & TELEVISION NEWS, that sells conversion instructions on various items of surplus equipment. Perhaps this company can provide you with the desired information.

Rain Alarm Has Fail-Safe Feature

I have read with great deal of interest the article concerning the "Rain Alarm" (June issue, page 58), and find that such a circuit is exactly what I have been looking for. There is, however, a slight problem in my particular application. I need a circuit that will "pull in" when the resistance is reduced. The reason for this is that I wish the circuit to be a little more foolproof.

JOSEPH JANES DUNN
Mineral, Va.

The present circuit has a "fail safe" feature, i.e., in case of a component failure, the relay

would drop out and actuate the alarm. This is the ideal type of operation; if the circuit were redesigned as requested above, failure of any components would not result in a warning to the user.

Converting to Battery Operation

I would like to change a tape recorder now operating on 110-120 volts to battery operation.

G. JENTZENS
Washington, D. C.

It is difficult to give general instructions on converting a 117-volt a.c. tape recorder to battery operation without knowing more about the recorder. Usually, the motor in such a recorder requires a 117-volt 60-cycle source, and cannot be directly converted. The electronic portion would require A and B batteries giving the same voltages as are presently used.

We recommend that an inverter be used, along with a 6- or 12-volt storage battery.

Crystal Receiver for R/C

Is it practical to trigger one of the new sensitive radio-control relays by means of the output of a receiver using a crystal diode with no external power supply for the receiver?

MELVYN JAFFA
Brooklyn, N. Y.

A crystal receiver can be readily designed to operate at R/C frequencies. However, the amount of power available from such a receiver would in general be far too small to provide reliable operation of even a very sensitive relay. The limited antenna size on R/C models and the low output power of most R/C transmitters severely restrict the power picked up by the receiver antenna.

Car Battery Inverter

I have an a.c.-d.c. set in the country. Sometimes the power line fails and I want to hook the set up to my car battery. Can you show a power supply taken from a 6- or 12-volt car battery that might be used for such operation?

CHARLES KUNDE
Roselle, Ill.

In the May issue (page 98), there was an article on "Tape Recorders" by Bert Whyte which I found very interesting. I was wondering what would be the best and cheapest way to put a tape recorder in my car, which has a 6-volt system.

WILLIAM J. GENTRY
Hoisington, Kans.

I wonder if you could provide some details or diagrams of a converter which would enable me to get 115 volts, 60 cycles, and 50 watts from my car battery.

HANS R. STEINHARDT
Rochester, N. Y.

Operation of 117-v.a.c. or a.c.-d.c. equipment from a 6- or 12-volt car battery is best accomplished by means of an inverter. Several good commercial units are available for this purpose, the price depending somewhat on the power required. We have not published construction details on such units because the required components would cost nearly as much as a commercial unit. Contact your local parts distributor for further information. —30—

NOW! SAVE up to 50%

BUILD YOUR OWN

E-V HIGH FIDELITY Speaker Enclosure

EVERY PIECE PRECUT

in *Ready-to-Assemble* KITS

Now you can own an acoustically correct *Electro-Voice* high-fidelity folded-horn speaker enclosure for your home music system and *save up to one-half!* Build it yourself...seven models to choose from...wall types...corner types...for full range loudspeaker...for separate two, three and four-way speaker systems.

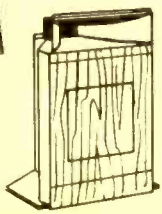
All parts are precut—ready to assemble. Exterior surfaces are clear-grained birch. Easy, step-by-step instructions show you how to "Do-it-Yourself."

Beautiful furniture finish is easily obtained with an E-V Finishing Kit.* E-V Decorative Trim Kit* adds the final touch. (*Available separately.)

See your E-V Hi-Fi Distributor for Construction Books and K-D Kits —or write for Bulletin 211.

Electro-Voice®

ELECTRO-VOICE INC. • BUCHANAN, MICH.

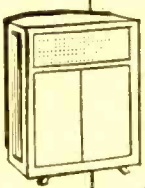


THE PATRICIAN IV KIT. An interior assembly kit for those desiring the finest. This augmented design of the Klipsch corner folded-horn bass section delivers an added full octave of bass. Designed for use with E-V Model 103C Patrician IV four-way driver components. For built-in installations or to be decorated as you choose. Finished size: 57½ in. high, 34½ in. wide, 26⅞ in deep. Shpg. wt. 150 lb.

Model KD1 Net, $99.00

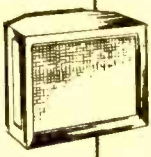
THE GEORGIAN KIT. An interior assembly kit that creates authentic Klipsch indirect radiator type corner folded-horn bass section for 15 in. 4-way speaker system. Exceeded in range only by the Patrician IV. For use with E-V Model 105 or Model 117 package of 4-way driver components. For built-in installations or to be decorated as you choose. Finished size: 38½ in. high, 26¾ in. wide, 22½ in. deep. Shpg. wt. 88 lb.

Model KD2 Net, $58.00



THE CENTURION KIT. Four-way system folded-horn, corner enclosure. Uses exclusive E-V "W" type single-path indirect radiator for propagation of extended bass. Sealed cavity behind 15 in. low-frequency driver cone promotes superlative transient response, subdues cone excursions, lowers distortion. For use with E-V Model 105 or Model 117 package of driver components. Finished size: 42⅛ in. high, 29 in. wide, 22½ in. deep. Shpg. wt. 75 lb.

Model KD3 Net, $79.00



THE REGENCY KIT. Most popular lowboy style folded-horn enclosure that can be used in corner or flat against one wall. Improves the bass range and response of any 15-in. speaker. Makes an outstandingly efficient reproducer when used with E-V SP15 coaxial speaker, 15TRX triaxial reproducer or 114A 2-way or 114B 3-way system. Finished size: 29⅝ in. high, 33½ in. wide, 19 in. deep. Shpg. wt. 70 lb.

Model KD4 Net, $69.00

THE EMPIRE KIT. Economical, folded-horn enclosure for use in a corner or flat against one wall. Designed for 15-in. speakers and separate 2 and 3-way systems. Particularly effective when used with SP15B coaxial speaker, 15TRXB triaxial reproducer, or 116 2-way or 116A 3-way system. Recommended components for Regency kit may also be employed. Finished size: 29⅝ in. high, 32 in. wide, 16 in. deep. Shpg. wt. 45 lb.

Model KD5 Net, $48.00

THE ARISTOCRAT KIT. Folded-horn corner enclosure designed for 12-in. speakers and separate 2 and 3-way systems. For use with Electro-Voice SP12 or SP12B coaxial speakers, 12TRX or 12TRXB triaxial reproducers, and 108, 111 2-way and 108A, 111A 3-way systems. Smooth reproduction down to 35 cps, with remarkable purity and efficiency. Finished size: 29⅝ in. high, 19 in. wide, 15¾ in. deep. Shpg. wt. 37 lb.

Model KD6 Net, $36.00

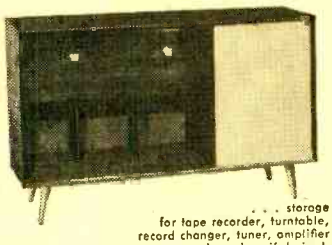
THE BARONET KIT. Phenomenal reproducer for such small size. This folded-horn corner enclosure is designed for use with E-V Model SP8B 8-in. Radax speaker. E-V T35 or T35B Super Sonax UHF driver can be added for a separate two-way system. Finished size: 23 in. high, 14 in. wide, 13 in. deep. Shpg. wt. 24 lb.

Model KD7 Net, $24.00

CABINART '56

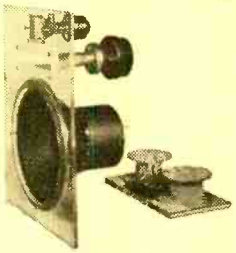
MODEL 10
MODEL 11
MODEL 21
MODEL 22
MODEL 27 ●
MODEL 28 ●
MODEL 27U ●
MODEL 28U ●
MODEL 65 ●
MODEL 70
MODEL 7112
MODEL 7115
MODEL 90
MODEL 91
MODEL 90U
MODEL 91U
MODEL 800 ●
MODEL 800U ●
MODEL KR-3
MODEL KR-3U
MODEL KR-4-12
MODEL KR-4-15
MODEL KR-5
MODEL KR-5-U
MODEL KR-5-P
MODEL ST-1 ●
MODEL ST-2 ●
MODEL ST-3 ●
MODEL ST-4 ●
MODEL ST-5 ●
MODEL ST-6 ●
MODEL ST-7 ●
MODEL ST-8 ●
MODEL ST-9 ●

MODEL 65



. . . storage for tape recorder, turntable, record changer, tuner, amplifier and speaker, if desired.

• 16 NEW EQUIPMENT CABINETS



THE Rebel 3 SPEAKERS

THE Rebel 4 SPEAKERS

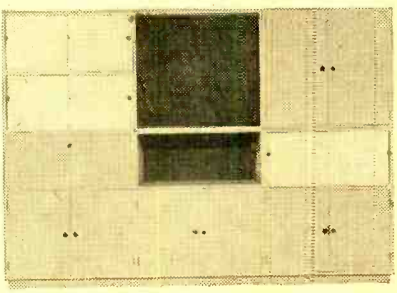
THE Rebel 5 SPEAKERS

CABINART SPEAKER SYSTEMS

KIT 27K ●
KIT 28K ●
KIT 80
KIT 8112
KIT 8115
KIT K-3 ●
KIT K-4-12
KIT K-4-15
KIT KST-1 ●
KIT KST-2 ●
KIT KST-3 ●
KIT KST-4 ●
KIT KST-5 ●
KIT KST-6 ●
KIT KST-7 ●
KIT KST-8 ●
KIT KST-9 ●

MODEL 27K
MODEL 28K

• TWELVE NEW HI-FI KITS



. . . EVEN A HI-FI STORAGEWALL

ACC-1
ACC-2
ACC-2U
ACC-3
ACC-4
ACC-5
ACC-6
ACC-7
ACC-7A

TURNTABLE BASE WITH LEVEL AND LEVELING DEVICES

RECORD CABINETS . . . 3 SIZES

and NINE HI-FI ACCESSORIES FOR THE SOUND ENTHUSIASTS.

Factory and Offices: B'klyn., N. Y.

Each CABINART design is an engineer's answer to an individual hi-fi equipment storage problem. Each cabinet, properly used, is a designer's expression of the elements of good furniture design.

If your hi-fi dealer does not stock Cabinart, write for the name of our nearest Cabinart dealer or mail order house.

WRITE

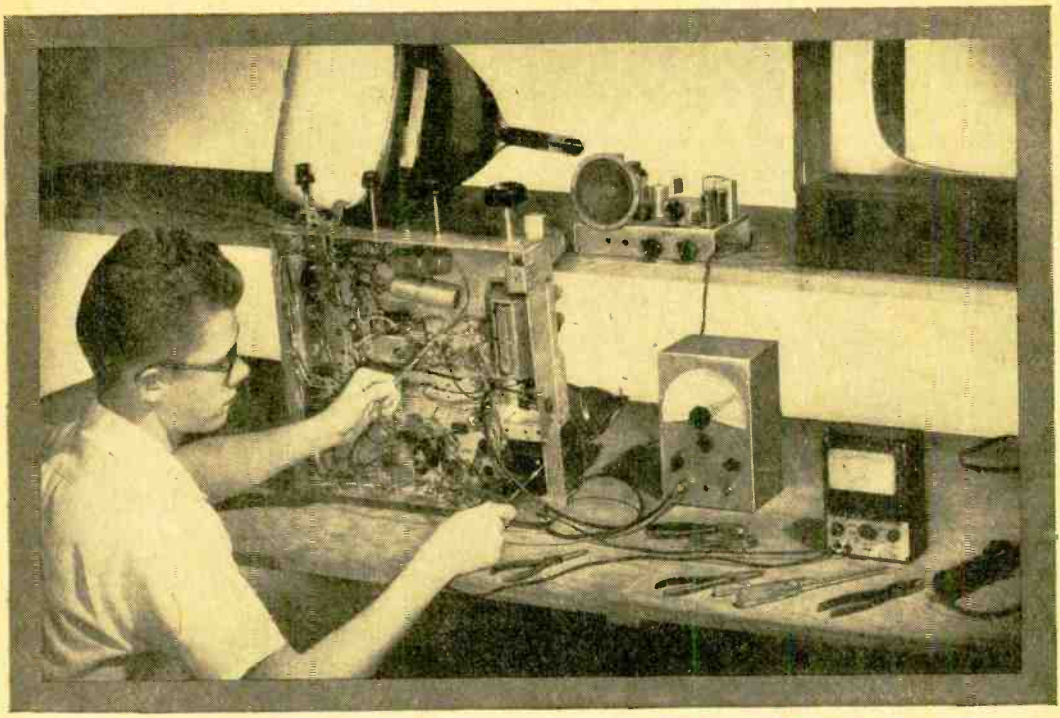
CABINART '56 CATALOGS:

1. EQUIPMENT STORAGE
2. EQUIPMENT/ENCLOSURE KITS
3. REBEL HORNS & SPEAKERS
4. THE CABINART STORAGEWALL
5. HI FI ACCESSORIES

cabinart

***The* pioneers in high fidelity radio furniture**

Cabinart is a division of G & H Wood Products Co., Inc. ● 99 N. 11th St. ● Brooklyn 11, N. Y.



NOW...RCA
TRAINS YOU AT HOME IN RADIO-TV ELECTRONICS

NEW AND UP-TO-DATE HOME STUDY COURSE . . . Clearly written by men with years of servicing and teaching experience. Easy to understand . . . step-by-step instruction.

NO PREVIOUS EXPERIENCE REQUIRED. This Home Study Course was specifically prepared for students with no previous electronics training . . . for those who want a sound foundation in this exciting field.

A PRACTICAL COURSE . . . You receive completely workable kits and perform valuable experiments to demonstrate the theory learned. In fact, many students will be able to do service work *even before* they complete all the lessons.

YOU BUILD AND KEEP THESE FINE INSTRUMENTS SHOWN

- a multimeter
- a 6 tube superheterodyne receiver
- an r.f. signal generator
- a television receiver

SINCE 1909, RCA INSTITUTES has trained thousands of men in Radio-TV Electronics in our Resident Classes. Many have well-paying jobs in industry; some have established their own business. *Now* this opportunity is available to you at home.

"PAY-AS-YOU-LEARN" PLAN . . . There is no binding contract. You pay for one study group at a time, as you progress through the course. The cost for everything—including the high quality equipment that you receive and build—is amazingly low. RCA INSTITUTES—a service of Radio Corporation of America—is licensed by the New York State Education Department . . . recommended by radio and television service organizations.

SEND FOR FREE CATALOG NOW

RCA Institutes, Inc., Home Study Dept. PE-105
350 West 4th Street, New York 14, N. Y.

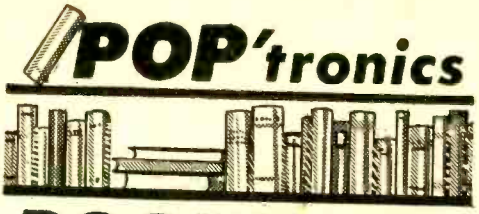
Without obligation, send me FREE CATALOG on the Home Study Course in Radio-TV-Electronics. *No salesman will call.*

Name_____
Please Print

Address_____

City_____ Zone_____ State_____

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N. Y.



BOOKSHELF

"YOUR TAPE RECORDER" by Robert and Mary Marshall. *Greenberg: Publisher*, New York, N. Y. 278 pages. Cloth bound. $4.95.

Magnetic tapes and tape recorders, subjects which usually occupy relatively small portions of most books on audio, are here accorded the full book-length treatment they warrant.

Helping the tape recordist get the most out of his equipment is the book's basic aim. While primarily intended for the amateur or home enthusiast, there is much in this volume which professionals may find useful.

The authors have based a good part of the book on four and a half years of research which included more than 2500 experiments with recorders of all kinds. A wealth of solid technical information is woven into the text to provide a basic understanding of the practical applications discussed.

The insides of recorders and the phenomena of sound and its recording and reproduction are explained; correct recording techniques are given; and suitable amplifiers and loudspeakers for playback are described. Numerous photos and diagrams add to the usefulness of a handy book that should be welcomed by all recording enthusiasts.

"THE ABC OF COLOR TV" by Harry G. Cisin. Published by *Harry G. Cisin*, Amagansett, N. Y. 25 pages. Paper bound. $1.00.

Basic principles underlying color television are clearly explained in language that will be familiar even to those with only a smattering of electronics or physics. Following a discussion of color and light, the book goes into the transmission of color video and tells what is required for black-and-white telecasts as compared with color programs. The new concepts and types of radio signals, such as "I" and "Q" and "additives" are all considered.

A section on color TV reception explores the video detector and amplifier; the luminance and chrominance channels; and the color sync circuits. The book concludes with

an explanation of color picture tubes. Numerous block diagrams and other drawings help to clarify the text.

"PROBES" by Bruno Zucconi and Martin Clifford. *Gernsback Publications, Inc.*, New York, N. Y. 224 pages. Paper bound. $2.50.

Based on the actual experiences of manufacturers and users of probes, this book explains what probes are, how they are designed, and how they should be used. It also provides valuable hints on what to look for when buying a set of probes. In addition, details are given for building one's own, including construction data on a transistorized probe. For those who are not familiar with probes and their importance in modern experimenting and servicing, a lucid explanation of this aspect of the electronics art is also included.

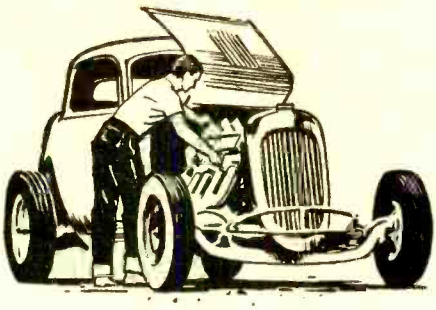
Free Literature Roundup

HI-FI SPEAKER SYSTEMS can be assembled with the aid of special instructions available from *University Loudspeakers, Inc.*, 80 So. Kensico Ave., White Plains, N. Y. A chart, describing this company's line, also suggests combinations of units. Any system so assembled may be expanded later. After selecting a particular system from the chart, the enthusiast may obtain additional data describing the system of his choice in detail. Construction plans for enclosures are included.

DESCRIPTIONS of *Electro-Voice* components, such as amplifiers, speakers, enclosures, pickups, and microphones, are contained in "Condensed Catalog No. 123," available on request from *Electro-Voice, Inc.*, Buchanan, Mich.

AN ATTRACTIVE BOOKLET entitled "Things You Should Know About the Purchase and Servicing of Television Sets" has been prepared by the Radio-Electronics-Television Manufacturers Association (RETMA) in cooperation with the Radio-Television Committee of the Association of Better Business Bureaus. Intended as a guide for the lay consumer, this booklet is being distributed through local TV sales and service organizations and Better Business Bureaus.

"HIGH FIDELITY in the palm of your hand" is the provocative phrase that leads off a brochure on the new *Hastings* "FM Jr." radio. This folder describes an FM receiver no bigger than a package of cigarettes. To obtain your copy, write to *Hastings Products, Inc.*, Newbury Street, Boston, Mass. —30—



MECHANICAL SKILLS CAN GET YOU AHEAD IN THE U. S. AIR FORCE

Here's why —

If you're interested in mechanics, join the U. S. Air Force. As an Airman you may develop your technical ability and learn a skill that will pay well...and win you extra stripes. Such interesting career fields as Aircraft and Engine Maintenance, Rocket Propulsion and Intricate Equipment Maintenance are open to you, if you qualify. Don't delay—see your local Air Force Recruiter or mail the coupon, *today*.

YOU GO PLACES *FASTER* IN THE U. S. AIR FORCE

AIRMAN INFORMATION BRANCH M-19-PE
Box 2202, Wright-Patterson AFB
Ohio

Please send me more information on my opportunities as an Airman in the U. S. Air Force.

Name_____

Address_____

City_____ Zone____ State_____

How a Capacitor Works

(*Continued from the August issue*)

In the September issue, we explained generally how rated capacitance values vary with temperature, and how this variation applies to paper tubular and dry electrolytic capacitors.

When it comes to ceramic capacitors, the mixtures of ceramic materials selected can give startlingly different capacitance values with temperature change. And we often take advantage of predictable temperature changes to balance changes in values of other circuit components. For the group of ceramic capacitors known as "temperature-compensating", which consist basically of titanium dioxide and an extender, the nominal capacitance change with temperature is shown in Figure 1. As the temperature coefficient of capacitance changes from positive to negative, the capacitors become progressively smaller. Another group of ceramic capacitors made of extended temperature coefficient materials also have relatively linear T-C curves as shown in Figure 2. These materials, at present, are most commonly used in TV yokes.

By introducing barium titanate, strontium titanate, or other titanates of rare earths, we get the higher dielectric constant materials which may range in value up to a K of 6000 (K being the letter symbol for dielectric constant which is the factor by which a particular capacitor is greater in capacitance than an air capacitor of the same plate area and spacing). This compares with a K of 85, for example, for an N750 material. It is characteristic of the higher dielectric constant materials to expect that the temperature coefficient will not be reproducible from one measurement to the next. The condition of shelf aging and the amount of d-c and a-c present in the measuring circuit will affect the final capacitance reading obtained at any given temperature. Curves on these materials, therefore, are stated as typical. Figures 3 and 4 illustrate the change in capacitance which may be expected with typical Class GA (General Application) ±20% capacitance tolerance and Class GA MRC (General Application—Minimum Rated Capacitance) units.

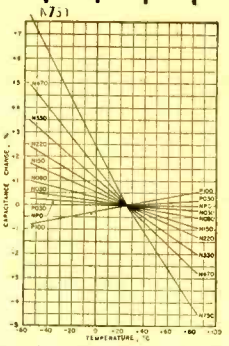


Fig. 1 — Capacitance Change with Temperature for Temperature Compensating Capacitors

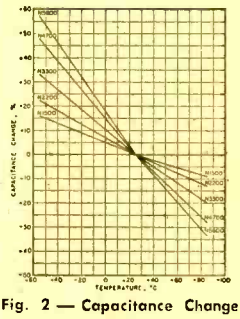


Fig. 2 — Capacitance Change with Temperature for Extended Range T-C Capacitors

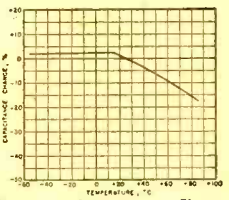


Fig. 3 — Capacitance Change with Temperature for Typical Class GA ±20% Tol. Units

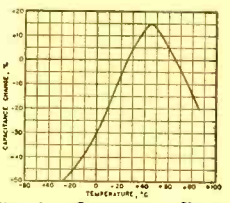


Fig. 4 — Capacitance Change with Temperature for Typical Class GA MRC Units

—To be continued in December issue—

Our First Anniversary

IT WAS with the usual trepidation felt by editors of a new magazine that I spoke to the first readers of POPULAR ELECTRONICS just one year ago. Many of you may not immediately realize the great question that invades the minds of the editors when a publication is launched. They must attempt to look into the future and predict the acceptance of the new magazine by the largest possible audience.

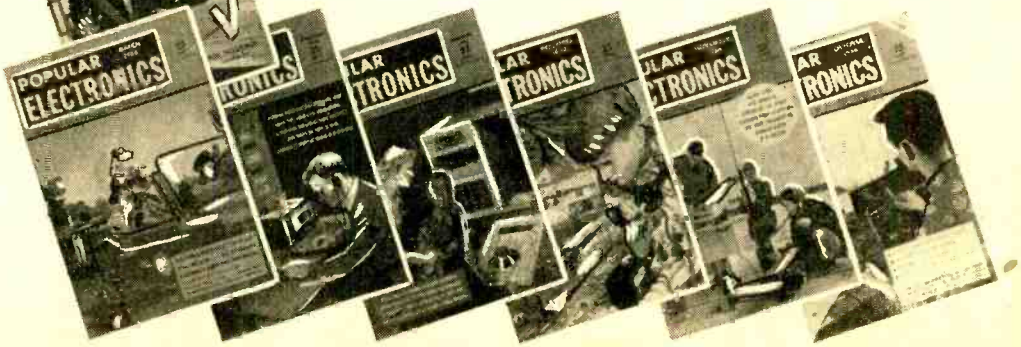
Looking back, I now wonder what we here at POPULAR ELECTRONICS were worrying about. The first three issues were all complete sellouts. After such a reception, a decision was made to increase the circulation until, at this writing, the distribution is now almost exactly double last year's figure.

Reader acceptance is always followed by increased advertising representation. Watchful readers will have noted months ago that the products and services offered POPULAR ELECTRONICS readers are many and varied. We are proud of this widespread encouragement and are doing everything in our power to put out a book that will interest readers and advertisers alike.

But most active readers are primarily interested in the months ahead. Editorially, POPULAR ELECTRONICS is now working into a pattern that includes outstanding feature articles and ideas for experimental projects, a well-rounded and varied program of departments, and—last but not least—an outstanding section on hi-fi "how-to-do-it" and "how-to-understand-it."

As you look through this very issue, note the changes that have taken place in the field of electronics within the past year. Earth "satellites" will soon be telemetering information on the upper atmosphere and interstellar space back to the earth's surface. The "Decision Meter" on page 42 is an example of an elementary computer, something which we would have thought impossible a year ago. And the future of electronics for you as readers is amply demonstrated in the resident school story starting on page 32.

O.R.



Learning Electronics in RESIDENT SCHOOLS

Cover Photo Story

By NORMAN EISENBERG
Feature Editor

Training available at resident schools can prepare you for a career in electronics, or help you advance within the field

COMPLETE training in theory and practice of every aspect of electronics, at all levels from the rank beginner to the advanced professional, is available at the resident technical school. Located in most parts of the United States and Canada, such institutions—with their lecture rooms, laboratories, studios, arrays of equipment, well-stocked libraries, and seasoned faculties—form what one observer has termed "a stronghold of electronic knowledge." No facet of the electronic art is neglected, and no possible means of instruction is overlooked in the resident school.

Generally, the picture of life at a resident institute looks something like this. A student enrolls for one or a series of courses. He then attends classes on a regular schedule, dividing time between lectures, experiments in laboratories, training films, building and handling equipment. In some cases, he may enjoy a rich and varied campus life with extracurricular and social activities.

Resident training does not always imply, however, that the trainee actually lives on the school grounds. Many schools do have provisions for such an arrangement. In other instances, students may live in nearby cities or neighboring communities and travel to and from the school. In either case, the term "resident" means that the student attends regular classes. Homework may be assigned, but the basis of the training is what is taught by an instructor at the school itself.

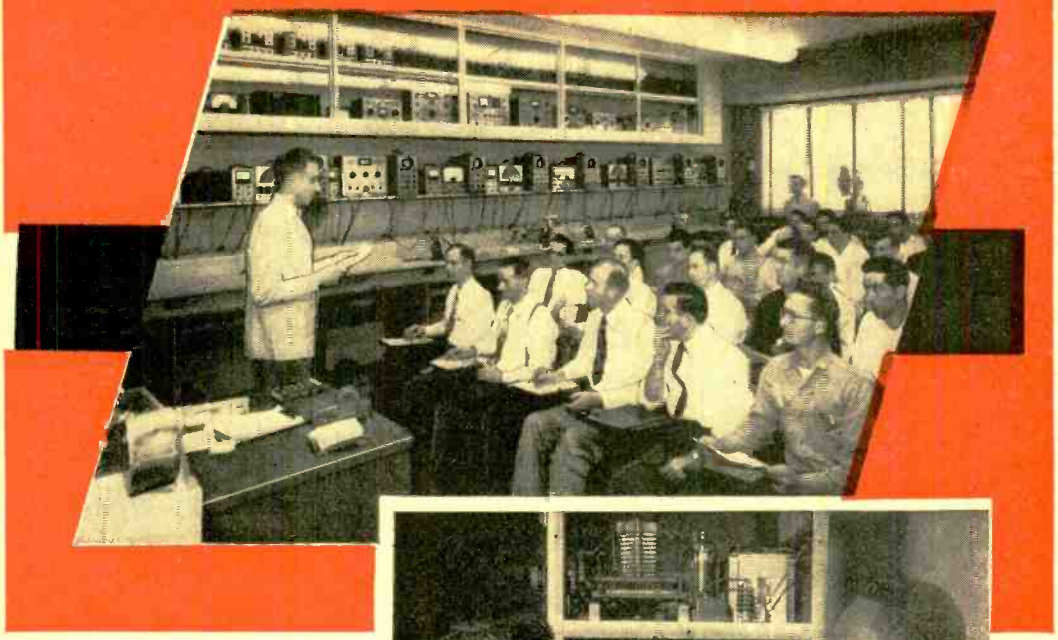
The resident school serves as a medium for the exchange of ideas, as a clearinghouse for electronic concepts and developments. The conversational "give-and-take" and the direct contact with both equipment and other electronic enthusiasts tend to enhance the value of the training itself. For those who have the time and inclination to immerse themselves in the atmosphere of electronics, this type of school offers vast opportunities.

Requirements for hundreds of job classifications are met by the multitude of courses offered at resident schools. And in keeping with the advanced nature of the many new developments in the electronics field, the schools employ the most modern approach to instructional methods and shop procedures. This modern pedagogical approach has proven capable of developing skilled technicians in the shortest possible time. The result is a continuous turning out of highly skilled personnel with the maximum potential for fitting into the needs of industry, and with the least expense or "learning pains" on the part of the trainees themselves.

High Training Standards

Despite their eagerness to train men, however, the schools are aware of their responsibility both to the men and to industry. No trainee is permitted to take ad-

EDITOR'S NOTE: This story continues our series on careers in electronics. The opportunities for employment, and the details on the training needed and available for such employment comprise what may well be—for thousands of our readers—the most important story of the year. In text and photographic references to various schools, we have sought to provide examples and illustrations of important points—and in no way express approval of any specific school. Comments on any one school generally apply to all. The schools mentioned, and listed on page 36, are but a few of those which are aptly suited for the task of training the prospective technicians and engineers who will shape our future in electronics.



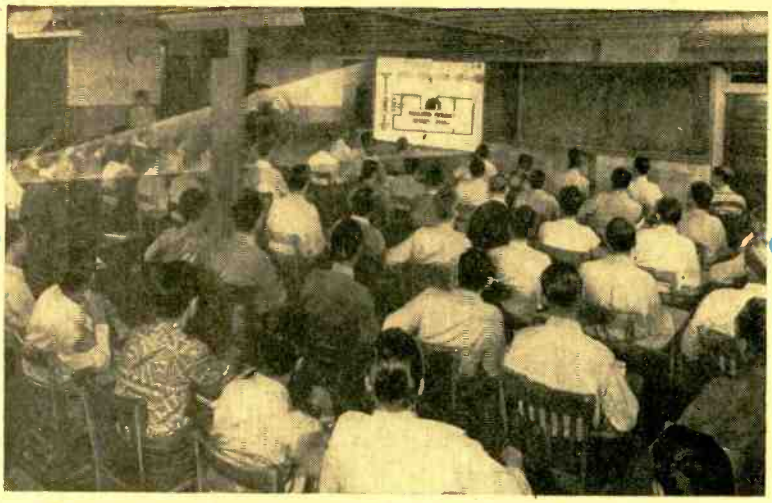
Above, classroom at United Television Laboratories, Louisville, Ky. Rooms like this one are used for lectures, reviews, and discussions. At right, instructor Boyd Brown guides trainee through complexities of a broadcast transmitter at RCA Institutes, New York City. Personalized instruction is one advantage of resident schools.

vanced courses unless he demonstrates that he has mastered all the necessary preceding technical material. Prospective students with no real aptitude for electronics are not permitted to enroll. Examinations are perennial, and standards of acceptance and instruction are high. No arbitrary matter depending on the personal whim of a particular instructor, the methodology and curricula must meet nation-wide standards set up by educational and industrial associations. Two such organizations are the Engineers' Council for Professional Development (ECPD), and the National Council of Technical Schools (NCTS).

ECPD is the group which accredits the curricula of engineering colleges and technical institutes. All courses taught must contain the proper type of subject matter in the correct proportions to warrant approval. This assures that courses will accomplish their avowed purpose in training men along specific lines. It also makes for a nation-wide standardization of what is taught in most schools. A man trained in a west coast institute need not fear that a job in the midwest or east, or even abroad, will make educational demands that he has not been prepared to meet.

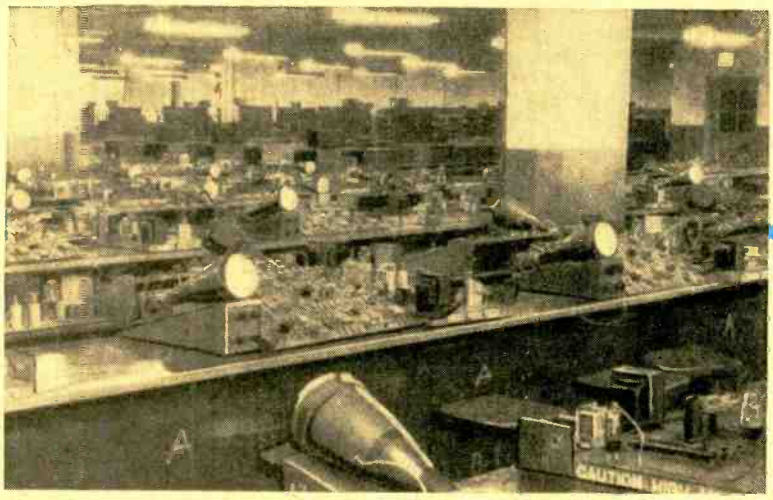
This program of accrediting the curricula is the technical schools' counterpart of the standard practice that prevails in all public and private schools and colleges. ECPD is made up of representatives of leading professional and technical organizations, including business firms, in the electronics field. Professional engineering is represented on the Council through the membership of founding engineering societies. The educational field is represented through the membership of many educational societies.

NCTS, on the other hand, is an association of the leading technical schools themselves. This group establishes standards—educational and ethical—that serve as policy-making guideposts for all member schools, and that represent the best thinking of the leaders in the field. The work of NCTS provides additional help in standardizing and improving the quality and level of instruction in all member schools.



Motion pictures help explain circuit theory at DeVry Technical Institute, Chicago. Schools utilize latest visual aids to enhance actual instruction.

Laboratories, such as this at school operated by American Television, Inc., Chicago, permit trainees to learn by experimenting with latest equipment.



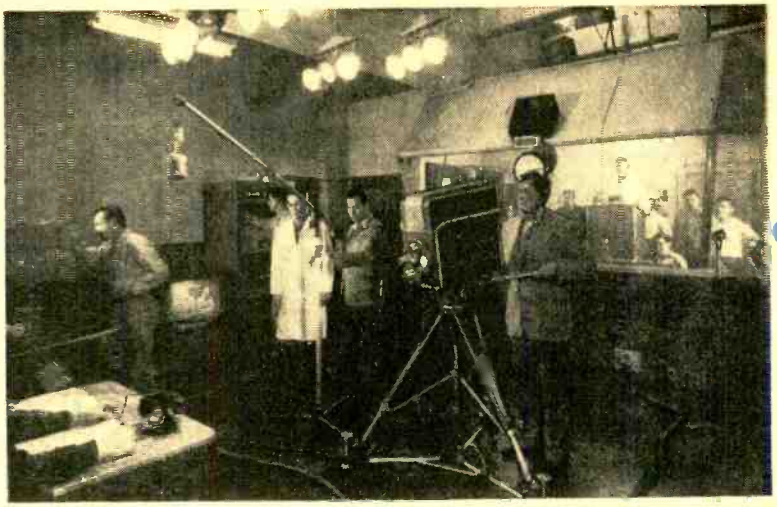
Further information on either of these groups may be had by writing to: the Engineers' Council for Professional Development, 29 West 39th St., New York 18, N.Y., and the National Council of Technical Schools, 912 Seventeenth St., N. W., Washington, D.C.

In addition to these national organizations, most schools maintain some kind of relationship with committees or groups comprised of representatives of leading local industrial and commercial organizations in the electronics field. In this way, the theoretical "meat" of electronic technology is constantly nourished by the demands of practical application and new developments in the field.

Training Methods and Facilities

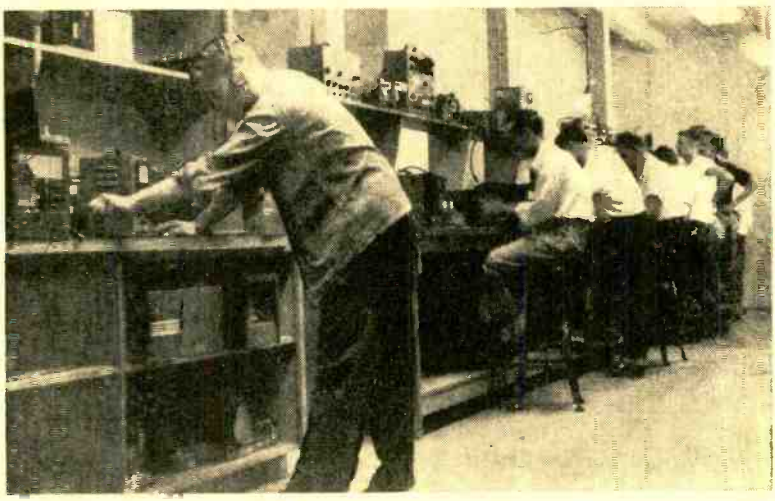
Depending on what course the student enrolls for, the intensity of the training may vary from two or three evening hours a week to full-time daily study. Often, 18 months at a resident school can provide a trainee with the equivalent of two years at college; while 27 months of intensive study can earn for a trainee a bona fide Bachelor of Science degree, normally a four-year haul at a university.

Instructional methods include regular



Student uses latest type of Orthicon TV camera at National Schools, Los Angeles, Calif. Typical program is staged under instructor's direction.

Each student in this TV laboratory at Valparaiso Technical Institute, Valparaiso, Ind., has his own workbench area, complete with equipment.



lectures, supervised experiments with equipment in labs, construction of components, and the operation of standard professional equipment, selected to be representative of the particular area of interest being taught. The resident school is, at best, a veritable storehouse of the latest and best in operating and testing equipment—from a voltmeter to a color TV transmitter, from a test probe to a radar installation.

Instructional aids comprise the latest and best in modern classrooms. The trainee at the resident school is shown movies and slides, carefully prepared to drive home important points in such a way as to make them acceptable and unforgettable. He will use a tape recorder for group discussions as well as for training his own speaking voice (an important part of broadcast console operation). Group work in laboratories, and reports—both oral and written—on his experiments help clarify subject matter and prepare him for the day when he has to report to his co-workers or to his superior on the job.

To guide the uninitiated through the complexities of electronic equipment, breadboards and mock-ups are widely used. A device that was successfully employed in

training technicians during World War II has come into its own in the resident school. This is the "dynamic demonstrator"—a large version of a unit of equipment, so wired as to resemble the schematic of the unit and presented on a large flat board. Any circuit action innate to the particular equipment being studied can be demonstrated on this board, with the results displayed on meters and oscilloscopes connected to it.

Finally, there are the large installations of commercial equipment, operated by trainees under actual or simulated conditions. These include industrial electronic devices, radar setups, broadcasting stations, etc. Several schools operate their own live transmitters and actually go on the air with regularly scheduled broadcasts.

Many schools devise their own instructional aids, such as the industrial video installation set up by the faculty of *Bailey Technical Schools* in St. Louis. Complete with TV camera, control panel and monitors, this installation facilitates instruction in the use and maintenance of industrial video equipment. The completely outfitted TV broadcasting studio and control room is a common feature at most schools.

Other facilities include libraries and cafeterias—to feed the "inner man." Many schools provide living accommodations, such as at *Valparaiso Technical Institute,* Indiana. Social and club activities are part of the picture. *Indiana Technical College* boasts a fully equipped gymnasium for working out those kinks (other than line-cord type). And trouble-shooting and maintenance of the "human mechanism" are handled by competent medical staffs, as—for instance—at *Capitol Radio Engineering Institute,* Washington, D.C.

The Engineering Technician

In addition to courses in servicing, communications, basics, etc., a good portion of

Directory of Resident Schools

American Television Institute of Technology
School Division of American Television, Inc.
5050 North Broadway
Chicago 40, Ill.

Bailey Technical Schools
1626 South Grand
St. Louis, Mo.

Capitol Radio Engineering Institute
3224 16th St., N.W.
Washington 10, D. C.

Central Technical Institute
Seventeenth and Wyandotte Sts.
Kansas City 8, Mo.

Coyne Electrical School
500 So. Paulina St.
Chicago 12, Ill.

Delehanty School of Television
115 E. 15th St.
New York 3, N. Y.

DeVry Technical Institute
4141 Belmont Ave.
Chicago 41, Ill.

Grantham School of Electronics
5910 Sunset Blvd.
Hollywood 28, Calif.
and
737 11th St., N.W.,
Washington, D. C.

Indiana Technical College
215 E. Washington Blvd.
Fort Wayne 2, Ind.

Milwaukee School of Engineering
1025 N. Milwaukee St.
Milwaukee 1, Wis.

National Schools
Figueroa St. at Santa Barbara
Los Angeles, Calif.

Philadelphia Wireless Technical Institute
1533 Pine St.
Philadelphia 2, Pa.

Pierce School of Radio & Television
52 East 19th St.
New York, N. Y.

Port Arthur College
Port Arthur, Texas

RCA Institutes, Inc.
350 West 4th St.
New York 14, N. Y.

Radio Electronic Television Schools
3730 Woodward Ave.
Detroit 1, Mich.

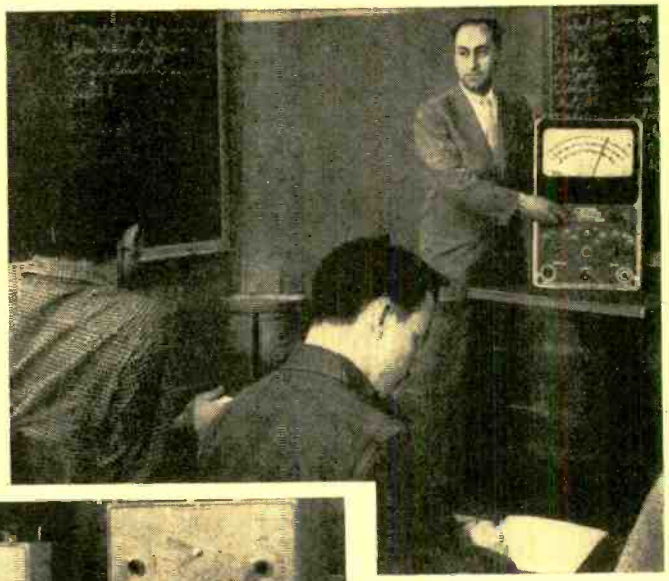
Tri-State College
Angola, Ind.

United Television Laboratories
3947 Park Drive
Louisville 16, Ky.

Valparaiso Technical Institute
Valparaiso, Ind.

Y.M.C.A. Trade & Technical School
15 West 63rd St.
New York, N. Y.

For specific information, write directly to the school concerned.



Operation of the vacuum-tube volt-ohmmeter is explained with the aid of "dynamic demonstrator" model made by Electronic Instrument Co., Inc. (EICO), of Brooklyn, N. Y. Scene is at Pierce School of Radio & Television, New York, N. Y. "Function" and "range" knobs of model activate mechanism behind panel to achieve realistic "clicks" into required positions. Meter pointer responds to settings of "zero-adjust" and "ohms-adjust" knobs. This demonstrator is typical of instructional aids widely used by all schools.

Student gets special help with tough television servicing problem at Coyne Electrical School, Chicago. Students get practice in using TV service instruments to locate faults and troubles placed in sets by instructor. Note specially constructed workbench and full assortment of test equipment.

Instructor Walter A. Carter (Pierce School) has the attention of every member of his class as he explains band response in a frequency-modulated receiver. Circuit analysis, using large schematics, is complemented with work on actual equipment to provide link between theory and practice essential to professional electronic technician.

the curricula is becoming increasingly devoted to training men for a new type of job that has developed in industry. This is the "engineering technician."

Many schools report that they have found the "engineering technician" to be more in demand today than the professional engineer. According to the *Milwaukee School of Engineering*, "for every engineer in industry today, five engineering technicians are needed to round out the engineering team essential to technical progress. It is the technician who applies what the engineer plans and creates." To date, jobs in this area still outnumber available personnel.

The technician combines some of the knowledge of the engineer with the skill of the craftsman. In a word, he does what the engineer plans. The engineer, in turn, plans on the basis of theories and concepts developed by the so-called pure scientists (chemists, physicists, etc.).

Educating the future technician is a specialized task, involving carefully planned courses which must be thorough, palatably presented, and sensitively geared to the realistic needs of industry. This all-important and complex assignment is adequately handled by the resident school.

Special Courses Meet Industry's Needs

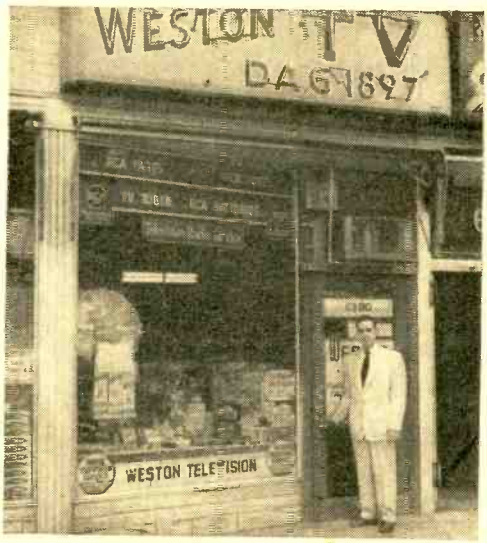
The extent to which the need for specialized skills shapes the school's curriculum is exemplified in the specific courses available. For example, the *Philadelphia Wireless Technical Institute* has the unique distinction of offering a complete course in radar, both maritime and airborne.

RCA Institutes, Inc., New York City, which started in 1909 as a training center for the first wireless operators, has evolved into a complete center of electronic instruction serving multiple training needs—from basic drafting to advanced technology. The latter course—designed for the practicing technician seeking advancement—stresses mathematics, physics, and advanced circuitry. Also available at other schools, such a program prepares men for work with broadcasting studios, research assignments with manufacturing organizations, etc.

And the semi-technical and non-technical subjects that may be necessary for a round-

(*Continued on page* 116)

William D. Houghton graduated from RCA Institutes in 1939. Together with Dr. Harry F. Olson, he headed a seven-man team of RCA engineers which developed the tape recorder used by the National Broadcasting Co. in its closed circuit transmission of the first tape-recorded color TV program.



After graduating from the Pierce School in 1952, Norman Weston operated as a television technician from his home. Later he opened a small shop. When business expanded, he moved into large shop shown above.

Floyd M. Totten, graduate of Milwaukee School of Engineering, operates panel board used in test guidance of missiles at Bell Aircraft Co., Inc., Buffalo, N. Y. Totten received degree of Associate in Applied Science in Radio and TV Technology in 1951. This graduate is currently rated as an electronic test engineer, second class.

Electronic STERILIZER

Keep your clothes hamper germ-free with a germicidal lamp that emits ultraviolet light

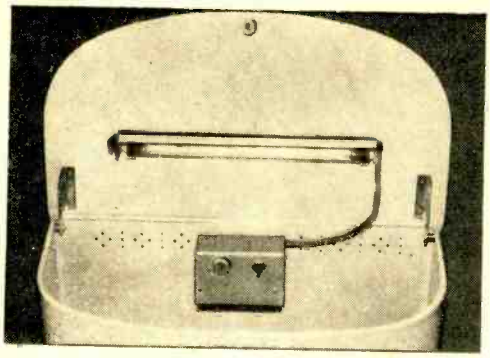
By LOUIS E. GARNER, Jr.

WHEN "Mrs. Housewife" lifts the lid of her "electronic clothes hamper," surface germs clinging to her soiled clothing had better start making their peace with the world. For, in a few short seconds, they are doomed to extinction under the "death-dealing" rays of a germicidal lamp.

The electronic clothes hamper, with its built in "death ray," is not an imaginary appliance from a science-fiction story of the future. Nor is it an expensive, impractical laboratory instrument. An experimenter of average skill should have little or no difficulty assembling a unit for his own home in one or two evenings.

Only a few parts are required, and these are neither prohibitively expensive nor hard to obtain. However, those who live in a large city might find it best to check with an electrical supply house rather than a radio parts distributor when asking for the germicidal lamp, ballast, starter and socket, and the mercury switch (see parts list). These items are more often stocked by electrical supply houses than radio wholesalers. Those who live in a small town or in a rural area should contact supply houses advertising in POPULAR ELECTRONICS, a few of which have the lamp assembly available in kit form.

Some of the material needed will be available at the local hardware store. A standard clothes hamper can be picked up



Completed electronic clothes hamper.

at a local department or housewares store, if it is not already at hand.

Construction Hints

The clothes hamper itself won't be needed until the final stages of construction. Wire the electronic components as two separate subassemblies *before* mounting in the clothes hamper proper and before making final connections. The ballast, "on-off" switch *S1*, starter and socket are wired in a small chassis which serves as a "control box," and which is mounted on the back panel of the hamper. Lamp sockets *SO1* and *SO2*, the germicidal lamp itself, and mercury switch *S2* are wired together in a "lamp assembly" which is mounted on the lid of the hamper, enabling the death-dealing rays to cover the entire interior of the container. The control box and lamp assembly are connected with a flexible cable during final stages of assembly.

Assembling the Control Box: A small commercially available aluminum chassis was used for a control box housing in the model. The general layout is given in the interior view of the unit, shown with most of the parts mounted (Fig. 1).

A commercial chassis or utility box may be used or, if preferable, a box can be bent from sheet metal stock. Steel is stronger and stiffer, but aluminum is easier to machine and bend.

When the machine work is completed, finish the chassis by applying one or two coats of enamel or clear plastic spray. An aluminum chassis may be left unfinished, if desired, but a steel chassis should always be given a protective coating to prevent rust. Finally, the parts are mounted, using small machine screws and hex nuts.

Lamp Assembly: Two short lengths of *Reynolds* "Do-It-Yourself" aluminum are used for assembling the lamp and mercury switch mounting. This aluminum is available in stock shapes at most hardware stores. It is a special soft alloy which may be worked with ordinary woodworking tools. The aluminum stock is cut to length, drilled and shaped as shown in Fig. 2.

Mount lamp sockets *SO1* and *SO2* and mercury switch *S2* on the angle stock, using small machine screws and hex nuts. Extend the leads at least 16" from the end of the lamp mounting, splicing to existing leads if necessary. Make sure that the lamp sockets are properly spaced for the lamp. The easiest way to do this is to mount the sockets on the lamp temporarily, until exact spacing is determined. Cover the top leads with the piece of U-channel aluminum, held in place with two *6-32* machine screws and small hex nuts. The complete lamp assembly is shown at the left. Note that the extended leads have been "cabled" together and are held securely with a small cable clamp.

A detail view of the mercury switch mounting is given in Fig. 3. Note that the switch is mounted at an angle. Determine the proper mounting experimentally. In operation, the switch should be closed when the clothes hamper lid is down (horizontal) and should open when the lid is raised.

Final Assembly: When the control box and lamp subassemblies are completed, they may be mounted on the clothes hamper proper and final connections made. Most commercial clothes hampers have a number of small holes punched in the top and bottom of the housing for ventilation purposes. Use as many of the existing holes as is practicable. The holes in the lid should be countersunk and flat-headed machine screws used for assembly.

Next step is to complete the wiring, connecting the control box and lamp assembly together. Then mount these two subassemblies in the clothes hamper, shaping the connecting cable so that it is not under a strain when the lid is opened and closed. Be sure to install a rubber grommet in the

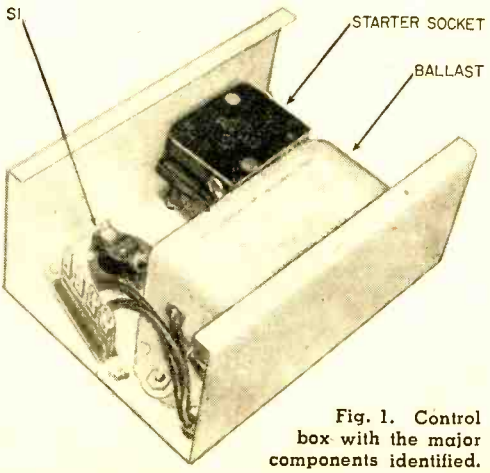


Fig. 1. Control box with the major components identified.

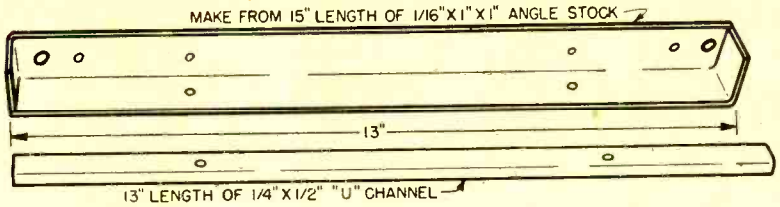


Fig. 2. Drawing at left shows construction of the metal parts needed for the lamp assembly.

hole where the line cord passes through the hamper housing.

When the wiring is completed and double-checked for errors, cover all exposed "hot" terminals with electrical tape or other protective insulation. As an alternative, a small plastic or sheet metal cover can be made to "snap" over the control box to form a completely enclosed housing.

Using the Hamper

With the assembly and wiring completed, install the germicidal lamp in its sockets and plug in the starter. Plug the line cord into a wall outlet. Turn the power switch (on the control box) "on" and close the lid of the hamper. In a few seconds, the lamp should come on, bathing the inside of the hamper with a purplish glow.

If the lamp does not light, check and make sure that both the lamp and the starter are properly seated in their respective sockets and that proper electrical contact is made. Make sure, too, that line voltage is available. Failure of the lamp to come on may also indicate that the mercury switch *S2* is not mounted at the proper angle. Check on this—make sure that the mercury switch *closes* when the hamper's lid is *down*. If unfamiliar with the operation of a mercury switch, check on the position of the mercury globule inside the glass housing. The switch is closed when the mercury is touching *both* of the electrodes which are sealed into the glass.

If the unit still fails to work after these preliminary checks, it may indicate either an open lead, a defective component, or an error in wiring.

The operation of the germicidal lamp used in the electronic clothes hamper is very similar to that of a fluorescent lamp, and it is for this reason that a ballast and starter are required. However, there is one important difference. Since the ultraviolet rays produced by the germicidal lamp are harmful to human eyes if long exposure is allowed, small mercury switch *S2* is connected in series with regular power switch *S1* so that the lamp is automatically turned "off" whenever the hamper's lid is lifted. Power is restored when the lid is closed, and the lamp will come on again after a few seconds delay (a second or so is required for the starter to operate).

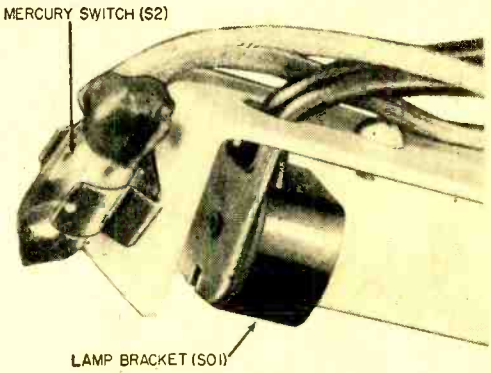
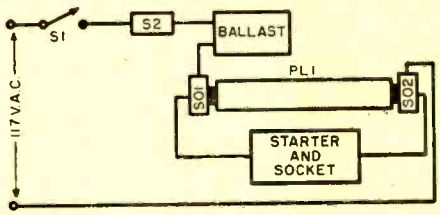


Fig. 3. Detail of mercury switch mounting.



S1—S.p.s.t. switch
S2—S.p.s.t. mercury switch
SO1, SO2—Bi-pin germicidal lamp socket
Lamp—8-watt germicidal lamp
Ballast—Ballast for 8-watt germicidal lamp
Starter—Starter and socket assembly for 15-20 w. fluorescent lamp
1—Chassis, 4½" x 3¼" x 2"
1—15" length 1" x 1" x 1/16" Reynolds "Do-It-Yourself" aluminum angle stock
1—13" length ¼" x ½" x ¼" Reynolds "Do-It-Yourself" U-channel stock
2—Cable clamps
1—4-lug terminal strip
1—Line cord and plug
Misc. machine screws, solder, etc.

Total cost of parts, approx. $10.50

Fig. 4. Schematic diagram and parts list.

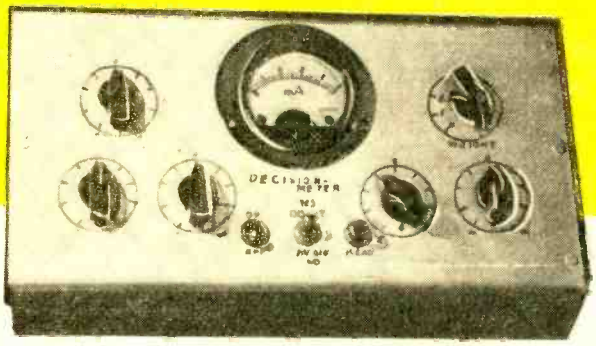
Regular power switch *S1* permits the lamp to be turned off whenever the hamper is not in use.

Although worked out specifically for use in the electronic clothes hamper, the germicidal lamp circuit—with its automatic switch —may be used in many other locations. Possible applications are limited only by imagination and ingenuity. Have fun!

—30—

Build a "DECISION METER"

By FORREST H. FRANTZ, Sr.



View of front panel, showing location of meter and controls.

"SHALL I BUY that house?" Should I take that correspondence course?" "Do I want the blue one or the red one?" "Which car should I decide on?" These questions are common examples of those that constantly crop up in everyone's daily life. Such questions require decisions —right decisions—to keep things running smoothly. Some people can make quick snap decisions and come up with the right answer most of the time. Many others, however, find that their decisions are more often correct when they analyze their problems systematically. The "decision meter" will help them to do so.

The most common type of decision requires the choice of one of two courses of action. Usually the answer is "yes" or "no," but quite often it may be "red" or "blue," or "the $99 model" or "the $159 model." Decisions involving a larger choice in the course of action may generally be broken down into several component parts and analyzed as "yes" or "no" decisions. In making a decision, the thinking process generally follows these lines: (1) the favorable and unfavorable consequences of a decision are reviewed; (2) a magnitude or degree is attached to each possible consequence; (3) insignificant consequences are weeded out; and (4) a decision is reached by balancing the favorable and unfavorable items generally weighted with the importance or urgency of the decision.

In building the decision meter, any type of panel or cabinet may be used, but an ordinary blank chassis serves the purpose nicely and yields a neat enclosure. The model described in this article was built on a 2½" x 6¼" x 11¾" chassis. Panel and enclosure should be drilled first. Then the panel may be painted if desired. Next, the panel wordings are drawn on the panel with India ink. A calibration layout for the five input or "consequence" controls that may be used with linear wire-wound controls is given at the bottom of page 43.

The circuit consists of five potentiometers connected in parallel across the d.c. voltage supply. Potentiometer contacts connect to a summing network which consists of the five 100,000-ohm resistors and the meter/200-ohm potentiometer combination. The meter polarity reversal switch provides the "yes" or "no" information, the meter an approximation of the magnitude of the "yes" or "no." The momentary push-button switch (normal position—off)

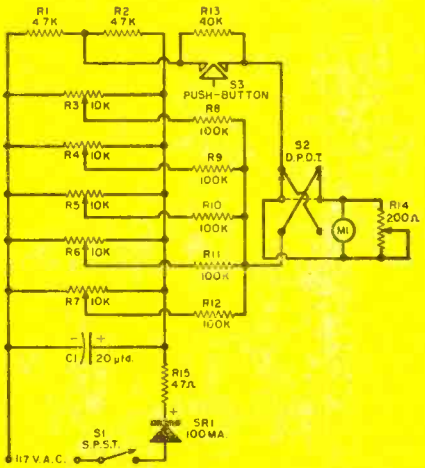
Analyze your problems systematically and make the proper decisions with the aid of this versatile "decision meter"

allows a 40,000-ohm resistor in series with the lead from the summing resistors to be shorted by depressing the switch for low-scale readings.

To test the decision meter, set the five consequence controls to the zero positions, the "weight" control to zero (i.e., shorting the meter). Plug in the a.c. cord, turn on, and gradually increase the weight control to maximum resistance. The meter should read zero. Turn one consequence control toward plus (yes) and the meter needle should deflect. If all goes well up to this point, turn all of the consequence controls to plus and note the full-scale meter reading. Then calibrate the weighting control by choosing a convenient fraction of the meter reading and marking the weight control graduations that provide the required steps in the meter reading. The decision meter is now ready to go to work.

Making "Decisions"

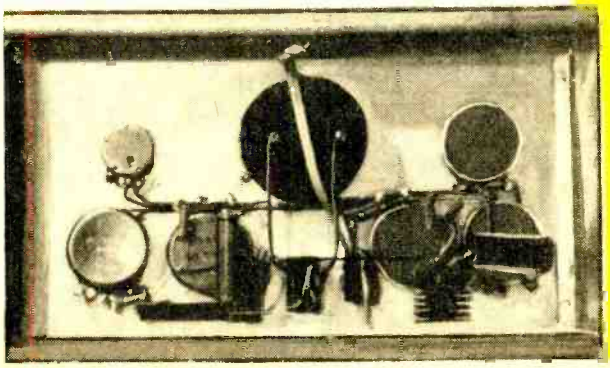
As an example of a decision meter application, consider the selection of an audio amplifier. Usually the choice will narrow down to two or three amplifiers, but it is difficult to converge on a final single choice. The important considerations might be: (A) frequency response, (B) distortion, (C) attractiveness, (D) ruggedness, (E) cost, (F) ease of operation, (G) ready availability of replacement parts in the event of failure, (H) how well the amplifier will fit into the hi-fi system as it is expanded, (I) how much modification will have to be made to the present system to accommodate the chosen amplifier. Desig-



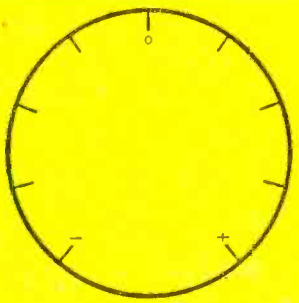
Schematic diagram and parts list of unit.

C1—20 μfd., 150 v. electrolytic capacitor
R1, R2—4700 ohm, 2 w. resistor
R3, R4, R5, R6, R7—10,000 ohm, 3 w. wire-wound potentiometer, linear taper ("consequence" controls)
R8, R9, R10, R11, R12—100,000 ohm, ½ w. resistor
R13—40,000 ohm, ½ w. resistor
R14—200 ohm, ½ w. potentiometer, linear taper ("weight" control)
R15—47 ohm, ½ w. resistor
S1—S.p.s.t. toggle switch (on-off)
S2—D.p.d.t. toggle switch (yes-no)
S3—S.p.s.t., normally open, momentary contact switch (read)
SR1—100 ma. selenium rectifier
M1—0-1 milliampere meter (2½" or 3½", round or square)
1—Chassis, approx. 11¾" x 6¼" x 2¼"
6—Pointer knobs
1—Line cord and plug
Misc. wire, solder, etc.

Total cost of parts, approx. $13.50



Under-chassis view, showing major components.



Template for the "consequence" controls.

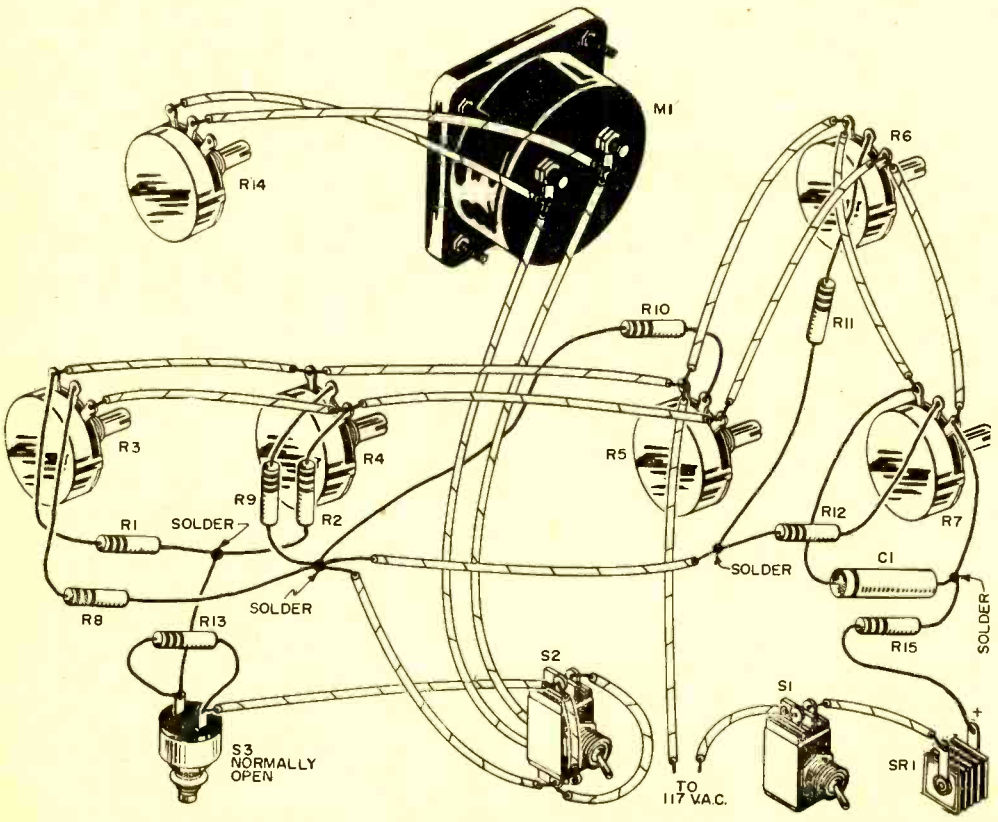
Characteristics	Amplifier "A"	Amplifier "B"
(A) Frequency response	equal	equal
(B) Distortion	equal	equal
(C) Attractiveness	no front panel	neat front panel
(D) Ruggedness	equal	equal
(E) Cost	$99.50	$89.75
(F) Ease of operation	all controls accessible from front panel	equalizer for phono preamp on rear of chassis
(G) Availability of replacement parts	equal	equal
(H) Suitability for future expansion	power output 8 watts (otherwise equal)	extra input channel; power output 6 watts (otherwise equal)
(I) Modification required for new unit	present cabinet will not have to be modified	some cabinet modifications will be required

Table 1. Tabulation of the relative merits of the amplifiers discussed in the text.

nating the amplifiers as "A" and "B," the relative merits of each are given in Table 1.

It is not necessary to prepare a tabulation of this sort with the decision meter. Simply review these items, and enter them on the decision meter. Assume all items favorable to amplifier "A" as plus, all favorable to amplifier "B" as minus. Then a "yes" decision would indicate that the

(*Continued on page* 124)

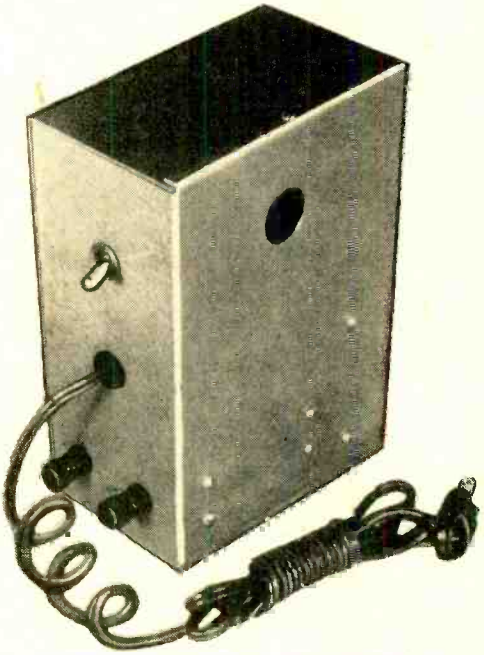


Pictorial diagram indicates how the various circuit components are interconnected.

PHOTOELECTRIC INTRUSION ALARM

By GUY DEXTER

This simple device can operate bells, lights, motors, etc., by detecting objects breaking light beam acting on a phototube



The completed unit is readily portable and will operate from almost any light source. Simply face the side of the case with the hole towards the light beam, attach the external circuit to the binding posts at the bottom of the box, and plug in the a.c. line.

A PHOTOELECTRIC intrusion alarm is, in effect, a "private eye" capable of operating around the clock without growing tired or losing its alertness. This simple device can be used to guard a door or window against entry by unauthorized persons, and will also count people who are supposed to pass through a door.

There are many other applications for such a photoelectric relay. For example, it can be used to control the opening of a kitchen door as the door is approached by a person with both arms filled, or to turn on the house lights whenever the daylight falls to a certain level, or to count moving objects. It will respond to automobile headlights at night and control a garage door-opening motor.

Some photoelectric devices are complicated and expensive. Some are hard for an amateur to put into operation. But the one shown here is neither expensive nor complicated. Using one tube (a 2050 gaseous type) and a type 930 phototube, it can be assembled and operated by any experimenter.

How It Works

Figure 1 shows the circuit diagram of the unit. The 2050 tube heater is heated by a small 6.3-volt filament transformer, *T1*. Plate voltage for this tube is taken directly from the a.c. power line. The 930 photo-

tube receives its operating voltage from the 6.3-volt winding of the transformer through the 10-megohm series resistor, *R1*. An a.c. relay, *RL1*, is connected in series with the a.c. line and the 2050 plate terminal.

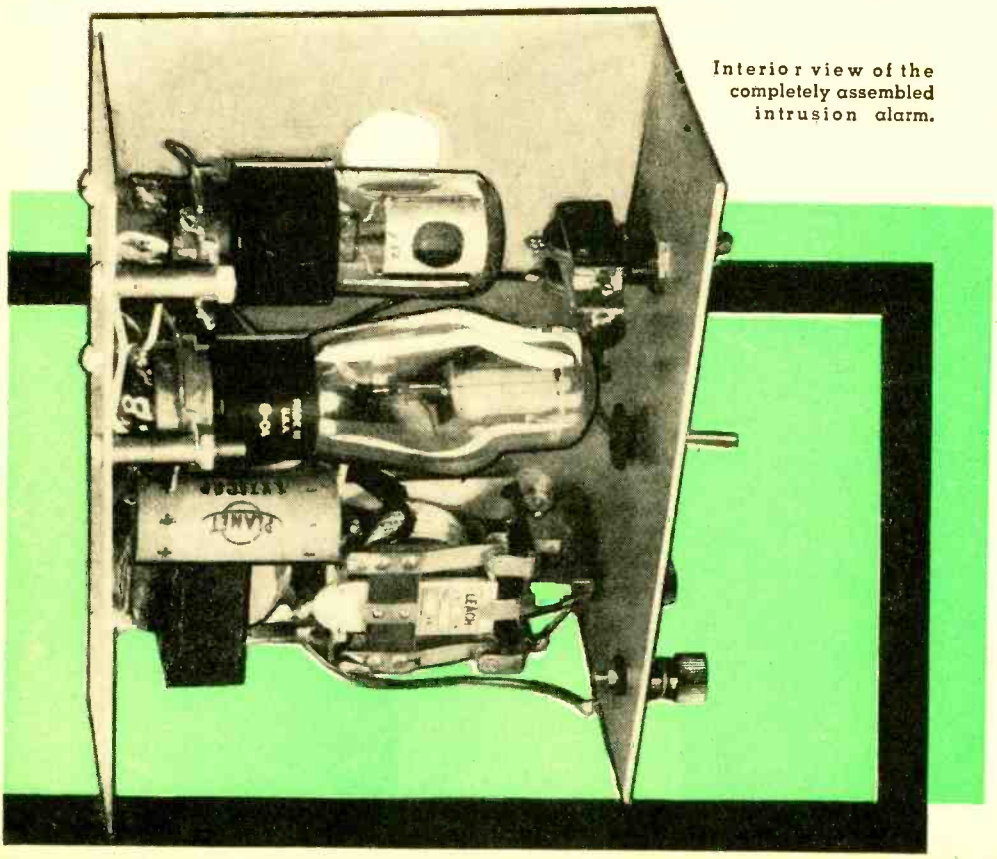
Normally, plate current flows in the 2050 tube through the relay, causing the relay to operate—or be *picked up*. Its contacts then are closed. When light falls on the curved cathode of the phototube, current flows through this tube and sets up a voltage across resistor *R1*. Through the circuit connections, this voltage is applied to the grid of the 2050 tube and causes the plate current flowing through that tube and the relay to decrease. The relay therefore goes out of operation, since the current now is not strong enough to hold it closed, and its contacts open. The 8-μfd. capacitor, *C1*, prevents the relay from chattering.

When the light is shut off, as happens when an opaque object passes between the light source and the phototube, the phototube current drops—or cuts off completely. This removes the voltage from the 2050 grid, and the relay closes its contacts. It is easy to see, then, how objects interrupting the light cause the relay to operate. An electric bell or electromechanical counter connected to the relay contacts and a source of power will go into operation each time a solid object passes through the light beam. The relay contacts can be connected either to close or open the external circuit when the light beam is interrupted.

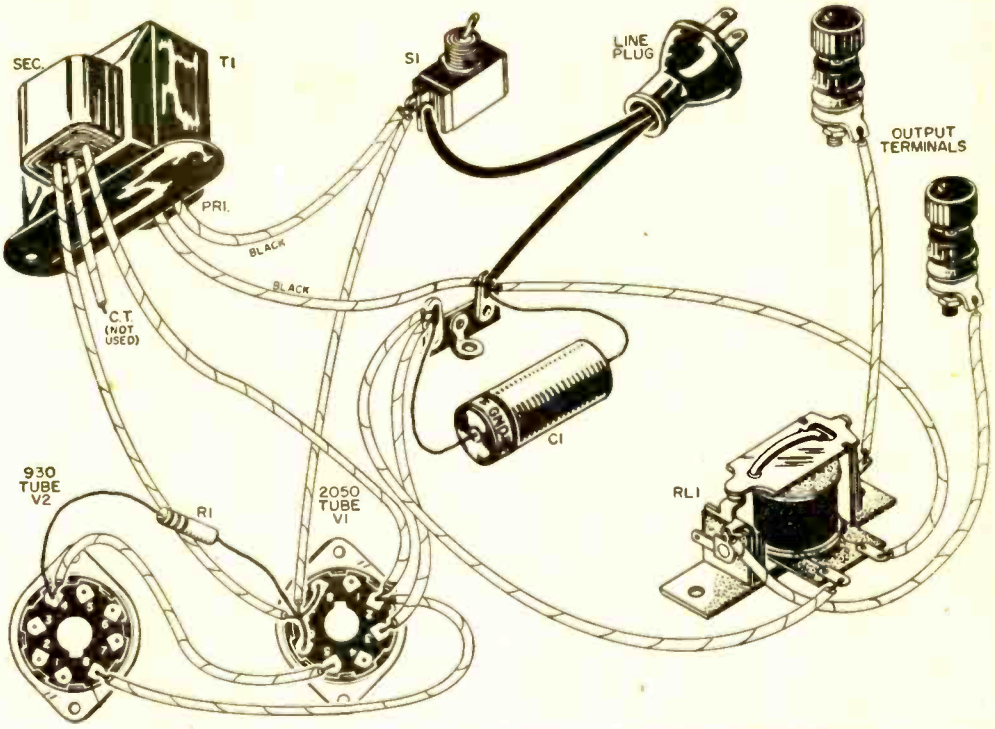
A good source of light for this device is a 75-watt lamp. The lamp can be placed in a metal box, similar to the one housing the phototube and its equipment, provided with a few air holes and a 1½" hole for passage of the light.

Construction

Construction of the device is shown in the photographs and the pictorial diagram. The entire unit is built in an aluminum chassis box which is 7" high, 5" wide, and 3" deep. Tube sockets are both mounted on one inside wall of the box. The concave inner surface of the phototube cathode faces a 1½" hole cut in the front face of the box to admit light. Relay, filament transformer, and a 2-lug insulated terminal strip are mounted on the inside front face of the box. The "on-off" toggle switch and two *insulated* output-terminal binding posts



Interior view of the completely assembled intrusion alarm.



Pictorial diagram shows actual connections to the various components.

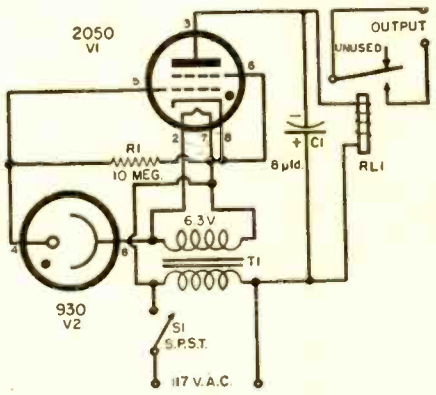
are mounted through the other wall of the box. A rubber-grommet-lined hole on this same wall admits the a.c. power cord.

Use flexible, insulated hookup wire for wiring the device. Do not connect the metal box to any part of the circuit.

Operation

After the unit has been assembled and the wiring checked as correct, insert the line plug into a 117-volt a.c. power outlet and turn on power switch *S1*. After a short warm-up period, the relay will be heard to close with a slight humming sound. Now, shine a flashlight through the light hole in the front of the box and the relay will be heard to open. Passing a hand in front of the flashlight, thus interrupting the light shining on the phototube, will cause the relay to close again.

A 75-watt lamp enclosed in a second ventilated metal box or can, with a light hole similar to the one in the front of the photocell box, will operate the relay easily at distances up to 3½ feet—without lenses of any kind in the light box or the relay box. This will be adequate for most house doors and windows. Lenses are needed for operation over longer distances. The relay box and the light box must be lined up when installed, so that the light hole in one box "looks" right at the light hole in the other box. —30—

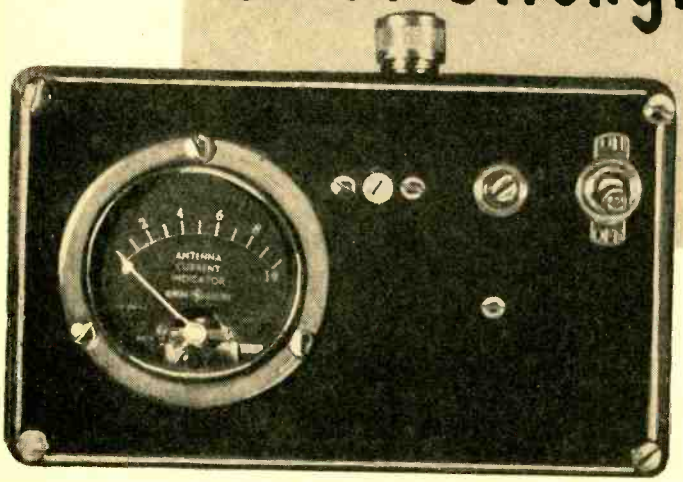


C1—8 µfd., 450 v. midget tubular electrolytic capacitor
R1—10 megohm, 1 w. resistor
RL1—110 v. a.c. relay, s.p.s.t., normally open contacts (Potter & Brumfield Type MRIA or equivalent)
S1—S.p.s.t. toggle switch
T1—Filament transformer, 6.3 v. @ 1 amp.
V1—Type 2050 thyratron
V2—Type 930 phototube
1—Aluminum chassis box, 3" x 5" x 7"
1—Line cord and plug
2—Binding posts
2—Octal sockets and mounting spacers
Misc. machine screws, wires, solder, etc.

Total cost of parts, approx. $12.00

Fig. 1. Schematic diagram and parts list.

Field Strength Meter for R/C



By PAUL F. RUNGE

Front view of the meter which employs surplus milliammeter and a transistor amplifier stage to increase sensitivity.

Use this easily built meter to make sure your R/C transmitter is putting out a strong signal

USING A BULB to tune a 27¼-mc. R/C transmitter is perfectly satisfactory when it comes to determining whether there is any r.f. in the tank circuit. It is not so satisfactory, however, when it comes to finding out just how much of that r.f. is being radiated by the antenna to control the model.

With the relatively low-powered transmitters used on the 27¼-mc. spot, it is extremely important that the power available be utilized with the greatest efficiency. Even transmitters which are bright bulb burners have been known to lose planes because their antennas simply didn't radiate their power efficiently enough.

Field strength meters of various kinds are called into service to determine the radiated output. For the serious R/C fan, these are generally built around sensitive microammeters—the lower the range the better. The R/C fan whose pocketbook is limited must forego these rather expensive laboratory-type meters. Less expensive instruments use the same circuits with less sensitive meters, requiring the instrument to be used closer to the transmitter. They work well enough unless stray radiations are picked up and a false reading is obtained.

With a simple transistor amplifier, all of this can be changed. The inexpensive higher-reading milliammeter can be made to perform about as well as a microammeter. With the transistor in the circuit, it is possible to obtain an amplification factor of ten, thus increasing meter sensitivity just that many times.

The field strength meter illustrated here has a simple circuit with a performance that far outshines its modest requirements. The whole outfit is housed in a small Bakelite instrument case and utilizes a surplus meter found in a BC-442, available in many of the larger radio stores and at electronic surplus suppliers for little more than a dollar.

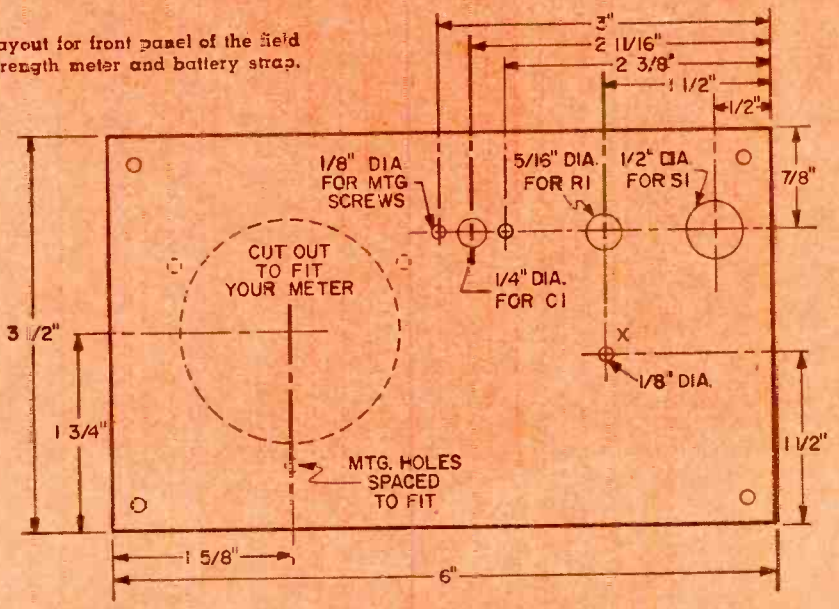
Basically, the meter in the BC-442 has a two-milliammeter movement, although it is calibrated 1 to 10. Many other meters, also surplus, are available with 0 to 5 milliammeter movements, which work very well in the circuit. Iron-vane types, which can be purchased new at a very reasonable cost, also work nicely.

Some builders prefer to house the r.f. part of the field strength meter in a small box and attach it to their regular test

→

Here are all of the necessary parts except for batteries and milliammeter.

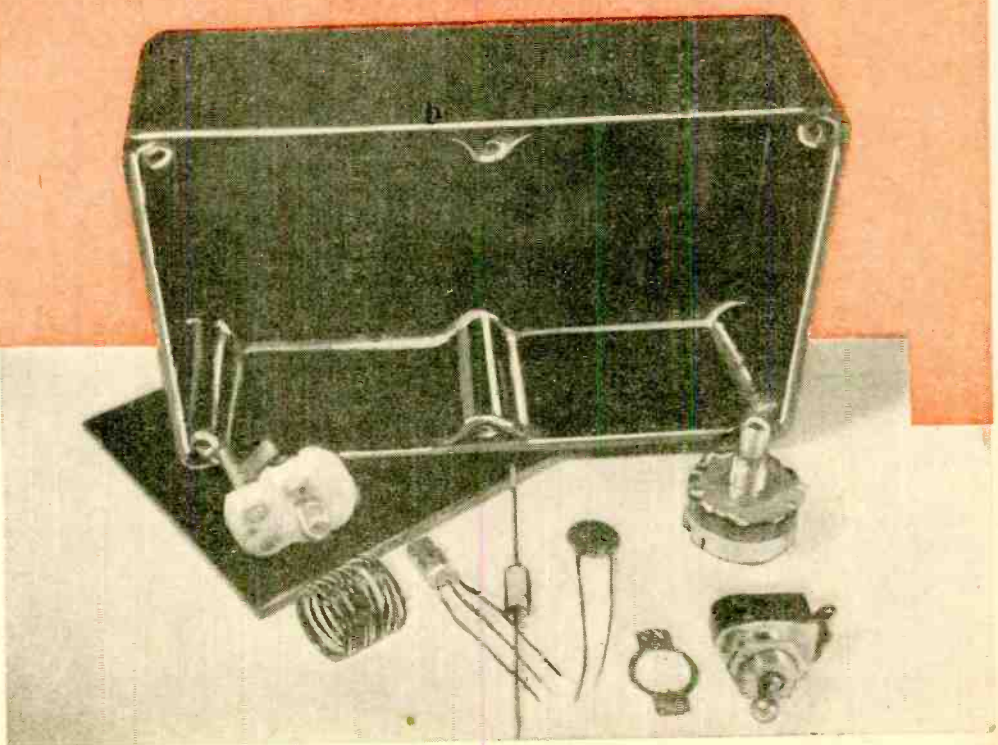
Layout for front panel of the field strength meter and battery strap.

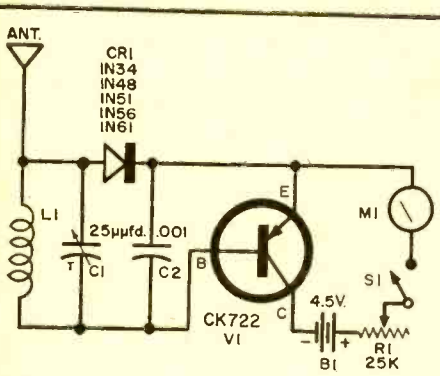


BATTERY MOUNTING STRAP

1/16" x 1 1/2" x 4 1/2" ALUM. WRAP AROUND 3 PEN CELLS AND FASTEN TO PANEL WITH 4/40 x 1/2" MTG. SCREW IN HOLE "X"

1/8" DIA. 1/8" DIA





Schematic diagram and parts list for the field strength meter for radio control. Transistor leads starting with the red dot at left (on the transistor) are collector, base and emitter, in that order.

B1—Three 1½ volt pen cell batteries in series
C1—25 μμfd. air-type trimmer capacitor
C2—.001 μfd. ceramic disc capacitor
CR1—1N34, 1N48, 1N51, 1N56, or 1N61 type crystal diode
L1—12 turns of No. 16 wire, ⅝" diameter, spaced to 1" length
M1—0-2 or 0-5 milliampere meter (see text)
R1—25,000 ohm potentiometer
S1—S.p.s.t. toggle switch
V1—CK722 transistor
1—"On-Off" switch plate
1—Waldom BC-138 plastic instrument case
1—4' television antenna element
1—Female cable-type microphone connector
1—Male chassis-type microphone connector
1—4-40 x ½" machine screw and nut for battery holder
2—4-40 x ¼" machine screws for trimmer capacitor
4—6-32 x ½" machine screws for cover fasteners

meter temporarily while taking readings. However, with this instrument, such a procedure is no longer necessary, since the total cost of meter, case, and transistor (especially in view of price reductions on the CK722) runs less than the cost of a new precision microammeter. Besides, the less sensitive meter used here is more rugged and able to withstand field use far better than the expensive jobs. The advantages of having a field strength meter that is ready to go and independent of other test equipment are obvious.

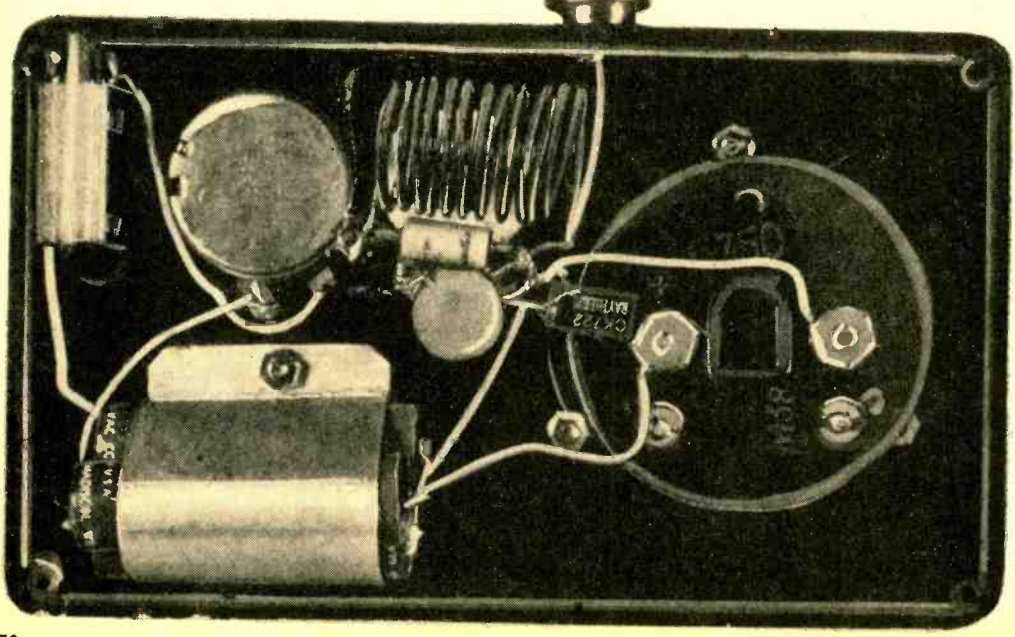
Construction

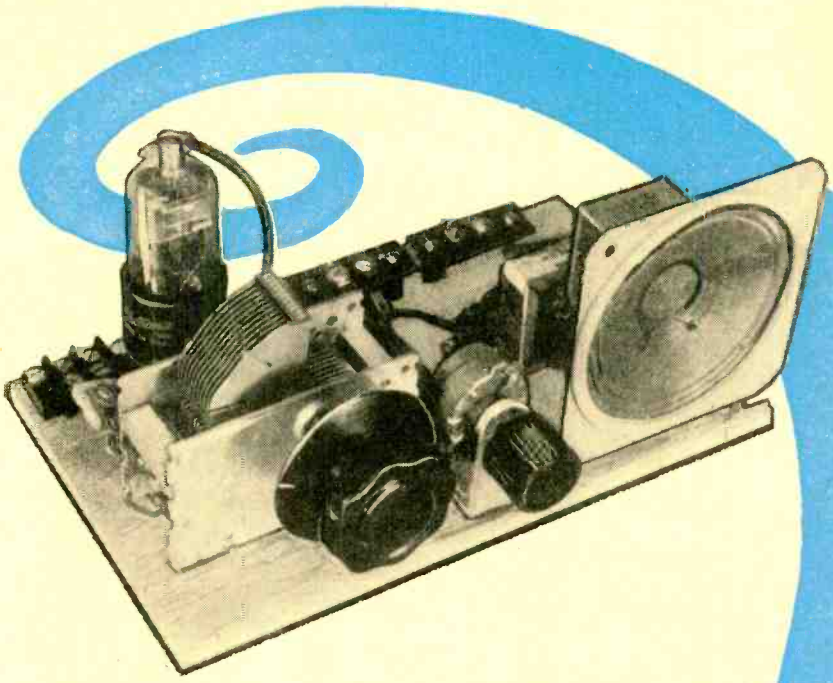
The case used to hold the instrument is a *Waldom* BC-138. It measures 3¾" by 6¼" and is 2" deep. The antenna is made from a 4' aluminum tube TV antenna element section. The end of the particular element used by the author has a solid aluminum plug, which just fits into a cable-type microphone connector when the cable spring is removed. This is used with the connector chassis mount to make a quick-connect antenna mast section.

The first step in building the field strength meter is to drill the cover of the instrument case. Make sure the holes

(*Continued on page* 134)

Rear view of the instrument showing parts placement. Transistor is wired directly into the circuit without using a subminiature socket. Antenna mount, a male microphone connector, is on top of the instrument case.





One-Tube "Wallop"

By RUFUS P. TURNER

Power-packed triple-purpose tube performs all functions needed in simple radio that will drive a loudspeaker

THIS ARTICLE details a simple one-tube radio that will drive a loudspeaker. Electrically, it is in reality a three-tube set because the single 1D8-GT is a triple-purpose tube type, i.e., the single bulb contains three separate sections—one diode, one triode, and one power pentode. The diode is used as the detector, the triode as the first audio amplifier stage, and the pentode as the output audio amplifier. Thus, one 1D8-GT performs all of the tube functions required in a simple radio.

The one-tube receiver is not as sensitive as a regular midget radio. But it will give good performance on strong local broadcast stations using only a few feet of wire as an indoor antenna. Using an outside antenna and ground, good results can be obtained even with the weaker stations. On very strong locals, no antenna at all is needed but the set itself must be rotated into the best position for pickup.

The Circuit

A complete circuit schematic of the receiver is shown on page 53. The antenna is

coupled into the circuit through *C1*, which is a 3-30-$\mu\mu$fd., screwdriver-adjusted mica compression-type capacitor. Station tuning is provided by the 365-$\mu\mu$fd. variable capacitor, *C2*. This capacitor is connected in parallel with the single coil, *L1*, which is an adjustable ferrite slug-type inductor.

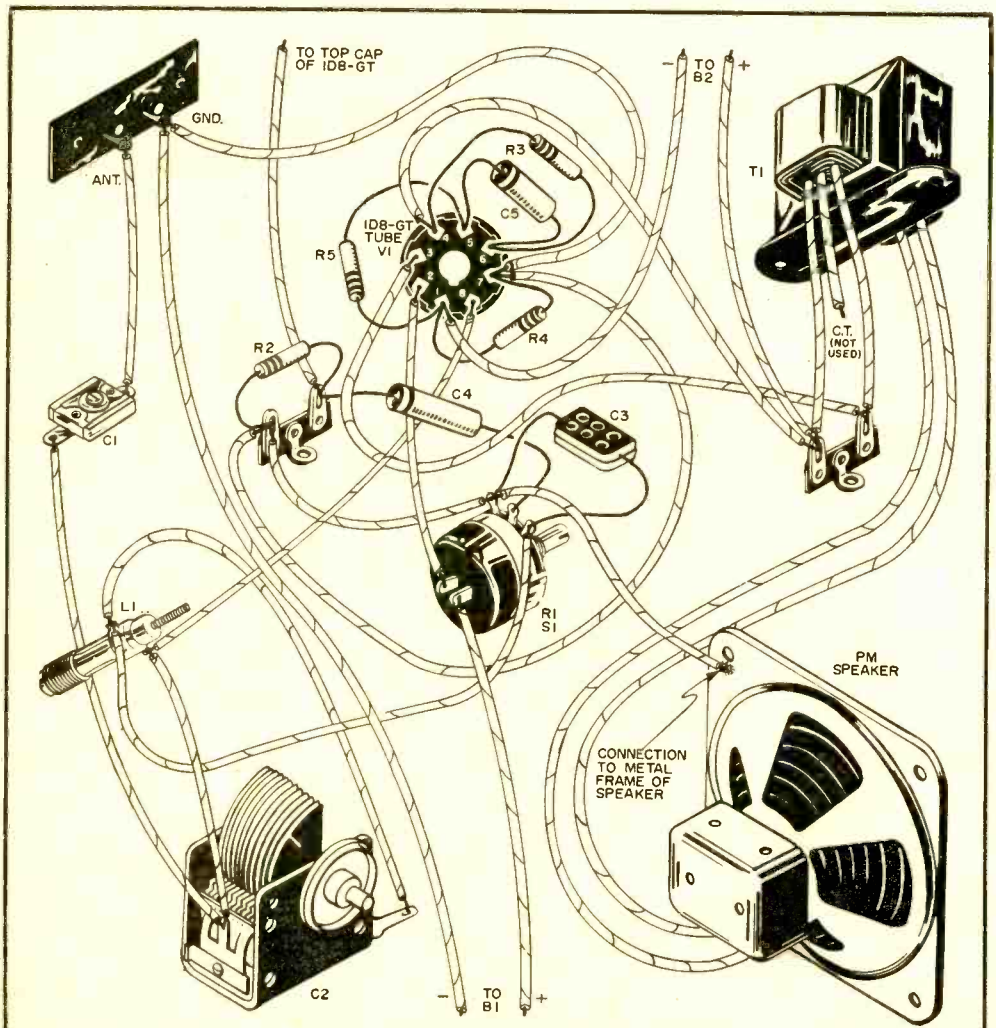
The signal selected by means of the tuned circuit (*L1/C2*) is detected by the diode section of the tube. Audio output from the diode appears across the volume control potentiometer, *R1*. The 50-$\mu\mu$fd. capacitor, *C3*, bypasses this control for radio frequencies. Audio output is coupled through *C4* to the triode grid which is the top-cap connection of the tube.

Amplified audio output from the plate of the triode is coupled through *C5* to the control grid of the pentode. Finally, the pentode is coupled to the loudspeaker through the small matching transformer, *T1*. Maximum obtainable audio output power is 200 milliwatts—almost one-quarter watt.

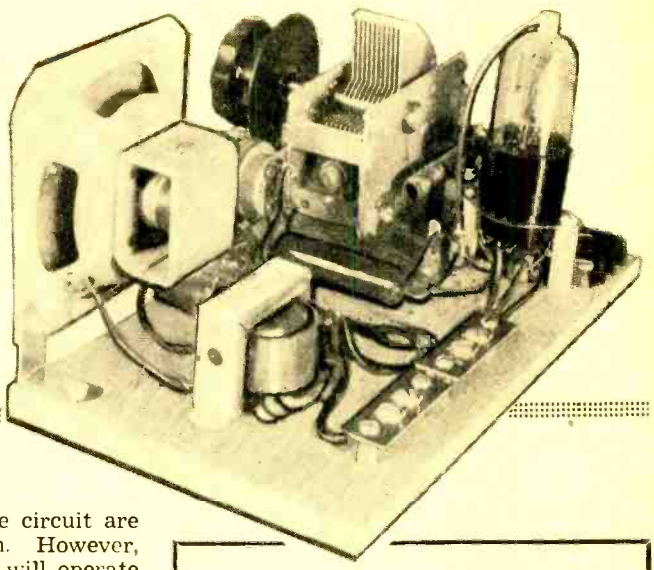
The 1½-volt A battery must supply 100 milliamperes, and the 90-volt B battery 7.1 ma. The d.c. grid bias of —9 volts, required by the control grid of the pentode, is developed across resistor *R4* by the flow of plate and screen currents through this resistor. Two 45-volt batteries connected in series can be utilized to obtain the 90 volts, or *both* the 1½ and 90 volts may be obtained from a combination battery similar to *Burgess* Type 6TA60.

Construction

This set was built breadboard fashion on a wooden base 8½" long, 5" wide, and ½" thick. Some experimenters may prefer this style of construction, since it is easily



Pictorial diagram indicates clearly how the various circuit components are connected.



This photograph and that on page 51 show rear and front views, respectively, of the radio receiver with cover removed. The single 1D8-GT tube used incorporates a diode as the detector, a triode as the first audio amplifier, and a pentode as the output amplifier.

assembled and all parts of the circuit are accessible for experimentation. However, the circuit is not critical and will operate in almost any housing.

Right-angle brass brackets from the dime store are used to mount the tuning capacitor, loudspeaker, and volume control on the base. One hole in the volume-control bracket must be reamed out to 3/8" to pass the threaded shank of this control.

For support, the coil is snapped into a small fuse clip which grips the coil around the neck of its insulated tubing. The clip, intended for 1/4"-diameter radio fuses, is screwed to the frame of the tuning capacitor. There are many other ways of mounting this coil rigidly so that its slug-screw can be rotated without turning the coil. For example, if a metal chassis is used, the coil will clip into a 7/16"-diameter hole without any attachments being added. Before mounting the coil, clip off and discard the length of antenna wire that is supplied with it.

Connections to antenna, ground, and batteries are made to screw-type terminal blocks. Each block is of the two-screw type. The tube socket is mounted above the baseboard on a pair of 1" studs.

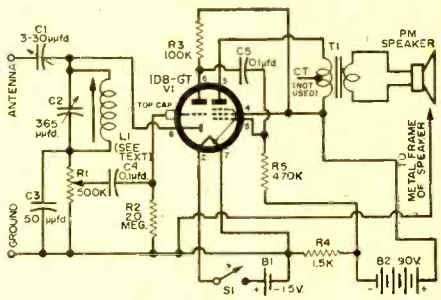
Attached to capacitor *C2*, as shown in the photographs, is a large finger-grip tuning knob. A scale reading in broadcast-band frequencies may be provided for this knob and marked off during the initial adjustment of the set, or the knob may be replaced with a standard broadcast dial.

Trimmer capacitor *C1* is mounted by supporting it with heavy wire leads (No. 18) between the antenna terminal and the coil-capacitor connection.

Several components are mounted under the tube socket by soldering their pigtails directly to socket terminals. These are ca-

(*Continued on page* 127)

B1—1½ volt battery
B2—90 volt battery
C1—3-30 μμfd. mica trimmer capacitor
C2—365 μμfd. variable tuning capacitor
C3—50 μμfd. mica capacitor
C4—0.1 μfd., 200 volt tubular capacitor
C5—0.1 μfd., 200 volt tubular capacitor
L1—Ferrite slug-tuned broadcast antenna coil—Miller No. 6300
PM—3.2 ohm PM speaker
R1—½ megohm potentiometer with switch
R2—2 megohm, ½ watt carbon resistor
R3—100,000 ohm, ½ watt carbon resistor
R4—1500 ohm, ½ watt carbon resistor
R5—470,000 ohm, ½ watt resistor
S1—S.p.s.t. switch, attached to volume control potentiometer R1
T1—Midget, universal output transformer—Merit A-2900
V1—1D8-GT tube



1—8-pin octal socket
3—2-screw terminal blocks
2—2-lug insulated terminal strips
5—¾" x ¾" x ½" right-angle brackets, brass
1—½"-diameter fuse clip (for holding coil L1)
2—Insulated knobs for ¼" shafts
1—8½" x 5" x ½" wooden base
1—Small grid cap (for top connection of 1D8-GT tube)—National Type 8
2—1" studs for mounting tube socket
6—½" studs for mounting terminal blocks

Parts list, circuit diagram, and bill of materials for the one-tube receiver.

Multi-Voltage POWER SUPPLY

By ALVIN B. KAUFMAN

Here is a versatile unit which will provide a multitude of a.c. and d.c. voltages; the d.c. ranges are metered

THIS unit can be used as a plate supply, bias supply, filament supply, or audio signal generator. A transformer is employed so that the unit can perform safely with a.c.-d.c. equipment.

The supply differs radically from the conventional bias or plate power supply in its use of a special, but readily available, component allowing the simple selection of numerous a.c. and d.c. potentials ranging from 1.1 to 117 volts a.c. and from 1.5 to 165 volts d.c. The a.c. power may be used during bench test of mobile equipment or in the breadboard design stage of gear. Another important use is as a 60-cps sine-wave signal source for testing audio amplifiers or modulators or calibrating oscilloscopes. In this application, it is advisable to check the output a.c. voltages, as they will generally be higher than stated under no-load conditions.

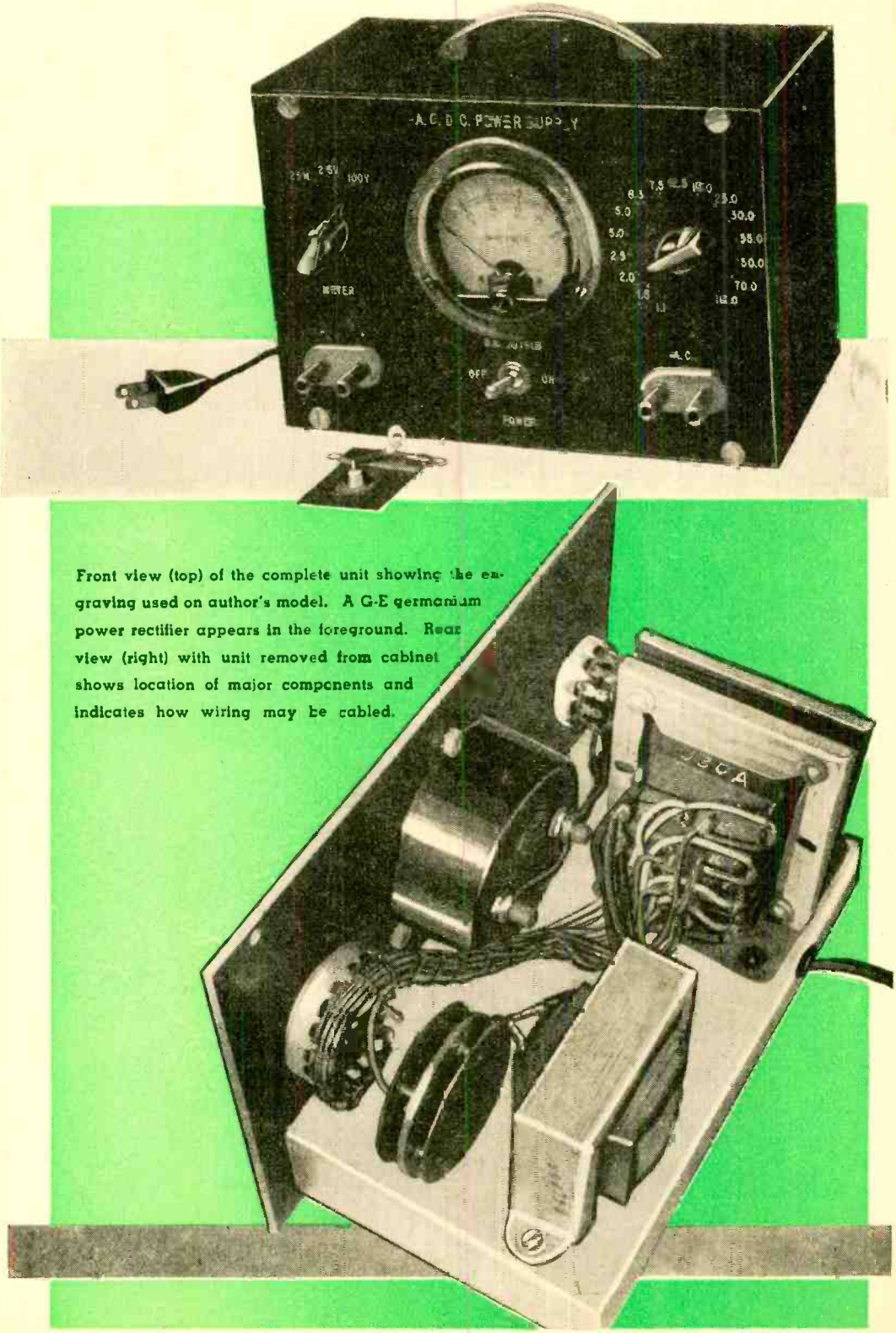
How It Works

Design of the power supply hinges on the use of a multiple-tap-secondary transformer of the type employed in tube testers. The transformer output taps are connected to a multiple-point switch, which connects the selected a.c. output directly to the a.c. output jack. The d.c. supply operates from the same a.c. output switch taps; thus, the setting of the a.c. switch regulates the d.c. output potential. The a.c. is half-wave rectified, filtered, and fed to the output jack. Bias or plate potentials are available between 1.5 and 150 volts, approximately, with sufficient current rating to operate a.c.-d.c. radios, test mobile equipment, and perform any of a dozen useful functions around the shack.

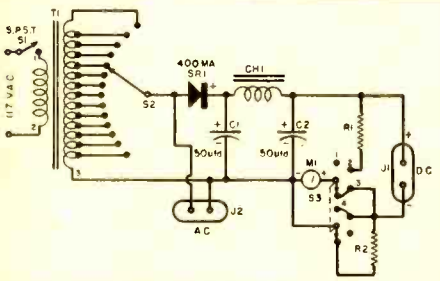
Actually, d.c. output voltage will vary from approximately one-half to 1.41 times the a.c. voltage selected, depending upon the load. The load especially affects the low voltage outputs, because the rectifier's forward voltage drop constitutes an appreciable part of the available voltage. As may be seen from the schematic diagram, both the a.c. and d.c. outputs are brought out through *National* FWH jacks and are ungrounded. This allows the d.c. output potential to be grounded externally and used for either a positive plate supply or a negative bias supply.

Components

The builder can choose components to suit his individual requirements. The transformer shown is a *Thermador* Type J30-A, which provides sixteen different a.c. output voltages; 1.1, 1.5, 2.0, 2.5, 3.0, 5.0, 6.3, 7.5, 12.5, 15, 25, 30, 35, 50, 70, and 117 volts.



Front view (top) of the complete unit showing the engraving used on author's model. A G-E germanium power rectifier appears in the foreground. Rear view (right) with unit removed from cabinet shows location of major components and indicates how wiring may be cabled.



C1, C2—50/50 μfd., 150 v. dual elec. capacitor
CH1—300 ma., 2.8 henry filter choke (see text)
J1, J2—Terminal strips (National Type FWH)
M1—0-1 ma., 2½" meter, 50 ohms resistance (see text)*
R1—Multiplier resistor, 150,000 ohms for 0-150 v. range*
R2—Meter shunt, 0.33 ohms for 0-150 ma. range*
S1—S.p.s.t. toggle switch
S2—Voltage selector switch (Mallory Type 321175 for 17 positions, Type 13124L for 24 positions)
S3—D.p., 4-pos. meter selector switch (Mallory Type 3234)
SR1—400 ma. germanium power rectifier (General Electric Type G10 or 4JA2A1)
T1—Tube checker transformer, Thermador Type J30A or Stancor Type P-1834-3)
1—Metal utility box, 6" x 9" x 5"
1—Chassis base, 4½" x 8" x 1½"
1—Sheet heavy-gage aluminum, 6" x 9"
1—A.c. line cord and plug
2—Pointer knobs
1—Kitchen cabinet handle
Misc. machine screws, wire, solder

**Exact values will depend on scales selected and meter movement used. See discussion in text.*

Catalog price of parts, approx. $35.00

Schematic diagram and parts list.

Maximum current is 0.3 ampere, continuous-duty, although this may be exceeded for short periods. The *Stancor* Type P-1834-3 is similar, but has taps on its primary for line voltages of 105, 115, and 125 volts. Its secondary has taps for all of the voltages of the *Thermador,* except 15 volts, and with the addition of 1.4, 3.3, 7.0. 85, and 110 volts. Switch *S2* is a rotary-type, single-pole switch having at least as many positions as there are secondary voltage taps on *T1.* For use with the *Thermador* transformer, with its sixteen voltages, the seventeen-position *Mallory* Type 32117J switch can be used. If the twenty-tap *Stancor* transformer is used, *S2* may be *Mallory* Type 13124L, a 24-position switch.

Rectifier *SR1* may be of the selenium type, but it is preferable to use the new *General Electric* germanium power rectifier. Its higher rectification efficiency and lower voltage drop provide greater output when operating at low a.c. input potentials. The much higher voltage drop of the selenium type may not be important at 117 volts a.c., but at 1.1 volts it definitely would limit the available output current. The *General Electric* germanium power rectifier has the lowest drop of any rectifier on the market, only 1.5 volts at 400 milliamperes! However, as low as this may be, it can be seen how it will affect the d.c. output with low a.c. input. If the particular type of rectifier specified in the parts list cannot be obtained, *General Electric* Type 1N158 can be substituted; it is a diffused-junction germanium rectifier with a current rating of 500 ma.

Filter requirements are rather simple, as the d.c. output potential cannot exceed 165 volts, no load. Capacitors of 150-v.d.c. working rating and 50-μfd. capacitance were considered adequate for this purpose. This approximates standard manufacturing practice for a.c.-d.c. radios and, while not ideal, is more suitable than going to 450-volt capacitors, which either would not have the capacitance desired or would be objectionable in size and cost. The filter choke to be used would depend upon the expected current drain from the supply. The *Stancor* Type C-2334 has a 300-ma. current capacity, which is equal to the rating of the transformer, an inductance of 2.8 henrys, and a d.c. resistance of 60 ohms. *Merit* Type C-2991 is rated at 2 henrys, 250 ma., with 53 ohms resistance.

Metering

The builder may provide metering to suit his own requirements. The author had on hand a multiple-scale meter with a basic 25-milliampere movement. It was decided to utilize three scales, 25 ma., 2.5 volts, and 100 volts; and a two-pole, four-position switch was employed, making an off position available for the meter. With the high current meter used by the author, considerable current drain is taken from the power supply in either voltage reading positions. Thus, the meter has the effect of a bleeder resistor and helps to stabilize the output voltage. Usually, the metering circuit is not intended to perform a bleeder effect and a low-current basic meter is used, with the required additional components, to measure the required ranges of voltage and current. The schematic diagram shows, with various positions of the switch, the different types of meter circuits which might be required. (It does not show the author's actual arrangement.)

In the first position of the switch, the meter is out of the circuit. In the second position, the meter movement and a multiplier resistor, *R1,* are connected in series across the power supply output to measure voltage. In the third position, the meter alone is connected in series with the negative output lead to measure current, using the basic range of the meter. In the

(*Continued on page* 105)

R/C NOTES

CRISP OCTOBER is upon us, and out at popular model flying fields and boating ponds many a radio controller may be seen in his zipped-up flight jacket putting his model through its paces. Still, time is running out, and some thought should be given to winter projects. How about converting to multi-channel? More and more multi-channel is being flown at the various flying contests. For model boating, multi-channel is well nigh a necessity if you desire to control direction and speed.

There's lots of new equipment hitting the market this fall and winter that puts multi-channel within range of the average R/C-er's pocketbook. Among the new audio tone jobs is the one shown below, made by the *Badaco Manufacturing Company* of 2801 Penick St., Shreveport, La. Three-tube operation is obtained in the receiver by using a 3A5 (two tubes in one envelope) and a 1U5, both hard tubes. Although the receiver shown here is equipped for five-channel operation, single-channel, three-channel, or six-channel equipment is also available.

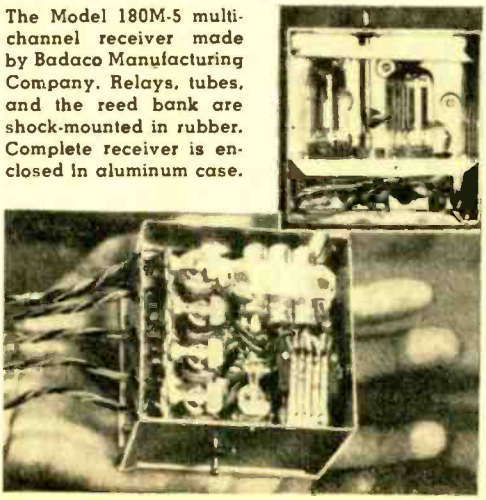
The transmitter to go with this receiver is a "three-in-one" unit. A removable plug enables the operator to have carrier, tone, or multi-channel operation.

THERE'S NO DOUBT but that the 27.255-mc. Citizen's band gets awfully crowded when a group of R/C'ers get together for an afternoon of flying or model boating. Add to this the interference from the nearby ham bands and after a while you can get really discouraged. What's the answer? Well, the 465-mc. band is one; but reliable, stable equipment in this range is a rarity.

More and more R/C'ers have been investigating the Technicians band of 50 to 54 mc. as a possible solution. This band requires an FCC license, however, for which a code and theory test must be passed.

This winter may be a good time to bone up on the required theory, which isn't beyond the ken of most hep R/C'ers, and do something about the code. Actually, a code speed of only five words a minute is all that is necessary. This part of the test is taken under the supervision of a local general or advanced class amateur; the theory test is taken by mail.

Write to your local field office of the FCC for Form 610 and the Technician's class examination.



The Model 180M-5 multi-channel receiver made by Badaco Manufacturing Company. Relays, tubes, and the reed bank are shock-mounted in rubber. Complete receiver is enclosed in aluminum case.

THE *Radio Control Club of Chicago* is sponsoring a Championship Flying Meet for R/C in Harvey, Ill., on October 2. Entry is restricted to members of the *Radio Control Club of Chicago,* but interested spectators are always welcomed. Those who are eligible should apply to R. E. Webb, C. D., 1303 W. 79th Street, Chicago, Illinois.

Shown here is Louis Petrella of New Jersey as he checks a Babcock multi-channel R/C receiver during the *Fifth Annual Metropolitan Model Airplane Championships* held recently at Staten Island, N. Y., and sponsored by the *Richmond Model Flying Club.* Al McBride, who copped second prize in the multi-channel radio control class, is shown with the transmitter. —30—

Bike Boasts Portable Radio

A BROADCAST RADIO RECEIVER is built into the tank of the new "Huffy-Radiobike," to be available for the 1955 Christmas toy season. The radio reportedly brings in

stations up to 100 miles away on the regular AM band. It includes a speaker, volume control, "on-off" lock switch, and non-directional loopstick antenna. Battery-powered, the set is said to be resistant to shock and rain.

The bicycle itself features a gearshift, white side-wall tires, headlight, and chrome rims. Additional information may be had by writing to *The Huffman Manufacturing Co.*, Dayton 1, Ohio. —30—

Low-Cost Photo Flash Kit

ECONOMICAL TO BUILD and operate is the "Illini 300," an electronic photo flash unit in kit form. Using high-efficiency tubes, capacitors, and reflectors, the device operates on standard batteries, or may be powered by an a.c. power pack also available in kit form.

Flash duration of the "Illini 300" is

1/600th of a second, said to be sufficiently short to stop almost any motion long enough for adequate film effect. The flash-gun unit is lightweight, and furnished with a universal mounting bracket. The kit sells for $59.50, less batteries; the power pack for $13.50.

Further information can be obtained from electronics part distributors, local photo supply dealers, or by writing direct to the manufacturer, *Illinois Condenser Co.*, 1616 N. Throop St., Chicago 22, Ill. —30—

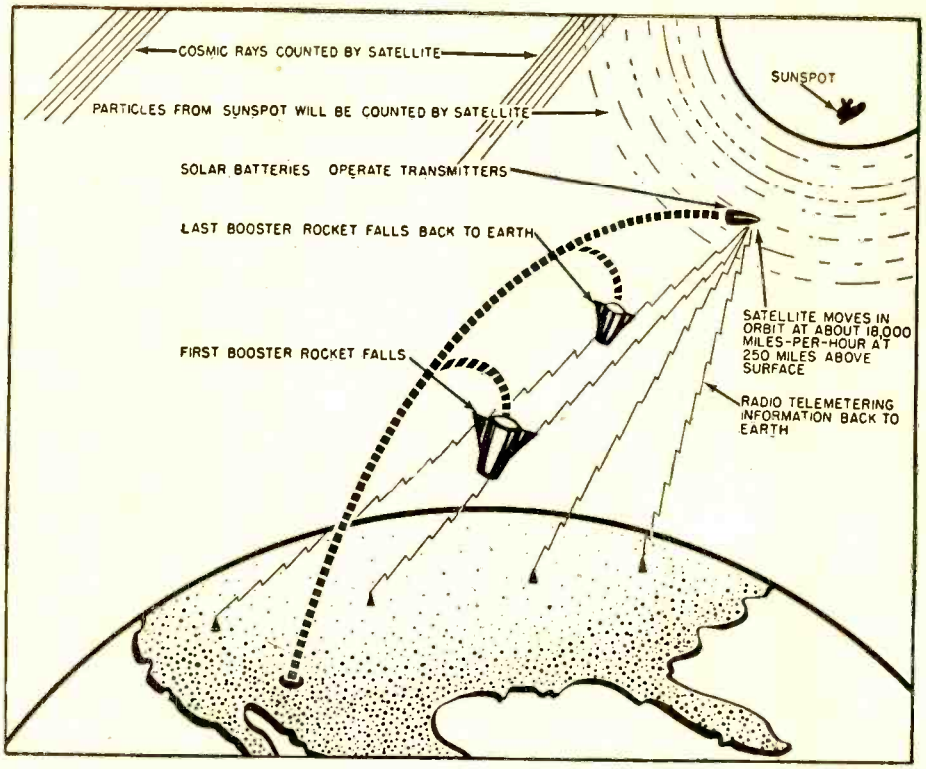
Counter Tallies Bus Riders

AN ELECTRONIC DEVICE that indicates whether all the seats on the top deck of a bus are full or not has been developed by *Hadley Telephone and Sound Systems, Ltd.*, of Smethwick, England, and is being tried out by the Birmingham City Transport Department.

Mounted at the rear platform of the bus, the device contains an electromagnetic counter which displays illuminated numerals behind an aperture in the front panel. When all of the seats have been taken, the indicator registers "zero," and a "full" sign flashes on. The device not only counts passengers moving up the stairway, but also works "backwards" to count people descending as they leave the bus. Getting the counter to do this was a problem which took *Hadley's* technicians two years to solve.

Operation depends on the interruption of a split light beam projected across the stairway. The beam is focused onto photoelectric cells which control magnetic relays. Interruption of the beam operates the relays in a certain sequence, depending on the direction of cutting of the beam. Controlled by the relays, the electromagnetic counter consists of two spools on which a length of printed tape is wound. The spools rotate in either direction, according to whether the passenger is entering or leaving the upper deck. Printed on the tape are the numbers which are visible through the unit's front panel.

The entire system, which operates from the 24-volt battery system of the vehicle, costs about £50 ($140.00). —30—



Electronics Important to Satellite

Scientific information will be telemetered back to earth

PLANS for small, unmanned, earth-circling satellites were dramatically announced by President Eisenhower on July 29. Joining the President in this announcement were many leading scientists from the National Academy of Sciences and the National Science Foundation. The satellite vehicles are to be launched in 1957 and used during the third International Geophysical Year (I.G.Y., 1957-58) for studies outside the earth's atmosphere.

First reports indicate that the satellites will be quite small—probably less than two feet in diameter. This size is dictated by the rocket power requirements necessary to project the satellites well outside of the main body of the atmosphere. Such satellites have long been considered feasible by scientists interested in counting cosmic rays, determining ultraviolet density, and ascertaining the nature of the particles released by the sun during sunspot storms.

The satellites will contain measuring equipment and will probably continuously transmit, or telemeter, information back to earth. Receiving sites will be established at numerous locations over the earth's surface in order to insure complete and uninterrupted radio reception. Cooperation for this end of the project has been definitely assured, with some 40 nations—including the USSR—promising I.G.Y. cooperation.

Once outside of the main portion of the earth's atmosphere, a satellite can adopt an orbit which will permit rotation around the earth for a period lasting from several days to several weeks. The period that each satellite will remain in the orbit will depend upon the final thrust, probably given by step rockets as they attempt to push outside the gravitational field. Once in the orbit, the satellite will gradually spiral down until it intercepts the atmosphere and dives to the surface, disintegrating along the way.

Theoretically, an ideal orbit will permit a satellite to stay outside the earth's atmosphere almost indefinitely, but the possibility of reaching this orbit is small. Preparations will be made to launch a number of these vehicles, each of which will be equipped with transistorized telemetering units, solar batteries, and the necessary scientific measuring gear. —30—

TIPS and TECHNIQUES

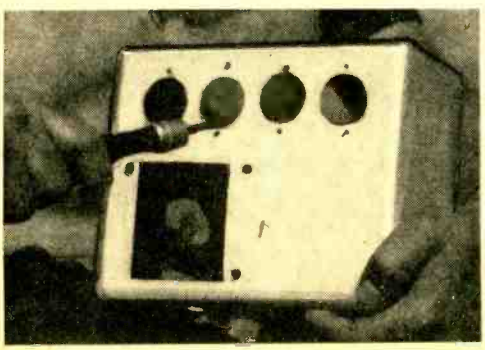
PICTURE TUBE EXTENSION SAVES TIME

Where a picture tube is mounted separately from the chassis in a TV cabinet, a socket extension is very convenient and time-saving. The extension shown in the photo has a standard 12-pin cap for the

tube socket extended on 36 inches of five wires to a plug with the usual six pins. Such an extension permits pulling the chassis out to a nearby table and attaching it to the picture tube which is left in the cabinet. This not only saves time but minimizes the danger of handling the large tube.

FILE REMOVES BURRS

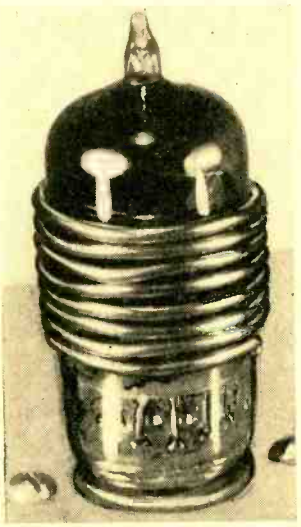
A handy deburring tool can be made from an old three-cornered file. To prepare the file for this purpose, clamp it in a vise. Break off the end by striking swiftly with a hammer, leaving about 2 in. nearest the shank. Next drive the tapered end of the file into a wooden file handle. Finally, grind the broken end of the file down on a water-wheel grinder so that the temper will not be taken out of the point. If a high-speed grindstone is used, keep the file cool while grinding, and hone it down on a wet stone.



This type of deburring tool will clean out drilled holes in a chassis neatly, without flaring the surplus metal around the edge of a hole.

TEMPORARY CURE FOR MICROPHONICS

Microphonic tubes may cause a variety of troubles in electronic equipment, ranging from streaks and picture tearing in TV sets to howls and "ringing" sounds in audio systems. A microphonic condition results from loosened elements within the tube, so that the electrodes vibrate with the sound vibrations, changing the amplification of the tube and making it act more or less like a microphone (hence the name "microphonic"). A microphonic tube may be identified by tapping the various tubes in the equipment with the rubber tip of a pencil—if the complaint is caused as a particular tube is tapped, the defect has been located.



The only sure cure for a microphonic tube is to replace it with one that is non-microphonic. But a spare tube may not always be handy. One "old-timer's" cure that often works is to wrap the tube with a length of solder. Use at least half a dozen full turns. The weight of the solder tends to "dampen" the tube's vibration and to reduce the effect of microphonics.

HOME-MADE BUS BAR

A bus bar may easily be made with nothing more than a length of tinned copper wire, a hand drill, and a vise. Simply fasten one end of the tinned wire in the hand drill chuck and secure the other end in the vise jaws. Then pull back on the wire, twist it several times, and remove the home-made bus bar.

STOP NOISE IN TV GUY WIRES

Many times the wind sets up vibrations in the guy wires on roof-mounted TV antennas. These vibrations are transmitted to the roof, which tends to amplify the sound to a point that is annoying. A simple means of stopping this noise is to cut

a slot in a sponge rubber ball (a ball about two inches in diameter is fine), slip it over the guy wire and tape with friction tape to hold the ball in place. One ball halfway up on each guy wire is usually enough to stop the vibration.

REMOVING DECALS

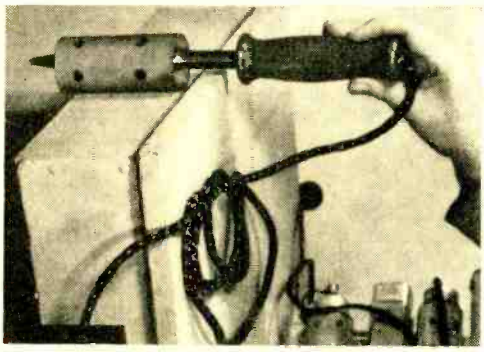
Whenever it is necessary to remove a decal from equipment, try using fingernail polish remover and carbon tetrachloride, mixed in a 50-50 solution. The carbon tetrachloride evaporates, thus controlling the solvent action of the nail polish remover without harming painted surfaces.

COVER WHEN NOT IN USE!

A radio or other electrical equipment left in a basement or out-of-doors may be subjected to dust and other harmful agents. This is particularly true of devices not used very often. An old typewriter cover will prove a cheap and adequate protection when draped over the equipment.

TUBE SHIELD HOLDS SOLDERING IRON

An old-style or large tube shield, when attached to the worktable or bench as shown, will hold a soldering iron in place,



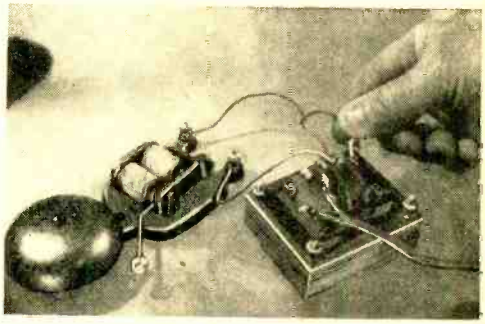
whether it is hot or cold. The shield can be attached easily with screws, by working with a thin screwdriver through the holes in the metal shield.

BASE FOR TV ANTENNA MAST

A base for a roof-mounted TV mast can be made from two 10" strap hinges. Attach the hinges to the bottom of the mast with two ⅜" bolts and attach them to the roof with lag screws. Go over the head of the lag screws with roofing compound to keep the roof from leaking.

OLD TRANSFORMERS ARE USEFUL

When it is time to replace a power transformer in a radio, save the old one. The high-voltage winding may have burned out, but the primary 110-volt winding and the secondary windings that provide from



1½ to 6 volts may still be usable. Let the old transformer supply the low voltages needed for door bells, buzzers, toy electric motors, and similar jobs.

CHISEL CLEANS CHASSIS

Handy aid for preparing chassis and other electrical equipment when soldering ground connections is a vibro tool. Using the chisel attachment, the metal is cleaned in a jiffy and the chiseling digs into the metal for a good solder contact.

Use a dull chisel attachment, or you can resharpen your good attachment easily on the set's sharpening stone after use.

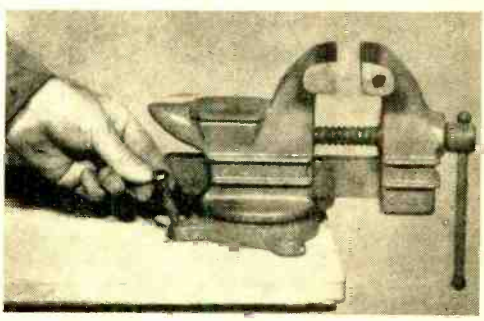
NEON BULB LOCATES SWITCH

A type NE-2 neon bulb placed across the terminals of a wall switch enables you to find the switch in the dark. The faint glow of the bulb shines through the cover plate of the switch. Of course, it goes out when the switch is turned on, but who cares?

WORKBENCH HAS REMOVABLE VISE

A test bench or worktable, fitted with a lifting top, can be adapted to hold a medium or fairly heavy vise. When the bench is being used for test equipment and the vise is in the way, it may be removed quite easily.

To mount the vise in the removable top, simply drill holes to accommodate bolts



through the vise frame. By lifting the top slightly, nuts may be placed on the underside of the top for tightening the vise in place. This arrangement is particularly valuable in crowded quarters. —30—

AFTER CLASS

DIODES AS RECTIFIERS

AFTER FIVE DECADES of unchallenged supremacy in the field of rectifiers, the vacuum diode has now begun to feel the hot breath of competition from newly improved crystalline materials like selenium and germanium. Nevertheless, it still remains the most economical device for converting a.c. to d.c., particularly at medium to high voltages.

The action of a vacuum diode rectifier is based on the fact that electrons emitted by a heated surface will move toward a positively charged conductor through the evacuated space inside the tube envelope; but if the charged element is negative, it repels these electrons so that they return to the emitting surface. Like charges attract; unlike charges repel.

Following the same line of thought, if the element were to change its polarity periodically from plus to minus, each time it became positive electrons would move from the emitting surface to the charged element in a stream which would constitute a true electric current; as the charged element swings in a negative direction, the stream of electrons would stop flowing.

Thus, in the circuit of Fig. 1, 60-cycle a.c. line voltage is applied directly to a series circuit consisting of a vacuum diode tube and a resistor. When the positive half-cycle of the applied emf (A) appears across the input terminals, the charged element (called the "plate" or anode) is positive with respect to the emitting surface (cathode) and an electron stream flows from the negative terminal of the source through the resistor, through the diode, and back to the positive terminal. This current flow produces a voltage drop across *R;* the potential builds up and drops off in the form of a half-cycle as illustrated (A').

When half-cycle B appears at the terminals, the plate becomes negative with respect to the cathode, repelling the electrons back into the cathode. Since an electron stream does not flow through the diode in this case, the tube "opens" the whole series circuit. Now there is no voltage drop across *R* and, consequently, no d.c. output. The action yields a pulsing d.c. voltage, making use of every alternate half-cycle and discarding every other alternate half-cycle. If some device were connected across the resistor, it would "see" a pulsating direct voltage just as though

Fig. 1. Rectifying action of a vacuum diode.

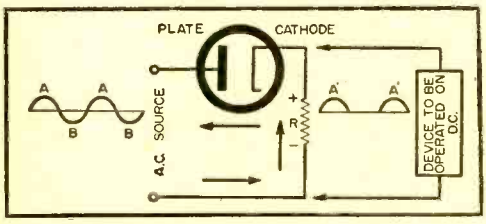


Fig. 2. (A) Voltage relations in circuit of Fig. 1. (B) Transformer and half-wave rectifier.

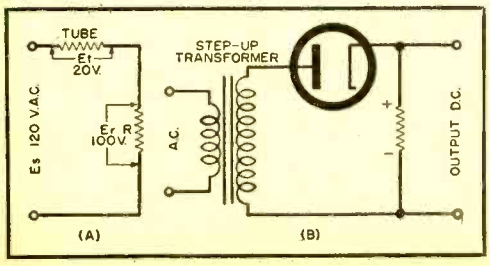
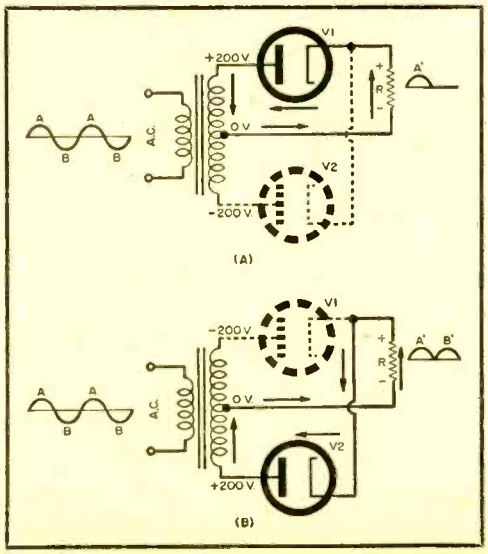


Fig. 3. How full-wave rectification takes place.



a generator were connected in place of *R*. This is called "half-wave rectification."

The magnitude of the emf that appears across *R* is equal to the original source voltage *minus* the voltage drop in the tube itself. In Fig. 2A, the diode—which is not a perfect conductor—is shown as a resistance; as such, it develops a voltage drop, *Et*, which forms a part of the series equation:

$$Es = Et + Er$$

Hence, *Er*, the useful voltage, is equal to *Es* minus *Et*. Assuming a source voltage (*Es*) of 120 volts and a drop in the tube (*Et*) of 20 volts, the available output voltage (*Er*) is then 100 volts.

In the above discussion, and that to follow, it is assumed for simplicity that the no-load d.c. output voltage from the rectifier is the same as the r.m.s. input voltage. This, of course, is not strictly true, but serves for illustrative purposes in the present example. Actual d.c. output voltage depends on such factors as load, type of filter, whether rectification is half-wave or full-wave, etc. These factors will be discussed in future articles.

A step-up transformer may replace the direct line connection (Fig. 2B) to provide a higher useful d.c. voltage across *R*. This circuit changes nothing but the magnitude of the output voltage; it is still an example of half-wave rectification.

Substantial improvement in the smoothness of the d.c. output is made possible by using two diodes and a transformer which is tapped in the exact electrical center of its secondary winding (Fig. 3). As the ends of this winding vary plus and minus with the changing a.c. input, the center-tap emf may be considered to remain fixed just as the pivot of a children's seesaw is stationary while the ends oscillate above and below its level.

Consider the situation portrayed in Fig. 3A, for the input of half-cycle A. The upper diode, *V1*, is conductive because its plate is positive with respect to its cathode (+ 200 volts is more positive than 0 volts); thus, electrons flow in the path indicated, causing a voltage to appear across the resistor as in the prior case.

On the next half-cycle (B), the polarity of the transformer reverses and *V1* becomes an open circuit, but now *V2* begins to conduct. Tracing the circuit discloses that the direction of electron flow (Fig. 3B) through the resistor is *exactly the same* as before. This means that the output voltage for this half-cycle has the same polarity as for half-cycle A, the result being d.c. in which both halves of the original a.c. input voltage are put to use. Logically, then, this arrangement is called "full-wave rectification."

It must be noted that only half of the available transformer voltage is being utilized by this circuit. In the transformer of Fig. 3, an output potential of 400 volts could be obtained if the entire winding were used in a half-wave circuit like that of Fig. 2; as it is, only 200 volts are being applied in the full-wave arrangement. On the other hand, the output waveform (A′ and B′) in Fig. 3B is much easier to filter than that of the half-wave system because the gaps or "valleys" between the half-cycles are much smaller in the case of the full wave. (See *RC* combinations in the June, 1955, issue of POPULAR ELECTRONICS, pages 84 and 85.)

In a future issue of PE, full-wave bridge rectifier circuits will be discussed. In bridge hookups, full-wave rectification at *full* transformer voltage may be obtained; to do so, four rectifier diodes are needed rather than two.

The following quiz is intended as a self check. All of the questions can be answered correctly if the foregoing text has been mastered. Answers are on page 114.

QUIZ

1. The plate of a rectifier has a potential of +500 volts referred to some point in the circuit. The cathode of the same tube has a potential of +100 volts referred to the same point. Will this diode conduct? Why?
2. The voltage drop across a rectifier is 10 volts. What output voltage is available if the source voltage is 500 volts?
3. In a full-wave rectifier system, the total transformer voltage is 800 volts. What useful output voltage is available after rectification, assuming a drop of 20 volts in the tube?
4. Which rectifying method is preferred, half-wave or full-wave, for applications which demand pure d.c.? Why?
5. For a given transformer, which system—half-wave or full-wave—provides the greater output voltage?

UNITS OF MEASUREMENT QUIZ

TEST your knowledge of units of measurement by pairing the letters of the first column with the correct numbers of the second column. A score of ten correct is excellent, nine correct is good, eight correct is fair, and seven or less correct is poor. Answers are given on page 114.

A. henry	1. phase angle
B. farad	2. conductance
C. ohm	3. wavelength
D. mho	4. capacitance
E. gilbert	5. electrical power
F. ampere	6. *Q* of a coil
G. watt	7. resistance
H. meter	8. magnetomotive force
I. no unit	9. current
J. radian	10. inductance

CARL & JERRY

By JOHN T. FRYE

Great Bank Robbery or "Heroes All"

"JUST ONCE," Carl complained bitterly as he trudged along the road toward the approaching hills, "I'd like to take a hike without having to be a packhorse for a whole mess of electronic equipment."

"Oh, quit your griping," Jerry said good-humoredly, as he skipped lightly along carrying a bulky but obviously not very heavy box. "You're just steamed because you outsmarted yourself and elected to carry the *little* box without knowing it contained the nice heavy batteries. You're just as eager as I am to try out this portable 420-megacycle rig, and we'll never have a better opportunity than to work back to town from the top of Old Saddle Back Mountain."

"Where does this joker who is supposed to work with us live?"

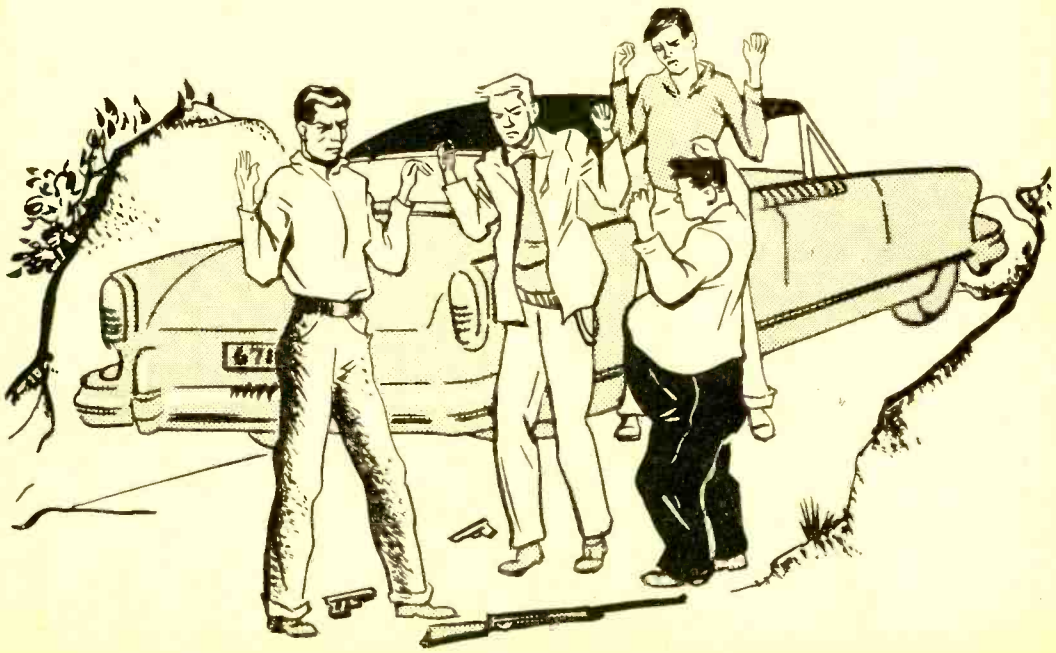
"He's a new ham in town. His name is Gene Mays, and he lives in an apartment on the third floor of that building the police station is in. Gene is a real v.h.f. and u.h.f. bug and has been concentrating on the ham bands above 30 mc. for several years. This combination transmitter and receiver is a home-brew job of his own manufacture."

"How come you're suddenly so hopped up on u.h.f. You can't talk any farther on those frequencies than you can on 75, 40, 20, or 10 meters, can you?"

"No. In fact, *reliable* communication on 420 megacycles is limited pretty nearly to line of sight. Much greater distances are achieved, of course, under unusual conditions, just as you occasionally get freak TV reception from a station many hundreds of miles away. Taxicab companies operating in the neighboring 460-mc. band have found that with the transmitter feeding an antenna 50' high they can depend upon reaching cabs cruising within a radius of eight to ten miles from the transmitter tower. On the other hand, atmospherics have practically no effect on reception and the wavelength is so short that the signals penetrate into tunnels, bridges, etc."

"What's the short wavelength got to do with that?"

"A scientific description would have to go into the modes of waveguide operation, but let's just say that a radio wave is very much like a cat. You know, they say a cat's whiskers serve it as a sort of feeler gage, and that the cat will not insert its head into any opening which the ends of those whiskers will not clear. A radio wave operates the same way. Unless a tunnel-like passage has cross-section



dimensions sufficiently great with regard to the wavelength of a radio wave, that wave will not enter the passageway. A good example of this would be when your car radio goes dead inside the framework of an iron bridge.

"But I like to fool around with u.h.f. because the field is not as crowded as are the lower frequencies. Here a bright young man like myself—ahem!—just might discover something new all by himself. On top of that, it's a wonderful place to play around with antennas because the half-wave elements are measured in inches instead of feet. You can build an elaborate multi-element array and set it on top of your dining room table. Gene will be using such a collinear array on top of the apartment building, and he has equipped this job with a clever collapsing corner-reflector that folds up and fits inside the case when not being used but will provide 10-db gain over a simple dipole when opened out."

The boys had been so busy talking that the distance to the hills melted away without their noticing it, and as Jerry finished they found themselves standing in the deep notch cut through the rough limestone where the road went over the small mountain. Hitching up their belts, they started the short but arduous climb to the top of the cut.

"Whew!" Jerry exclaimed as they finally made it. He set the bulky transmitter-receiver case on the ground and stretched out on his back. "A guy ought to drink goat milk before trying that."

"YOU should talk," Carl remarked as he set the heavy battery box squarely on top of his pal's stomach. "How would you like to tote *that* all those seven miles from town?"

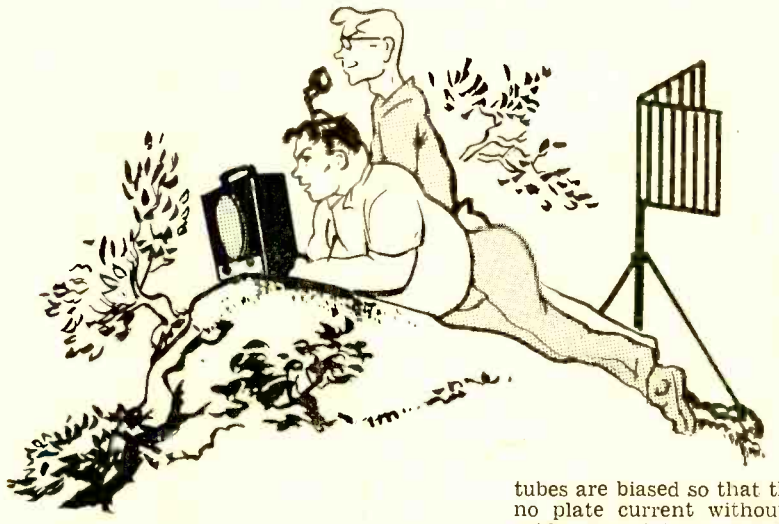
Jerry squirmed out from beneath the box and began to open up the portable station case. In just a matter of minutes, he had the connecting cable plugged into the battery case; and the corner reflector, opened up so that it looked like the wide-open jaws of a striking snake, was aimed at the distant town.

"We've got a while to wait," Jerry remarked, as he glanced at his wrist watch. "Gene was not to start looking for us until a half hour from now."

"Where are the earphones?" Carl asked.

"This set uses a speaker, and you'll be surprised at the volume," Jerry told him. "The output stage is operated class B so as to put out a good strong signal and yet be as economical as possible so far as battery current is concerned."

"Let's see now," Carl reflected, "class B tubes are biased so that they draw practically no plate current without a signal on their grids. The plate current rises as there is need for it to handle an increasing signal voltage on the grids. Right?"



". . . if one of you will be so accommodating as to try a little funny stuff, he can save the county the cost of a trial for the whole lot of you."

"Hundred per cent—" Jerry started to say, when the receiver he was idly tuning blared forth with such a bellow that he fell backward off the rock on which he had been sitting.

"W9CFI! W9CFI! W9CFI! Here is W9HST calling. If you're hearing me, Jerry, come in at once. This is important!"

Jerry scrambled back to his knees, threw a switch and shouted into the mike, "W9HST, W9HST. You're five by nine, Gene. What's up? W9CFI over."

"Roger, Jerry, and listen closely for we haven't much time. A gang of men just held up the Farmers & Merchants Bank and have headed out that road in your direction. I was down in the police station when the report came in. A couple of carloads of men are after them, but the police chief says they can never catch the hopped-up hot rod the robbers are using before they reach Old Saddle Back. Once across it, the thieves can lose themselves a dozen different ways in the valley on the other side. I told the chief, who is right here with me, that maybe you and Carl could stop them. Do you think you can do it—without getting hurt, I mean? They're bad characters and shot a teller in the bank during the holdup."

As this transmission was coming through, Carl and Jerry stared at each other with widening eyes across the receiver case.

"Stand by while we talk it over," Jerry finally said weakly into the mike, and then his eyes followed Carl's searching stare down into

(*Continued on page* 128)

THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

POSSIBLY the most important decision the newly licensed amateur must make concerns the type of equipment to buy. Is it better to start out with simple equipment and progress gradually to more elaborate equipment, or is it better to obtain the very best equipment from the beginning? Which is more important, the receiver or the transmitter? Should you buy your equipment or should you build it?

Giving advice on these questions is difficult because there is no one set of answers which will satisfy everyone. Naturally, a high school student with lots of enthusiasm and time, but with little money, who hopes to make a career in radio and electronics, will have different ideas than a busy doctor or businessman with just as much enthusiasm and more money but much less time. Nevertheless, a discussion of the various possibilities will help you to make your own decisions.

If at all possible, you should build at least part of the equipment in your station. No matter how diligently you study your license manual, handbooks, and other radio books, all you read about the properties of resistance, capacity, and inductance, how vacuum tubes amplify, and so on, can be only abstract theory until you see it in action.

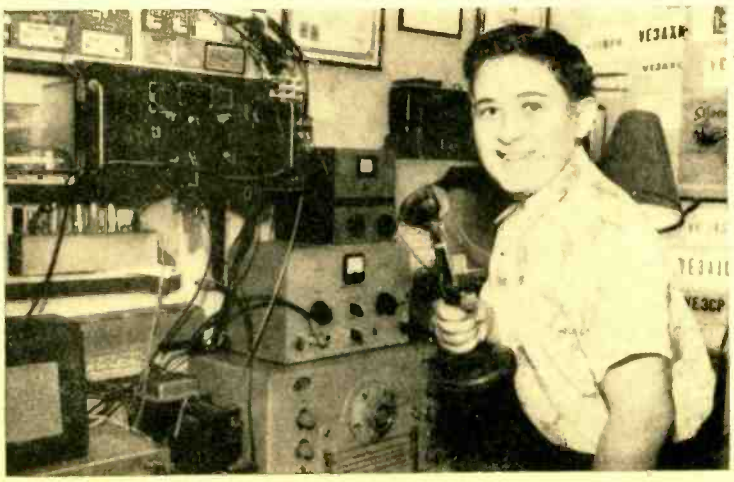
If you were studying radio in school or through a correspondence course, you would be furnished a kit of parts for your course; and each time you learned a new bit of theory, you would perform a set of experiments in order to see how theory translates into practice. You can do the same thing for yourself by building pieces of equipment and observing how they work under different conditions.

It is difficult to overestimate the value of combining study with construction in rapidly increasing your knowledge of both the theoretical and practical sides of radio. Combining them prevents you from becoming either a "Theoretical Timothy," or a "Billy, The Builder." Timothy can explain how radio works in five-syllable words, but needs help to change a pilot bulb in his receiver; while Billy can build anything as long as he has step-by-step instructions to work from, but he has never bothered to learn why the things he puts together work.

Start with Simple Gear

It is not necessary to build complicated equipment at the beginning. In fact, it is better to start with something simple, like a small power supply, a one- or two-tube receiver, or a small transmitter. Such a unit will not take too long to assemble, and if it does not work the first time you turn it on—and it probably won't—it will not be beyond your skill to find the trouble. Success with a small project will encourage you to build something else, while failure with too large a project might discourage you.

Do not expect the first gadgets you build to outperform expensive, commercial equipment, and do not expect to save a lot of money by



Jack Emerson, VE3DSU, Dresden, Ontario, was licensed two years ago as Canada's youngest ham operator. Now 15, Jack operates between 2 and 80 meters, phone and c.w. Next to his license, Jack's proudest possession is a 35-wpm code certificate.

building them yourself. Unless you have one of those marvelous "junk boxes" owned by some writers, it will usually cost as much to build a piece of equipment as to buy an equivalent commercial unit. Fortunately, we amateurs do not have to make a profit from our hobby to enjoy ourselves. When we build something, it is for the pleasure we get out of doing it.

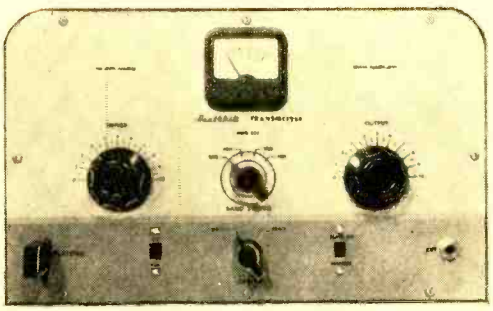
Not the least of this pleasure is the thrill of communicating over long distances with equipment we have built ourselves. Contacts made over equipment built by someone else can never equal it.

"Build-It-Yourself" Kits

There are valid objections that can be raised against building the permanent equipment for your station. Among them are lack of tools and working space, the fear that the finished product will not look as well as it works, and lack of time.

Certainly, it is discouraging to plan to build a piece of equipment only to discover that, after buying the tools needed, you will have no money left to purchase the parts required. And there are better places to construct your dream transmitter than on the kitchen table or the living room rug, which is the choice open to many city apartment dwellers. But these need not be fatal handicaps.

Several manufacturers market kits for home assembly that eliminate most of the objections. All parts are supplied with the kits and



A Heathkit AT-1 transmitter is a neat and efficient unit assembled from a complete kit.

all holes are drilled; therefore, assembling one consists of mounting the parts and wiring them according to the very complete instructions furnished. When this is done, the finished product looks and works like a commercial unit. Oddly enough, the complete kit usually costs no more or even a bit less than it would cost the individual to buy the individual parts, and 10 to 30% less than an equivalent wired unit.

The only tools required to assemble such kits are a screwdriver or two, a pair of pliers for tightening nuts and cutting hookup wire to length, a knife for removing insulation and dirt from wires before making connections, a soldering iron or soldering gun and a spool of rosin-core solder.

As in constructing equipment "from scratch," do not choose too complicated a kit for your first attempt. Probably the ideal kit

J. "Stan" Surber, W9NZZ, Peru, Ind., is often called the "radio mailman" because of the traffic handled between his station and hams in the Canadian and U. S. Arctic regions. The certificates, trophies, and awards on the wall were given to Stan for his unselfish efforts in relaying messages.

for a beginning amateur to cut his teeth on is one for a 30-50 watt crystal-controlled transmitter. Such a transmitter normally contains three tubes: the oscillator, the power amplifier, and the power supply rectifier. It is simple enough so that anyone who can read and *follow* clear instructions will have no particular trouble in assembling it and making it work.

On the other hand, such a transmitter is difficult enough to build so that there is a sense of satisfaction to be gained in doing the job. Wiring wizards claim they can do it over a weekend. The rest of us can expect to take up to ten days or two weeks to finish the job, assuming no more than an hour or two of work an evening.

Another reason for choosing a transmitter kit to assemble is that the transmitter will be a thoroughly usable piece of equipment around your station after it is finished. It will have enough power to allow you to work all over the United States and Canada and even to work an occasional foreign station. Yet, it will not be so complicated to operate that you have to be an engineer to adjust it.

Reading what I have written so far indicates that I advocate starting your amateur career with a simple transmitter which you have built yourself or assembled from a kit. When you have learned to operate it well, then it is time enough to advance to more elaborate equipment, which may well be commercially manufactured if your taste should run in that direction.

One reason for this advice is that there are so many facets to amateur radio that you will probably change your mind a couple of times in the first few months about what you like the best. For example, many new Novices plan

(*Continued on page* 121)

AMA-TOURING with Roger Legge

DX STATIONS are not so easy to hear on the 7-mc. amateur band as on the 14- and 21-mc. bands, but there is nevertheless a considerable amount of DX on the 7-mc. band.

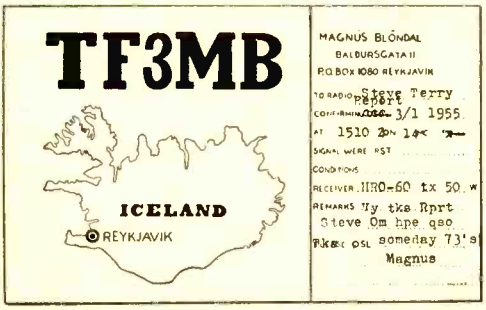
For many years, this band (7.00 to 7.30 mc.) was assigned in the USA to c.w. operation only. However, in February, 1953, the 7.20-7.30 mc. portion of the band was opened to U.S. phone stations. There is still a considerable amount of c.w. DX to be heard on the low end of the band, but it appears that the possibilities for phone DX on this band have not been fully developed, primarily because of the interference from foreign broadcast stations using the band.

Outside of the Americas, the 7.20-7.30 mc. sector is assigned exclusively to broadcasting and the 7.10-7.20 mc. part of the band to shared broadcast and amateur usage. Due to the higher power of the broadcasting stations, they cause considerable interference to amateur operations.

The season for best DX conditions on the 7-mc. band is from October through March, when the static level is lower than during the summer months. Here are some notes on looking for DX on this band:

Oceania and Asia—Most consistent DX reception from this area is from New Zealand, around 0500-0700 EST, with particularly good signals from ZL1BY and ZL2BE. The VK's from Australia are also heard at that time, but less frequently. Other Pacific Area DX reported includes: KJ6FAA, Johnston Island; VK9MF, New Guinea; VK90K, Norfolk Island; ZM6AR, Samoa; and a number of JA's from Japan.

Latin America—The Latin American stations are heard principally during the evening hours, between approximately 7.05 and 7.15 mc., talking in Spanish with other stations in the area. Some operate higher in the band when contacting U.S. stations. The KP4-KG4-KV4 stations operate in the 7.20-7.30 mc. U.S. phone band, and are heard best around 0600-0700 before the stateside QRM is too heavy. Stations heard recently from this area include: CO1AH, HH2PL, HI6EC, HP3FL, HR4WH, KG4AJ, LU3AW, PJ2AF, PY2CK, TI5JCH, VP10JF, VP2DN, VP2LN, and YV5AG.



QSL card from one of the rare DX countries.

Africa—Africans are scarce on 7 mc., but a South African is heard occasionally in the evening, notably: ZS1MP, ZS6BW, or ZS6DW. EL2X in Liberia is also active on this band. EA8AX, Canary Islands, and EA9AS, Spanish Morocco, have been heard contacting Latin Americans.

Europe—The European amateurs do not attempt to contact W's on phone on this band very much, due to the severe interference from European broadcast stations, but a few can be heard in the evening hours, especially during one of the DX contests.

20-Meter Band DX

The 14-mc. band continues to be the outstanding band for DX. Here are reports on stations heard recently. All times are 24-hour clock in EST.

Bhutan—AC5SQ is on the air from this very rare country and was heard on 14.165 mc. at 1000. He is believed to be AC3SQ from Sikkim. (*Jim Moore, Calif.*)

Burma—XZ2KN, Rangoon, was heard on 14.187 mc. at 1055. (*Moore*)

Fiji Islands—VR2AA was heard on 14.18 at 2345. He uses 100 watts. (*Don Kenney, Calif.*)

VR2AP has been heard on 14.165 at 2030. (*Moore*)

Hongkong—VS6BA, 14.085, and VS6CT, 14.19, were logged around 1000-1030. (*Moore*)

India—VU2CT operates on about 14.145 or 14.345 mc. He was heard at 1030. (*Moore*)

VU2FX was heard on 14.17. (*Emmet Riggle, Ohio*)

Indo-China—FI8AO, Saigon, has been heard at 0830 on 14.205 and 14.25. (*Riggle*)

Israel—Signals from Israel have been coming through around 2230; 4X4CX was heard on 14.16 and 4X4GB on 14.15 mc.

Lebanon—OD5AB, Beirut, is the best heard station from Lebanon. He was logged on 14.16 mc. at 2230.

Malaya—Malayan stations heard at 0900-1100 are: VS2CU, 14.198; VS2DB, 14.19; VS2DC, 14.19; and VS2UW, 14.185. (*Moore*)

Sarawak—VS4CT was heard at 0945 operating from Sarawak. He usually operates on about 14.17 mc., but if QRM is heavy, he moves to about 14.125 mc. He previously operated as VS5CT in Brunei, and plans also to operate from North Borneo (VS4) and Christmas Island (ZC3). He uses a 90-watt transmitter. (*Moore*)

Singapore—Additional Singapore stations heard around 0945 are: VS1AD, 14.145, and VS1BC, 14.145. (*Moore*)

Africa

Algeria—FA8AY was heard on 14.16 mc. at 2000 & 2300. (*Curt Swenson, Minn.*)

French Morocco—CN8MM is the best heard station from this country, with Eva usually at the mike. She is heard well on 14.18 around 1600-1800. (*Wayne Ashworth, No. Carolina; Kurt Meyers, Ohio*)

Libya—5A1TK has been heard on 14.17 at 1630 and 5A2TZ on 14.18 at 1800. Reports may be sent to APO 231, New York, N. Y. (*Swenson*)

South Africa—ZS1SW, 14.17, has been coming through at about 0600, the long way around, across Australia.

Spanish Morocco—EA9AX is a new one noted on 14.155 at 1630.

Tangier—KT1WX was heard on 14.17 mc. at 1815. (*Swenson*)

Tunisia—3V8AS, Bizerte, was logged on 14.18 at 2200.

Europe

Azores—CS3AC continues to be heard well around 1400-1800. He usually operates on about 14.19 or 14.31 mc. The address for this one is AACS Sqdn., APO 406, New York, N. Y. (*Pete Hemingson, Conn.*)

Finland—OH1PN, 14.15 mc., and OH5QN, 14.17 mc., were heard at 2230.

Iceland—U. S. personnel at Keflavik Airfield are now on the air, using TF2 calls. TF2WAF is the one most active, heard on 14.15 mc. around 1400-1600. Reports may be sent to APO 81, New York, N. Y. (*Ashworth*)

SWL Robert Burns at his listening post in Whitman, Mass. The receiver which Bob uses is the popular Hallicrafters S-38D.

Norway—LA5YE has been getting out well; heard on 14.13 mc. at 0700 and also at 2000. (*Meyers*)

Sweden—SM5ARL, 14.18, and SM5LL, 14.17, were heard at 2030 contacting Central Americans.

Yugoslavia—YU1GM continues to be the best heard station from Yugoslavia. He is heard with good strength on 14.19 mc. around 1730.

Americas

Canadian Arctic—K2MEA/VE8 is operating from Frobisher, Baffin Island, and is heard frequently on 14.18 around 1600-2000. W9RJV/VE8 is on Resolution Island, between Labrador and Baffin Island; reports for him may be sent to APO 677, New York, N. Y.

Galapagos Islands—HC8HN is a new one operating from here, and is heard on 14.15 at 2200. HC8GI continues to be heard evenings occasionally around 14.17 mc.

Leeward Islands—VP2KB, St. Kitts, has been quite active on 14.11 mc. around 0700.

Paraguay—ZP5CG is the most active station from this infrequently heard country; heard on 14.12 mc. at 1830. (*Meyers*)

(*Continued on page* 125)

DX FORECAST FOR OCTOBER

From	In Eastern & Central USA (EST)			In Western USA (PST)		
	14 mc.	*21 mc.*	*28 mc.*	*14 mc.*	*21 mc.*	*28 mc.*
Central & South America	0600-2000	0700-1800	0900-1600	0600-1900	0700-1700	0800-1600
Europe & North Africa	0600-0800 1300-1600	0800-1400	———	———	0700-1000	———
Central & South Africa	1300-1800	0700-1600	0900-1500	1600-1900	0700-1700	1100-1500
Near & Middle East	1300-1500	0800-1200	———	———	0700-0900	———
Far East	———	1600-1800	———	1900-2200	1300-2000	1400-1700
Australia & New Zealand	0730-0830	1300-1900	1500-1800	1900-2200	1200-2000	1300-1900

Tuning the Short-Wave Bands

By HANK BENNETT

RADIO PROGRAMS in Sweden are produced by *AB Radiotjanst* (the *Swedish Broadcasting Corporation*) and distributed by the *National Telegraph System*, which owns and operates the transmission facilities. *Radiotjanst* is supervised by a board of seven members. The chairman and three of the members are appointed by the Government and the three remaining members by the shareholders, who represent Swedish newspapers and radio manufacturers. All phases of radio operation are financed by means of license fees from listeners. A license costs 15 Kr. (equivalent to the British one pound or the American three dollars). Listener frequency is greater than in any other country with a licensing system—327 licenses per 1000 inhabitants.

By special agreement between the Swedish Government and *Radiotjanst*, radio programs are to be characterized by responsibility, objectivity and impartiality. The board of *Radiotjanst* interprets this agreement to mean that in any cases where differences of opinion might exist in such important matters as politics, economics, and sociological questions, it shall not deny facilities for the expression of alternative opinions. On the other hand, the radio is not to serve as an organ devoted to the service of the Government or any political party.

The painting on the face of this striking QSL from "Radio Sweden" depicts Elijah being taken up to heaven. On the reverse side is the verification and information on Sweden.

The Swedish Home Service is transmitted on long, medium and short waves; the International Service on short waves via two 100-kw. transmitters at Horby. *Radio Sweden* broadcasts programs in seven languages: Swedish, English, American, French, German, Spanish, and Portuguese.

The Swedish Home Service (non-directional transmissions) broadcasts at 0000-0400 on 6065 kc., 0400-1100 on 11,880 kc. (March to October), and on 9260 kc. (November to February); and at 1100-1800 on 6065 kc. The Home Service is also broadcast over Motala, 12 kw., on 7270 kc.

In the European Service, they have one non-directional transmission daily: in German at 1500-1530, English at 1530-1600, French at 1600-1630, Spanish at 1630-1645, and in Portuguese at 1645-1700. Frequency is 6095 kc.

For real DX'ers, the following long and medium wave stations are generally the most reliable: Motala on 191 kc., with 200 kw.; and Horby on 1178 kc., with 100 kw. Although these stations are used for European reception, they have been heard in the USA.

Call letters assigned to these stations include: SBO (6095 and 6065 kc.); SBU (9620 kc.); SBP (11,880 kc.); SBH (1178 kc.); and SBG (191 kc.). The outlet on 7270 bears no call sign.

The interval signal, which is often a positive way to identify an otherwise unknown station, is as follows:

The interval signal tune comprises the first notes of a song by the Swedish 18th century composer and poet Carl Michael Bellman.

Other frequencies used by *Radio Sweden* are: 11,705 kc. (SBP); 9535 (SBU); 15,155 (SBT); and 7210 (no call).

English Newscast Stations

Reports are shown in EST, based on the 24-hour clock system. As mentioned previously,

we omit contributors' names for the purpose of having more space for items of general interest.

This month we will feature stations having ENGLISH news periods.

Albania—*Radio Tirana* has ENGLISH from 1530-1600 and French from 1600-1630 only on 7850 kc.

Australia—VLA9, Shepparton, 9615 kc., has *ABC* news ending at 0815; VLC9, same channel, has ENGLISH news at 0715-0720. On 9610 kc., VLW9, Perth, has an ENGLISH news period at 0600.

Brazil—A letter from *Radio Emissora Paranaense,* at Curitiba, gives the information that the call is ZYS30 (9545 kc.) and ZYZ9 for the medium waves. Address is Rua Senador Alencar Guimaraes, 97, 5, Andar, Caixa Postal 471, Curitiba, Paranaense, Brazil. The call for *Fundacao Radio Maua,* on 9705 kc., is ZYX24; on 11,885 kc., it is ZYX25. The call for *Radio Clube Paranaense,* on 11,935 kc., is probably ZYR35.

Bulgaria—A QSL from *Radio Bulgaria* lists ENGLISH at 1600-1630 and 1645-1715 on 7670 and 6070 kc.; also at 1930-2030 and 2300-2330 on 9700 kc.

Ceylon—Colombo, 11,875 kc., has a VOA ENGLISH newscast at 1000.

Czechoslovakia—*Radio Prague,* 9550 kc., has an ENGLISH broadcast to North America at 2300-2315.

England—London is noted on the West Coast at 1109 with news on 15,310 (GSP); sports news on GWR (15,300 kc.) at 1110.

French Equatorial Africa—*Radio Brazzaville,* 15,595 kc., has an ENGLISH news period at 0515.

Finland—OIX4, Pori, 15,190 kc. has ENGLISH news at 2300, French news at 2315.

Formosa—ENGLISH news can be heard from Taipeh on BED4 (11,920 kc.) at 0000 (parallel to 15,235 kc.) and at 0130; on BED3 (15,235 kc.) at 0230 with news and music. BEC27, 6927 kc., the *Voice of MAAG,* is noted s/off at 0900. Power is 500 watts; address is MAAG-Formosa, APO 63, San Francisco, Calif. This one sometimes has variety programs around 0530.

Germany—*Nordwest Deutsche Rundfunk,* Cologne, 5980 kc., has ENGLISH at 2030, German news following; an ENGLISH announcement at 2315 is followed by music and German news.

Greece—An Army station in Greece is often heard around 1600 on 7000 kc., with recorded music. It may possibly be located at Jannina.

Haiti—4VC, Port-au-Prince, on 9485 kc., has ENGLISH news and music at 1730. 4VWI, on 15,280 kc., Cap Haitien, is testing here at 0700-0930; on Saturdays until 1030.

Hungary—Budapest, 11,910 kc., has ENGLISH to North America at 2315.

India—ENGLISH news can be tuned from Delhi on 17,760 kc. at 0230; at 1930 on 11,895, 11,875, and 9770 kc., with Home Service following the news on 11,895 kc.

Indo-China—*Voice of Vietnam,* Hanoi, 11,998 kc., has French news and music at 0530. ENGLISH news at 0800 and 0900. *Radio France-Asie,* Saigon, 15,420 kc., has ENGLISH news at 1100. The *Voice of the Vietnamese National Army,* Saigon, 7260 kc., is noted in ENGLISH at 0715-0730. Address is requested. *Voice of Vietnam,* 7260 kc., is noted at 0800 with ENGLISH news.

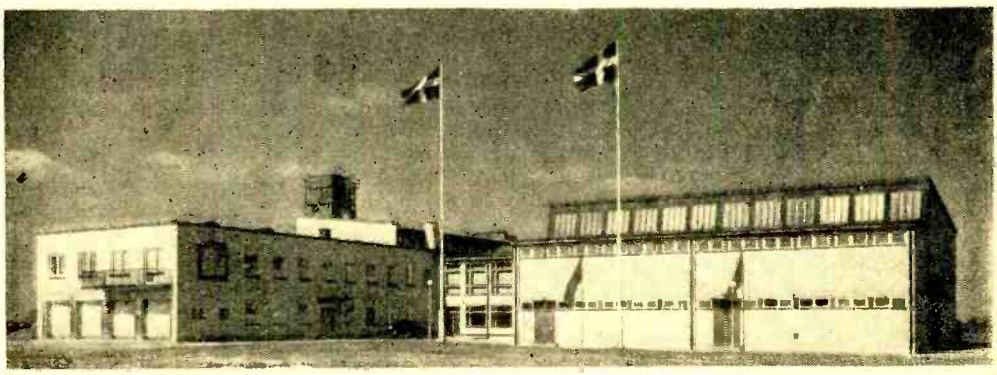
Indonesia—ENGLISH news and music is tuned on YDF6, 9710 kc., Jakarta, at 0430-0600, announcing as *The Voice of Indonesia.* YDF, 6045 kc., Jakarta, has Indonesian news and music at 0430, with ENGLISH noted at 0645. Other Indonesian xmsns include: YDJ, 5060 kc., Jogjakarta, at 0800 with native music; YDP, 4930 kc., Medan, at 0820, with music. Most of the Indonesians below 5000 kc. are heard on the West Coast around 0800-0900, usually in native languages.

Israel—Tel Aviv, 4XB31, 9010 kc. AV, has an ENGLISH news period at 1600, and is usually heard well in Eastern USA.

Italy—Rome, 11,900 kc., has an Arabic news session at 0130, ENGLISH at 1920. On 9570 kc., ENGLISH news is noted at 1930 and on 11,810 kc. at 1915 and 2130. The outlet on 11,810 kc. can be identified with its bird chirp interval signal around 1730; a language program follows.

Japan—ENGLISH news from Tokio can be heard on JKJ, 7285 kc., at 0400; at 0545 from the *Far East Network* on 6160 kc. beamed to the USA; and at 0900-0915 from JOA6 on 15,135 kc.

(*Continued on page* 125)

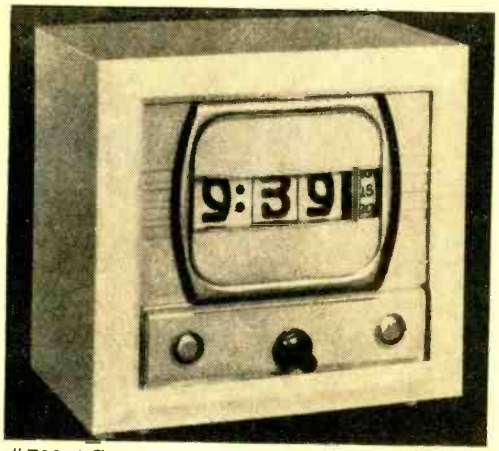


Short-wave transmitter building of "Radio Sweden" at Horby, Sweden.

TV Clock-Lamp

FEATURES of an electric clock and a TV lamp are combined in the #700-AG "Glo-lite" announced by the *Pennwood Numechron Co.*, 7249-51 Frankstown Ave., Pittsburgh 8, Pa.

This device contains a precision timing unit that registers the hour, tenth-minute, minute, and second. In addition, its case and face are molded from a luminous plastic which glows in the dark, independent of any light source. The glow is present when the unit's switch is on "off." With the switch turned "on," additional illumination is provided which enables the



#700-AG to serve as a night light for hallway, bedroom, etc.

The clock movement is a self-starting type that operates regardless of the switch position. Clock numerals are colored for quick and easy reading. The #700-AG retails for $12.95. -30-

Compact Hi-Fi Amplifier

THE "MARK 10" is the latest of the new line of compactly designed *Brociner* hi-fi amplifiers intended for home installation where both space and cost must be held to a minimum. Making extensive use of printed circuitry, the "Mark 10" includes a phono preamplifier-equalizer and 10-watt power amplifier. Inputs and controls provide for its use with AM, FM, and TV tuners, any type phono pickup, and for tape recording and playback.

Frequency response is 20 to 20,000 cycles ±1 db. Less than 1% harmonic distortion is reported at its full power output. Hum level is low: —70 db on radio input; —50 db on phono input.

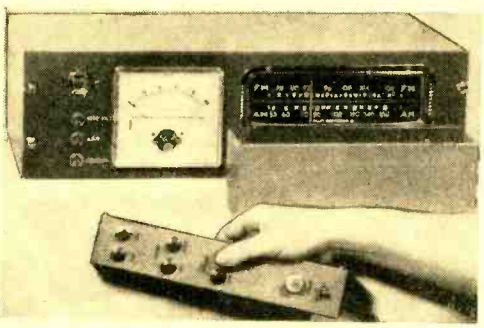
Other features include an input selector switch, record compensator switch, independent treble and bass controls, loudness-compensated volume control, take-off jack for tape recording, and a record noise filter which may be switched in or out of the circuit. Net price is $75.00. For additional

information, write to *Brociner Electronics Laboratory*, 344 East 32 St., New York 16, N. Y. -30-

De Luxe AM-FM Tuner

TOP QUALITY HI-FI RECEPTION on both AM and FM is available with the "Custom Special" FM-AM tuner made by *Collins Audio Products Co., Inc.*, Westfield, N. J. Reputed to be one of the most advanced tuners in production, this set features an unusually wide AM range with a frequency response of 20 to 11,000 cycles. The FM section reproduces 20 to 20,000 cycles with a reception sensitivity of 3 microvolts for 30 db of quieting. Push-button control of all tuner functions from a considerable distance is possible with the attachment of a remote control box.

Tuning accuracy on FM is assured by a front panel mounted meter; on AM, by a type 6U5-G "tuning eye." The FM circuit uses eleven tubes, including circuits for automatic frequency control and for eliminating interchannel hiss, while the AM cir-



cuit uses five additional tubes and includes a 10-kc. whistle filter. The tuner is powered by a 5Y3-GT rectifier circuit.

Net price of the tuner alone is $285.00. The remote control unit sells for $79.50, and a cabinet in gold or gray is priced at $11.40. For additional information, write to the manufacturer. -30-

POPULAR ELECTRONICS

Audio and Hi-Fi Section

Disc and Tape Review

By BERT WHYTE

AS REGULAR readers of this column know, the last few issues have been devoted to the basic building blocks in your record library. We have not strayed from the standard repertoire, getting in some good solid Mendelssohn works and other "standards." As I have often said in the past . . . there is a long, long way to go boys, before we can begin to approximate a basic library. But to use an old cliche . . . "variety is the spice of life." After a pretty steady diet of standards, I thought that this month we would take a little breather and review some items that may not be considered as standard repertoire, but which I feel will be of interest to you and—literally—will add "spice" to your growing library.

The Mask of the Red Death

To get off to a good start, how about a record with the exotic title *The Mask of the Red Death!* It sounds like a theme in the classics from a grade Z television space opera. Actually, it is a work by French composer Andre Caplet, and is not at all the cornball you might expect. Caplet died in 1925, so for all practical purposes, the work can be called modern, although it has relatively little dissonance when compared to other works of that era. Some of you more erudite readers may recognize the title as the story written by Edgar Allan Poe. Caplet was fascinated by the story, which had music as an important part, and composed this impressionistic work which very graphically portrays the masked ball and the coming of the "Red Death" . . . the plague!

Scored originally for string quartet and harp, in this recording by the Concert Arts Orchestra on *Capitol* P8255 it has been expanded to a string orchestra to obtain greater so-

Hi-Fi Record of the Month

Ravel—***Daphnis and Chloe (complete ballet)***

Antal Dorati conducting the Minneapolis Symphony Orchestra

Mercury 50048

The second complete version of the great Daphnis and Chloe ballet on records and an outstanding job in every respect! Performance is superb, the orchestral playing is miraculous, the sound quite unbelievable. With this disc, Mercury has reached a new stage of perfection in the recording of symphonic music.

nority. The harp has been retained and, as brilliantly played by Ann Mason Stockton, is employed in extraordinary fashion. It is used to simulate the tolling of an old clock and, in combination with the eerie scoring in the strings, it is chillingly effective! You are likely to hear more tricks of the violinist's trade in this work than in any other I can think of at the moment. Playing harmonics, double stopping, using mutes, all sorts of odd fingering and bowing techniques . . . brother, the whole bag of tricks is trotted out for your edification.

On the whole, the work is very listenable and easy to assimilate. In spite of the fact that the scoring is strings and harp, the power generated by the orchestra here is considerable. This is one of *Capitol's* most successful "FDS" recordings. String tone is exceptionally rich, very smooth and clean, with virtually no "edginess." The mellow resonance of the celli and the deep sonority of the double basses are especially notable. The harp is superbly reproduced, whether it is being used softly and liquidly, or in sharply plucked or percussive manner. Frequency response and dynamics are very wide range and the acoustic perspective employed is ideal for the forces involved.

Flip side of this record is occupied by American composer Harl McDonald's *Suite From Childhood*. A very charming and lovely little score which I feel sure you will like, it too uses harp in an interesting manner and is another example of fine string recording. This is the only disc available of both these works, so choice of recording is no problem. By all means listen to this one for an unusual musical adventure.

Dance Suite

Now we turn to one of the great masters of modern music, Bela Bartok. No, don't start running! I know very well that the mere mention of this man's name to some people starts the blood pressure upwards. I really and truly feel that people in this category just haven't given Bartok a fair shake. I'll be the first to admit that some of this composer's scores are pretty rough stuff. And I suppose that a person who is relatively new to classical music and whose tastes have not gone much beyond the Beethoven-Brahms-Tchaikovsky stage might have been exposed to something like a Bartok string quartet or his *Suite From the Miraculous Mandarin* with most horrific results! But in spite of Bartok's formidable reputation for dissonance and atonality, there are many scores of his which are fairly easy to take and contain some fascinating hi-fi sounds.

Such a work is his *Dance Suite*, written for the anniversary of the conjoining of Buda and Pest, into the present-day Budapest. It is a very varied work, for the most part gay and sparkling, as Bartok skillfully takes some native Hungarian folk songs and magically transforms them into a unique orchestral fabric. Is there dissonance? Most assuredly there is . . . but not reams of it, and what there is doesn't seem out of place or in any way unpleasant. As a matter of fact, the present interest in the music of Bartok is almost wholly a hi-fi phenomenon. The scoring . . . dissonance and atonality, if you will . . . lends itself particularly well to hi-fi recording. Some of the most spectacular hi-fi sound in the entire LP catalog can be found among the Bartok works. This *Dance Suite* is one of the most brilliant, and is available in three recordings.

The son of Bartok, Peter Bartok, is one of our most astute audio engineers, and has turned out discs which must be reckoned as among the finest recordings to appear on LP. He has recorded his father's *Dance Suite* for his own label, *Bartok* 302, with Franco Autori conducting the New Symphony Orchestra of London. Georg Solti conducts the London Philharmonic on *London* LL709, and on *Urania* 7161 the work is performed by the Leipzig Philharmonic under Pfluger. The *Urania* we can dismiss, as the performance, while competent enough, is pale beside the luster of the other two conductors' versions. The sound on the *Urania* disc also leaves much to be desired.

Between the performance of Autori and Solti there is little to choose. Solti seems slightly surer of his ground, while Autori gets more precision from his orchestra. In matters of sound, the choice is largely a question of what *kind* of sound you like. The *Bartok* disc was recorded in Kingsway Hall in London and benefits from the superb acoustics. This is a big, "over-all" type of sound with super-clean strings, nicely rounded brass, woodwinds of great purity and percussion which is amazingly articulate and of great impact. The *London* sound is also "big-hall," but has more inner detail. Strings, brass, woodwinds . . . all are much more sharply focused; the percussion is clean and crisp but lacks something of the punch in the *Bartok* disc. Both discs are of very wide frequency and dynamic range, and very little distortion was evident even in the most heavily modulated passages. Percussion fans will delight in the plentiful scoring for the high percussives like the triangle, cymbals, and small bells.

As to which is the record of choice, I'd put it this way . . . I like the Solti performance a shade better than the Autori, and I find on repeated listening that I prefer the sound on

(*Continued on page* 117)

By H. H. FANTEL

Choosing a De Luxe Hi-Fi Tone Arm

For the ultimate in record reproduction, select one of these carefully designed and precision-manufactured arms

THE BASIC FUNCTION of the tone arm in a phono system is to carry the pickup across the record. This is not as simple as it may seem at first glance, since it involves a host of acoustical and physical problems. The better tone arms come extremely close to solving these difficulties.

An arm must provide correct stylus pressure and conditions of groove tracking and non-resonance that will allow the best possible interaction between pickup and record. Only a very good arm gives the pickup a chance to "read out" all the tonal information from a record groove without omitting or distorting any part of it. Ideal conditions, of course, can only be approximated. The changers and manual players shown last month (pages 71 to 76) offered a good approximation, quite well matched in quality to many hi-fi home installations.

In the equipment shown here, the approximation to the ideal is as close as modern precision technology can provide. The remarkable engineering achievement attained in these fine instruments becomes apparent in view of the factors involved in their design.

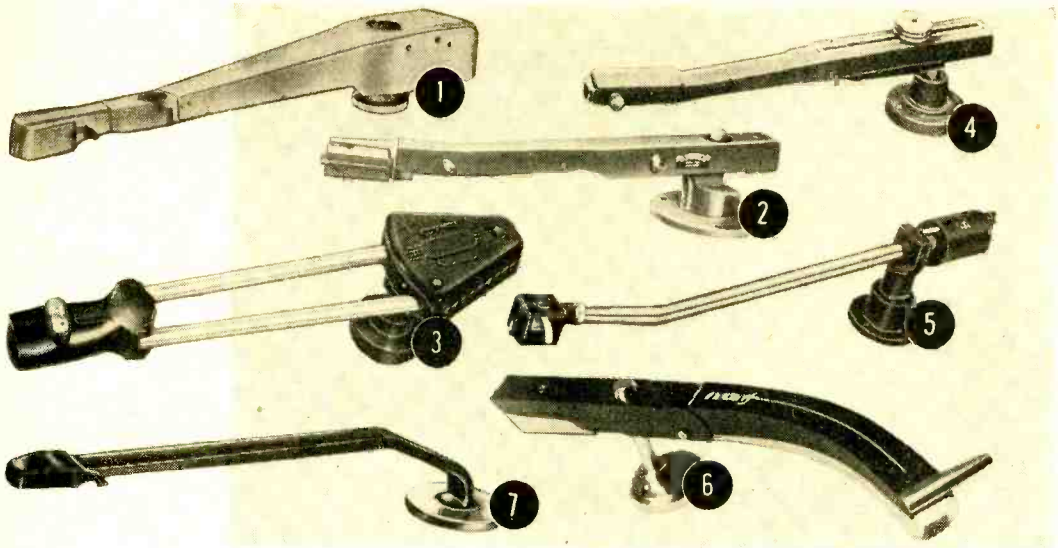
Tracking the Grooves

Accurate tracking of the record grooves is the main task of the tone arm. Some fine points of geometry are involved, however, which make this apparently simple task quite difficult. The recording head which originally cut the spiral groove on the record moved across the record face in a straight radius line. It could do so because the record-cutting lathe guided the cutter across the record on a supporting bridge, which functions somewhat like an overhead traveling crane. The tone arm cannot follow this straight line across the record. Since it is pivoted at one end, the arm's path is necessarily curved. The difference between the straight and the curved path is known as the "tracking error." To assure good reproduction, this path divergence must be kept at a minimum. In other words, the tip of the tone arm should be approximately tangent to the record groove at all points of the recorded surface.

Theoretically, this problem has a very simple solution. In an infinitely long arm, the tracking error would approach zero. But since infinity is a hard place to reach with a screw driver, more practical solutions had to be found. A curved or angled tone arm, if correctly pivoted, will stick much closer to a true tangent line on its way across the record than a straight arm. For this reason, all modern tone arms are either curved or set off at an angle, as shown in the photographs.

Also, if the arm does not lead the pickup directly toward the center spindle, but to a point slightly ahead of center, two tangent points instead of one occur within the tracking arc, resulting in a marked decrease of mean and maximum tracking error. In this way, the maximum tracking error in the arced path of the tone arm can be kept down to four degrees, and the mean tracking error to two degrees.

The distance between the turntable



1 Angel Model 17A is the newest tone arm to utilize the viscous-damped principle. Arm is furnished with its own pickup (moving-coil type requiring matching transformer). Suspension (low-friction, single-pivot) maintains constant stylus force for any height of pickup above the record. Plug-in arrangement for 78-rpm and LP heads. This unit is made by EMI, British manufacturer who also produces Angel records. Net, $89.50. Distributed in the U. S. by Kingdom Products, Ltd., 23 Park Place, New York 7, N. Y.

2 Audax arm was designed originally for use with the Audax pickup, illustrated here. However, with an adapter, it accommodates other hi-fi pickups. Arm's long pivot stud is seen protruding from rear. It carries a special rotating section, mounted like a compass needle. The arm itself pivots on this intermediary rotating section. Arm is counterweighted with adjustable stylus force. Net, $20.00, for 16" arm; $14.00, for 12" arm. Audak Co., 500 Fifth Ave., New York 17, N. Y.

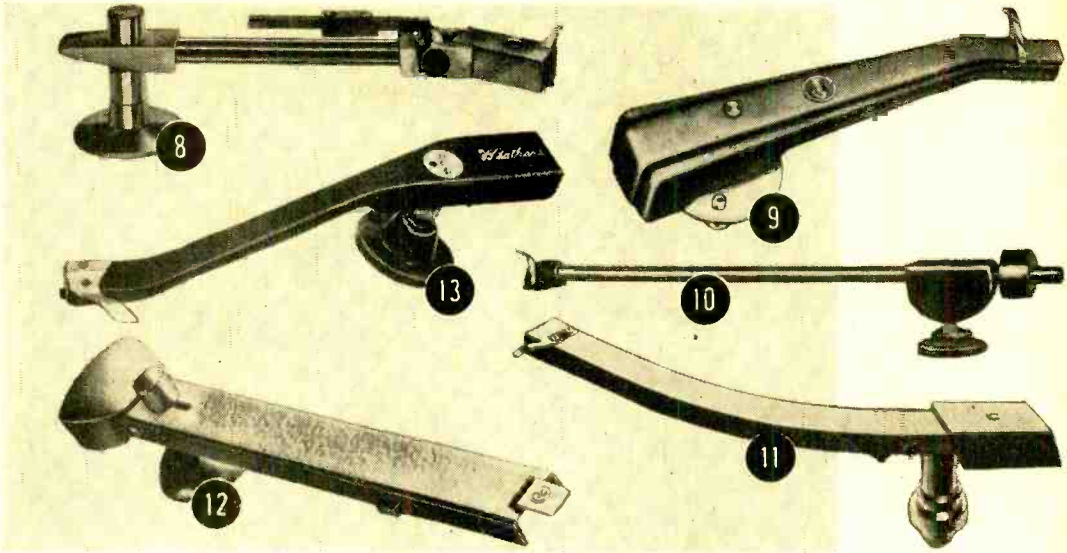
3 B-J arm launches a new design principle which virtually eliminates tracking error. Arm consists of two interconnected—but separate—arms of unequal length whose respective tracking errors cancel each other. Likewise, individual resonances of two arms tend to eliminate each other. Stylus and record wear are greatly reduced; reproduction is very "clean." Shell will accept standard hi-fi pickups. Net, $22.50. Hi-Fidelity, Inc., 420 Madison Ave., New York 17, N. Y.

4 Clarkstan arm offers maximum convenience for frequent changes of pickup. The slide-in cartridge holder instantly mounts the pickup by means of a setscrew. Electrical connection is made by spring-loaded contacts. Weight adjustment is rapid and simple. All standard cartridges are accepted. Vertical roller bearings and ball thrust bearings minimize mechanical load on pickup. Low arm resonance assures good bass response. Net, $22.00 (approximately). Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 64, Calif.

5 Electro-Sonic arm is designed for use with company's own moving-coil pickup. Precision-made, the arm is very simple—being essentially a counterweighted tube. Its resonance complements the pickup compliance for optimum results. Adjustable counterweight is provided. The ESL cartridge itself is an electrodynamic type, requiring a matching transformer. Different models are available to suit different applications. Prices range upward to $106.00. Electro-Sonic Laboratories, Inc., 35-54 36th St., Long Island City 1, N. Y.

6 Fairchild Model 280 uses the dual-mass principle discussed in text. High vertical compliance is attained without sacrificing lateral damping. Structure eliminates resonance in 166-200 cps range, resulting in very clean bass. Arm also features height adjustment and safety drop-limit. Although intended for use with Fairchild pickup, the Model 280 will readily accept all standard cartridges, including the G-E "triple-play." Net, $29.50. Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone, N. Y.

7 Ferranti arm is used with Ferranti pickup and matching transformer as an integral system. Arm utilizes a double ball race arm-bearing, and features a built-in



rest. Resonance is said to be beyond audible limits. Device was designed by D.T.N. Williamson of amplifier fame. Entire suspension is located beneath the mounting platform. Safety device prevents damage to record or stylus if arm is dropped accidentally. Complete system net, $75.00 (approximately). Ferranti Electric, Inc., 30 Rockefeller Plaza, New York, N. Y.

8 G-E Model A1-500 arm represents a variation of the dual mass principle. The front section is hinged separately for improved vertical compliance, while the overall mass of the total arm provides lateral damping. Calibrated, adjustable counterweight is attached to front section, eliminating need for spring loading. Ball bearings are used along all rotational axes. Net, $32.00. General Electric Co., Electronics Park, Syracuse, N. Y.

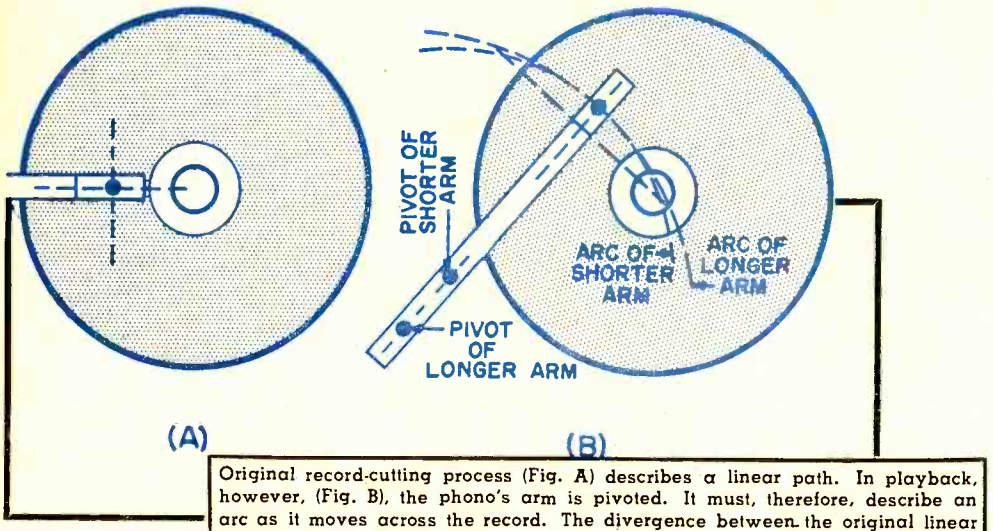
9 Gray Model 108C features viscous damping (see text) for suppression of arm resonance and for stylus and record safety. Damping is provided by a silicone oil film between a convex spherical surface on the arm and a similar surface on the base. If "dropped," the pickup floats down slowly, setting down gently on the record without bouncing. Cartridges are instantly interchangeable, with automatic adjustment provided for correct pressure. Net, $40.00. Gray Research and Development Co., Inc., Hilliard St., Manchester, Conn.

10 Leak Model A is a moving-coil pickup on a tubular, counterweighted, single-pivot, low-friction arm. Height is adjustable, and mounting requires a single hole. Resonance frequencies of arm lie beyond limits of audibility. Pickup features extremely low stylus pressure, high compliance, requires matching transformer. This system has been used successfully by the British Broadcasting Company. Net, $59.00. British Industries Corp., 164 Duane St., New York 13, N. Y.

11 Livingston arm offers excellent tracking, correct pressure settings, adjustable height, and simple installation (single-hole mounting) at comparatively low cost. "Universal" model for records up to 16" diameter, net $18.75. "Special" model for records up to 12" diameter, net, $17.50. Latter has been designed especially for the G-E dual-stylus cartridge. Livingston Electronic Corp., Livingston, N. J.

12 Pickering Model 190D offers unique design in which the cartridge is held on a spring-loaded, hinged plate within the arm. This reduces distance between stylus and horizontal axis of motion to less than 3", providing maximum vertical compliance while retaining good lateral damping. Cartridge plate can be lifted independently within the arm. Offsetting the plate reduces tracking error to less than 2.5°. Protective stop prevents stylus from accidentally touching turntable. Arm is locked in "rest" position by magnetic anchor. Net, $32.00. Pickering and Co., Inc., Oceanside, L. I., N. Y.

13 Weathers A-510-S arm is designed for use with Weathers FM pickup. At 1 gram, it boasts the lowest stylus pressure of any arm and pickup combination. Together with high-stylus compliance, this assures minimum record wear. Arm is made of non-resonant balsa wood. Operating principle of the FM pickup system is described on page 78, June issue of POPULAR ELECTRONICS. Net, $24.50, for 16" arm; $14.50, for 12" arm (Model A-500). Weathers Industries, Barrington, N. J.



Original record-cutting process (Fig. A) describes a linear path. In playback, however, (Fig. B), the phono's arm is pivoted. It must, therefore, describe an arc as it moves across the record. The divergence between the original linear cutting and the tone arm's arc results in tracking error. Use of longer arms, offsetting the cartridge head, and other design features minimize this error.

spindle and the pickup stylus at center position is called "overhang." Correct amount of overhang for a given tone arm depends on choosing the proper pivot point for the specific arm. For this reason, the manufacturer's mounting specifications and templates should be very accurately followed. Essentially, this is a simple matter, requiring no more than the accurate measurement of the distance from the turntable spindle to the mounting center (pivot point) of the tone arm. (Users of preassembled turntable and tone arm units are spared this minor headache.)

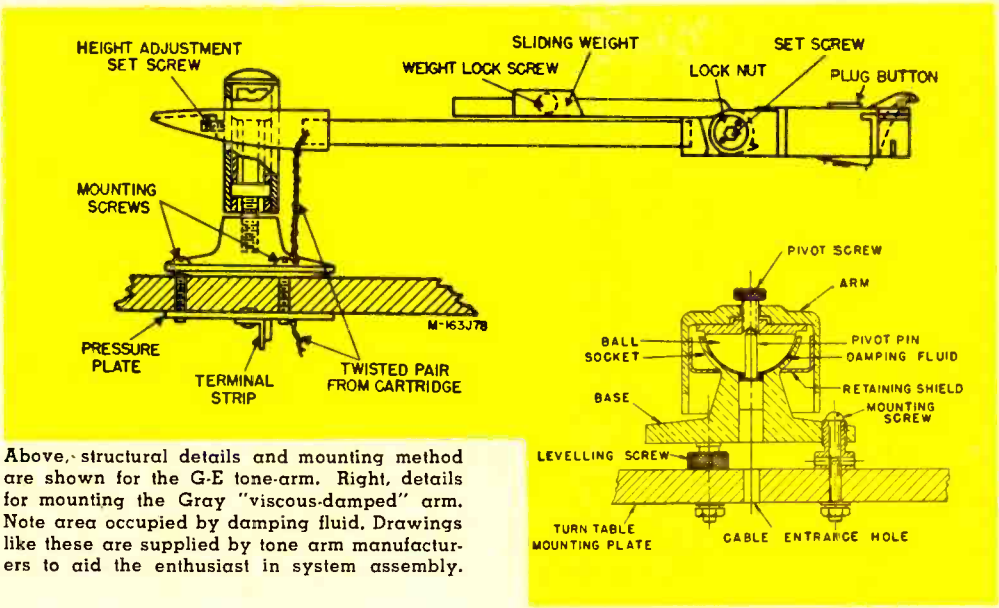
A recent answer to the problem of tracking and tangentiality is given by a design called the "B-J Arm," (using the initials of its inventor, Mr. Burne-Jones). In this arm, the pickup rides between two hinged—but separate—arms. Their respective tracking errors are so calculated that they simply cancel one another. Result: nearly perfect tracking (less than one degree deviation). In ingeniousness and simplicity, this arm belongs in the category of things that invariably make one say, "Why didn't someone think of that before?"

One possible drawback to this kind of arm is the friction generated at the multiple bearing points. In the present design of the "B-J Arm," this friction has been minimized by the use of needle pivots.

Damping and Compliance

In addition to the geometric problems in tone arm design, there are the even trickier dynamic problems, i.e., problems involving the checking and balancing of the various moments of force acting on the tone arm. The arm receives both lateral and vertical moments from the record groove at frequencies ranging from the slow undulation of a warped record to the shimmering overtones of cymbals. Throughout this tremendous range, no arm resonance may occur. The arm must always remain neutral and impassive to the motions of the pickup stylus. If the arm oscillated with the pickup at some arm resonance frequency, the arm resonance would intermodulate the signal, thus causing one of the most annoying forms of distortion. Furthermore, this oscillation would partially cancel out the stylus motion in the range of the arm resonance frequency, weakening bass response.

The arm must therefore be damped, i. e., restrained from any oscillation in resonance with lateral stylus movement. However, the arm should be compliant vertically, so that the pickup can easily follow the up-and-down movement of a slightly warped record. An even more important reason for vertical arm compliance is the fact that the record grooves are unequal in their widths at various points. The loud passages are narrower; they squeeze the stylus from the sides, practically lifting it out of the groove at the tiny, sharp curves representing the recorded sound. The stylus faces the task of negotiating up to 10,000 hairpin curves per second while being almost lifted from the "road." In such a predicament, the pickup needs all the help the arm can possibly give. This help consists largely of keeping the stylus force reasonably constant throughout the up-and-down oscillations due to the "pinch effect." In terms of



Above, structural details and mounting method are shown for the G-E tone-arm. Right, details for mounting the Gray "viscous-damped" arm. Note area occupied by damping fluid. Drawings like these are supplied by tone arm manufacturers to aid the enthusiast in system assembly.

road analogy, a properly designed arm keeps the traction steady on some very bumpy curves.

In most cases, the proper combination of lateral damping and vertical compliance is obtained by suitable distribution of mass in the arm. Mass, in this context, is distinctly different from weight. Weight, as expressed in terms of stylus force, is adjustable. Mass represents the totality of the arm, including the counterbalance, and remains constant. The *Fairchild* and *Pickering* arms employ a system of dual masses—a large over-all mass to provide good lateral damping, and a small spring-loaded section on which the pickup is mounted. Far better vertical compliance is attained with these dual-mass arms than would have been possible with a single-section arm of sufficient over-all mass to give equally good lateral damping.

Viscous Damping

Another damping method employs the shock-absorber effect of hydraulic fluid or oil. This is called "viscous damping." Viscous damping provides a gentle cushion against practically all external forces, so that nothing but the groove modulation acts on the stylus: it literally floats on music. The floating quality of these arms insures against careless handling or "accidents." The arm simply will not drop on the record. Instead it floats down slowly and gently, making any damage to either stylus or record next to impossible. People with unsteady hands who are apt to damage the first groove or the lead-in of a record in setting down the tone arm will find viscous damping a veritable boon.

Arms featuring such fluid cushions are naturally complex in design, and must be manufactured with the individual care befitting their status as precision instruments. Consequently, these viscous-damped arms are among the most highly priced as well as the most highly prized. However, if one takes into account the manufacturing problems presented by viscous damping (precision-machined fluid chambers, etc.), the cost of these arms, such as the *Gray* and the *Weathers,* appears surprisingly reasonable.

Arms and Their Pickups

Most arms will accommodate most of the standard cartridges. Yet some arms and cartridges were literally made for each other, and what the designer has thus joined let no audiophile put asunder. Whenever the cartridge manufacturer provides a special arm for his cartridge, the combination will generally provide excellent results. Some manufacturers—such as *Electrosonic, Leak, Weathers,* and *Angel*—leave no choice. This enforced combination of arm and cartridge by the same manufacturer stems less from commercial motives than from a genuine concern for attaining the top performance of both components. The proper matching of arm and cartridge is especially important with cartridges operating at low stylus pressure, where a very small force must accomplish the lateral movement of the arm across the face of the record. —30—

Professional Turntables For Home Use

TURNTABLES and tone arms are the vehicles that carry the phono pickup through the music. The kind of ride they provide vitally affects the quality of the reproduced sound.

Last month, record changers and manual players were covered in which the turntable and tone arm were preassembled on a chassis or base plate. The equipment discussed was unquestionably hi-fi. Now, however, the "fi" will be raised clear up to the stratosphere as the professional-type turntables are investigated. (Professional-type tone arms, to be employed in conjunction with these turntables, are discussed in another article in this issue.) While many of the components are found in recording and broadcasting studios, they are all suited for home use by the most critical of listeners.

It should be remembered that any hi-fi component which is conspicuously better than the rest of a system may prove a waste of money. So, before buying an expensive turntable (and a comparable tone arm), the user should evaluate the quality of his amplifier and loudspeaker. If these components are top-notch, then the type of equipment covered in these articles will be matched to them, quality-wise. These turntables and tone arms are capable of the best record reproduction to be had for love AND money!

The basic principles for professional-type turntables are the same as in the record changers and manual players previously discussed. The turntable must rotate evenly at the correct speed without flutter or wow. It must remain inaudible and introduce no magnetic motor hum or noises due to mechanical vibration (rumble).

Design and Quality

Constant speed is achieved by the use of suitable motors and heavy, balanced turntables to smooth out the rotation by their flywheel effect. The two-pole motors of cheap turntables do not meet hi-fi requirements. Four-pole motors are standard for hi-fi; and for the ultimate in smoothness, some professional-type turntables feature hysteresis motors at a corresponding jump in price.

The rotational constancy of a turntable is easily checked by means of a constant-tone test record or a stroboscope disc. The *Scott* turntable and the *Rek-O-Kut* "Rondine" feature built-in stroboscopes with extremely clear speed indication.

One may argue that the best proof of this particular pudding lies in the playing of long, sustained notes on organ or piano records. If they come through with steady pitch, the turntable itself must obviously be steady. However, the reverse is not necessarily true. If the tone wavers, don't jump to conclusions about the turntable; the fault may be in the record (e.g., an off-center hole). For this reason, ordinary commercial recordings should not be used for turntable tests.

Most modern turntables are made of nonmagnetic materials so that magnetic pickups will not be attracted by them. Otherwise, such magnetic attraction might increase the effective weight of the pickup as it rests on the record.

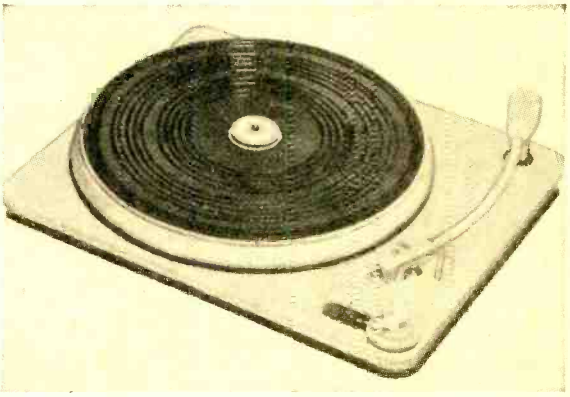
Another problem is hum induced by magnetic radiation from the motor. Most quality turntables have practically eliminated hum by shielding the motor and locating it at a maximum distance from the pickup. Of course, the pickup leads must also be shielded.

Vibration, the cause of turntable rumble, can be largely eliminated by physical separation of motor and turntable through shock mounts, elastic drives, and similar devices.

In the *Scott* 710-A turntable, vibration damping is accomplished by means of two soft-rubber universal joints. This turntable was developed at the Massachusetts Institute of Technology by Prof. Buckingham, a

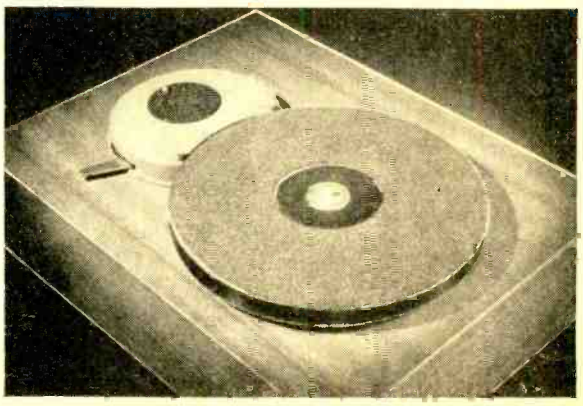
For the best in performance and quality, the hi-fi record listener can do no better than to choose one of these top-flight turntables

By H. H. FANTEL



Collaro Model 2010 includes preassembled arm and pickup. Turntable rotates on single steel ball to minimize friction, is driven by a pulley-and-idler arrangement. Low mass, non-resonant arm turns on ball bearings. Unit handles records up to 16" in diameter. Pickup supplied is claimed to have frequency response of 40 to 16,000 cps. Net, $85.00 (approximately). Rockbar Corp., 215 E. 37th St., New York 16, N. Y.

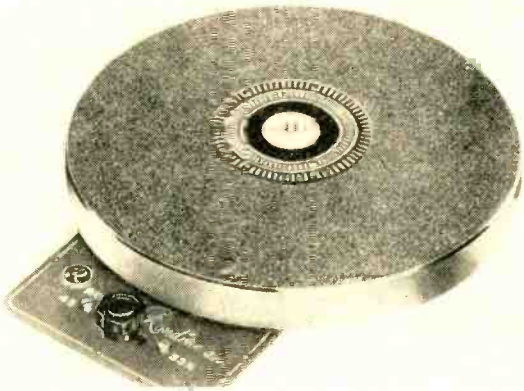
Components Corporation Model PBT gets maximum flywheel effect from 25-lb. cast-iron turntable. Nylon sleeve bearing, in which it rotates, reduces metal-to-metal contact. Motor is double-shock-mounted at maximum distance from turntable to reduce magnetic hum pickup. Reported performance data: 0.25% speed accuracy; 0.05% wow and flutter; —70 db rumble. Special spindle centers record on turntable and prevents slipping. Net, $99.50. Components Corp., Denville, N. J.



D & R Model DR-12A employs shock-mounted motor widely separated from turntable to reduce magnetic hum pickup. Turntable is driven by an idler acting against the outside rim. The idler itself "floats" to reduce possibility of mechanical vibration. Turntable is completely non-magnetic. Constant speeds are produced by a dynamically balanced motor featuring a high starting torque. Signal-to-noise ratio is reported as 60 db. Net, $87.00. Audio Equipment Div., D & R, Ltd., 402 E. Gutierrez St., Santa Barbara, Calif.

Garrard Model 301 meets rigid specifications of less than 0.2% wow, less than 0.05% flutter, and rumble below the limit of audibility. Units are made with individual quality control; inspection report is enclosed with each one. Motor, employing dynamically balanced armature and self-centering bushings, is permanently lubricated. Speed adjustment is provided for three common speeds. Net, $89.00. British Industries Corp., 164 Duane St., New York 13, N. Y.

Presto Model T-18 is heavy, carefully machined and balanced aluminum casting driven by mechanism of utmost simplicity. Three idlers, one for each speed, transmit power from motor to turntable. Idlers are disengaged in "off" position. Reported performance data: speed accuracy, 0.25%; noise level of shaded pole motor, —40 db, of hysteresis motor, —50 db. Net, $53.50 for shaded-pole motor; $108.00 for hysteresis motor. Presto Recording Corp., Paramus, N. J.



Rek-O-Kut "Rondine, Jr." is a two-speed design available in two models: L-34 for 33⅓ and 45 rpm, and L-37, for 33⅓ and 78 rpm. Net price of each is $49.95. Turntable is non-magnetic, cast aluminum, and is dynamically balanced for optimum flywheel action. Strobe disc is permanently affixed. "Rondine De-Luxe," (Model B-12H) is superb 3-speed unit employing hysteresis motor. Net, $119.95. Three-speed model (B-12) with induction motor, $69.95. Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City 1, New York, N. Y.

perfectionist who got used to reaching for the stars when he designed the drive mechanism for the giant telescope on Mt. Palomar. Among its unique features, the *Scott* 710-A has a rigid yoke between the turntable and a floating platform, where the tone arm is to be mounted. Turntable and arm will therefore always respond in unison to any possible vibration while being at the same time isolated by shock mounting from the motor base plate.

The idea of physical separation of turntable and motor is carried to a highly effective extreme in the *Components Corporation* turntable. A 25-pound cast-steel turntable (excellent flywheel effect) is mounted at some distance from the motor, driven directly from the motor shaft by a cloth belt.

At the other extreme is the Swiss *Thorens*, which achieves top quality with a compact, direct gear drive, relying on care-

Scott Model 710-A features unique drive with hardened steel worm, nylon drive gears and multi-stage vibration filter. Rigid yoke between turntable and floating platform for tone arm mounting virtually eliminates acoustic feedback. Skip clutch permits cueing of records. Each speed selector has its own built-in vernier control, used in conjunction with illuminated stroboscope. Speed constancy is reported at 0.1%; rumble, —60 db. Supplied with platform. Net, $102.00. H. H. Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.

Thorens Model E-53N eliminates all friction-causing elements, utilizing a direct gear drive in which all rotating parts are machined, balanced, and positioned with precision accuracy. Centrifugal speed governor permits slower-turning rotor, thus reducing vibration. Gear-shift speed selector provides continuous speed variation over range of ±5% within three speeds. Noise level is reported at –48 db. Net, $60.00 (approximately). Thorens Co., New Hyde Park, N. Y.

Weathers Model K-700 is a complete FM pickup system, comprising turntable, tone arm with FM cartridge, and combination preamplifier, oscillator, and power supply. Discs ride on cushioned float affixed to turntable. Equalization facilities, volume, treble, and bass controls are provided. Entire assembly, net, $125.00 (approximately). Components used are available separately. Weathers Industries, Inc., 66 E. Gloucester Pike, Barrington, N. J.

ful balancing of all rotating parts for smooth operation.

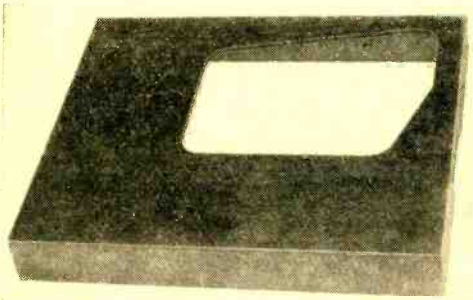
Each design principle has its own advantages and drawbacks. One may, for instance, argue both sides of the question in choosing between a belt drive and a gear drive. None of the various drive systems are inherently superior or inferior. Each represents one of the many roads, usually marked by a set of intelligent compromises, that lead to the goal of perfection.

Installation

Nothing in the installation of turntables and tone arms is intrinsically difficult. Even a person with only moderate mechanical skill can do the job. Drill, saw, and screwdriver are the only tools necessary. Templates for cutting out the turntable mounting board are provided by the manufacturer. Mounting centers for the tone arm are also clearly indicated on templates.

Most turntables and arms have simple

Indispensable equipment in broadcasting and recording studios is the turntable of the type shown here. Assembled correctly with a tone arm of comparable quality, this type of unit provides performance characteristics that cannot be excelled. Many discriminating home users are finding that the added investment required to assemble such a system pays off in years of matchless performance.



For home use, a simple base may serve to mount the turntable as well as the tone arm. Note the cutout for the motor. Tone arm is mounted at specified distance from turntable center by means of simple drilled holes. Manufacturer's templates provide complete guidance.

leveling adjustments—which brings up a vital point. All effort and expense are wasted unless the turntable is absolutely level. Even the slightest tilt upsets the delicate balance involved in groove tracing. Therefore, a spirit level should always be within reach so that the leveling screws can be properly adjusted and periodically checked.

The variety of equipment and design principles, of conflicting theories and claims in the field of audio, has confused practically everybody including the experts. Actually, this divergence can add to the adventure of exploration and widen the range of possible choices. It shows the vitality and inventiveness of current audio ideas, the healthy avoidance of the cut-and-dried. Backed by a public demand for top performance and by excellent quality standards among responsible manufacturers, this variety of approaches adds immeasurably to the excitement and the rewards that hi-fi fans receive from their hobby.

Yet the adventure of hi-fi is no guessing game when it comes to getting one's money's worth. The professional-type equipment described here, regardless of the design principle in each case, is durably built and engineered for years of reliable operation at its rated performance standard. —30—

Attend New York Audio Fair

READERS WITHIN the New York City area are urged to attend the *Audio Fair* to be held in the Hotel New Yorker on October 13, 14, 15 and 16. During the first three days of the *Audio Fair,* all exhibits will be open from 1 to 10 p.m. On Sunday, October 16, the rooms will be open only from 12 noon until 6 p.m.

Many new hi-fi and audio developments are scheduled to be announced during this show. As in the past, practically every hi-fi manufacturer will have all of his equipment on display. Admission to the *Audio Fair* is free.

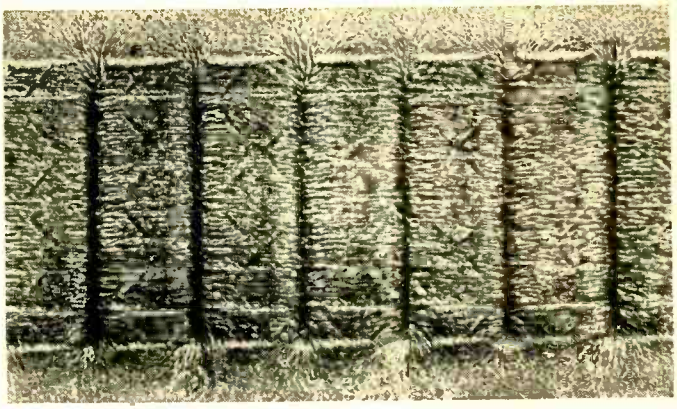
Readers of POPULAR ELECTRONICS and RADIO & TELEVISION NEWS are invited to stop at our combined exhibit which this year will feature one of the world's foremost collections of old-style phonographs. This collection is the property of Oliver Read, Editor of both of these outstanding journals. If you are interested in what was considered good hi-fi equipment in the late nineteenth century, you will certainly enjoy seeing—and hearing—these old cylinder and disc phonographs.

Also in attendance at the *Audio Fair* will be the staff of POPULAR ELECTRONICS—ready and willing to hear your comments on our magazine. —30—

Live Sound to Magnetic Tape

By LEON WORTMAN

Second article in the tape recorder series traces signal path from the microphone to the recording head



Audio signal recorded on "Scotch" magnetic tape.

"LIVE" SOUND to be recorded onto magnetic tape must first pass through a microphone. This is an electromechanical device which detects the sound vibrations in the air (created by voice, musical instrument, etc.) and changes them into tiny electrical impulses. The electrical impulses follow the tonal and loudness variations (frequency and amplitude) of the original sound.

Because these impulses are quite small, they must be built up considerably before they can be used to make an actual tape recording. This build-up is accomplished by the amplifier section of the tape recorder. If the microphone used is a low-level type, then its electrical impulses are so weak that they must pass through a preamplifier before going to the main (or "intermediate") amplifier section. If the microphone is a high-level type, then its output can skip over the preamplifier stage and be fed directly into a voltage amplifier.

Inputs from other signal sources follow a similar rule. For instance, the signal from a radio tuner is strong enough not to require a preamplifier. The signal from a magnetic phono pickup, on the other hand, is relatively weak and must be preamplified before it can be fed to the voltage amplifier. (This is true in direct listening as well as in tape recording.)

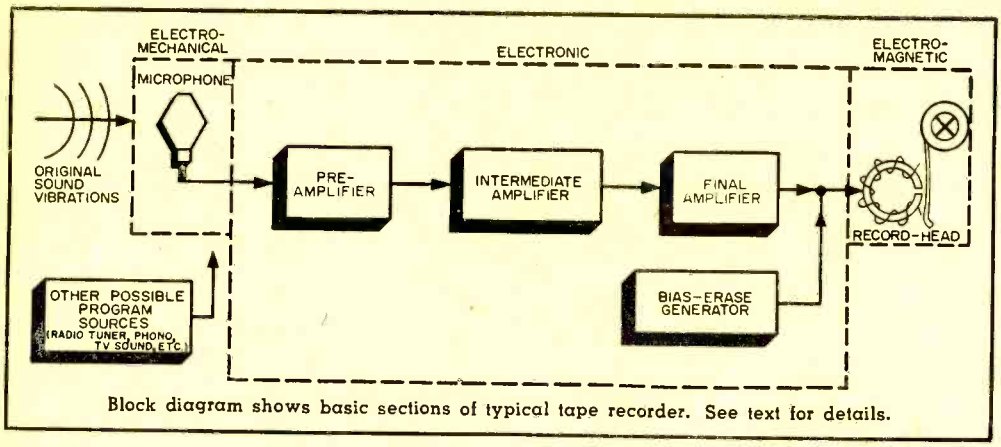
The intermediate voltage amplifiers provide additional build-up for the electrical impulses they receive. Also, from a design standpoint, it is desirable to insert into these stages the necessary equalization, tone, and volume control networks.

From the intermediate amplifying stages, the electrical impulses go to the final or power amplifier stage. Sometimes referred to as the "record-head feed" section, this stage builds up the impulses to the point where they are strong enough to be connected to the recording head of the machine. Assuming an ideal state of no distortion, the impulses which finally reach the recording head should be identical to the original sound fed into the machine, but considerably greater in amplitude.

Recording Head and Bias

Fundamentally, the recording head is an electromagnet consisting of a bar or laminations of suitable metal with a coil of many turns of fine wire wrapped around it. This magnet is formed into a circular shape so that its two poles are extremely close together, separated by a gap of the order of a thousandth of an inch. Once properly formed, the gap is maintained by a thin shim of plastic or non-magnetic material inserted tightly between the poles.

The magnetic field generated by the recording head varies in accordance with the electrical impulses fed into it. Shape of the field changes with the tonal values of the sound (frequency); strength of the field changes with the loudness (ampli-



Block diagram shows basic sections of typical tape recorder. See text for details.

tude) of the sound. The recording head's core is made of iron so that it is magnetically "soft." Thus, it becomes a magnet only when, and to the extent that, current flows in the coil.

Associated with the recording head, but actually a part of the electronic section, is a circuit known as the "bias-erase generator." This is an oscillator that produces a.c. at an ultrasonic frequency, well above the hearing limits of the human ear. With home-type recorders, a frequency of 39,000 cycles per second is often used. Professional music recorders and special data recorders employ frequencies even higher.

The "erase" function is utilized only when a tape is to be erased. (This process will be discussed in a subsequent article). The "bias" function is not yet completely understood by technicians, but has been proven to be essential to good-quality recordings. As in the case of bias applied to vacuum tubes, bias applied to magnetic tape serves to control the tape's inherent distortion characteristics. The ultrasonic bias frequency is applied to the recording head as a fixed value of a.c. Thus, it mixes with all incoming sound signals. The accompanying diagram illustrates how the bias applied to the head helps "straighten out" the recording characteristic of the tape.

The tape itself is a flat ribbon of flexible material coated with a layer of finely powdered iron oxide particles, micro-thin but magnetizable. Passing through the field set up by the recording head, the iron particles on the tape are formed into new patterns that conform to the varying magnetic field of the head. These patterns remain constant until erased by demagnetization. Thus, once the iron particles on the tape have been arranged in accordance with the field generated by the recording head, a record has been made on the tape of whatever signals have entered the head, and consequently, of the signals that originally entered the recorder.

Viewed under magnification, the recorded tape contains a series of magnetic areas, resembling tiny bar magnets laid out side by side.

Factors Influencing Fidelity

In addition to tape bias, discussed above, which helps reduce intermodulation distortion, other factors have a direct bearing on the quality and fidelity of magnetically recorded tape. High-frequency response is influenced by the width of the gap between the recording head poles and by the speed of the tape. The general rule is that the slower the speed, the narrower must be the gap. On some recent recorders, a gap as narrow as 1/4000 of an inch has been achieved—allowing for a reasonably good handling of 15,000 cps at 7½ ips. With the more prevalent wider gaps, this speed cannot handle the high frequencies as well. And when the speed is reduced to 3¾ ips, the high end is rolled off quite markedly.

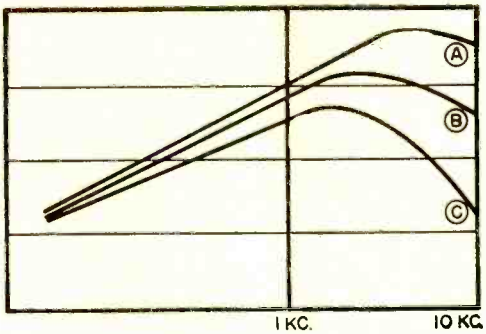
Misalignment of the tape head will also cause loss of highs. The tiny bar of magnetized oxide on the tape must be perfectly perpendicular to the tape edge to obtain full frequency response.

Low-frequency response is influenced by a characteristic loss of 6 db per octave due to constantly decreasing current that occurs as frequency is lowered. This phenomenon, resulting from the laws of physics that govern tape recording, is compensated for by bass boost during recording, playback, or both.

Flutter and wow are largely a matter of how well—mechanically—the tape recorder has been designed and constructed.

Tape Styles and Sizes

Magnetic tape is now supplied wound on plastic or aluminum reels. It is available in a number of different forms, with



A. 15 INCHES PER SECOND
B. 7 1/2 INCHES PER SECOND
C. 3 3/4 INCHES PER SECOND

Representative curves show how frequency response falls off as tape speed is decreased.

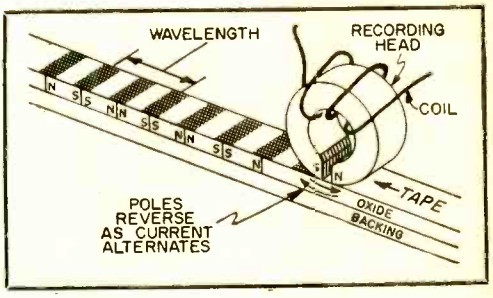
respect to width and length, and with or without edge sprockets. When the magnetic tape has sprockets (like motion picture film), it is called "magnetic film." Such film is available in widths of 16 mm., 17½ mm. and 35 mm. Magnetic film sound recorders are used most often in motion picture sound-track production for both TV and theatre showings.

In widths of ½", 1" or more, magnetic tape is employed in very specialized recorders for scientific data and research.

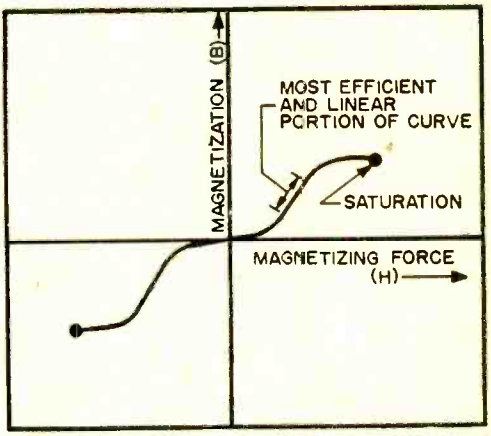
Home-type as well as many broadcast and commercial music recorders, portable and non-portable, utilize the popular ¼"-wide magnetic tapes. A smaller width of ⅛" has been proposed and tested but has not yet been adopted by the equipment manufacturers. However, there is every reason to believe that the ⅛"-width will eventually become popular. Using less material, it should be less expensive in mass production. Narrower in width, it will use up less storage space on the shelf. And it should be just as easy to handle as the ¼" tapes.

Reels for magnetic tape vary in diameter from 3" to 14". Home recorders usually handle a maximum diameter of 7". Of course, such a recorder will also work with the smaller 3"- and 5"-diameter reels. The wider the reel, the more the tape it holds, and consequently, the longer the uninterrupted recording or running time. Some of the more expensive home and high-fidelity recorders handle the 10½"-diameter reels as well. The extra-large reels up to 14" are used by some broadcast stations, and in other professional applications.

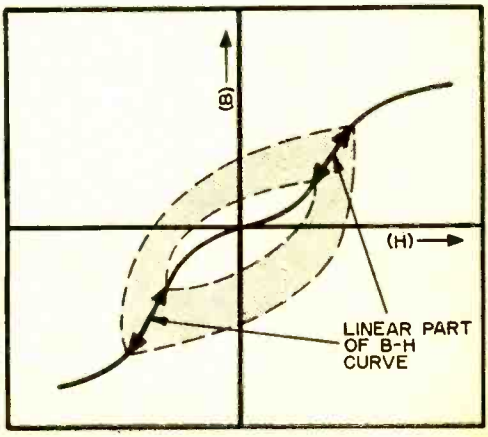
The next article in this series will describe how magnetic tape recordings are played back and how they are erased for reuse. It will also cover the "mechanical" section of a tape recorder. —30—



As tape passes under recording head, row of tiny bar magnets is impressed on it. Coil connects to output of tape amplifier.

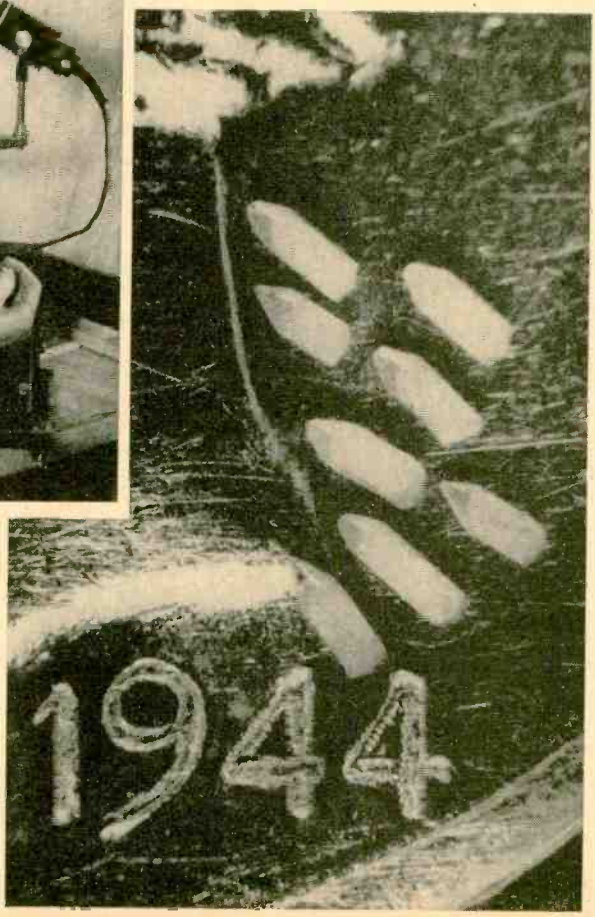


Above, magnetizing force (H) is current present in recording head. Resultant magnetization (B) does not follow straight linear pattern. Note "knees" in B-H curve at the points near zero magnetizing force and also as saturation is approached. Below, a.c. bias "straightens" curve to improve fidelity. Bias occupies inner white area, while signal modulation occupies shaded area. Thus, the signal to be recorded operates on the two most linear portions of the curve.



Inspection of the raw unfinished diamonds and sorting according to size.

Highly accurate shadowgraph and microscopic studies are made of the finished diamond styli tips.



Smaller than grains of sand are eight diamond styli on a background of a Liberty-style dime.

Diamond Styli for Hi-fi

By E. J. MARCUS

For maximum permanent enjoyment of the LP record collection a diamond stylus is a "must" for every hi-fi enthusiast

THERE IS one component of the hi-fi phonograph playback system which wears out quickly and which must be replaced. The phonograph needle, or stylus, as it is properly called, is subject to rapid wear and deterioration. As the stylus becomes worn, it changes from a smooth, gentle translator of record waves into an abrading weapon of groove destruction.

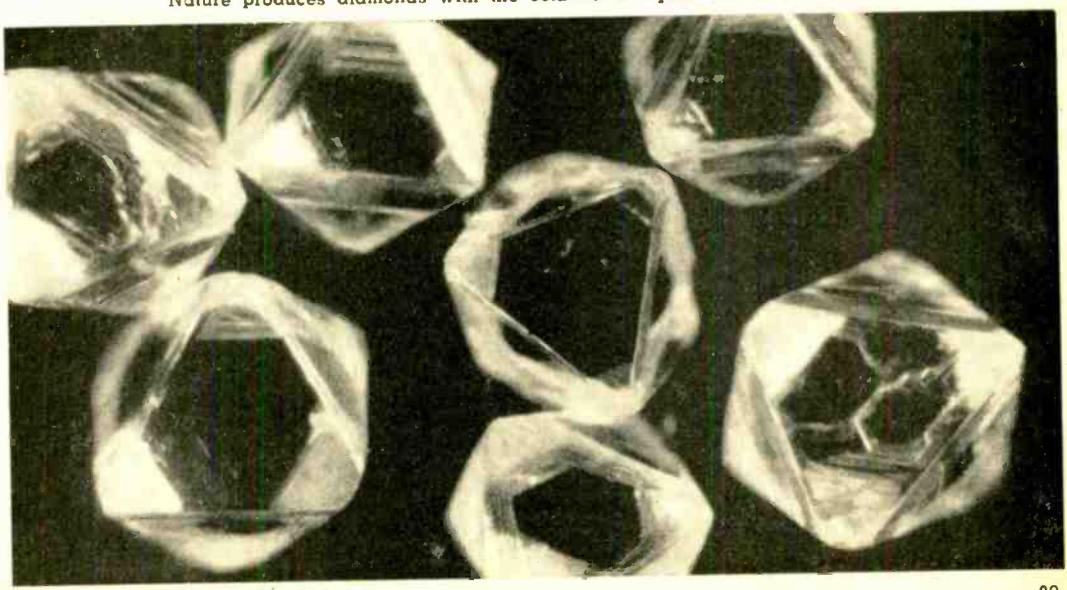
Causes of Stylus Wear

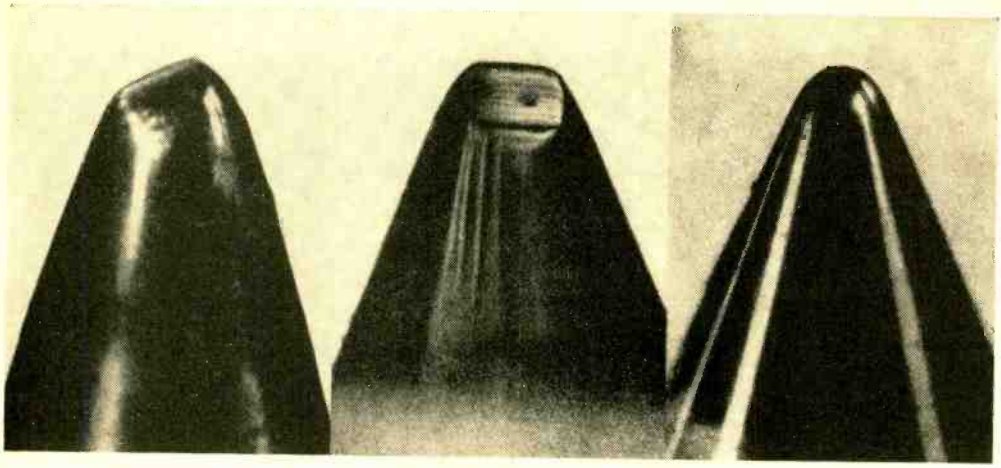
A record groove is a long V-shaped channel which spirals concentrically towards the center of the record. If the groove of one side of a 12" record were fully extended, it would measure one-half mile in length. Sound is present in the record groove in the form of microscopic wiggling curvatures or waves.

The length of each curve or wavelength is dependent upon the frequency of the sound recorded. High-pitched sounds form waves of shorter length than do low-frequency signals. Thus, when a record spins rapidly past the stylus, the recorded waves cause the stylus to vibrate rapidly with the almost fantastic speed of up to 15,000 times per second! Those vibratory movements of the stylus are converted into electrical impulses by the pickup cartridge, increased in power by the amplifier, and converted into sound by the speaker.

Since the stylus movements are microscopic, and the grooves are comparatively

Nature produces diamonds with the octahedral crystalline shape shown below.



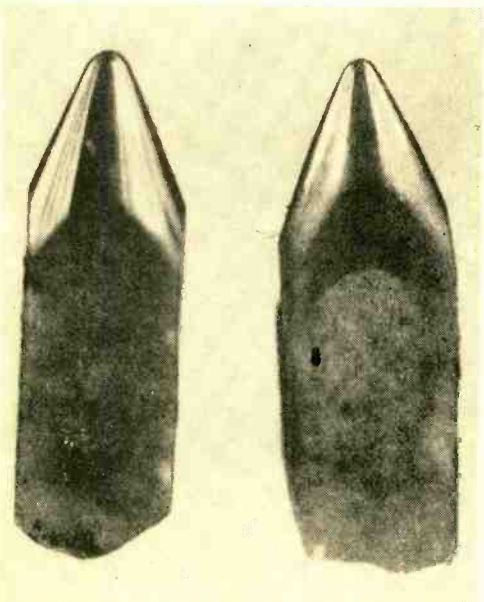


Microphotographs show wear of osmium tip (left) after 10 hours of use, sapphire tip (center) after about 24 hours, and a diamond tip (right) after 432 hours.

STYLUS REPLACEMENT CHART

Stylus	Playing Time	Replacement
Diamond	as many hours per day as desired	must inspect after 1 year; may not be worn
Sapphire	1 hour per day	after 24 days
Osmium	1 hour per day	after 18 days

This photograph illustrates the highly polished surfaces of the diamond stylus. Many manufacturing processes were developed in order to obtain this degree of perfection on minute diamonds (see bottom of page 88).



delicate, only a properly shaped stylus can be expected to follow the movements accurately and harmlessly. A properly shaped needle tip contacts record groove walls at two small areas of the sides of the groove.

The needle (stylus tip) is cone-shaped with a highly polished hemispheric tip. This tiny section of curved needle tip surface seeks out every microscopic undulation of the groove walls and vibrates to its influence. Under hi-fi playing conditions with a good stylus, this process is sensitive enough to play back practically all sound heard by the human ear.

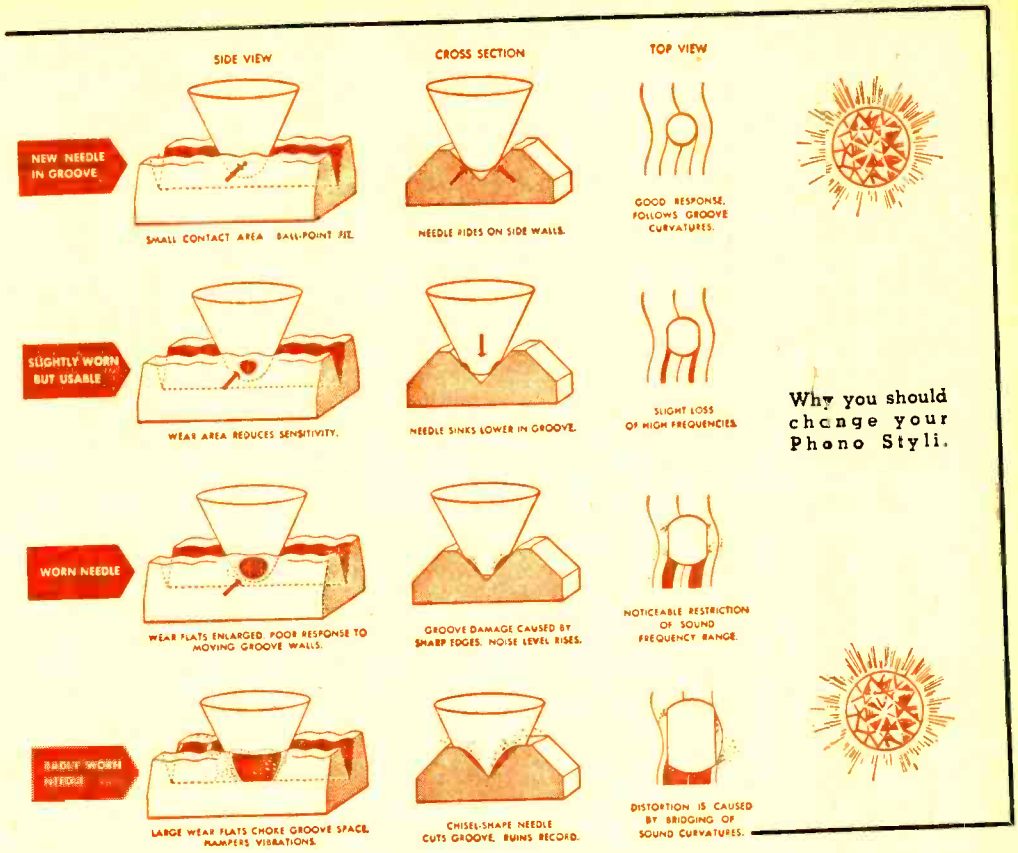
Contact area of the stylus tip is so small that the pressures between stylus and groove are astronomical—being 25,000 psi for a 6-gram tone arm pressure. Heat generated at point of contact has been estimated at 1800° F!

A record withstands this pressure because there is a certain amount of plasticity or flow in the record material which absorbs part of the pressure. It must be remembered that the stylus is only in momentary contact with any section of the groove.

However, the stylus itself is in continual contact, and the triple forces of destruction-pressure, temperature, and friction constantly tend to abrade its surface. This wear is always focused on the same small sections of the stylus tip. The effect is to wear down the stylus sides into flat sections, which gradually become wider and larger in area, until sharp cutting edges are formed.

Effect on High Fidelity

With the appearance of wear flats on a needle tip, there is a gradual deterioration of sound. This distortion is noticed first in the high frequencies but extends to middle



frequencies as stylus wear becomes progressively worse. Since musical sounds consist of a mixture of a dominant frequency combined with higher frequencies (overtones), stylus wear will almost always cause distortion.

The worn stylus with its large wear flats can no longer fit into the troughs of the recorded sound waves. Playing a record with a worn stylus is similar to trying to fit a square peg into a round hole. No music system, no matter how fine, can remain hi-fi with a worn stylus.

A stylus that is worn has a disastrous effect on a record collection. The worn tip blocks groove passages. It is forced to move clumsily, chopping its way past groove curvatures. It is no exaggeration to say that a worn stylus is the single greatest cause of damaged records.

Use of Diamond Styli

Obviously, the ideal stylus would be one which would never wear out, insuring optimum performance and minimum groove wear. Unfortunately, no material has been discovered which will last forever and can honestly be called permanent. The nearest approach to any degree of permanence is the *diamond*.

At present, phonograph needles are made of three types of materials: osmium alloy, synthetic sapphire, and genuine diamond. The recommended lifetime of each of these materials is shown in the stylus replacement chart on page 90. This chart is a compilation of figures given by the foremost experts—record reviewers and audio engineers who have tested these materials thoroughly under various playing conditions.

Diamond is by far the best material for phonograph styli. It maintains its smooth contours and highly polished surface about 90 times longer than any other material. Being an excellent conductor of heat, diamond transfers excess heat away from delicate groove surfaces. It does not deposit into the groove quantities of abraded stylus dust which add to surface noises and further abrasion. Although higher in initial cost, it is easily the most economical material in view of fewer replacements required, and especially so considering its value in protecting records.

Knowing the cause and effect of record wear and distortion of recorded sound, it is sheer folly to consider any phonograph "high fidelity" unless it contains a diamond stylus as standard equipment. —30—

THE MEANING OF (PART 2) FREQUENCY RESPONSE

BY NORMAN H. CROWHURST

The second part of this series deals with the effects of inductance on the frequency response of audio circuits

THE TWO KINDS of reactance that can affect frequency response are inductive and capacitive. A "capacitor" is fairly simple to understand when it is considered as a storage device for voltage, or potential. By the same reasoning, an "inductance" can be considered as a storage device for current.

An inductance opposes the change of current flowing through it. A constant current flowing through an inductance (assuming no resistance in the coils) produces no voltage across it. Similarly, as long as the voltage across a capacitor is constant, no current flows in or out of it.

Assume an inductance connected to a supply voltage, as shown in Fig. 1, through a series resistor. If the supply voltage is steady, the current flowing through this network will depend upon the value of the resistor. Since the current is steady, no voltage appears across the inductor. This means that the full input voltage will appear across the resistor only.

But if the input voltage fluctuates, it will produce fluctuations in the current. These fluctuations will be opposed by the inductor. As a result, some of the fluctuating voltage will appear across the inductor and the amount of current through the resistor will begin to change.

As the voltage on the capacitor took time to change, dependent upon the relative values of the resistance and capacitance, so—in the resistance and inductance arrangement—the current will take time to change, depending upon the relative values. Therefore, waveforms similar to those demonstrating behavior of a resistance/capacitance arrangement will show what happens with a resistance/inductance arrangement at different frequencies. (See Fig. 2.)

Inductance in Circuit

What will an inductance contribute to the frequency response performance of a circuit? If the inductance is fed through a series resistor and the output voltage is picked up across the inductance, then at higher frequencies all the voltage put into the arrangement will appear across the inductance, and the resistance will produce negligible change in voltage from input to output.

At lower frequencies, as is shown by the waveforms of Fig. 2, the voltage appearing across the inductance is actually in advance of the voltage at the input. This is because the current, and with it the voltage across the resistance, lags behind the applied input voltage; and to compensate for this lag, the voltage across the inductance part of the circuit has to be in advance.

A question arises as to how the output voltage can possibly anticipate the input voltage. Such a thing would seem to be an impossibility because it would mean that the output voltage must start to change before the change in input voltage is applied. Actually, this does not happen. The waveforms shown at Fig. 2 are only produced after several cycles of the frequencies they represent have enabled the circuit to settle down to steady performance.

When a waveform starts up, the circuit will behave somewhat differently, as shown at Fig. 3 which represents the waveform

across the same arrangement when a steady sine-wave input is suddenly started. This effect is known as a *transient effect,* because the waveform is passing from one condition to another—in this case from a steady voltage to a sinusoidal fluctuation.

Using the circuit shown in Fig. 1, the inductance across the line will—after the circuit has reached its normal operating level—result in two effects: (1) as the frequency of the input voltage is reduced, the output voltage will advance in phase with respect to the input voltage; and (2) the output voltage will be reduced in amplitude until, with a zero frequency input (steady d.c.), there is no output voltage at all across the coil.

Now suppose the same input is put across the series arrangement of resistance and inductance, but that this time the output is taken from across the resistance instead of the inductance. It will be realized that at low frequencies the inductance will only absorb some of the fluctuations, most of which appear across the resistance, while at high frequencies progressively more of the fluctuations are absorbed across the inductance.

In this case the output voltage, being always proportional to the current fluctuation, will be slightly lagging behind the input voltage, and when the inductance begins to take over (so that there is high frequency loss), the voltage across the resistor will lag behind by increasingly greater amounts.

Comparison of Reactances

Compare now the two possible forms of reactance that can contribute to frequency response and the effects they have (see Fig. 4).

Capacitance in series with resistance, taking the output across the resistance, gives rise to loss at the low frequencies and advance of output voltage in time as compared with input voltage. The same effects result from a resistance in series

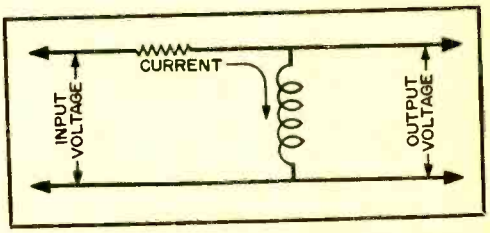


Fig. 1. Arrangement of resistance and inductance in series, as discussed in text.

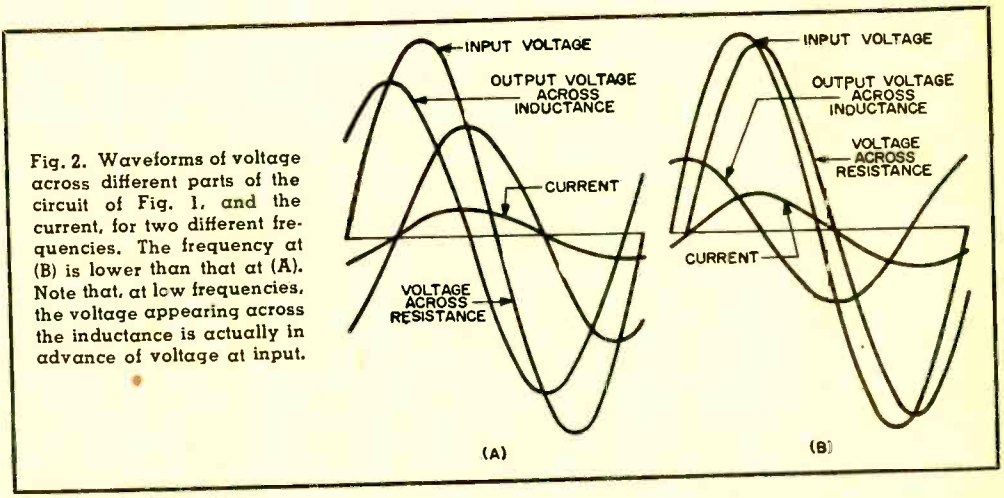


Fig. 2. Waveforms of voltage across different parts of the circuit of Fig. 1, and the current, for two different frequencies. The frequency at (B) is lower than that at (A). Note that, at low frequencies, the voltage appearing across the inductance is actually in advance of voltage at input.

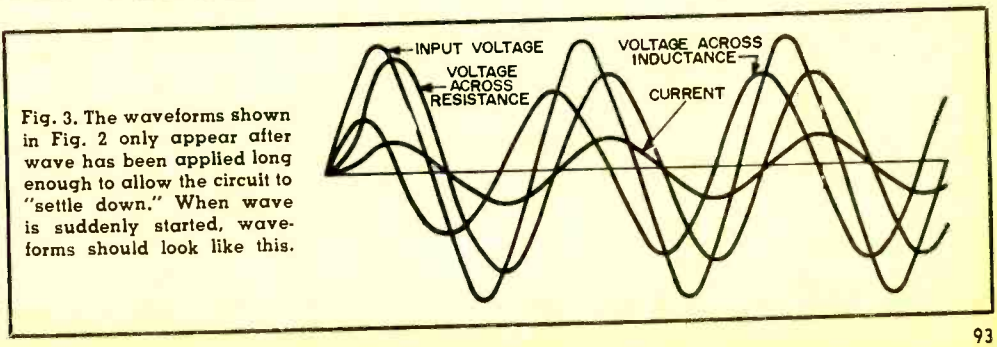


Fig. 3. The waveforms shown in Fig. 2 only appear after wave has been applied long enough to allow the circuit to "settle down." When wave is suddenly started, waveforms should look like this.

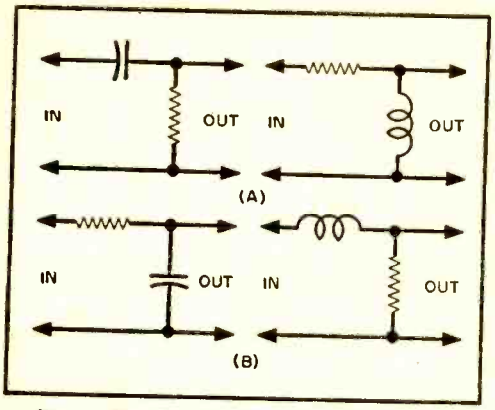


Fig. 4. Four basic arrangements involving resistance and either inductance or capacitance. The two arrangements at (A) produce low-frequency loss and time advance of a continuous wave; the arrangements at (B) produce high-frequency loss and time delay.

with an inductance, taking the output across the inductance.

Resistance in series with capacitance, taking the output voltage across the capacitance, and inductance in series with resistance, taking the output voltage across the resistance, both give rise to high-frequency loss and delay of output voltage behind input voltage.

In each case—low-frequency losses at progressively lower frequencies or high-frequency losses at progressively higher frequencies — the relationship between waveforms shows that there can be a noticeable difference between the timing, or phase, before appreciable loss shows up. Phase shift eventually reaches only 90° for each kind of circuit, when the loss is 100%; but there is a 25° shift in phase before the loss has fallen by 10% of the input value.

Effect of Inductance

Now to see how inductance can contribute to frequency response in a practical way. Experimenters don't usually put inductances into an audio circuit because they like to have them, any more than they would use coupling capacitors for deliberately producing a low frequency loss. Inductances just happen to be part of the audio equipment everyone must use.

Every transformer introduced into an audio circuit has a primary inductance, due to the magnetic field in the core set up by the current in the primary. Whenever this field changes, due to change of current in the primary, a voltage is induced across both the primary and secondary windings. This is the action upon which the behavior of a transformer is based. Because the number of turns on each winding is different, the voltages induced are different, and the transformer produces a step-up or step-down ratio as required.

At most frequencies in the audio range, the inductance of the transformer primary is so high that the changes in current due to the voltage fluctuation, or audio signal, are almost entirely controlled by the resistances associated in the circuit instead of by the primary inductance.

At low frequencies, the inductance will have the phase-advancing and loss effects already discussed, because the primary inductance is fed from a source resistance. In the case of an input transformer, this source resistance will be the resistance of the microphone, pickup, or whatever the transformer is used to feed from. In the case of an output transformer, the source resistance is the plate resistance of the audio output tubes.

The important thing to remember at this point is that *the primary inductance* of a transformer, which is its main inductance, *always produces a low-frequency loss* and a phase advance. In Part 3 of this series, the more intricate ways in which reactances can contribute to frequency response will be discussed.

(To be continued)

Educational High-Fidelity Lecture-Demonstration at Carnegie Hall

GILBERT A. BRIGGS, British authority on loudspeakers and audio systems, will give a non-technical high-fidelity lecture-demonstration at Carnegie Hall in New York City, Sunday, October 9, at 3 p.m. The event, which is sponsored jointly by *Wharfedale Wireless Works* of Bradford, England, and *British Industries Corporation*, Port Washington, N. Y., will show what can be done today with hi-fi equipment now available.

Collaborating with Mr. Briggs are P. J. Walker, who will operate the equipment and make the concluding address, and *Columbia Records*, responsible for artists, recording and playback. The following *Columbia* artists will appear on the program: E. Power Biggs (organ), Leonid Hambro (piano), John DeLancie (oboe), and members of the Philadelphia Orchestra and Philadelphia Woodwind Quintet. Recordings of the artists will be compared with their live performances.

All seats are reserved; tickets will be available from $1.15 to $2.50 at the Carnegie Hall box office and hi-fi salons in New York City after September 6. —30—

Get more money! More security! More out of life!

Learn TELEVISION · RADIO · ELECTRONICS

Get the best!

Get National Schools' SHOP-METHOD HOME TRAINING!

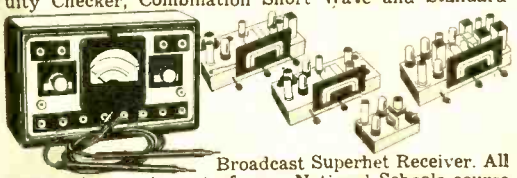
Start now! Why wait around for that raise or promotion that may never come? Get started *now* in high-paying TV-Radio-Electronics! National Schools' SHOP METHOD Home Training prepares you for success in a top-salary job or in your own business. You learn *all three*... Television, Radio, Electronics...in one complete course. Our Shop-Tested lessons and manuals help you master all phases in shortest possible time! Send coupon, find out today!

WHY NATIONAL SCHOOLS LEADS THE FIELD

Located in the "Television Center" of the world, our staff is in close touch with latest developments and opportunities. We give you personalized job placement assistance. We also give you confidential help with both technical and personal problems relating to your training. We show you how to make Part Time Earnings as you progress. Whether you live 30 miles away, or 3,000, you will always be pleased with our prompt, friendly service.

DRAFT AGE? Our home training helps you achieve specialized ratings and higher pay grades if you go in service.

We send you this precision-tested Multitester! Plus parts to build Oscillators, Receivers, Signal Generator, Continuity Checker, Combination Short Wave and Standard



Broadcast Superhet Receiver. All this equipment is part of your National Schools course. NO EXTRA CHARGES! Send coupon for free books!

NATIONAL SCHOOLS, world-famous technical trade school. Now entering our 50th year!

NATIONAL SCHOOLS

TECHNICAL TRADE TRAINING SINCE 1905

LOS ANGELES 37, CALIFORNIA

In Canada: 811 W. Hastings St., Vancouver, B.C.

- APPROVED FOR G. I. TRAINING
- BOTH HOME STUDY AND RESIDENT COURSES OFFERED

30 MILLION TV SETS need regular repair! Color TV means more sets than ever before. NOW is the golden opportunity to cash in on this multi-billion-dollar industry. Or "write your own ticket" in broadcasting, manufacturing, and other specialized phases!

YOUR AGE IS NO OBSTACLE!

Send for FREE LESSON!

FREE BOOK & SAMPLE LESSON will convince you!

SEND COUPON TODAY!

MAIL NOW TO OFFICE NEAREST YOU!

(mail in envelope or paste on postal card)

NATIONAL SCHOOLS, DEPT. R2G-105

4000 SOUTH FIGUEROA STREET, LOS ANGELES 37, CALIFORNIA — OR — 323 WEST POLK STREET, CHICAGO 7, ILLINOIS

Please rush FREE BOOK, "My Future in Radio-Television-Electronics," and FREE LESSON at once. I understand there is no obligation, and no salesman will call.

NAME _____ BIRTHDAY _____ 19__

ADDRESS _____

CITY _____ ZONE _____ STATE _____

☐ Check if interested ONLY in Resident Training at Los Angeles.

VETERANS: Give date of discharge _____

Build YOUR OWN HEATHKITS

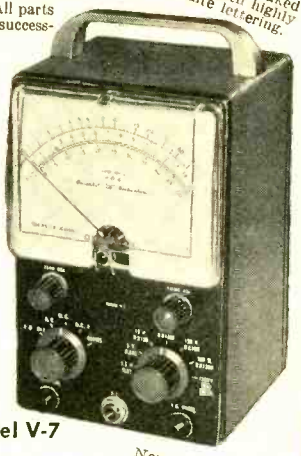
INTERESTING—EDUCATIONAL

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

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



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 microamperes 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 10, MICHIGAN

New PRINTED CIRCUIT

Heathkit 3" OSCILLOSCOPE KIT

Model OL-1

$29.50 Shpg. Wt. 15 lbs.

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

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

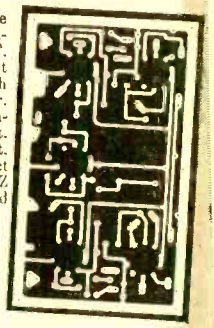
New, modern styling, gray panel with white lettering, light gray knob and case — contrasting red and black terminal posts.

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

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

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.



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 10, MICHIGAN

New Heathkit VFO KIT

MODEL VF-1

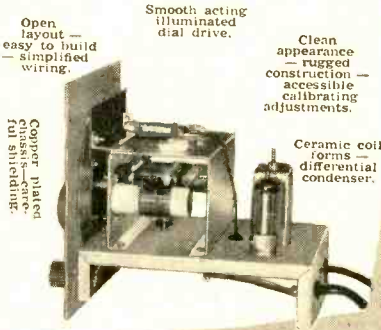
$19.50

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

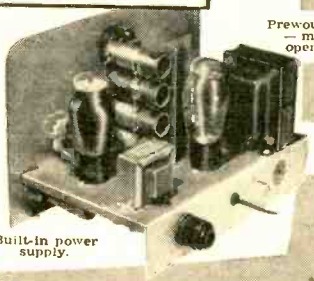
$29.50

Ship. Wt. 16 lbs.

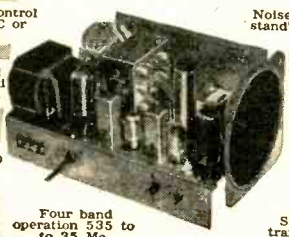
SPECIFICATIONS:

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, incorporaring 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.

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.

MODEL AR-2

$25.50

Ship. Wt. 12 lbs.

CABINET:

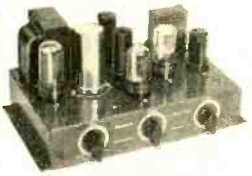
Proxylin impregnated fabric covered plywood cabinet. Shipg. weight 5 lbs. Number 91-10, $4.50.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 10, 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.

HEATH COMPANY • BENTON HARBOR, MICH.

MAIL YOUR ORDER TODAY TO THE
HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC
BENTON HARBOR 10, MICHIGAN

ORDER BLANK

From _____

_____

_____

SHIP VIA
- ☐ Parcel Post
- ☐ Express
- ☐ Freight
- ☐ Best Way

(PLEASE PRINT)

QUANTITY	ITEM	MODEL NO.	PRICE

Enclosed find ( ) check ( ) money order for
Please ship C.O.D. ( ) postage enclosed for pounds.

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

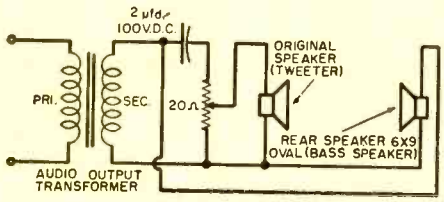
ON PARCEL POST ORDERS insure postage for weight shown.

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

Hi-Fi in Your Car

THE AVERAGE CAR RADIO rear seat speaker is usually connected in parallel with the front speaker. Results are not always pleasing for two reasons. The driver of the automobile receives more sound from the front speaker because of his position. He also hears more bass from the rear speaker because of the ready-made hi-fi cabinet—the trunk.

By balancing both speakers with 8-ohm rheostats and equalizing the level the



driver hears, one can obtain "poor man's stereophonic sound." The effect may be enhanced by converting the front speaker to a "tweeter." This would seem logical since the front speaker does not reproduce the bass notes as well as the rear speaker.

Conversion to tweeter service can be accomplished by connecting a 2.0-μfd. oil-filled capacitor in series with the output transformer. Frequencies below 2000 cycles, therefore, will be attenuated. As the front speaker will have more volume than the rear speaker, a volume control is required to reduce excessive high-frequency output.

To balance the system, turn the tweeter off by its volume control. Adjust the rear speaker volume with the car radio control for normal volume; then advance the tweeter control for the desired amount of high frequencies.

The low-frequency sounds, such as the string bass, viola, drums, and brass instruments, will emanate from the rear speaker. Violins, trap drums, and other high-frequency sounds will be heard best from the front speaker. The similarity to "binaural sound" is truly amazing. —30—

Another Audio Mixer

IT IS OCCASIONALLY DESIRABLE to mix two phonograph pickups, two microphones or other audio signals into a single amplifier input. One method of accomplishing such mixing was described on page 81 of the July issue of POPULAR ELECTRONICS. This short article brings to light a similar circuit which uses a transformer for complete isolation between the sources to be mixed and the amplifier input.

The transformer may be either a *Merit* A-2913 or the *Stancor* A-4711, both of

Whether you're interested in RADIO! TELEVISION! ELECTRONICS!

For Love...or Money

SEND FOR THIS FREE BOOKLET... *find out*

- **how to turn your love for electronics into a well-paid career**
- **how to make more money and get ahead more quickly**

This is the free booklet that can change your whole future

Why not do the kind of work you love to do—and be paid handsomely for it? Join the thousands of electronics hobbyists who are converting their hobbies to good paying jobs and exciting careers. The electronics industry is crying desperately for trained men. The electronics industry is expanding so rapidly (from $3.5 billion in 1943 to $9.2 billion in 1954) that the demand for well-trained electronics men far exceeds the supply. Hundreds of new employment opportunities are being created almost every month. Completion of a CREI course very often automatically qualifies the CREI graduate for employment or promotion. Here is *your* opportunity to get ahead in electronics, America's fastest growing industry!

LOOK HOW DESPERATELY ELECTRONICS NEEDS MEN

Here is just one of the thousands of high-level opportunities now available from coast-to-coast:

"We are interested in securing a good, qualified aircraft radio and auto-pilot technician for our Radio Installation Service Department. He will be in charge of all radio and auto-pilot installations and service at our field.

"We have complete facilities here on the field and have been in business at the present location for over 30 years. We were the first organization to make complete aircraft radio service available and we are interested in growing with the present day pace.

"If you can advise us of anyone qualified for this position, we would appreciate it very much. We prefer to obtain a man that has received training from a recognized school, such as yours."

HUNTER FLYING SERVICE, INC.
Cedar Rapids, Iowa

Thousands of Positions Like This Must Be Filled

And only trained men can fill them—men who take the time now to get ADVANCED TECHNICAL TRAINING. Men with only partial technical knowledge will stand still while you—with advanced training—will always be ready to advance to better jobs.

CREI TRAINS YOU IN MINIMUM TIME AT HOME

Use spare-time hobby hours for CREI Home Study, as thousands of successful technicians have since 1927. Get concentrated training in minimum time, then step into a good job and enjoy good pay in the mushrooming electronics industry. Thousands of men before you have benefited quickly from CREI Home Study training. Thousands of CREI graduates are now employed in industry here and abroad. Here is a typical example:

"In this time of less than two years, I have almost doubled my salary and have gone from wireman to engineering assistant and now to junior engineer. I have CREI to thank."
—Frank A. Eckert, 22 Clover Lane, Levittown, Pa.

SEND FOR BOOKLET NOW. IT TELLS YOU HOW . . .

How badly the industry needs trained men. How quickly the industry is expanding. How CREI home study works—how it trains you quickly, economically, and surely—to take, go after—and get a good job, with high pay—in a fascinating electronics career. Act today—send for the free booklet, "Your Future in the New World of Electronics." Your future depends on it.

FAMOUS FOR 28 YEARS

CREI is known and respected throughout the electronics world. Since 1927 we have trained thousands in the military, industry and government. "ASK ANY ENGINEER."

KOREAN WAR VETERAN?

If discharged after June 27, 1950, let new GI Bill of Rights help you get resident instruction. Check coupon for full data.

LIKE TO STUDY IN WASHINGTON?

CREI also offers resident instruction at same high level day or night. Classes start often. Check coupon for Residence School catalog. Qualified residence graduates earn degree; "Associate in Applied Science."

MAIL THIS COUPON . . . TODAY!

CAPITOL RADIO ENGINEERING INSTITUTE
Accredited Technical Institute Curricula—Founded in 1927
3224 16th St., N. W., Dept. 1210B, Washington 10, D. C.

Send booklet "Your Future in the New World of Electronics" and course outline.

CHECK FIELD OF GREATEST INTEREST
- ☐ Practical Radio Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Television Engineering
- ☐ Aeronautical Electronics Engineering

To help us answer your request intelligently, please give the following information:

EMPLOYED BY .....

TYPE OF PRESENT WORK .....

SCHOOL BACKGROUND .....

ELECTRONICS EXPERIENCE .....

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED? .....

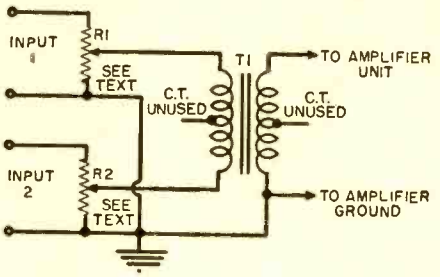
Name .....

Street .....

City ..... Zone ..... State .....

Check: ☐ Home Study ☐ Residence School ☐ Korean Veteran

which are used without their center taps. It is necessary that the transformer have a 1:1 ratio and be of very high impedance. The potentiometers should be linear units of a value to match the particular signal source. If a *General Electric* cartridge is used, one potentiometer should be about 7000 ohms. For a crystal microphone or



phono pickup, the potentiometer should be about 500,000 ohms.

Mount the transformer, potentiometers, and appropriate jacks in a metal utility box. Be sure to provide a means of grounding this box to the chassis of the amplifier in order to remove any possible trace of hum. —30—

Uranium Detection Kit

A KIT, SO SIMPLE that a child can use it, has been announced by the *CMG Industries Co.*, 615 So. 2nd, Laramie, Wyo., for the detection of uranium by ultraviolet rays. Called the "Urani-tector," the kit is a re-

cent invention of two scientists from the University of Wyoming. It includes samples of uranium ore and is claimed to assay approximate percentages of valuable uranium ore. Advertised price is $8.49. —30—

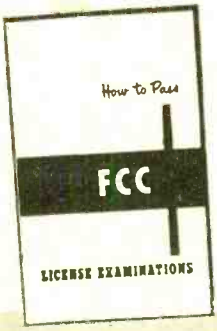
Whenever writing advertisers or companies whose new products are described in this magazine, be sure to mention that you saw it in POPULAR ELECTRONICS.

CARL E. SMITH, E. E.
President

I can train you to pass your FCC License Exams in a minimum of time if you've had any practical experience — amateur, military, radio servicing, etc. We can put you on the road to success.

An Approved Member

How to Pass



FREE

Tells where to apply and take FCC examinations, location of examining office, scope of knowledge required, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examination.

GET YOUR FCC TICKET IN A MINIMUM OF TIME

TV ENGINEERING INCLUDED IN OUR TRAINING & COACHING

Get This Valuable Booklet FREE

TELLS HOW

WE GUARANTEE

To Train and Coach You at Home in Spare Time Until You Get

YOUR FCC LICENSE

If You Have Had Any Practical Experience—Amateur, Military, Radio Repair, Experimenting, Etc.

Here's Proof FCC Licenses Are Often Obtained In a Few Hours of Study with Our Coaching at Home in Spare Time

	License	Time
A/1C Ronald H. Person, St. Louis 20, Mo.	1st	25 weeks
Carl Verboomen, Wrightstown, Wis.	1st	18 weeks
Marvin F. Kimball, Lafayette, Ind.	2nd	21 weeks
L. M. Bonino, Harlington AFB, Tex.	2nd	16 weeks

TELLS HOW

Our Effective JOB FINDING Service Helps CIRE Trainees Get Better Jobs—

INDUSTRIAL ELECTRONICS—"Upon my discharge from the Navy I used your Job-Finding Service and as a result I was employed by North American Aviation in electronic assembly (final checkout)." Glen A. Furlong, Fresno, Calif.

TELLS HOW

Employers Make JOB OFFERS Like These to Our Graduates Every Month . . .

WEST COAST MANUFACTURER—"We are currently in need of men with electronics training or experience in radar maintenance, and we would appreciate if you will refer interested persons to us."

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
4900 Euclid Ave. Desk PE-5 Cleveland 3, Ohio

MAIL THIS COUPON TODAY

GET ALL 3 FREE!

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk PE-5, 4900 Euclid Bldg., Cleveland 3, Ohio

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examination" (does not cover exams for Amateur License), as well as a Sample FCC-type lesson and the amazing new booklet "Money-Making FCC License Information." Be sure to tell me about your Television Engineering Course.

PLEASE PRINT CLEARLY

NAME .....

ADDRESS .....

CITY ..... STATE .....

FOR PROMPT RESULTS SEND AIR MAIL
Special tuition rates to members of the U. S. Armed Forces
Electronic Training Available To Canadian Residents

Navy's "Flying Laboratory"

ANSWERS TO MANY OF THE PROBLEMS that plague the radio propagation and radar fields may be forthcoming with the aid of a "flying laboratory" now being used by the U.S. Naval Research Laboratory. This R5D aircraft (Navy version of a *Douglas* DC-4) has equipment versatile enough so that a wide variety of problems on radar target properties and wave propagation patterns and effects may be studied.

Four huge nacelles beneath the wings carry parabolic radar antennas as well as radar transmitters. The antennas are stabilized along all three axes of the aircraft,

and can transmit and receive with vertical, horizontal, or circular polarization. A wide range of radar frequencies can be investigated.

A 15′ mast, retractable into the top of the fuselage, houses meteorological instruments. Wet and dry bulb temperatures, raindrop size and distribution, electric fields, total water content, and total air pressures can be continuously measured. Inside the cabin are located the control equipment, cathode-ray tube displays, and cameras for recording experimental data during flight.

NRL scientists expect to use the plane to measure the reflecting and back-scattering properties from both individual targets and distributed reflecting areas such as ground, sea or precipitation returns. Propagation investigations of radio ducts and atmospheric scattering will also be conducted. —30—

Liquid Cleans LP Records

A NEW LIQUID PRODUCT, called "Quiet," is claimed by its manufacturer, *Beyland Engineering Co.*, P. O. Box 53, Yalesville, Conn., to provide complete care for records. Surfaces are kept clean and lubricated; static, needle hiss, and surface noises are stopped; record life is extended considerably; and better record tone is enjoyed.

Each "Quiet" kit contains a 5-oz. bottle of the liquid, an applicator, case, and needle brush. One bottle treats both sides of 200 ten-inch records. The kit is available by mail for $2.00. To order, write directly to the manufacturer. —30—

Multi-Voltage Power Supply

(*Continued from page* 56)

fourth position, a shunt resistor, *R2*, is connected in parallel with the meter to measure a higher range of current. The switch used is a *Mallory* Type 3234, two-pole, six-position switch, with two positions unused.

To compute the values of multiplier and shunt resistors, one should know the full-scale current and internal resistance of the basic meter movement. Suppose that these are, respectively, 1 ma. and 100 ohms. The voltage drop across the meter for full-scale deflection is $E = IR = .001 \times 100 = 0.1$ volt. For a 100-volt range, the multiplier resistor would have to drop $100 - 0.1 = 99.9$ volts at 1 ma. Therefore, $R = E/I = 99.9/.001 = 99{,}900$ ohms. For a 100-milliampere range, the shunt resistor would have to pass 100 ma. $-$ 1 ma. $=$ 99 ma. at 0.1 volt. Therefore, $R = E/I = 0.1/.099 = 1.01$ ohms.

The exact values of the required multipliers and shunts usually will be odd values, but the error produced by using standard values may not be large. For example, the difference between 100,000 ohms and 99,900 is only 1/10th of 1%; the difference between 1.00 ohm and 1.01 ohms is 1%. If maximum accuracy is required, and the basic meter movement justifies it, precision resistors (of 1% tolerance, for example) should be used. If the required shunt is a very small resistance, some allowance may have to be made for the resistance of connecting wires, if any.

Construction

The supply was assembled in a 6"x9"x5" metal utility box with a 4½"x8"x1½" chassis. To attain a professional appearance, the regular panel was replaced by a thick engraved aluminum panel. Engraving is a bit expensive but it does add the appeal of a factory-built appearance.

Mechanically, there are several factors to remember when constructing the unit. If the heavier panel is used, be sure to mark and drill the four mounting holes *before* placing any of the components on the panel. In laying out the panel, remember that the chassis must be attached high enough to clear the mounting flange at the bottom of the box, and centered to clear the side flanges. This can be seen in the rear view photograph of the unit. Holes for the output jacks should be centered vertically on the chassis and placed far enough in from the sides to clear the corner folds in the chassis. The transformer, choke, and rectifier must be mounted to clear the meter and switches, which protrude from the panel over the front edge of the chassis, as seen in the photograph. —30—

TOOLS & GADGETS

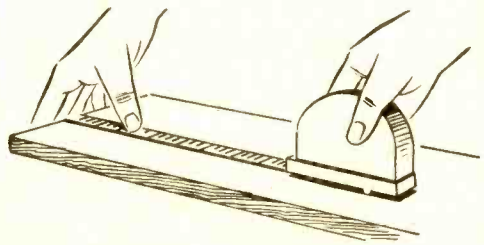
"TUBE-SAVER"

The *Wuerth* "Tube-Saver" provides a thermal cushion action against initial surges of high current which may damage tubes in TV and hi-fi sets when they are first turned on. According to the manufacturer, laboratory tests have shown that de-

terioration of tube filament and cathode elements is greatly reduced by use of the "Tube-Saver." Measuring 5½" x 2½" x 3½", the unit mounts out of sight behind the set. It retails for $7.95. For additional information, write to *Wuerth Enterprises*, 7819 Farnsworth St., Philadelphia 15, Pa.

AUTOMATIC SURFACE MARKER

"MARK-IT" is a built-in marking device that fits standard measuring tapes. When connected to a tape, it marks any surface



being measured. Made of plated steel, "MARK-IT" retails for 49 cents. It is a product of the *Dresden Manufacturing Co.*, 2375 Walnut Ave., Long Beach, Calif.

CAPACITOR TESTER

"Capacitest" performs many tests that cannot be made with an ordinary meter. It will show open, shorted, or intermittent capacitors and leaky electrolytics, indicating leakage of over 300 megohms. In addition, this meter will show circuit continuity

You Get This Valuable Book FREE

(Mr. Ray Snyder Gen. Mgr. Coyne Book Publ. Div.)

Just For Examining COYNE'S NEW 6-VOLUME SET "Applied Practical Radio-Television" ON 7 DAYS FREE TRIAL!

Yes, this big new book, "150 Radio-TV Picture Patterns & Diagrams Explained," is yours FREE! Up-to-the-minute, practical book gives complete 11 x 22" Schematic Diagrams on leading models of Radio and TV sets. Easy-to-read, large 8½ x 11" pages, with full instructions on how to read and use diagrams. Also analysis of TV servicing; trouble-shooting patterns. It's yours as a FREE Gift for asking to see Coyne's great new 6-book set, "Applied Practical Radio-Television"!

Gives You Money-Making "Know-How" On TRANSISTORS! COLOR TV! SERVICING!

Coyne's new set gives you all the answers to servicing problems—quickly! For basic "know-how" that's easy to understand, you'll find everything you want in volumes 1 to 5, which contain over 5000 practical facts and data. Cover every step from principles to installing, servicing, trouble-shooting and aligning all types of radio and TV sets. Includes latest data on COLOR TV and UHF, adapters, converters and **TRANSISTORS.** Then, for speedy on-the-job use, you get Volume 6—famous, quick reference, Coyne TELEVISION CYCLOPEDIA—covering today's TV problems in A-B-C order, cross indexed. Use this complete 6-volume TV-RADIO LIBRARY free for 7 days. Get valuable Picture Pattern-Diagram Book ABSOLUTELY FREE!

ACT NOW . . . SEND NO MONEY!

Just mail coupon for 6-book set on 7 days free trial. Book of 150 TV-Radio Patterns & Diagrams will be included. If you keep the set, pay $2 in 7 days and $2 per month until $22.50 plus postage is paid. (Cash price $20.95.) Or return Library at our expense in 7 days and owe nothing. **Either way, Radio-TV Diagrams Book is yours to keep, FREE!** Offer limited. Act NOW!

Vol. 1—Application of TV-Radio Principles. 300 pages—resonance, tuning, amplifiers, oscillators, etc.

Vol. 2—Radio, Television & FM Receivers. 403 pages—rectifiers, high frequency, short wave, FM, antennas.

Vol. 3—Radio-Television Circuits. 336 pages—power tubes, decoupling, distortion, photo-tubes, phase inverters, etc.

Vol. 4—Latest Instruments for Servicing. 343 pages—all types of testing instruments; their use in servicing.

Vol. 5—TV Servicing & Trouble Shooting Manual. 400 pages—servicing of all TV sets, UHF, boosters, color TV printed in 4 colors, transistors, etc.

PLUS TV CYCLOPEDIA—quick answers to all TV problems in A-B-C order. 870 pages, illustrated. Hundreds of facts on servicing UHF, transistors, installation, alignment and more.

COYNE ELECTRICAL SCHOOL
(Educational Book Publishing Division)
500 S. Paulina St., Dept. A5-PE Chicago 12, Illinois

FREE BOOK • FREE TRIAL COUPON

Mr. Ray Snyder, General Manager
Educational Book Publishing Division
COYNE ELECTRICAL SCHOOL
500 S. Paulina St., Dept. A5-PE, Chicago 12, Ill.

O.K., Mr. Snyder! Send new 6-book set "Applied Practical Radio-TV" for 7 days FREE TRIAL per your offer. Include TV-RADIO Patterns & Diagrams Book FREE!

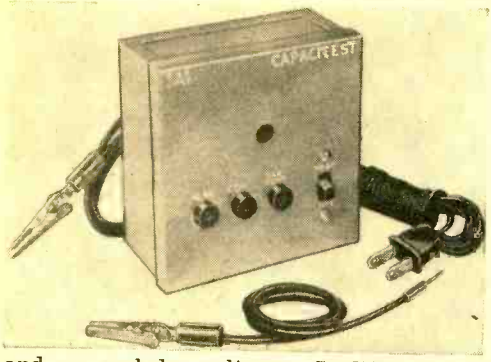
Name ..... Age .....

Address .....

City ..... Zone ..... State .....

Where Employed .....

☐ Check here if you want Library sent C.O.D. You pay postman $20.95 plus C.O.D. postage on delivery. 7-day money-back guarantee.



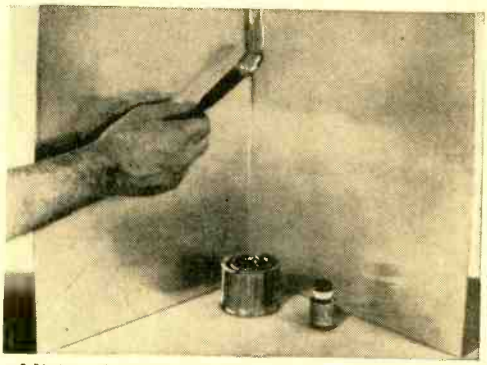
and a.c. and d.c. voltages. It differs from most meters in that it can check capacitors at 150 volts, which is approximately the working voltage in a radio or TV set. Most meters will not provide this type of check because the applied voltage is 20 volts or less.

Compact and light, "Capacitest" measures 4" x 4" x 2" and may be carried conveniently in a tool kit. Priced at $9.95, it is made by *The Barjay Co.*, 145 W. 40th St., New York 18, N. Y. For further information, or to order, write direct to the manufacturer.

PUTTY HAS MANY USES

A new versatile aluminum putty, "Metalset A201," is useful for caulking seams and holes and for building up metal and wood surfaces. It shrinks less than two-tenths of 1% while hardening. It hardens at room temperature to a metallic density, and can be machined, tapped and drilled.

"Metalset A201" is easily mixed and applied to vertical and overhead surfaces. For



additional information, write to *Smooth-On Mfg. Co.*, 572 Compwell Ave., Jersey City, N. J.

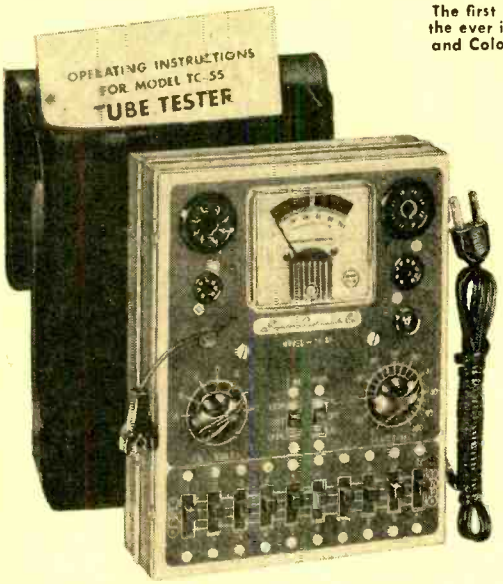
AEROSOL SPRAY KIT

Maintenance, tool room and service departments are expected to find the *Crown* "Spray Line" utility kit highly useful. It consists of four 6-oz. Aerosol (spray type) cans, each containing the following prod-

The New Streamlined Model TC-55

TUBE TESTER

TESTS TUBES IN LESS TIME THAN IS REQUIRED TO SET-UP AND ADJUST OLDER, COMPLICATED MODELS!



The first realistic approach towards solving the problems of *quickly* testing the ever increasing number of tube types used in Radio, Hi-Fi, Monochrome and Color TV.

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.

The Model TC-55 will of course also test the Octal, Loctal and 7 pin Miniature types. Although the TC-55 is a comparatively low-priced tester, it will we feel sure, be used more frequently than your higher-priced tube tester if you have one; for this new, streamlined model will often test a tube in a shorter time than would be required to set up and adjust some of the older, complicated tube testers.

FEATURES

✔ YOU CAN'T INSERT A TUBE IN THE 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." Please note this is not a variation of the commonly used "floating-filament" arrangement but instead represents a real advance in design, inasmuch as it provides a true "free-point" system. Tubes having tapped filaments and tubes with filaments terminating in more than 1 pin are truly tested with the Model TC-55 as any of the pins may be placed in neutral position when necessary.

✔ 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.

✔ EACH SECTION IN MULTI-PURPOSE TUBES IS TESTED SEPARATELY.

The new free-point system described above permits the Model TC-55 to overcome the difficulties encountered with other emission type tube testers when checking Diode, Triode and Pentode sections of multi-purpose tubes, because sections can be tested individually. The special isolating circuit allows each section to be tested as if it were in a separate envelope.

✔ ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATION.

The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test. This feature will be appreciated especially by servicemen who, when using other tube testers, have been compelled to first try various positions to locate the correct element and then have had to look up charts in order to learn which pin is used for that particular element.

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

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try it for 10 days before you buy. If completely satisfied then send $6.95 and pay balance at rate of $5.00 per month for 4 months — *No Interest or Finance Charges Added!* If not completely satisfied, return to us, no explanation necessary.

MOSS ELECTRONIC DIST. CO., INC.
Dept. D-165 3849 Tenth Ave., New York 34, N. Y.

Please rush 1 Model TC-55. I agree to pay $6.95 within 10 days after receipt and $5.00 per month thereafter.

Name_____

Address_____

City_____ Zone_____ State_____

ucts: lubricating oil, penetrating oil, rust inhibitor, and all-weather "Clear-Coat."

These Aerosol products may be sprayed in and around places not ordinarily reached, providing an over-all coverage. There is no

loss due to evaporation or spillage, as the unused material is always under seal in the pressure can. For additional information, write to *Crown Industrial Products Co.*, 1331 Amsterdam St., Woodstock, Ill.

"HEATHKIT" TV SERVICE AID

Designed for accurately adjusting monochrome or color TV receivers is the Model LP-1 linearity pattern generator, available as a kit from *The Heath Co.*, Benton Harbor, Mich.

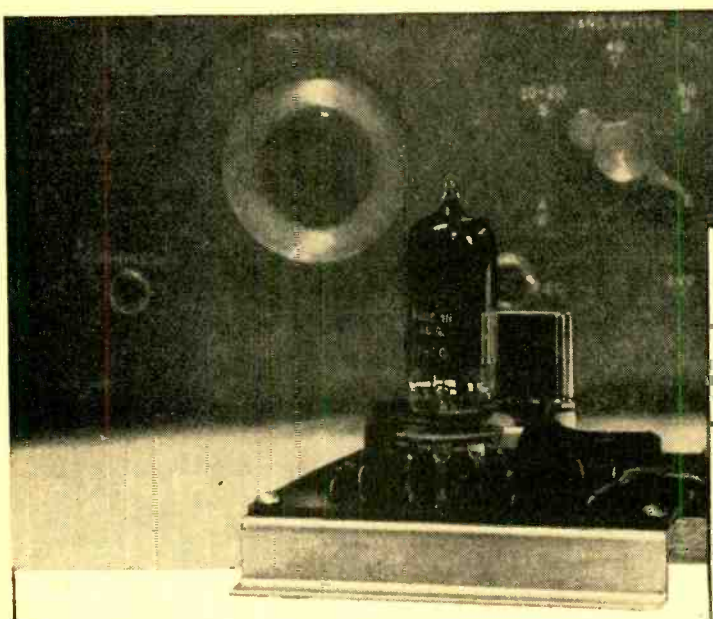
This unit functions to produce vertical or horizontal bar patterns, a cross-hatch pattern or a white dot pattern on the TV receiver under test. These patterns, readily switched on or off, and easily connected

to the TV set, enable the set to be correctly adjusted.

Covering all channels from 2 to 13, the LP-1 can be built in one evening by the home constructor. For further details, write to the manufacturer.

MAGNETIC LOCATOR

The "Tru-Point" magnetic locator is shaped like a pencil in an aluminum case.



OSCILLATOR SPECIFICATIONS

	FO-1 (fundamental)	FO-1B (overtone)
Freq. Range	200 KC-15,000 KC	15 MC-60 MC (in 4 ranges)
RF Output	3 to 10 volts into 1200 ohms	2 to 7 volts into 1200 ohms
Plate Power	210 volts @ 5 ma	210 volts @ 5 ma
Heater Power	6.3 volts @ 150 ma	6.3 volts @ 150 ma
Tube	6BH6	6AK5
Maximum Drift with ± 20% change—	Plate Voltage .0002%	.0002%
Maximum Drift 40°F to 120°F—	±.002% incl. crystal* (*except 200 to 500 KC ± .02%)	
Calibration Tolerance	.001% to .01%	.001% to .01% depending on FX-1 crystal used
Size	4"x4"x3" overall	4"x4"x3" overall
Mounting	4 holes (with brackets provided)	

PRINTED CIRCUIT OSCILLATORS

for Generating Spot Frequencies with GUARANTEED Tolerance from 200 KC to 60MC

Since the operating tolerance of a crystal is greatly affected by the associated operating circuit, the use of the FO-1 Oscillator in conjunction with the FX-1 Crystal will guarantee close tolerance operation. Tolerances as close as .001 percent can be obtained.

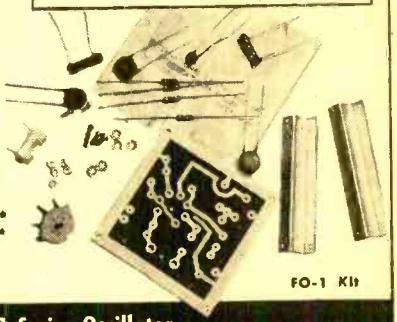
FO-1 for Fundamental Operation 200 KC to 15,000 KC

FO-1—Oscillator Kit (less tube and crystal) $3.95
FO-1A—Oscillator, factory wired & tested with tube (less crystal) ...$6.95

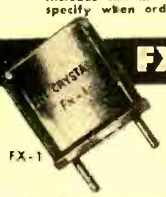
FO-1B for Overtone Operation 15 MC to 60 MC

FO-1B—Oscillator Kit (less tube and crystal).....$3.95*
FO-1BA—Oscillator, factory wired & tested with tube (less crystal) $6.95*

*Includes coil in one of four ranges: 15-20 MC, 21-30 MC, 31-40 MC, or 41-60 MC, specify when ordering. Extra coils 35c each.



FO-1 Kit



FX-1

FX-1 CRYSTAL Companion to the FO-1 Series Oscillator

The FX-1 Crystal is designed for use only with the FO-1 Oscillator. For tolerances of .01% and .005% any FX-1 Crystal can be used with any FO-1 Oscillator.

For tolerances closer than .005% the Oscillator and Crystal must be purchased together. The Oscillator is factory wired, and the crystal custom calibrated for the specific oscillator.

For crystal prices consult table below:

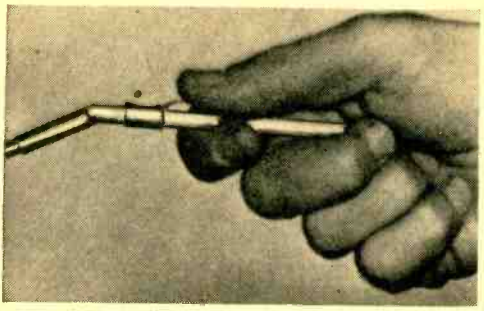
TOLERANCE	200-499 KC	500-999 KC	1000-1499 KC	1500-1999 KC	2000-9999 KC	10,000-15,000 KC	15 MC-29.9 MC	30 MC-60MC
.01%	$ 8.75	$12.50	$ 5.25	$ 3.75	$ 2.50	$ 3.25	$ 3.00	$ 4.00
.005%	$12.50	$15.00	$ 6.00	$ 4.50	$ 3.00	$ 4.00	$ 5.00	$ 6.50
(.0025% and .001% tolerances are available only by purchasing the FO-1 Oscillator and Crystal together)								
.0025%	$17.50*	$17.50*	$ 6.75*	$ 5.25*	$ 3.75*	$ 4.75*	$ 6.50*	$ 8.50*
.001%	$25.00*	$25.00*	$ 8.00*	$ 6.50*	$ 5.00*	$ 6.00*	$10.00*	$15.00*

*Prices are for crystal only. To insure tolerances closer than .005% crystal must be purchased with oscillator factory wired and tested. For total price add $6.95 to price of crystal desired.

HOW TO ORDER: In order to give the fastest possible service, crystals and oscillators are sold direct. Where cash accompanies the order, International will prepay the postage; otherwise, shipment will be made C. O. D.

International CRYSTAL Mfg. Co., Inc. 18 N. Lee Phone FO 5-1165 OKLAHOMA CITY, OKLA.

Its powerful Alnico V magnet can be used to locate wall studs, to locate and retrieve small metal objects, as a nail starter. Re-



tailing for $1.00, it is made by the *Dresden Manufacturing Co.*, 2375 Walnut Ave., Long Beach, Calif.

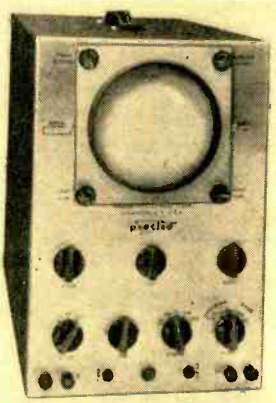
UNIQUE SCREW DRIVER KIT

A new screw driver assortment has been announced by *Vaco Products Co.*, 317 East Ontario St., Chicago 11, Ill. Called *"Vaco's* Screw Driver Assortment with Tool Board and Special Vari-Board Hangers," this package includes six screw drivers of various sizes and types. Also included is a "Vari-Board," approximately 12" x 24" with 1" perforation centers. Eight special "Vari-Board" hangers with 20 hanger hooks complete the package.

Retail price of the kit is $4.95. For further information, write to the manufacturer.

ECONOMY 5" SCOPE

For general radio and TV applications, *Precise Development Corp.*, Oceanside, L.I., N.Y., has announced a low-priced, all-purpose 5" oscilloscope. Known as the Model 315, it features frequency-compensated vertical and horizontal attenuators along with identical vertical and horizontal amplifiers. Both horizontal and vertical sections are of the cathode follower input type, and are a.c.-coupled. Response of the amplifiers extends to 500 kc. ± 6 db. Basic sensitivity is about 250 millivolts per inch, and outputs are push-pull. The Model 315 is available as a kit for $49.95, or as a factory-wired unit for $84.95. For additional information, write to the manufacturer. —30—



Remarkable NEW Training Plan by A Reputable OLD School!

NO EXPERIENCE NEEDED
This *New* PRACTICAL
DELEHANTY PLAN *entails*
NO RISK, NO OBLIGATION
Money Back Guarantee

EARN EXTRA MONEY in SPARE TIME in a few weeks! And GOOD FULL TIME JOBS at HIGH PAY... or a PROFITABLE BUSINESS of YOUR OWN in matter of months!

Learn TELEVISION RADIO & ELECTRONICS AT HOME

We Furnish ALL Your EQUIPMENT without Extra Charge!

YOU GET FULL-SIZE **21"** PICTURE TUBE *at No Extra Charge!*

The DELEHANTY SCHOOL

...one of America's foremost Vocational Training Centers for nearly Half a Century with over Half a Million students... has developed this remarkable New Shop-Training-At-Home Method. Perfected by a large staff of electronic experts, engineers, technicians and teachers with extensive practical field experience. Right up to the minute in every phase of TELEVISION, RADIO and ELECTRONICS, including U.H.F., COLOR TV, HIGH FIDELITY, etc.

PRACTICAL SHOP WORK STARTS with *FIRST* LESSON! with TOOLS and PARTS that WE FURNISH *IMMEDIATELY!!*

There's no other course quite like this! No need to plow laboriously through difficult uninteresting theory lessons before getting into actual practical work!

The DELEHANTY "LEARN-BY-DOING" method makes every lesson a thrilling new experience! You get a big kit of quality tools and parts with your very *first lesson* ...you start right in with practical shop assignments which are an interesting part of every lesson...nearly 400 shop jobs in all!!

SET YOUR OWN PACE!

DELEHANTY TRAINING lets you study and experiment at your leisure...Order new Training Units only as you want them... Pay as you go at your convenience! You move steadily forward until you attain the high level of technical knowledge and skill that marks DELEHANTY graduates as thoroughly competent RADIO, F-M and TELEVISION TECHNICIANS.

YOU PAY AS YOU GO YOU'RE NEVER IN DEBT!
When you complete your DELEHANTY TRAINING you will owe nothing!

YOU WILL HAVE AS YOUR OWN PROPERTY:

• 21" TV SET WITH 21" PICTURE TUBE • SUPERHETERODYNE RADIO WITH ALL TUBES • MULTITESTER-AMMETER, OHMMETER, VOLTMETER • OSCILLATORS • MODULATORS • RADIO TELEPHONE TRANSMITTER • TOOLS • RF AMPLIFIERS • AUDIO AMPLIFIER • OTHER ELECTRONIC DEVICES • REFERENCE LIBRARY IN DURABLE LOOSE-LEAF BINDERS

MAIL COUPON TODAY FOR FREE ILLUSTRATED BOOKLET

NO OBLIGATION • NO SALESMAN WILL CALL

DELEHANTY SCHOOL OF TELEVISION PE 10-5
115 East 15 Street, New York 3, N. Y.

Please send me by return mail your Free Booklet "How to Achieve Success in Television, Radio and Electronics." This does not obligate me in any way.

NAME _____ AGE _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

(PLEASE PRINT — Paste on Post Card or Mail in Envelope)

DELEHANTY SCHOOL of TELEVISION
LICENSED BY STATE OF NEW YORK
115 EAST 15 ST., NEW YORK 3, N. Y.

DIODE RECTIFIER QUIZ

(Questions on page 63)

1. Yes. The plate is more positive than the cathode; hence, electrons emitted from the cathode will be attracted to the plate and the tube will conduct. 2. 490 volts. 3. 380 volts. 4. Full-wave method. This system permits easier filtering because of the small gaps between output half-cycles. To provide pure d.c., these "valleys" must be filled in by a resistor-capacitor or resistor-inductor network. The wider the gaps, the more filtering required. 5. Half-wave system. The need for a center-tap in a full-wave system results in the loss of half of the transformer's available a.c. output voltage.

UNITS OF MEASUREMENT QUIZ

(Quiz on page 63)

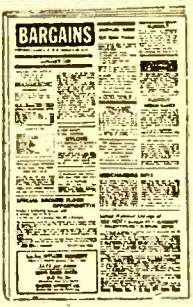
A. 10	B. 4	C. 7	D. 2	E. 8
F. 9	G. 5	H. 3	I. 6	J. 1

PHOTO CREDITS

PAGE	CREDIT
57, right	Staten Island Advance
75	Pickering & Co., Inc.
84	Radio Corporation of America
85, 86, 87	Minnesota Mining & Mfg. Co.
88, 89, 90	Tetrad, Inc.

BARGAINS

IS THE ONLY BIG TABLOID PUBLICATION in Existence That Tells You WHERE & HOW —EVERY MONTH—



- **To Buy Bankrupt, Closeout, Surplus Bargains!**
- **To Buy Items at Wholesale! • At Below Wholesale!**
- **To Buy Many New & Unusual Items!**
- **To Obtain Information on Rare Money Making Offers!**

TOYS, BOOKS, JEWELRY, GREETING CARDS, COSMETICS, HOUSEHOLD MERCHANDISE, APPLIANCES, INDUSTRIAL MATERIALS, MACHINERY, TOOLS, ETC.

Often as Low as 10c-25c on the Retail Dollar!!

ONE issue of this Sensational NEW publication can save you MORE MONEY than the cost of the entire subscription! You can BUY BETTER, CHEAPER, NEWER THINGS EVERY MONTH OF THE YEAR! Today, when your dollar buys so little, you absolutely need every single issue of BARGAINS in order to get the MOST FROM EVERY PENNY YOU SPEND. Each issue carries HUNDREDS of bargain offers . . . many times SO EXTRAORDINARY that it's hard to believe that they're GENUINE! Buying at WHOLESALE, BANKRUPT, SURPLUS, CLOSEOUT PRICES can save you from 40¢ to 80¢ or more on every dollar you spend! THIS MAY BE HARD TO BELIEVE. BUT IT IS THE TRUTH!

YOU Can Make FANTASTIC PROFITS Buying Up Bargain Merchandise CHEAP and Selling It CHEAP

Thousands of Agents, Salesmen, Dealers are subscribers to "BARGAINS". They want to know where to buy BEST in order to sell at low prices for BIG PROFITS. NO REASON why you CAN'T DO THE SAME! Special articles in BARGAINS give you valuable tips on HOW to sell these bargains for BIG PROFITS. And you know, EVERYBODY is looking for bargains these days . . . in fact, this is the only kind of merchandise that is being sold in tremendous volume. Ask any big businessman!

Unique "Subscribers Shopping Service Enables You to Buy Big Name Merchandise at TREMENDOUS SAVINGS

You won't find this feature in ANY OTHER MAGAZINE. ONLY "BARGAINS" has it. For subscribers ONLY, each month it negotiates bargain offers in famous merchandise at LOW WHOLESALE PRICES and then offers them to subscribers AT NO PROFIT! Enables you to buy in small lots—singly or in quantity at the same prices (sometimes even lower) that dealers are paying! This SINGLE FEATURE OF BARGAINS IS WORTH THE LOW SUBSCRIPTION PRICE A DOZEN TIMES OVER. Yet, it's only ONE feature among many to be found! Yes, Just one!

"Bargains" Is the ONLY Publication of Its Kind in Existence!

Search your newsstand high and low. You won't find another publication like it! BARGAINS is available by subscription ONLY. Read the glowing letters by subscribers who received their 1st copies and WERE AMAZED by this sensational publication! You will be, too!

SAVE Up to $1,000—EARN Up to $3,000!

We honestly believe that it's possible to SAVE up to $1000—and EARN up to $3000. within a year by reading "BARGAINS" EVERY MONTH! WHY NOT PROVE THIS FOR YOURSELF!

Your subscription will automatically include the BIG 1955 CHRISTMAS SPECIAL ISSUE . . . jam full of terrific, eye opening holiday BARGAINS! JUST $2.00—17¢ per month gives you 12 great money saving issues of Bargains!

$2.00 Per Year—12 Big Issues

(Regular price, $3.00 per Year)

Special Limited Time Offer to Get 10,000 New Subscribers!

Your Money Back IN FULL if the First Issue Doesn't Please You!

LET'S FACE IT . . . Claims, promises are easily made on paper. You may or may not believe all we say here. BUT can you go wrong in subscribing to "Bargains" on this iron-clad MONEY BACK GUARANTEE . . . Your money back IN FULL if the first issue that you receive doesn't please you! Can any offer be more POSITIVE, more FAIR than this POWERFUL guarantee?

Tower Press, Inc., P. O. Box 591-DA Lynn, Mass.

DON'T Take Our Word For it—Here's What Subscribers Say About "BARGAINS"!

". . . Received my 1st issue and may I say IT IS A GREAT MAGAZINE."—M. C., Ark.

". . . I am very pleased with BARGAINS. I have never seen anything like it." —Mrs. D. M., Maine.

". . . Just received my 1st copy of "Bargains" and believe me, it is all that you claimed it to be."—T. A., N. Y.

". . . I was the recipient of my 1st copy a few days ago. I am completely satisfied with the periodical. I also wish to express my appreciation to you for having made the magazine available to me. I shall be pleased to continue my subscription as long as the magazine is available."—W. S., Wash.

Every One OF THESE LETTERS ARE IN OUR FILES & WERE NOT SOLICITED IN ANY WAY OR MANNER!

Here's a FEW Samples of the Bargains Usually Found in "BARGAINS"!

- PENCILS, 57½¢ per Gross!
- 25¢ Rudolph the Reindeer Brooches, 2¢ each!
- Plastic Toy GUNS, 2¢ each!
- $1. Mufflers, Scarfs, 12½¢ each!
- Double edge razor blades, $1.50 per 1000!
- LADIES APRONS, 6¼¢ each!
- $2.50 WALLETS, 30¢ each!
- $1. val. BILLFOLDS, 15¢ each!
- $1. Kiddies handbags, 3¢ each.
- CIGARETTE HOLDERS, 1¢ each!
- BUTTONS, 144 for 25¢!
- LOW Phono records, 78 & 45 r.p.m. 7¢ each!
- 69¢ Insect Repellent, 5¢ each!
- New 20" T.V. Pic. tubes, $21.95 each!
- Famous brand $18.75 perfume, $1. each!
- 49¢ Xmas window decorations, 10¢ per set!
- $1-$3 Hard cover books, 20¢ each!
- $200.00 Surplus typewriters, $23.00 each!
- 50¢ Everyday greeting cards, 7¢ per box!
- $1.95 Men's Silk Ties, 12½¢ each!
- $1. val. personal cloth name tapes, 40¢ for 72!
- 39¢ Under arm deodorant, 2¢ jar!
- $1. Automatic card shufflers, 9¢ each!
- NEW HAIRNETS, ½¢ each!
- $15.00 Electric Percolators, $5.00 each!
- $1.75 Rudolph Reindeer kiddies toiletry sets, 35¢ each!
- $5.50 Lucite Hairbrushes, 65¢ each!
- New Bobby Pins, 70¢ per 700 pins!
- $10. Men's Toiletry Sets, 60 each!
- Calendar Wrist Watches, $5. each!
- Christmas Seals, 25¢ per 1000!
- $2.98 Horserace game records, 30¢ each!

- **PLUS HUNDREDS OF OTHER SENSATIONAL BUYS!**

(Above list merely illustrates type of bargains usually found in this paper. Lists naturally change from month to month.)

—"Tear out Coupon. Mail NOW—at once!"—

Tower Press, Inc., Box 591-DA Lynn, Mass.

O.K. Here's my $2.00 for 1 year subscription. Rush me 1st copy!

Name .....

Address .....

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

Remember! Your Money Back IN FULL if the 1st issue you receive doesn't please you!

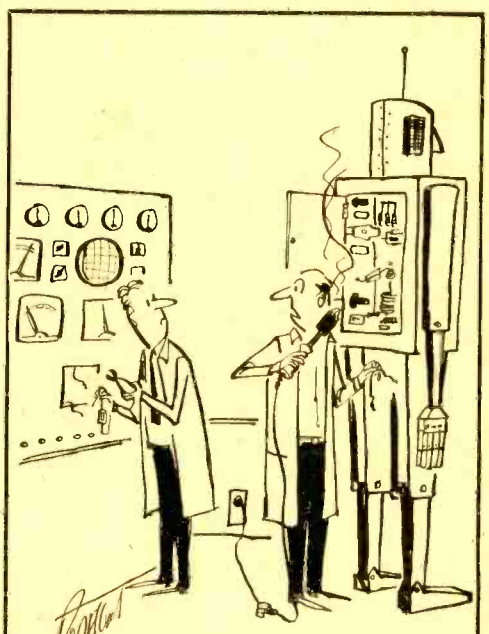
Resident Schools

(*Continued from page* 38)

ed career in electronics are by no means neglected. For instance, the *DeVry Technical Institute* of Chicago includes a course in "customer relations" for the service shop-owner; *Central Technical Institute* of Kansas City features an 80-hour semester in the writing of technical reports. The *Grantham School of Electronics,* in Washington, D.C., and in Hollywood, Calif., specializes in courses that prepare trainees for obtaining FCC licenses.

On the other side of the picture, it is apparent that the training pays off—literally and liberally. For example, the *Radio Electronic Television Schools* of Detroit, Mich., report that 29 of their 54 April graduates have been employed by *Boeing,* while other companies such as *Western Electric, Philco,* etc. "are constantly seeking our graduates." This happy side of the story is typical of every school in the field.

The accompanying photographs show only a few of the numerous examples of resident school graduates who have "made good"; countless other "case histories" are available on request to the schools themselves. The next article in this series will investigate the unique aspects of the correspondence school and its associated program of home-study training. —30—



"Did you say 'Ouch, that's hot?'"

Disc and Tape Review

(*Continued from page 74*)

the *Bartok* disc. Whichever you might acquire, both are outstanding examples of recording and you won't go wrong with either. Again, let me urge you to listen to this *Bartok* music. Abandon your prejudices and preconceived notions about this composer and hear the *Dance Suite*. I don't think you will have any regrets.

Symphony in B

Next in this month's lineup is the *Symphony in B* of Ernest Chausson. This could be called a "standard," but it is rarely performed these days. Chausson was a contemporary of the great Cesar Franck. If you are a lover of the Franck *D Minor Symphony*, you will undoubtedly like this work. Although it is true that the two works are similar in many respects, it would be unkind to malign the Chausson work as a mere "copy." There is a Franck influence to be sure, but it is still a highly individual score and is one of considerable beauty.

There are four recordings of this work on LP, only one of which can really be considered as a modern hi-fi version. This is the Pierre Monteux reading on *Victor* LM1181. Mr. Monteux has a particular flair for this sort of repertoire and his performance is far and away the best. His tempi and his phrasing, so important in this work, are wonderfully precise; and he exhorts from his men in the San Francisco Symphony a reading which is warm and glowing, yet does not lack vigor. The sound of the orchestra is captured with excellent fidelity, although the quality is not comparable with the best of today. Strings are clean, but they lack authority . . . brass is nice and bright, good to fair woodwind sound. Acoustics are not as dry as some of the old *Victor* recordings, but some extra reverb wouldn't do a bit of harm. Compared to the sound of the other recordings, this is a positive gem!

The next best effort is by Fournet on the *Epic* label. His performance has much to recommend it, although it is not on the order of the Monteux reading. But his sound is only charitably called hi-fi. Typical of some of the early *Epic* discs, this has the wiry strings and the over-emphasized bass so hard to correct with even the best preamps.

The Frederick Stock/Chicago Symphony reading on *Victor* was blessed with a very fine performance, but the sound is dry and ancient . . . an old, old, 78-rpm transfer, as is very evident from the first bars. The Mitropoulos/Minneapolis Symphony effort on *Columbia* is best described as impossible . . . the reading is no great shakes, but the sound —another 78-rpm transfer—is miserable.

o o o

Well, that's all for the classical section this month. Next month, we will hie ourselves back to the "basics" with an eye cocked for the onrushing Christmas, for which I hope to be able to furnish you with a buying guide. It should be in the November or December

issue if that's not too late. Now for the "pops."

Mantovani Plays Song Hits from Theatreland

London LL 1219, 12"LP, RIAA curve, $3.98

Ordinarily, I don't go for the Mantovani brand of sentimental slush, but when a collection of good tunes from such hit plays as Carousel, Guys and Dolls, Oklahoma and others is recorded with such striking fidelity, you've got to give the devil his due.

Mantovani Plays Song Hits from Theatreland is one of the best sounding discs of its type I've yet to hear. The famous Mantovani strings are heard in their usual stratospheric register, but this time they don't bite. And recording that kind of string work without too sharp an edge is no mean feat. The brass is bright and punchy and, as always, Mantovani has some of the best woodwind players available in his band; the *London* engineers have captured their fine intonations to perfection.

Another big improvement is in the acoustics, which have been toned down from the excessive reverb which made you think the thing was recorded in Grand Canyon. A lot of people yelp about "over-orchestration" in this type of music, and while it is true I've heard some stuff so "arranged" that the tunes were virtually unrecognizable, such is not the case here. Yes, there still is plenty of "schmaltz," but it is skillfully and tastefully done. Best numbers on the disc are *Hello Young Lovers* and *Stranger in Paradise.*

For those of you who complain that pop music doesn't get the super hi-fi recording afforded the classics, this is your answer. You won't find stuff much wider in range and dynamics than this collection.

The Music of Richard Rodgers

Stanley Black and his Orchestra
London LL 1209, 12" LP, RIAA curve, $3.98

Here is another winner from *London,* which seems to be on a campaign of recording hi-fi pops. If anything, this disc is even better than the Mantovani reviewed above . . . probably largely because it was recorded in Kingsway Hall and the acoustics of that famous hall have wrought miracles with the sound. This is a big orchestra, and it sounds that way. The *London* engineers have successfully captured the "bigness" along with superb detail.

There are sections in this disc like the trombones in *June is Bustin' Out All Over* that are fabulous in the simulation of liveness. Through big high-quality speaker systems, the pizzicato sections of *Lover* and *Surrey With the Fringe on Top* dazzle you with the superbly clean transients. With some of the very best Richard Rodgers like *It Might As Well Be Spring, Where or When* and *Bewitched,* as well as about eight other hits, this disc is a terrific buy.

The orchestration is extremely clever and the sound textures achieved are quite remarkable. In all departments, from strings to percussion, the sound is ultra-wide in frequency and dynamics. While undoubtedly many people will buy this sort of disc for "back-

TELTRON TUBES

Guaranteed! Lowest Prices Ever!

All tubes individually boxed . . . unconditionally guaranteed for one year.

GIFT OFFER! One 6BG6G tube will be shipped FREE with any $10 order accompanying this ad.

FREE
$7.20 list value Bonus Box of three 6SN7 tubes and 25 assorted resistors with each order of $25 or more.

SAME DAY SERVICE
48 hour Postal Delivery to West Coast.

FREE! BONUS OFFER!

Model 625K

- Illum. gear-driven "Speed Rollchart"
- New lever-action switches for individual testing of every element
- Tests all conventional and TV tubes

This Eico Tube Tester is yours FREE when you buy $199 worth of tubes or more within 60 days at Teltron.

May be bought outright from Teltron for $34.95.

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
0Z4	.45	6AQ5	.48	6CU6	.95	7F7	.59	25L6GT	.41
1A7GT	.53	6AR5	.48	6D6	.59	7F8	.77	25BQ6GT	.82
1B3GT	.62	6AS5	.52	6E5	.60	7N7	.52	25W4GT	.43
1H5GT	.51	6AT6	.37	6F5	.44	12AT6	.37	25Z5	.55
1L4	.51	6AU5GT	.60	6F6	.42	12AT7	.71	25Z6GT	.36
1L6	.51	6AU6	.43	6H6	.50	12AU7	.58	35A5	.48
1LC6	.49	6AV5GT	.60	6J5	.49	12AV6	.42	35B5	.48
1N5GT	.51	6AV6	.37	6J6	.61	12AV7	.73	35C5	.48
1R5	.51	6AX4GT	.60	6K5	.60	12AX4GT	.60	35L6GT	.41
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
5Y3	.30	6BL7GT	.78	6V3	.80	12SJ7	.45	80	.40
5Y4G	.37	6BN6	.90	6V6GT	.48	12SK7	.45	84	.46
6A8	.40	6BQ6GT	4 .83	6W4GT	.43	12SL7	.60	117GT	1.20
6AB4	.43	6BQ7	.85	6W6GT	.53	12SN7GT	.56	117L7GT	1.20
6AC7	.65	6BY5G	.60	6X4	.37	12SQ7	.38	117N7GT	1.20
6AG5	.52	6BZ7	.95	6X5GT	.38	14A7	.43	117P7GT	1.20
6AH4GT	.65	6C4	.41	6X8	.80	14B6	.36	117Z3	.33
6AF4	1.02	6C5	.46	6Y6G	.61	14Q7	.52	117Z6GT	.65
6AK5	.96	6CB6	.51	7A8	.46	19BG6G	1.48	1629	.39
6AL5	.43	6CD6G	1.63	7C5	.44	19T8	.71		

We have thousands of tube types too numerous to list here. On ordering types not listed take 75% off current list price for cost of tube.

Repeated By Popular Demand!

SPECIALS TO NOV. 1ST

TYPE	REG.	SPEC.
1B3GT	.62	.56
1R5	.51	.42
1U4	.51	.42
6AC7	.65	.59
6CD6G	1.63	.99
6J6	.61	.49
6SN7GT	.60	.49
6W4GT	.43	.37
12AT7	.71	.55
125A7	.48	.42
125K7	.45	.42
125Q7	.38	.36
25BQ6GT	.82	.73
50L6GT	.50	.42

NEW LIBERAL TERMS!

No minimum order. All postage paid on orders over $10.00 in U.S.A., A.P.O.'s and Territories. 10% deposit on C.O.D.'s. 25¢ handling charges on orders under $5.00. To our Canadian and foreign friends, please send approximate freight—excess will be refunded. Orders subject to prior sale.

WE WANT NEW ACCOUNTS

If you are rated, your credit is good with us. We are "Eico" distributors. Write us about special deals on test equipment.

TELTRON ELECTRIC COMPANY

428 HARRISON AVE. | DEPT. PE-10 | Phone HUmboldt 4-9848 | HARRISON, N. J.

KLIPSCH

SHORTHORN

corner horn speaker system

Designed and manufactured by the originator of the Klipschorn speaker system, the Shorthorn is second only to the Klipschorn system in performance. Using coordinated acoustic elements, including filters, it offers exceptionally smooth response, free from distortion. Back loading horn extends bass range without resonance.

Available in kit form, with or without drive system. Prices from $39 for the do-it-yourself horn kit to $209 for assembled horn with Klipsch Ortho 3-way drive system installed. *Write for literature.*

KLIPSCH & ASSOCIATES
HOPE, ARKANSAS

HIGH FIDELITY RECORDINGS, INC.
presents

FIVE NEW RELEASES

R-702 GEORGE WRIGHT ENCORES AT THE MIGHTY WURLITZER PIPE ORGAN

R-201 JOE ENOS PLAYS TWO PIANOS

R-301 THE MITCHELL BOYS CHOIR SINGS

R-401 DICK STEWART SINGS

R-703 A RICHARD PURVIS ORGAN RECITAL IN GRACE CATHEDRAL

ALL ARE RECORDED IN FULL FREQUENCY RANGE HIGH FIDELITY SOUND WITH STRIKING REALISM AND ARE OUTSTANDING FOR DEMONSTRATION PURPOSES OR TO SHOW OFF YOUR OWN "HIFI" EQUIPMENT. . . .

SEE YOUR DEALER OR ORDER BY DIRECT MAIL AS FOLLOWS:

1. Long playing 12" HIFIrecord . . . . . $ 4.95
2. 7½ IPS half track HIFItape 6.95
3. 7½ IPS full track HIFItape 8.95
4. 15 IPS half track HIFItape 8.95
5. 15 IPS full track HIFItape 15.95

simply forward your check, specifying which release you want together with reference to above numbered "HIFIrecord" or "HIFItape" desired. Prices include tax and mailing charges.

HIGH FIDELITY RECORDINGS, INC.
6087 Sunset Boulevard
Hollywood 28, California

ground" music, the fidelity is such that it will soon command attention. You can't go wrong on this one!

Loring Nichols and His Band

Audiophile AP-8, 12" 78-rpm microgroove, AES curve, $5.95

This is a most unusual recording, to put it mildly! Please pay particular attention to the fact that it is a *78-rpm disc* which, however, is cut for *microgroove* and must be played with your *regular 1 mil LP stylus*. Why the seemingly odd combination? Mr. E. D. Nunn, the painstaking gentleman who records these discs, claims this combination is productive of better quality sound in respect to dynamics, frequency, and lack of distortion. After listening to this record, I'm inclined to agree with Mr. Nunn.

Who Loring Nichols and his band are, I haven't the remotest notion. They play a half a dozen standard pops, such as *I Can't Believe That You're in Love With Me* and *Candlelight* with reasonable proficiency. The orchestration won't win any awards, but it isn't bad and the numbers are all recognizable. Frankly, I wouldn't care if Elmer Flubb and his High School Hotshots were the performing artists (?) . . . the absolutely fantastic fidelity of the disc overrides any other considerations. Believe me, friends, on a really high-quality system, this is something to hear and marvel at.

Clarinet sounds on the disc are amazing . . . the breath sounds, the sharp transient attacks, the essential timbre of the instrument are clearly revealed. The same can be said of the trumpet and trombones and the super-clean percussion. This recording is very "close-to," with rather dry acoustics; although it must be said in Mr. Nunn's defense that this is a small group and that he recorded it with a view towards how it would sound in an average good-sized living room where conceivably a group of this size would not be out of place. I think this is a fairly valid reason, and the band does indeed fill my living room quite comfortably. As heard through two speakers, the intimacy and liveness of the sound is altogether remarkable.

Once again, we have the lesson that a small company or an individual dedicated to turning out a good recording can meet and often surpass the best efforts of the largest companies. As a demonstration record, this disc has few equals; and if Mr. Nunn can turn his attention to a larger better-known group or do some concert stuff in future releases, I am sure he will gain a large and appreciative audience.

Through the Sound Barrier with McIntosh (Sounds of our Jet Age)

McIntosh MM 105, 12" LP, RIAA curve, $4.95

Calling all sound nuts! Boys, you've got yourself a new toy. Yessir, if you want to

frighten small children, or get rid of your mother-in-law (maybe your wife, too) or break your lease . . . this is for you! It is positively the howlingest hunk of noise ever recorded, and with super fidelity!

With the cooperation of the Air Force, Frank McIntosh (he of amplifier fame) took his recording rig to an air base and proceeded to immortalize the banshee wail of jet planes. He's got them warming up, taking off, landing, plane-to-tower conversations just for good measure, planes making passes over the field, and to top everything . . . the blast of the shock wave as a jet breaks through the sound barrier! No foolin', it's the real thing; and as this particular passage is preceded by comparative quiet, when it hits you, you'll jump a mile! It so happens I live fairly close to the *Grumman* factory on Long Island and they are forever screaming over in their Panther-jets and occasionally one bashes through the barrier. With this experience, I can assure you that the fidelity on the disc is ultra-faithful.

Of course, the one thing missing is the actual acoustic power, which Mr. McIntosh—with tongue in cheek—states would take a mere 600,000 watts to reproduce correctly. Maybe so, but through two of Mr. Mac's 30-watt units and two outsized exponential horn systems, I managed to create enough sound to frighten the neighbors into thinking the Russkies must have slipped past our radar pickets! One last warning . . . if you have any kiddies at home at the space cadet stage, better not get this recording. They might have you walking around in an oxygen mask!

⊙ ⊙ ⊙

Tape suppliers are very remiss, so there are still no new tapes to report. New *Victor* stereos have been promised, and just as soon as they or anything else worth reviewing comes along, we'll resume the tape department. —30—

The Transmitting Tower

(*Continued from page 67*)

to use c.w. (code) only long enough to increase their proficiency to the point where they can pass the 13-wpm General code test, after which they plan to operate "phone" exclusively. Often, though, as their code speed does improve, they enjoy c.w. so much that they decide to get better code equipment instead of phone equipment. Those who do switch to phone have the choice of using conventional amplitude-modulated (AM) transmission or single-sideband, suppressed-carrier (SSB) transmissions. Each of these methods of phone transmission employs different techniques and requires different equipment to obtain the same end results—putting your voice in the other fellow's receiver.

Similarly, if you become a high-frequency DX man, rotary beam antennas may keep you broke, and so on. After a few months on the air, you may have entirely different ideas about the kind of equipment you want. As a result, the surest way to get the most from

your equipment dollar is to invest it with caution until you are sure just what you want.

Communications Receiver

I have left until last a discussion of the most important piece of equipment in your station —your receiver. I have mentioned several times the distances that can be covered with a simple, low-power transmitter. But the transmitter doesn't mean a thing unless there is a receiver tuned to the transmitter frequency at the remote point to pick up the signal.

A good communications receiver has several attributes: (1) it is sensitive enough to pick up any signal striking its antenna that is stronger than the noise which is also picked up by the antenna; (2) it is selective enough to separate signals on nearly the same frequency, so that the desired signal can be received without undue interference from the others; (3) it is stable and easy to tune. This sounds like a reasonable set of specifications, but it is a difficult one to meet.

Obtaining sufficient sensitivity is the easiest. A half-dozen modern tubes arranged in the proper circuits will do it.

Obtaining sufficient selectivity is much more difficult. A comparison will show why. On the broadcast band, all stations are spaced ten kilocycles apart. In addition, the strong stations in an area are separated from each other by several channels. Therefore, a broadcast receiver normally requires only enough selectivity to separate strong, local signals from much weaker signals on the adjacent channels.

In the amateur bands, however, any amateur may use any frequency, as long as he stays within the band. As a result, signals are as close together as noodles in soup. To make things even more difficult, it is often desired to separate a weak DX signal from a strong local signal on a slightly different frequency.

The ideal communications receiver will separate phone signals 2.5 to 3 kc. apart, and it will separate c.w. signals 100 to 250 cycles apart. More selectivity makes the desired signals difficult to copy. All modern communications receivers are superheterodynes, and the required high selectivity is obtained by using many tuned circuits or an electromechanical filter in the intermediate frequency amplifier.

With a selectivity of 3 kc. or less, it is easy to see why ease of tuning and high stability become of major importance. Unless the dial and tuning system are of the highest quality, it will be impossible to tune slowly enough to avoid passing over stations. And if the receiver drifts or jumps in frequency as a result of temperature changes or mechanical shocks, it will be impossible to keep tuned to the desired signal.

These and the other features that are desirable or necessary in a communications receiver add both to its cost and its complexity. At today's prices, the better ones cost between $250.00 and $700.00. As prices go down, so do the selectivity and other desirable features, until receivers in the $50.00 bracket have selectivity comparable to a broadcast receiver. This degree of selectivity is inadequate during

the hours of peak amateur operation, between about 5:00 p.m. and 11:00 p.m. on weekdays and all day on weekends, although it is often sufficient during the hours when the bands are less crowded.

Partially contradicting what I said earlier, it is worthwhile to obtain a receiver above the lowest price class as soon as you can, because it will pay off in more successful contacts, even with a very simple transmitter. This does not mean, however, that you should necessarily buy the most expensive one you can afford.

Because the simple receivers, such as 2- and 3-tube regenerative ones, do not have enough selectivity to cope with today's crowded amateur bands, and because many amateurs doubt their ability to build an elaborate superheterodyne, comparatively few amateurs build their own receivers. Those who do are men among men.

The average home-built communications receiver uses plug-in coils for changing bands and six to eight tubes. There is one communications receiver kit on the market, the *Heathkit* AR-2, which—although more complicated to assemble than a simple transmitter kit—is within the capabilities of most beginners. It sells for about $30.00, with cabinet, and its performance is comparable to that of commercial receivers in the $50.00 bracket.

News and Views

In answer to many questions, I have obtained some interesting information about amateur licenses from Miss Mary Jane Morris, Secretary, Federal Communications Commission. The figures cover the latest period for which accurate data are available, July 1, 1954 through March 31, 1955.

A total of 32,369 examinations was taken for the various classes of licenses. Of this total, 24,711 applicants passed and 7658 failed, making the percentage of licenses granted 77%. Of the 7658 failures, 5662, or 17%, failed the code test; and 1996, or 6%, failed the written technical examination.

For the Novice class license, 14,605 examinations were taken; 12,097 applicants passed (83%) and 2508 failed. For the Technician class license, 3028 examinations were taken; 2699 passed (89%) and 329 failed. A complete breakdown is not available for the General, Conditional and Extra classes. However, 11,571 examinations were taken for the General license, 2969 for the Conditional license, and 196 for the Extra class license, making a total of 14,736. Of this total, 9915 passed (67%) and 4821 failed.

That just about half (49%) of the licenses issued are of the Novice class indicates that this license is doing its intended job of making it easy for prospective amateurs to obtain their first licenses. Equally important, the number of Technician, Conditional, and General class licenses issued indicates that it is also apparently doing the second part of its job, helping them to acquire the information needed to qualify for a more advanced license.

Unfortunately, the figures do not show the percentage of these licenses that is issued to Novices, but all indications are that it is high. Neither do they give any indication of

the number of persistent individuals who took an examination two or three times before finally qualifying for a license. This group represents at least a few per cent of the examinations given.

When the FCC first proposed issuing the Novice and Technician licenses by mail only, there were predictions that no one would ever fail the tests, implying that both the applicant and the examiner would cheat a little. Certainly, the figures do not bear out the predictions. Instead, they show that some applicants must underestimate the Novice examination. As I have said many times, the examination is easy, but only if you have prepared for it. This is borne out by the fact that for anyone to fail it twice is virtually unknown.

Jim, WN9KZM, Mt. Morris, Ill., reports on some experiments made with his new *Johnson* "Adventurer" transmitter and three different antennas in the 80-, 40-, and 15-meter bands. Starting on 80 meters, he worked South Dakota and Missouri using a 135' center-fed antenna. Switching to 40 meters, he worked Tennessee, Kansas, and Texas the same evening.

The next day, he put up a 65' center-fed antenna and worked eight states on 40 meters. Replacing this antenna with an end-fed piece of wire 65' long, he made several contacts on both 40 and 80 meters, plus contacts with North Carolina, Mississippi, and New York on 15 meters. For the moment, the last one is Jim's favorite antenna.

Not by coincidence, antennas will be the topic of discussion in the *Transmitting Tower* next month. In addition, the column will feature news and pictures of general amateur interest. Please let me know what kind of information you would like to see in the *Transmitting Tower*. And, to get full value from your stamp, why not include some information about yourself and your station. Slip the letter in an envelope along with a sharp picture of yourself and your equipment and mail to: Herb S. Brier, c/o POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y. I'll do the rest.

Until next month, 73.

Herb, W9EGQ.

Build a "Decision Meter"

(*Continued from page* 44)

purchase of amplifier "A" would be more favorable, while a "no" decision would indicate the purchase of amplifier "B" to be more favorable. From the information given, the following readings might be entered: (A), (B)—no entry; (C)—dial 1, minus 1; (D)—no entry; (E)—dial 2, minus 2; (F)—dial 3, plus 2; (G)—no entry; (H)—dial 4, plus 1; (I)—dial 5, plus 4; weight, 4. The meter and "yes-no" switch will indicate that amplifier "A" is the more favorable.

This is a simple example, but the decision meter can be used equally well when

ten or twenty variables are involved. For these more complex decisions, make five entries and record readings till all variables have been entered. Then the recorded readings are summed, considering "yes" as plus, "no" as minus. The scope of the decision meter may be enlarged considerably in this way.

Remember that the decision meter can only give a correct decision when it is given correct information. Simple and inexpensive to build, it is useful as an aid in learning how to make decisions and in learning how to be systematic, as well as an accurate means of analyzing problems. It can also provide a great deal of pleasure as a parlor entertainment item. —30—

Ama-Touring

(*Continued from page* 69)

Turks and Caicos Islands—VP5DC is another station on Grand Turk Island, the same location as VP5BM. VP5DC operates on about 14.15 mc. around 1900. QSL's from both go via W4NMO.

Uruguay—CX5AF, using 1 kw., has the best signal from Uruguay. He is heard on 14.15 mc. around 2030. Others heard are: CX2CO, 14.15; and CX6CM, 14.37 mc.

Windward Islands—Stations active from here are: VP2DA, Dominica, heard on 14.16 at 2000; VP2DL, Dominica, noted on 14.15 at 2000; and VP2GG, Grenada, logged on 14.17 at 0730. (*Meyers*)

Wayne Ashworth of North Carolina reports the following on c.w.: FY7YC, 14.03; KC6CG, 14.01; KJ6BG, 14.01; VQ4EO, 14.03; VQ8AG, 14.00; VR2AG, 14.01; ZM6AS, 14.03; and 4X4CK, 14.00; all heard between 2300 and 0100.

DX on Other Bands

UPOL3, a Russian expedition station in the Arctic, operates at 1700-1800 on 7-mc. phone and c.w. Reports may be sent to Box 88, Moscow, USSR. (*Gunnar Persson, Sweden*)

VK4IC, who operates on about 7.10 mc., is on Willis Island, a tiny island off the east coast of Australia. He receives mail about twice a year.

ZE2KR, Southern Rhodesia, was heard on 21.25 mc. at 0915. (*Swenson*)

HR3HH, Honduras, 21.03 mc., and YS1RA, El Salvador, 21.095 mc., were heard at 1330. (*Meyers*) —30—

Tuning the Short-Wave Bands

(*Continued from page* 71)

Kenya—The schedule for VQ7LO, Nairobi, on 4885 kc., is at 0500-0600 (from 0200, Sunday) and 1000-1500 (until 1400, Sunday). These times make it nearly impossible to hear in the USA, but a DX'er with a very good antenna/ground system might pull them in.

Libya—The *Forces Broadcasting Station* at Benghazi, on 4930 kc., is being heard at 1300 with *BBC* news (in Kentucky); at 1545 with a variety program and news; at 1630 with music; at 2300-2330 with a non-stop musical program; then, *BBC* news until 2345, followed by more music.

Malaya—*British Forces Station*, Singapore, 11,820 kc., has ENGLISH news and music at 0515. The *Far Eastern Broadcasting Station*, Singapore, 15,300 kc., is being heard well at 1230-1235 with an ENGLISH announcement of time and frequency just before s/off. VS2K6, Kuala Lumpur, 6025 kc., is noted at 0900 with an ENGLISH newscast.

Mexico—According to a verification from XEBT, Mexico City, 9265 kc., they have an ENGLISH news program at 1915, Monday-Friday.

Netherlands—The new xmtrs for PCJ, *Radio Nederland*, will be ready by early 1956 instead of during 1955 as previously reported. This one can be tuned at 1645-2200 on 11,730 kc., and on same channel at 2310 in the New Zealand beam.

Pakistan—This country has an ENGLISH news period at 2100 on APD, Dacca, 11,726. Music follows the news.

Philippines—DZH2, Manila, 9640 kc., has ENGLISH news and music at 0435-0500; at 0520 there is music announced in Spanish. DZH8, Manila, 15,300, has an ENGLISH period at 0900.

Roumania—*Radio Bucharest*, 9570 kc., has ENGLISH at 2345.

Sarawak—This small country in the East Indies also has an ENGLISH newscast that can be heard at 0800 after Moscow signs off. The frequency is 5052 kc.; the news is relayed from the *BBC*. This is a good catch! It is one for the DX'ers in the Middle and Far West, although some on the East Coast have verified it.

South Korea—AFKN (*Armed Forces Korean Network*) operates from *Radio Vagabond* on 6895 kc. Variety programs are noted around 0630; around 0755 with music.

Spain—Madrid, 9360 kc., has ENGLISH programs at 1930 and 2300. This is normally an easy one to pick up, especially in the east.

Sweden—ENGLISH news is heard from Stockholm over SBP, 11,705 kc., at 1800 and 2145; from SBU on 9535 kc. at 1930. SBU on 9620 now transmits to North America at 2000.

Switzerland—Berne presents ENGLISH news on HER6, 15,305 kc., at 1150; and on HER4, 9535 kc., at 2315.

Syria—One that is a challenge is *Radio Damascus* on 9550 kc. At 1652, there is ENGLISH news. An announcement at 1655 is followed by dance music. Another ENGLISH news and talk period is tuned at 1715.

Turkey—*Radio Ankara*, TAT, 9515 kc., has an ENGLISH period to North America at 1830.

Thailand—*Radio Bangkok*, HSK9, 11,690 kc., is tuned around 0530 with ENGLISH news, musical program, and commentary.

USSR—*Radio Moscow* has many periods of ENGLISH news, but one that is widely reported —especially throughout the west—is at 1945 on 9565 kc. According to reports recently received, *Radio Moscow* verifies ONLY reception

reports of its English programs to North America. Many of the lesser-known stations throughout Soviet Russia, especially in Siberia, are being heard; but evidently verifications cannot be obtained from them.

Yemen—A station in Sanaa, Yemen, is reported to be testing on 9705 kc. at 0300-0400 and 0900-1000.

Belgium—Brussels has discontinued all ENGLISH programs to the USA and Canada for the time being for "material reasons." They are continuing, however, to broadcast to Belgians abroad.

Sunspot Activity

For June, 1955, the average sunspot count was 33.1. Averages predicted are as follows: for October—31; November—34; December—37. This shows that the sunspot activity is still on the increase; therefore, s.w. reception should still be improving. Keep the earphones well oiled and the electricity bills paid because now is the time to hunt for those rare catches that can only be heard when sunspot activity is at its greatest. I hope that the English news periods given here will enable DX'ers to log new countries. —30—

▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲

One-Tube "Wallop"

(*Continued from page* 53)

pacitor *C5* and resistors *R3, R4,* and *R5*. Note that resistors *R4* and *R5* are connected to socket terminal 1. It is permissible to use terminal 1 as a tie point in this manner, since it is not connected to any element inside the tube.

Initial Adjustment

After the wiring has been checked and any corrections made, the set must be aligned, using one of the following methods, in order that it may cover its tuning range of 500 to 1600 kc.

This procedure is preferred: (1) Connect the batteries. (2) Connect an amplitude-modulated signal generator to the ANTENNA and GROUND terminals. (3) Set the generator to 1600 kc. and switch on its power. (4) Switch on the receiver and set the volume control to maximum volume. (5) Turn the plates of the tuning capacitor all of the way out. Or if a broadcast dial is provided, set the latter to 1600 kc. (6) With a screw driver, adjust the slug of coil *L1* until a signal tone is heard from the loudspeaker. Continue to screw the slug until the point of highest signal volume (peak point) is reached. (7) If it is hard to distinguish this peak, the signal generator probably is overloading the receiver. To correct this, reduce the generator output.

If a signal generator is unavailable, use broadcast stations in its place, thus: (1) Connect batteries and a good outside an-

tenna and ground to the receiver. (2) Switch on the receiver. (3) Turn the plates of tuning capacitor *C2* all of the way out, or set the tuning dial (if one is used) to 1600 kc. (4) Tune in a broadcast station on 1600 kc. by screwing the slug of coil *L1* for peak loudspeaker signal. (5) If there is no local station on 1600 kc., pick the highest-frequency station in the locality, set the dial of *C2* to that frequency, and adjust the slug screw of coil *L1*.

Proper adjustment of the trimmer capacitor, *C1*, will minimize the loading and de-tuning effects of the antenna. One of the most noticeable of these effects is the broadening of tuning and pronounced interference between stations. With the antenna and ground connected to the set, reduce the setting of capacitor *C1* by unscrewing its leaf until the station tuning is sharpened. —30—

Carl & Jerry

(*Continued from page* 65)

the valley toward town. Because of the trees, the course of the road could only be seen for a short distance, and there was no sign of a car.

"Don't look at me," Carl said to the eyes he could now feel boring into the back of his head. "I promised my mother never to have anything to do with bank robbers."

"We've GOT to do something," Jerry declared, as he rubbed his flat-topped haircut in desperation. "You start pushing rocks down onto the road. Just get enough of them down there, spaced so that a car can't pass through without blowing a tire or knocking a hole in the oil pan. If you can make it look like a rockslide, all the better; but just make sure a car will have to stop until the rocks are cleared away before it can pass."

Without waiting for an answer to this command, he pushed the transmit switch and barked into the mike: "Gene, have the chief get three of his men up there in your shack on the double. Give the chief and each of the men a number from one through four. In a couple of minutes I'll start calling out a number first and then say a short sentence. Have the man whose number is called step up to the mike and repeat that sentence in just as mean and hardboiled a fashion as he can. And you will have to listen closely, for I'll be whispering into the mike—"

He broke off sharply as his straining ears caught the distant throbbing of a racing motor. Instantly he began dragging the portable station case over to the edge of the cut and stopped right at the brink where a small bush hid him from view from below. A glance down at the road revealed that Carl had done an excellent job of blocking it, and now that worthy threw himself, panting heavily, down beside Jerry.

"Help me prop up the back of the case so that the speaker points down at the road," Jerry said; "then, when and if we get the car stopped, you keep moving back and forth just out of sight along the edge of the cut. Try to make a lot of noise. And keep your fingers and toes crossed. We're going to need all the help we can get."

As he finished saying this, a car came roaring over the rise, and then, as the driver glimpsed the rocks in the road, slithered crosswise to a stop amid a great screeching of brakes and showering of gravel.

"What're you stopping for, you fool?" a hawk-nosed man in the rear seat demanded.

"I can't drive over that rockslide," the driver answered sharply.

"Well, all right. Everybody pile out and get those rocks out of the way," Hawknose ordered. "Those yokels back there ain't chasing us to give us the key to the city, you know."

All of the men except Hawknose got out of the car and started toward the pile of rocks. Jerry whispered a few words into the mike and threw the switch to the receive position.

"All right, you birds," a gruff voice bellowed from the speaker; "freeze right where you are. The first one who makes a move gets sprayed with double death from this tommy gun."

The men stopped in their tracks. Only their eyes shifted nervously from one to another and then turned toward the car.

"And you, Bugle Nose, crawl out of that car with your hands over your head or we'll rip it open like a can of sardines," the voice ordered.

The man in the car hesitated, and promptly the harsh voice shouted, "All right, you asked for it; now you're going to get it."

"Hold it! I'm getting out," the man with the large nose said hastily, as he scrambled out the car door with his wrists stretching up out of his coat sleeves.

"That's better," the rasping voice commented. "Bill, you keep a bead right on Bugle Beak's belt buckle and let him have it first if anyone makes a funny move of any kind. Brad, you watch the two on the right."

"Okay, Chief," another voice answered after a little pause.

"Spike, you keep an eye on the other two."

"Gotcha, Chief," was the prompt reply in still a third voice.

"Now let's everyone very, very carefully take his gun out of his pocket and drop it on the road. Then kick it off to one side. If one of you will be so accommodating as to try a little funny stuff, he can save the county the cost of a trial for the whole lot of you."

Like a scene in slow motion, the men began relieving themselves of a collection of revolvers and automatic pistols. It was noteworthy that the .45 automatic of Hawknose was the first to clank on the gravel. Doubtless the mental picture of the submachine gun pointed at his belt buckle had something to do with his alacrity.

After the guns were kicked aside, there was a long pause. Carl, who had been busily scurrying back and forth, dragging his feet and trying to sound like a small posse, looked over his shoulder at Jerry.

That youth's round face was nearly apoplectic as he fiddled desperately with the controls of the u.h.f. station that quite obviously had gone dead. A hurried peek over the edge of the cut revealed that the men below had sensed that something was wrong, and a couple of them were cautiously edging toward their guns.

"What's wrong?" Carl whispered hoarsely, as he bent over his frantically working chum.

"Don't know; but this outfit is as dead as we're going to be in about sixty seconds," Jerry answered.

Spurred on by this electrifying prospect, Carl drew back and made the typical American's classic and ultimate military service gesture for non-operating equipment: he gave the case of the portable station a lusty kick. Instantly Gene's anxious voice burst from the speaker demanding: "What's wrong, Jerry? We can't hear you. What do you want us to do now?"

Before either the bandits or the horrified boys had time to react to this development, another car came over the hill and slid to a stop behind the first. Men erupted from the car into the side ditches in twin sprays the way grasshoppers clear your path in the fall of the year; but before the bandits had time to take advantage of the shock that the unexpected sight of them gave the posse, the latter recovered themselves and collared the unarmed desperadoes. Jerry leaped to his feet and began to shout, "Boys, are we glad to see you—;" but as a bullet from the gun of a trigger-happy posseman ricocheted off the rock at his feet and whined off into the distance, he ducked back behind his bush.

"Wouldn't it be too bad if you potted one of your buddies up there!" the hawk-nosed man sneered.

At this moment, the voice of the chief of police bellowed from the speaker. "You men down there listen to me. This is Chief Hall. These two boys up here stopped the bandits and held them for you. Here's the way they did it." And then he went ahead to describe the ruse in detail.

"Finally," he continued, "I'd like to say two things. First, you boys will be in on a nice reward for helping to capture those bandits. Secondly, I don't know what kind of books you've been reading, shows you've been seeing, or TV programs you've been watching, but let me tell you here and now that real cops simply don't talk the way you've just made us talk. We're all going right down to the station and wash our mouths out with soap!"

Jerry and Carl grinned happily at each other as the chief signed off.

"This has certainly taught me one thing," Jerry confessed, beginning to pack up the portable station. "I'll bet that as long as I live I'll never again be careless about inserting a plug in a socket. It was the battery cable plug that caused the set to go dead. I found it while the posse was grabbing those characters down there."

"I give up," Carl said, as he tossed his hands into the air. "A guy who keeps on trouble-shooting when there's a good chance of shooting-trouble is beyond all hope!" —30—

GLOSSARY OF ELECTRONIC TERMS

This glossary, which is being published in serial form, started in August. 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.

diode—A component having two electrodes, one being the cathode and the other the plate or anode. A diode allows electrons to pass in only one direction, from the cathode to the anode.

diode detector—A diode used in a demodulation circuit. Detection may be half-wave or full-wave rectification.

dipole antenna—A conductor one-half wavelength long at a given frequency. The most common form of the dipole antenna is separated exactly at the center by an insulator. Conductors of a balanced transmission line connect to the dipole sections at the insulator. Characteristic impedance at center is usually 72 ohms.

discriminator—Component part of an FM receiver, which converts frequency-modulated signals into audio signals.

doubler—In a transmitter, a circuit in which the output is tuned to twice the frequency of the input circuit. Also used in referring to voltage doublers for doubling the voltage in power supplies.

dropping resistor—A resistor used to decrease the voltage in a circuit, or from across which a potential difference (voltage) is taken.

dry-disc rectifier—Dry contact rectifier. A rectifier consisting of discs of metal and other material in contact under pressure, such as a copper-oxide rectifier or a selenium rectifier. Passes current only in one direction.

dual-track recording head—A magnetic recording head which records on half the width of the recording tape. By inverting the tape, a second track can be recorded on the other half of the tape.

dynamic microphone—A microphone in which the flexible diaphragm is attached directly to a coil positioned in the fixed magnetic field of a permanent magnet. Sound waves move the diaphragm, causing the attached voice coil to move with respect to the magnetic field, and thereby inducing the desired a.f. voltage in the coil. Sometimes called **moving-coil microphone.**

dynamic noise suppressor—Circuit for audio amplifiers, especially those for record players. The frequency response at both ends is continually adjusted by reactance tubes so that low- or high-frequency noise is blocked unless the amplitude level at these frequencies is sufficient to provide a satisfactory signal-to-noise ratio.

dynode—One of the secondary emitting electrodes in an electron multiplier tube.

echo chamber—A reverberant room, enclosure or box, used in radio studios to create hollow effects or actual echoes for radio programs. The same effect may also be produced electronically.

eddy currents—Circulating currents induced in conducting materials by varying magnetic fields. They are usually undesirable because they represent loss of energy and cause heating. Eddy currents are kept at a minimum by employing laminated, powdered or sintered construction for the iron cores of transformers, a.f. choke coils, and other magnetic devices. Eddy currents are useful as the source of heat in induction furnaces.

effective height—(1) The true electrical height of an antenna corresponding to a "perfect" antenna that will produce the same field strength. (2) The virtual height of an ionized layer of the ionosphere.

efficiency—The ratio of energy output to energy input, usually expressed as a percentage. A perfect electrical device would have an efficiency of 100%.

electrical bandspread—The use of a small variable capacitor in parallel or series with the tuning capacitor in a receiver. Used to spread the normally crowded stations over a greater linear range of a dial, and thereby obtain more accurate and easier tuning.

electric eye—A photoelectric circuit. A cell or vacuum tube having electrical properties which are modified by the action of light, e.g., one that uses photoelectric effect to produce an electrical current.

electrolytic capacitor—A fixed capacitor in which the dielectric is a thin film of gas formed on the surface of an aluminum electrode by a liquid or paste electrolyte.

electrolytic rectifier—A rectifier consisting of metal electrodes immersed in a suitable solution permitting the passage of current in one direction more readily than the other.

electromagnetic spectrum—Total range of frequencies of electromagnetic waves.

Type of Wave	Wavelength
Radio	Above 1000 km. to below .1 cm.
Infrared (heat rays)	.03 cm. to .000076 cm.
Visible light	.000076 cm. to .000040 cm.
Ultraviolet	.000040 cm. to .0000013 cm.
X-rays	10^{-6} cm. to 10^{-9} cm.
Gamma rays	10^{-8} cm. to 5×10^{-11} cm.
Cosmic rays	10^{-11} cm. to 10^{-12} cm.

electron-coupled oscillator—An oscillator circuit employing a screen-grid tube so connected that its input and output are internally connected by the stream of electrons from the cathode.

electron emission—The ejection of electrons from the surface of a material into surrounding space under the influence of heat, light, high voltage, or any other cause.

electron gun—Tube electrodes designed for the production of a narrow beam of electrons intended for use in fluorescent screen or microwave tubes. A common type of gun used in cathode-ray tubes consists of a cathode and three concentric end-to-end cylinders called the grid and first and second anodes. Grid and first anode contain washerlike discs which restrict the beam. Potentials are adjusted to focus the electron stream.

electronic bug—A code transmitting key employing electronic circuits for automatically producing both dots and dashes. Movement of its operating lever to the left produces any required number of dashes; movement of the lever to the right produces any required number of dots.

electronics—A broad term used to cover a field which deals with the use, characteristics, and properties of electrons, especially in vacuum or gas-filled tubes. For example, radio, TV, radar, control circuits, etc.

electrostatic—Pertaining to electricity at rest.

electrostatic focusing—Use of an electric field to focus an electron beam in a cathode-ray tube.

electrostatic shield—A grounded metal screen, sheet, or object placed around or near a radio device to prevent the action of any electric field through the shield.

emission types—The classification of modes of radio transmission, as adopted by international agreement. Type A 0—unmodulated, unkeyed, continuous wave transmission. Type A 1—telegraphy on pure continuous waves. Type A 2—modulated telegraphy. Type A 3—telephony. Type A 4—facsimile. Type A 5—television.

equivalent circuit—An electrical circuit used in analyzing the function of electronic devices such as vacuum tubes, crystal cartridges, etc. The circuit is made up of series and parallel capacitors, inductors and resistors that are equivalent to the internal capacitance, inductance and resistance of the device under study.

exponential horn—A horn whose cross-sectional area varies exponentially with its length. It is an impedance-matching device between the diaphragm and free space. Has a low-frequency cutoff value dependent on the taper.

extended play record—A 7-inch, 45-rpm record, with microgrooves spaced closer together, to provide up to 8 minutes of playing time per side, compared to 3 minutes per side with conventional 45-rpm microgroove records. Abbreviated **EP.**

facsimile—A system of communication in which previously reproduced images such as photographs, drawings, handwriting or printed matter are transmitted for graphically recorded reception.

farad—Unit of capacitance. In the practical system of units, the farad is too large for ordinary use, and capacity measurements are made in terms of microfarads and micromicrofarads. The microfarad is one-millionth of a farad, the micromicrofarad is one-millionth of a microfarad. Both are commonly used in radio.

ferrite—An iron compound in which the iron is bivalent, and which contains a small percentage of carbon. An excellent conductor of electricity. Used in transformers.

fidelity—The degree of exactness with which a system or portion of a system reproduces an input signal.

field intensity—In radio, it is the effective value in microvolts or millivolts per meter, produced by radio waves from a particular station. Syn.: **field strength.**

field strength meter—A measuring instrument used to determine the strength of radiated energy (field strength) from a radio transmitter. Field strength meters are usually portable to permit making measurements at any desired location. Widely used to determine the directional characteristics of broadcast transmitting antennas and to determine the possibility of television reception at various distances from the transmitter.

filament—The wire through which current is sent in a vacuum tube to produce the heat required for electron emission.

filter capacitor—A capacitor used in a power-pack filter system to provide a low-reactance path for alternating currents.

filter choke—An iron-core coil used in a power-pack filter system to pass direct current while offering high impedance to pulsating or alternating currents.

flock—Finely divided felt used on phonograph turntable surfaces, underneath microphone stands, and in similar locations where a nonscratching surface is desired.

fluorescent screen—A sheet of suitable material coated with a phosphor that fluoresces visibly when hit by an electron beam, x-rays, or radium rays. Used in electron beam tubes.

flywheel effect—The effect of the resonant circuit in a class C oscillator or feedback amplifier. Although the grid controls the input energy in pulses as in the cylinder explosions of a gasoline engine or the escapement mechanism of a clock, the resonant circuit maintains continuous operation as does the flywheel of the engine or the pendulum of the clock.

folded dipole—A receiving or transmitting antenna composed of two parallel dipoles, connected together at the ends and with connections to the receiver or transmitter made at the center of one of the dipoles.

frequency—The number of complete cycles or vibrations per unit of time, usually per second. Frequency of a wave is equal to the velocity divided by the wavelength.

frequency deviation—In frequency modulation, the number of cycles by which the modulated carrier frequency differs from the resting frequency.

frequency modulation—A method of modulating a carrier frequency by causing the frequency to vary above and below the monomodulation value in accordance with the sound to be transmitted. The amount of deviation in frequency above and below the resting frequency is at each instant proportional to the amplitude of the sound being transmitted. The number of complete deviations per second above and below the resting frequency corresponds at each instant to the frequency of the sound being transmitted. Advantages of this system include almost complete freedom from atmospheric and man-made interference, as well as little or no interference between stations, thereby permitting the transmission of a much greater volume range and a wider audio-frequency range than is possible with amplitude modulation. One disadvantage is the necessity of employing ultra-high carrier frequencies, at which the range of a station is limited to approximately 100 miles.

frequency response—A rating or graph which expresses the manner in which a circuit or device handles the different frequencies falling within its operating range. Thus, the frequency response of the Knight high-fidelity amplifier may be specified as being essentially flat or uniform between 20 and 20,000 cycles per second.

fringe area—An area or locality at such a distance from the transmitting station that the signals received are weak.

front-to-back ratio—The ratio of the effectiveness of a directional antenna, microphone or loudspeaker toward the front and toward the rear.

fundamental—The lowest frequency component of a complex vibration, sound, tone, or electrical signal.

gang capacitor—Two or more variable capacitors mounted mechanically so they can be simultaneously turned by a single shaft.

gaseous rectifier—A gas-filled rectifier which may have a hot cathode, a mercury pool or a cold cathode.

gassy tube—High-vacuum or other tube in which a leak has developed, admitting air. A "soft" tube.

(To be continued next month)

Field Strength Meter for R/C

(*Continued from page* 50)

drilled will fit the components to be used, since some of these vary in size. The meter hole may be sawed out with a coping or jig saw and should provide a snug fit.

Mount the switch, potentiometer, air trimmer, and meter on the panel. All other components are mounted on their own leads by soldering to the nearest mounted component. Wiring in this manner is rapid, and since the parts are light and the finished unit will not be subject to vibration, more than adequate.

The battery holder is made from 1/16" aluminum or other metal. Batteries of pen cell size are soldered right into the circuit. Because of the low drain of this unit, infrequent replacement is necessary.

Adjustments

After double-checking the schematic diagram to ascertain that all connections have been made correctly, make sure the potentiometer is in the maximum resistance position and turn on the switch. The meter needle should swing over just a fraction of a milliampere. This indicates that the transistor is working. The meter may be readjusted to zero if desired by means of the zeroing adjustment, although the slight drain will not be found to be objectionable in most instances.

Next, connect the antenna to the instrument and set the meter ten feet or so away from the transmitter. While someone else keys the transmitter, tune the air trimmer *C1* to obtain the greatest needle swing. With the potentiometer in full resistance position, this will be quite small. Advance the potentiometer to obtain the deflection desired.

In practice, the field strength meter should be set the same distance away and in the same position for subsequent checks. If initial readings are taken with the instrument on a car hood, for example, future readings should also be taken in the same position at the same distance. The field strength meter will give a higher reading when placed on a metal surface than when hand-held.

Having this sensitive instrument at the test spot allows the R/C fan to make the fine transmitter touch-ups necessary for top control. He can try different crystals and tubes, changing antenna-coil coupling, antenna length, and tuning, and so on. When the meter's needle swings over the greatest distance consistently, the transmitter is putting its r.f. into the air, and there should be no flyaways due to an improperly tuned transmitter. —30—

ADVERTISERS' INDEX

OCTOBER 1955

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Classified

RATE: 50c per word—minimum 10 words

FOR SALE

DIAGRAMS for repairing radios $1.00. Television $2.00. Give: make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

DIAGRAMS: Counters, Timers, Organs, Intercoms, etc., $1.00 each. List Free. Parks, 104-A S. E. 57th, Portland 15, Oregon.

DECADE Capacitor, 0-10 M.F.D., in 1 M.F.D. steps. High quality 400 V.D.C. working voltage paper capacitors; Tol. 10%, in gray Hammertone aluminum case. Use to extend range of present capacitor decades to 10 M.F.D., in Loudspeaker dividing networks, in Labs., by experimenters, hams and servicemen. $9.95 postpaid. High Fidelity Products, Box 131, Owensboro, Kentucky.

BUILD Pocket Radios, 5 selected plans 50c. Cook, 422 Shandon, Midland, Texas.

HAVE Fun experimenting with transistor receivers, amplifiers, and oscillators. All operate off flashlight batteries. Guaranteed CK722 transistor and circuit diagrams, $3.20 postpaid. J. P. Elliott, 401 Roosevelt Ave., Montebello, Calif.

GOLD plated microphone buttons, four for $1.00. Hundred insulated carbon resistors $1.00. Earphone $1.00. All Postpaid. Electronic Outlet. Box 72, Lawrence, Mass.

SCHEMATICS, Simple Instructions, Capacitor, Tube, Signal Checkers, Amplifiers, Transistor Receivers, Others. $1.00 Complete Booklet. Surge Designs, Syosset, L. I.

COLOR TV—Simple new Colordaptor circuit converts any BW TV to receive compatible color using color wheel. Complete construction information $2.50. Colordaptor, 3471 Ramona, Palo Alto, California.

SUPERSENSITIVE VHF radio receives television, FM broadcast, special services and amateurs without antenna or ground. Factory wired and tested chassis including special tube $5.98. In kit form $3.98. Thousands in use by experimenters, amateurs, civil defense. Transistor audio stage complete with transistor for extra loud reception only $2.00 extra. Springfield Enterprises, Box 54-E10, Springfield Gardens 13, New York.

WALKIE-Talkie. Build wireless portable radiophone for less than $10.00. Plans for variable frequency and crystal control types, only 50c for both. Springfield Enterprises, Box 54E10, Springfield Gardens 13, New York.

ELECTRIC Pencil: Engraves all Metals, $1.50. Beyer Mfg., 10511-P Springfield, Chicago 43.

FIDELITY Unlimited: Authorized Distributors of High Fidelity Components. Shipments Prepaid and insured. Specials: New Collaro RC-54 with Mounting Board, 45 spindle, dual Blank Heads, $38.75. Accessories: RPX-050, dual sapphires, $6.50. Diamond and sapphire Stylus, $10.75. Write Us Your Hi-Fi Requirements. Free Audio Guide. Complete Stock Fidelity Unlimited. 63-03—39th Ave., Woodside 77, New York. Dept. PE.

BUILD crystal, match box, and one tube radios. Plans 50c. Radio kit $1.99. Don Smith, Fruitland Park, Florida.

BEGINNERS' "Radiobuilder" 25c; 12 $2.50. Laboratories, 328-L Fuller, Redwood City, Calif.

WANTED

CYLINDER and old disc phonographs. Edison Concert, Balmoral, Conqueror, Opera, and Oratorio models. Berliner Gramophones and Zono-o-phones. Columbia disc and cylinder Graphophones. Bettini micro-reproducer. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Popular Electronics Box 50.

HELP WANTED

EARN to $1500 Monthly. Jobs, South America, The Islands, USA, etc. All Trades. Labor. Drivers, Clerical, etc. Fare Paid. Application Forms. Free Information. Write Dept. 72E, National Employment Information, 1020 Broad, Newark, N. J.

RUN spare-time Greeting Card and Gift Shop at home. Show friends samples of our new 1955 Christmas and All-Occasion Greeting Cards and Gifts. Take their orders and earn to 100% profit. No experience necessary. Costs nothing to try. Write today for samples on approval. Regal Greetings, Dept. 77, Ferndale, Michigan.

EARN Extra Money Selling Advertising Book Matches. Free Sample Kit furnished. Matchcorp, Dept. EZ-2, Chicago 32, Illinois.

EXTRA Cash Spare Time! Sell exclusive magic cushion shoes. 133 styles. No investment. No experience. Steady repeats. Commissions to $4.00 pair, plus bonus, paid vacations. Free outfit. Paragon Shoes, 79-E Sudbury, Boston.

INVENTIONS WANTED

INVENTIONS wanted. Patented; unpatented. Global Marketing Service, 1404 Mitchell, Oakland 1, Calif.

BUSINESS OPPORTUNITIES

BECOME Tax Consultant. Our students earn to $3,000 in 3-month season, part-time. We train you—help you start. State approved. Union Institute, 68 Hudson, Hoboken 3C, New Jersey.

TO $50.00 Weekly. Sparetime, Home Operated Mail-order Business. Successful "Beginner's" Plan. Everything Supplied. Lynn, 10420-E National, Los Angeles 34.

FREE Booklet "Money-Making Facts" tells mechanically-inclined men how to start sparetime business at home. Lee Foley Company, Columbia Heights, Minnesota.

WANT To Make Big Money At Home? $5 profit in an hour possible with Invisible Reweaving. Make tears, holes disappear from clothing, fabrics. Steady year-round demand from cleaners, laundries, homes. Details Free. Fabricon, 8341-S Prairie, Chicago 19, Ill.

$200 weekly cleaning Venetian Blinds. Free-revealing book. Burtt, 2434 BU, Wichita 13, Kansas.

TAPE RECORDERS

TAPE Recorders, accessories. Best buys. Boynton Studio, 10 PE Pennsylvania, Yonkers, New York.

RECORDERS and tapes at lowest prices. Kerstin, 215 E. 88, N. Y. C. 28.

TAPE Recorders, Tapes, Accessories. Unusual values. Dressner, Box 66E, Peter Stuyvesant Station, N. Y. 9.

INSTRUCTION

PHYSICAL Therapy and Massage Pays Big Profits. Learn at Home. Free Catalog. National Institute, Desk 36, 159 East Ontario, Chicago 11.

SLIDE Rule easy to learn methods. Write for Particulars, L. J. Klersey, 1510 C. Street SW, Cedar Rapids, Iowa.

BOOKS

NATIONAL Geographic Magazines 1888-1955. Periodical Service. Box 465-PE, Wilmington, Delaware.

CRYSTAL Set Book. 132 Illustrations, Charts, Circuits. Over 18,000 Words. Refund Guarantee. $1.00. Kott, 5024 St. Clair, Detroit 13, Michigan.

FREE Booklet "Forming Sheet Metal." Also catalog unusual bench tools. Telvac, 1412-C Great Northern Bldg., Chicago 4, Ill.

MINERALS & PROSPECTING

24x36 MAP Uranium And Oil Areas Canada. $2. Mineral Surveys, 3 Trading Co. Building, Regina, Saskatchewan, Canada.

GEIGER Counter an Mineral Locators, Assembled and Kits. Free Geological Advice: Write for Details. Frontier Instruments, Box 276, Annandale 1, Virginia.

GEIGER Counter and Metal Detector Kits. Inexpensive. Educational. Free Literature. Electronic Applications, Dept. B, 5024 Lee Highway, Arlington 7, Va.

GEIGER Counters—Metal Detectors, The World's Most Complete Line. $37.50 up. Detectron Corp., 5530 Vineland, North Hollywood, California.

STAMPS AND COINS

FREE! Catalog! About stamps. Illustrated. Free! The Stampmart, Hartford 1, Conn.

ARTS AND CRAFTS

FREE! Leathercraft Catalog. Do-It-Yourself! Tandy Leather, Box 397 C-4, Tulsa, Okla.

OF INTEREST TO WOMEN

WANT To Make Big Money At Home? $5 profit in an hour possible with Invisible Reweaving. Make tears, holes disappear from clothing, fabrics. Steady year-round demand from cleaners, laundries, homes. Details Free. Fabricon, 8343-S Prairie, Chicago 19, Ill.

MISCELLANEOUS

500 Name address gummed labels $1.00, 350 Stationery and envelopes beautifully imprinted $2.98 Postpaid. Vazcar Specialties, 381 Bartolome Las Casas, Santurce, P. R.

BECOME a Radio Amateur. Free Information on how to pass Code and Theory FCC examinations. American Electronics, 1203 E. Bryant Ave., New York 59, N. Y.

HOW To live without money. Write—Cosmic, Clayton 2B, Ga.

POWER. "Like Yoga-hypnotism-telepathy-psychology-combined." (Details—10c.) Delmar Wisdom, 833-S8 Sunnyside, Chicago 40.

FREE Condenser & Resistor Code Chart! Get yours now Plus new value-packed catalogue! K. & L. Radio Parts Co., 1406 Venice Blvd., Los Angeles 6, California.

TUBES—TV, Radio, Transmitting, special purpose types—Bought, Sold, Exchanged. Send details to B. N. Gensler W2LNI, 512 Broadway, New York 12, N. Y.

IMPORTERS' amazing prices binoculars, 22 models. Free trial. Folder, "Selecting Binoculars", catalog free. Prentiss Importers, 212 Mercury Bldg., West Los Angeles 25, Calif.

ADULTS—What is your "I.Q."? Reliable intelligence test, confidential report. Only $2.00. Recognized. University Test Bureau, Desk P2, Box 401, Palo Alto, California.

CRYSTAL Photocells, extremely sensitive type CL-1. $2.50 Postpaid. Horton, 267 W. Eleventh Street, New York City 14.

NO luck finding a book publisher? Write for free booklet—EL. Vantage, 120 W. 31, New York.

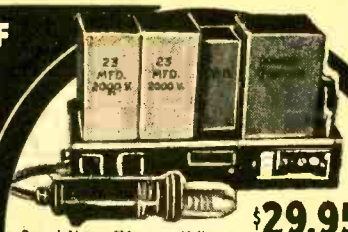
PSORIASIS Victims—Hopeless? New Discovery! Free Trial Offer. Write Pixacol, Box 3583-PE, Cleveland 18, Ohio.

FREE! YOUR CHOICE OF ANY KIT LISTED IN THIS AD

WITH EVERY $10.00 PURCHASE

$10.00 — 1 KIT $20.00 — 2 KITS $30.00 — 3 KITS

Please Specify the Kits You Want



Brand New Ship. Wt. 60-lbs. **$29.95**

ELECTRONIC PHOTO FLASH 100 watt SEC.

Operates on auto battery or any 6/12 or 12/24 VDC source. Complete with ignition coil, trigger, housing and strobe light. Assembly includes 20 ft. cord, SYLVANIA A-1073 200 watts bulb. (Similar to Sylv. 4330). Extra Parts Kit, Spare 1073. FUSES, VIBRATOR Instruction Manual

TUNING UNITS

$50.00 Value! **$2.75** Less Case

From BC 375 TRANS. YOUR CHOICE of TU 26B, TU 88, or TU 10B. Wt. 12 lbs.

BUTTERFLY CONDENSERS

YOUR CHOICE **$4.95**

TYPE A 4¼" Dia.

TYPE B 4⅜" Dia.

TYPE A—106-330 MC—Antenna Type
TYPE B—300-1000 MC Uses 368AS tube
TYPE C—300-1000 MC Clip for Xtal Det
TYPE D—135-485 MC

These units make the finest tuners for Ultra-high frequency transmitters, receivers, frequency meters, and oscillators.

TYPE C 2½" Dia.

TYPE D 2½" Dia.

IGNITION COILS

PRI. 3VDC. Ideal for Photo flash, Model planes, SEC. 15,000 Volt. **$1.29**

MODULATION and DRIVER TRANSFORMERS

Both Units Only

Modulation trans. 815 class AB2-55 Watt Driver, 6SN7 to Modulator. **$4.95** Brand New

HI GAIN DYNAMIC MIKE KIT

Uses UTC. Transformer and Western Electric Mike. Ideal for Hams, PA, CAP, Recording, Mobile Equip. —50 DB 80-7500 CPS. Diagram Furnished **$1.95**

PHOTO ELECTRIC CELL

95¢ CE Vacuum Cell used in AMPRO Sound Projector. Also useful for opening garage doors and Alarm Systems.

KIT 1. HARDWARE

Over 1,000 pieces, 2½ lbs. of assorted RADIO & TV HARDWARE. **99¢** was $1.49

KIT 2. CERAMICONS

100 ASSORTED. Range from .75 mmfd. to 6,000 mmfd **$2.50** was $3.50

Kit 3. Volume Controls

25 ASSORTED. Range from 2 ohm to 3 meg. Some with switch. **$2.75** was $4.75

Kit 4. Rotary Switches

25 ASSORTED TYPES. A Real Buy at only. **$2.50** was $4.75

KIT 5. RESISTORS

100 ASSORTED TYPES. Range from 1 ohm to 15 meg. ½ to 5 watt. **$1.75** was $1.98

KIT 6. R.F. CHOKES

28 ASSORTED. Range from .5 mh. to 25 mh. **95¢** was $1.98

KIT 7. TOGGLE & SLIDE SWITCHES

25 ASSORTED. DPST, DPDT, SPST, etc. **$3.25** was $4.95

KIT 8. PAPER & CAN CONDENSERS

25 ASSORTED. Range from 4 mfd. 150 v. to 80 mfd. 450 v. **$2.75** was $3.50

All New MYSTERY PACKAGE of ELECTRONIC PARTS

Worth $40.00 Our Price **$3.95** Ship. Wt. 20-lbs.

It's the surprise of your life! 20 pounds of brand new usable Govt. surplus The ideal gift for hams, etc.

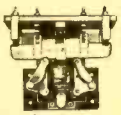
We now ship parcel post to save you more money!

SOUND POWERED HEAD & CHEST SETS

Excellent, Used, only **$4.95** per set

2 SETS for $8.50 Ideal for TV Installation. Field Telephones, Home Installations. Attn Boy Scouts & Civil Patrol Works up to 10-mi with Aux. Battery.

1 KW ANT. CHANGE-OVER 110 VAC RELAY

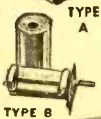


60 Cycle 15 Amp 2500 Volt D.P.D.T. **$9.95**

VARIABLE CONDENSERS

YOUR CHOICE **95c**

TYPE A 100 MMFD—Double Spaced size: 2¾" x 3¼" W x 1½" H. Hammorlund Mfg.



TYPE B 200 MMFD—Shielded Can ¼" Shaft

VARIABLE TRANSFORMER

$4.95

Pri. 115 VAC. 4 Amp 50-60 cy. Sec. 30 to 135 V. .25 Amp. Used with Dictaphone Reproducer MFD. U.T.C.

ARC-5 COMMAND TRANSMITTER

YOUR CHOICE **$6.95**

2.1 to 3 MC. 7 to 9.1 MC. Brand New in Cartons. with tubes.

HOTTEST BUY IN THE COUNTRY

RCA OUTPUT TRANSFORMER

P.P.616'S 25 watt

PRI 5000 Ohms output. Sec. #1 500 Ohms. Sec. #2 600 Ohms. Sidetone 15 to 15,000 cy. flat. **$1.95**

GUN CAMERA MOTOR

95¢ Brand New

Used in Gun Camera 24 VDC. Will run on 110 VAC.

TUBE SPECIALS

	PRICE
955, 957, 9004, 9006	.35
9001	.59
9002	.69
807	1.00
2051	.50
1625	.25

FULL WAVE METER RECTIFIER

For use with 0-1 MA Meter **95¢**

R.F. CHOKE

2.5 M.H. 125 MA. **29¢**

PHONOGRAPH CRYSTAL

Ceramic Type

Made by Sonotone Mtg. 1.4 Volt output. Sapphire Needle. 50 to 14,000 cycle Freq. Response Hi Fi. Special ..... Ceramic Type Only **$2.25**

HERSHEL RADIO CO.

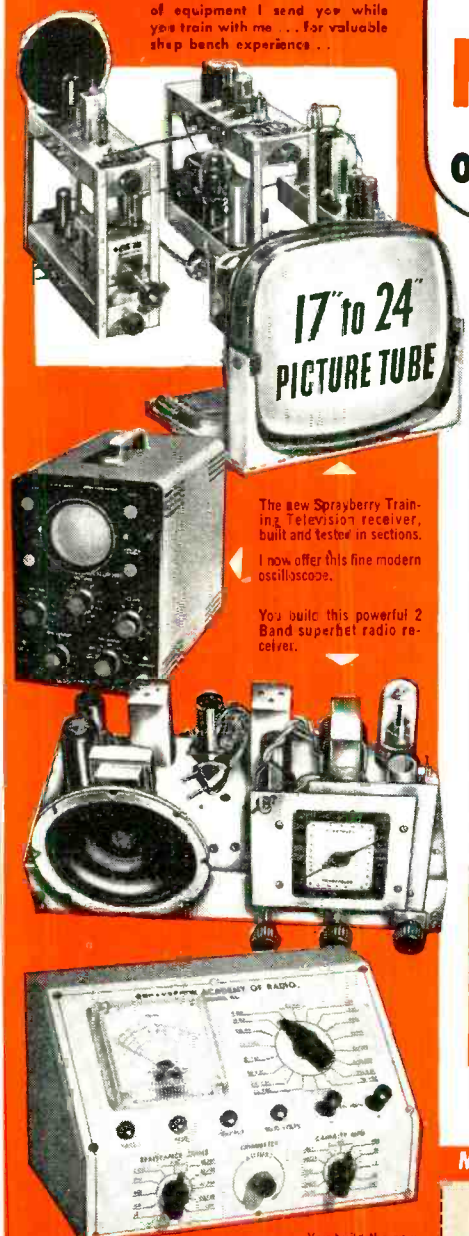
5249 GRAND RIVER
Detroit 8, Michigan
Phone TYler 8-9400

TERMS: Cash with order or 25% DOWN—BALANCE C.O.D
ALL PRICES NET F.O.B. DETROIT
MINIMUM ORDER $2.00

Printed in U.S.A.

Learn PRACTICAL RADIO-TV with **25 BIG KITS**

of equipment I send you while you train with me . . . for valuable shop bench experience . .



The new Sprayberry Training Television receiver, built and tested in sections.

I now offer this fine modern oscilloscope.

You build this powerful 2 Band superhet radio receiver.

You build the new Sprayberry Tester . . . 18-range Volt-Ohm-Milliammeter readings.

In addition to modern lesson training, I also give you plenty of home practice on actual Radio-Television equipment . . . you will build and use the units shown here plus many more. All this equipment is yours to keep . . . keep everything you need to set up your own shop.

Prepare for a Good Paying Job—Or Your Own Business

"I Will Train You at Home in RADIO-TELEVISION on Liberal No Obligation Plan!"

New Equipment! New Lessons! Enlarged Course! The true facts are yours in my big new catalog . . . YOURS FREE . . . JUST MAIL COUPON!

Frank L. Sprayberry
President, Sprayberry
Academy of Radio

I can train and prepare you in as little as 10 months to step into the big opportunity Radio-Television service field. Train *without* signing a binding contract . . . without obligating yourself to pay any regular monthly amounts. You train entirely at home in spare hours . . . you train as fast or as slowly as you wish. You'll have your choice of THREE SPRAYBERRY TRAINING PLANS . . . planned for both beginners as well as the more experienced man. Get the true facts about the finest most modern Radio-Training available today . . . just mail the coupon for my big new 56 page fact-filled catalog plus sample lesson—both FREE.

Train the Practical Way—with Actual Radio-Television Equipment

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My students are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

See for Yourself . . . Make Your Own Decision . . . Mail Coupon Today!

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item I include in my training. With the facts in your hands, you will be able to decide. *No salesman will call on you.* The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO

111 North Canal Street, Dept. 105-D, Chicago 6, Illinois

Mail This Coupon For Free Facts and Sample Lesson

SPRAYBERRY ACADEMY OF RADIO
Dept. 105-D, 111 N. Canal St., Chicago 6, Ill.

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

Name_____ Age____

Address_____

City_____ Zone____ State____

MODEL S-38D
$49.95

COVERAGE: Standard Broadcast from 540-1650 kc plus international reception on 3 Short-Wave Bands covering 1650 kc—32 Mc.

The radioman's idea of radio . . . This famous Hallicrafters' radio, now with smart new styling, amazes even the experts with its superior performance. Featuring the same skillful engineering found in much higher priced communications sets make the S-38D ideal for the Short-Wave listener or new radio amateur.

MODEL S-94 or S-95
$59.95

COVERAGE: S-94: 30-50 Mc—S-95: 152-173 Mc

For the thrill of emergency radio—Police, Fire . . . Two new high performance receivers replacing the popular Hallicrafters S-81 and S-82. Compact, easy-to-operate and covers police, fire, taxicab, bus, railroad, private telephone mobile, forestry and other industrial and emergency-service communications operating within models' frequencies. Newly engineered FM chassis provides low frequency drift and high signal-to-noise ratio.

for hams • novices • short wave listeners...

MODEL S-53A
$89.95

COVERAGE: Standard Broadcast from 540-1630 kc plus four Short-Wave bands over 2.5—31 and 48—54.5 Mc.

FEATURES: Large easy-to-read overseas dial with international stations clearly marked. Electrical bandspread and logging scale. Five inch built-in PM speaker, jacks for headphones plus phonograph jack. Temperature compensated to reduce fading due to frequency shift. Two stages of i.f.

MODEL S-85 or S-86
$119.95

COVERAGE: Broadcast band 540-1680 kc plus three S/W bands 1680 kc—34 Mc.

This newly engineered Hallicrafters receiver has the 10, 11, 15, 20, 40 and 80 meter amateur bands calibrated on large easy-to-read dial. Over 1000° of calibrated bandspread for better selectivity on ham bands. Husky, full sized unit features separate bandspread tuning condenser and built-in PM 5" speaker.

world wide enjoyment is yours with hallicrafters

...at everybody's price!

MODEL SX-96
$249.95
Matching R-46B Speaker $17.95

COVERAGE: Standard Broadcast; 538-1580 kc; Three S/W Bands, 1720 kc-34 Mc. Band 1: 538 kc-1580 kc—Band 2: 1720 kc-4.9 Mc—Band 3: 4.6 Mc-13 Mc—Band 4: 12 Mc-34 Mc.

TYPE OF SIGNALS: AM-CW-SSB

FEATURES: Precision gear drives are used on both main tuning and band spread dials.

Most talked about receiver on the air . . . This Hallicrafters double conversion selectable side band receiver offers major improvements in stability by the addition of temperature compensation in the high frequency oscillator circuits and the use of crystal controlled second conversion oscillators. Hallicrafters highly selectable 50 kc i-f system is used in this new precision-built receiver.

MODEL SX-99
$149.95
Matching R-46B Speaker $17.95

COVERAGE: Broadcast Band 540-1680 kc plus three Short-Wave Bands covers 1680 kc-34 Mc. Packed with all the features most in demand by the DX enthusiast, this model is a real stand-out in its price range. The large, very easy to read dial features over 1000 degrees of calibrated bandspread through the 10, 11, 15, 20, 40 and 80 meter amateur bands. Incorporated in the advanced design are such much-wanted components as an "S" meter, a separate bandspread tuning condenser, a crystal filter and an antenna trimmer. Grey-black steel and brushed chrome cabinet is perfectly styled for appearance and function.