POPULAR ELECTRONICS

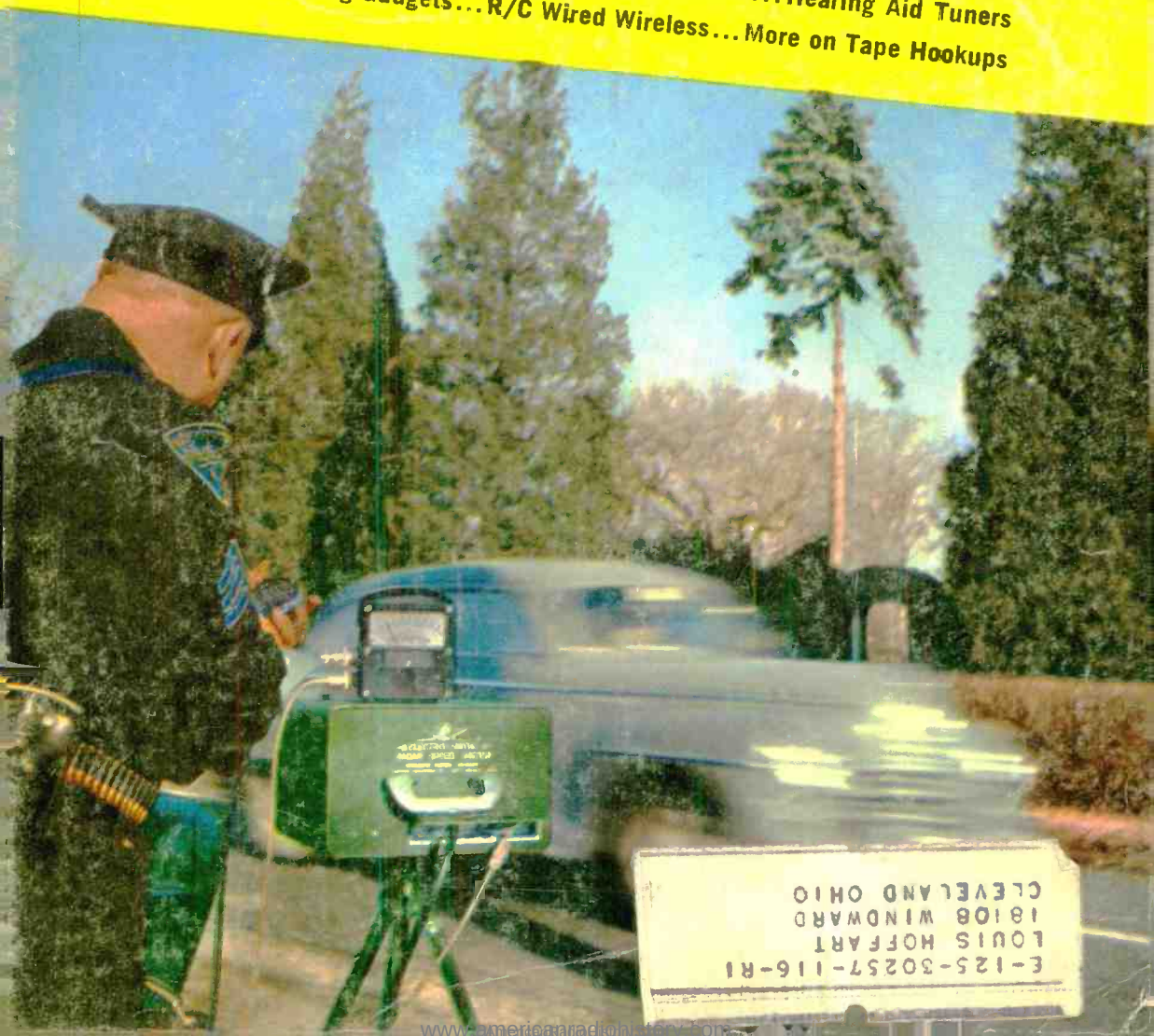
MAY 1956

25 CENTS in U. S. and Canada

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

The Truth About RADAR Speed Traps

IN THIS ISSUE: Transistor Portable... $3 Hi-Fi Baffle... Hearing Aid Tuners
Electronic Gardening Gadgets... R/C Wired Wireless... More on Tape Hookups

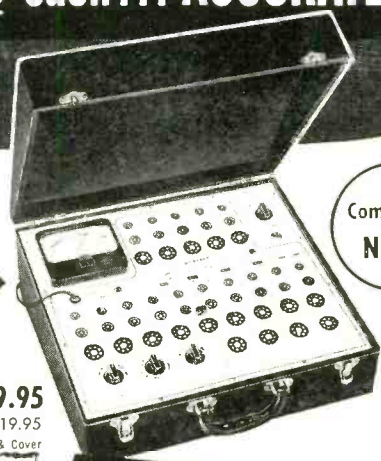


TEST 5 TUBES in 4 SECONDS each... ACCURATELY!

WITH THE NEW ADVANCED ENGINEERED

precise MODEL 116

Gm. & Em. ULTRAFAST TUBE & TRANSISTOR TESTER



Completely NEW!

PRECISE MODEL 116K in kit form **$69.95**
PRECISE MODEL 116W factory wired $119.95
Incl. Carrying Case & Cover

Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST . . . the fastest, most accurate is the PRECISE Model 116. What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 IF tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

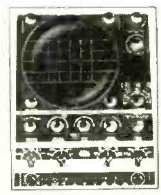
The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube seperately . . . by rotating the FUNCTION SWITCH . . . each triode of a duol triode is checked individuallly . . . each diode and the triode of a duo-diode-triode is seporately tested and not lumped as in other testers . . . and a pentode is tested as a pentode—not a diode. TRANSISTORS, SHORTS, GAS, LIFE, Em,. Gm etcetera can be tested with the PRECISE Model 116.

You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

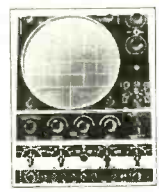
Not yet at your distributor. Order NOW to insure early delivery.
SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER — OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.

THE FAMOUS MODEL 111
111K $79.95
111W $139.95
Incl. Carrying Case & Cover



THE FIRST LOW PRICED 7" COLOR SCOPE
300K $99.95
300W $199.50

LOW PRICED 5" SCOPE
315K $49.95
315W $84.95



THE FIRST AND ONLY 8½" COLOR SCOPE
308K $129.50
308W $229.50

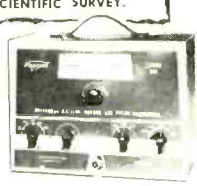
LOWEST PRICED WIRED 4½" VTVM
909K $25.98
909W $37.50

RF—AF—BAR GENERATOR with pre-assembled* head
630K $39.95
630KA* $38.95
630W $53.95

THE FINEST VOLT, REG. 7" VTVM KIT
9071K $35.95
9071W $49.95

K = KIT
W = WIRED

LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD
610K $23.95
610KA pre-assembled head $28.95
610W $39.95



UNIV. AF, SINE, SQ, & PULSE GEN
635K $33.50
635W $52.50

Prices slightly higher in the West. Prices and specifications subject to change without notice.

PTAK $2.95
PTAW $4.25

SEE THE MANY MORE PRECISE INSTRUMENTS AND PROBES AT YOUR DISTRIBUTOR TODAY!

WRITE FOR CATALOG PE 5-6

precise DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

J. E. SMITH
President, National Radio Institute. 40 years' experience training men at home for Radio-TV.

I Will Send You A

SAMPLE LESSON FREE

to show you how easy, practical it is to

Train at Home for Good Radio-Television Jobs

America's Fast Growing Industry Offers You Good Pay Plus a Bright Future

TRAINING plus OPPORTUNITY is the PERFECT combination for ambitious men. Let me send you a sample lesson from my course to prove you can keep your job while TRAINING at home in your spare time for better pay and a brighter future. I will also send my 64-page book to show you that Radio-Television is today's field of OPPORTUNITY for properly trained men.

Make $10, $15 a Week Extra

Many men I train fix neighbors' Radios, make extra money, soon after they enroll. Actual equipment you build gives you practical experience.

Television's Growth is Making More Jobs, Prosperity

Radio is bigger than ever and television is growing fast. Government, Aviation, Police, Ship, Microwave Relay, Two Way Communications for buses, taxis, railroads are other growing fields for Radio-Television trained men.

Mail Coupon—Find Out About This Tested Way to Better Pay

Take NRI training for as little as $5 a month. Many NRI graduates make more in two weeks than the total cost of my training. Mail coupon today for Actual Lesson and 64-page Book—Both FREE. J. E. SMITH, National Radio Institute, Dept. 6AD4, Washington 9, D. C. Our 40th Year.

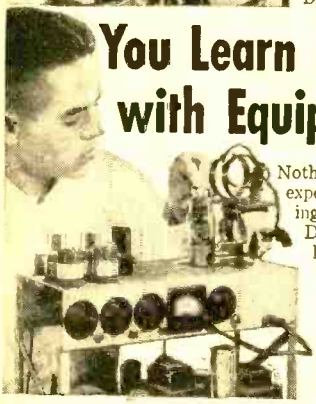
I Trained These Men

"I have a regular job as a police captain and also have a good spare time Radio and Television service business. Just opened my new showrooms and shop."—C. W. LEWIS, Pensacola, Florida.

"I decided to quit my job and do TV work full time. I love my work and am doing all right. If fellows knew what a wonderful investment NRI is, they would not hesitate."—W. F. KLINE, Cincinnati, Ohio.

"Thanks to NRI, I operated a successful Radio repair shop. Then I got a job with WPAQ, later WBOB and now am an engineer for WHPE."—VAN W. WORKMAN, High Point, N. Carolina.

You Learn by Practicing with Equipment I Send



Nothing takes the place of practical experience. That's why NRI training is based on LEARNING BY DOING. My training includes kits of parts which you use to build equipment and get practical experience on circuits common to both Radio and Television. Shown at left is the low-power Broadcasting Transmitter you build as part of my Communications Course.

AVAILABLE TO **VETERANS** UNDER G.I. BILLS

Good for Both—FREE

Mr. J. E. Smith, President, Dept. 6E04
National Radio Institute, Washington 9, D.C.

Mail me Sample Lesson and 64-page Book, FREE. (No salesman will call. Please write plainly.)

Name_____ Age_____

Address_____

City_____ Zone____ State_____

VETS write in date of discharge_____

Approved Member, National Home Study Council

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 Features

DEPARTMENTS

(Also see page 6)

MAY 1956

VOL. 4—NUMBER 5

EDITOR
OLIVER READ, W1ETI

MANAGING EDITOR
O. P. Ferrell

TECHNICAL EDITOR
H. S. Renne

FEATURE EDITOR
Norman Eisenberg

ASSOCIATE EDITORS
H. H. Fantel
M. C. Magna

ART EDITOR
A. J. Reich

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

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

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

Member
Audit Bureau of
Circulations

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.

CONTRIBUTORS:

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.

ITEMS OF INTEREST

NEW PRODUCTS

(See also pages 64, 65 and 74)

COMING NEXT MONTH

POPULAR ELECTRONICS

New Life for Citizens Band

The citizens radio band for two-way communication is being revitalized. Read this account of new equipment and how you may own and use a transceiver.

Economy V.T.V.M.

Simplified circuit design for an efficient test instrument. Construct this unit in your spare time at half the cost of kits and ready-built equipment.

SWL's Friend—The Antenna Peaker

A gadget to tune the receiving antenna. It will add miles to your DX'ing and S-points to your receiver.

Two Are Better Than One

Hi-fi discussion of two-way speaker systems. Practical hints on setting up your own, recommendations for components.

TV DX

Here is proof positive of those reports on 2500-mile TV reception. How TV signals jump fantastic distances and what you have to do to see these programs.

IN THIS MONTH'S

RADIO & TELEVISION NEWS

(MAY)

The Transistor in Industry

Magic Earphones

Transistor Intercom Amplifier

Ceramic Cartridges and Equalization

Realistic High Fidelity—The Room in Which You Listen

By JOHN T. FRYE

Feedback

YOU MIGHT have thought—if you were a careless observer and didn't know the boys very well — that Carl and Jerry were doing nothing. It must be admitted that they looked idle as they sprawled on the turf of Jerry's back yard under the relaxing rays of the warm May sun. However, you had only to look a little closer to notice the slowly revolving reels on the tape recorder beside them and to see the cord leading from it to a slender microphone mounted in the center of a metal object shaped like a huge shallow dish some three feet in diameter. This was propped up on edge so that its concave side carrying the microphone faced away from the boys toward the hedge separating Jerry's yard from the one next door.

"I think that's a lot of stuff about that king-size popcorn bowl picking up sounds we can't hear," Carl muttered in low tones with a somewhat disparaging glance at it.

"Have it your way," Jerry answered, "but when we play back the tape, you'll hear those birds that are playing around in the hedge now cheeping and twittering as though they were right in front of the microphone. That parabolic reflector focuses the sound waves on the microphone the same way the concave mirrors we play around with in the physics lab at school focus light rays down to a single bright spot. People who collect bird calls and insect sounds use this technique all the time. Just keep your voice down so you don't scare the birds and so the microphone doesn't pick it up."

"Mrs. Selden is the one who ought to keep her voice down," Carl remarked, as the shrill complaining of the woman next door came through the hedge.

"They're taking out the storm sash and washing the windows," Jerry reported, after rising to his knees so that he could see over the hedge.

"How come she bends Mr. Selden's ear that way all the time?" Carl asked.

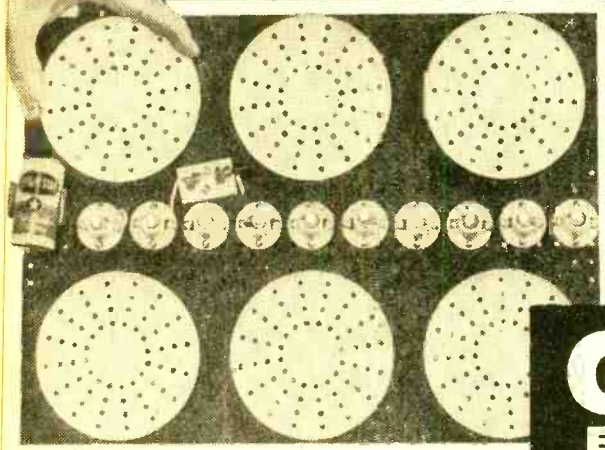
"Habit, I guess. Leastways, that's what Mom thinks. She says Mrs. Selden has been scolding so long she doesn't know she's doing it," Jerry explained with a yawn as he stretched out on the grass again.

"HEY, Jer," Carl said lazily, toying with the rubbery stem of a plucked dandelion, "how's about briefing me a little on negative feedback while we're eavesdropping on the birds? I'm cooking up a new speech amplifier for my ham rig, and I don't know whether to use feedback or not."

NOW—BUILD IT YOURSELF in a few hours!

Amazing *electric* Brain

COMPUTES, PLAYS GAMES, "REASONS"!



Here's a wonderful kit that *gives you a fascinating introduction to the logic machines of our modern age!* The devices you can build test intelligence, code and decode, count, play Tic-tac-toe, solve problems! Converts from binary to decimal — reasons in syllogisms — computes! Send for your kit today!

GENIAC ELECTRIC BRAIN

You can build 33 different machines, including

- Binary Adding Machine
- Secret Coder & Decoder
- Machine for Arithmetical Carrying
- Comparing Machine
- Reasoning Machine
- General Combination Locks
- Games Requiring Logic
- Automatic Oil Furnace Circuit
- Machine for a Space Ship's Airlock
- Intelligence Tester
- Burglar Alarm
- Puzzle Solvers
- Adder, Subtracter, Multiplier, Divider

● ● ●

Some Firms and Institutions that have ordered GENIAC:

Allis-Chalmers
Remington-Rand
International Business Machines
Wheeldex Mfg. Co.
Manuel Missionary College
Walter V. Clarke Associates
Barnard College
Westinghouse Electric
Phillips Laboratories
General Insurance Co. of America
Lafayette Radio
Rohr Aircraft Co.
Southwest Missouri State College
Albert Einstein Medical College
Naval Research Laboratories
Board of Education, Tecumsah, Nebraska
Marshfield Public Schools
Los Angeles Public Schools
Jefferson Union High School
Oklahoma A&M
Kansas State University
Duke University
Coral Gables Senior High School
Courtland Jr. High School
Bell Telephone Laboratories

YES, you build any one of 33 exciting electric brain machines in just a few hours by following the clear-cut, step-by-step directions given in a thrilling booklet! No soldering required . . . no wiring beyond your skill! GENIAC is a genuine brain machine—not a toy. The *only* logic machine kit that not only adds, subtracts, etc., but presents the basic ideas of cybernetics, Boolean algebra, symbolic logic, automatation, etc. So simple to construct that even a twelve-year-old can make a machine that will fascinate people with advanced scientific training!

OVER 400 COMPONENTS AND PARTS. Circuits operate on one flashlight battery, and the use of ingeniously designed parts makes building circuits one of the most fascinating things you've ever done! You set up problems in a variety of fields—and get your answers almost quicker than you can set them up! Play games with the machine—nim, tic-tac-toe, etc.—and pit your brain against its logic! Solve puzzles in a few seconds that would take you hours without the aid of the machine. You actually *see* how computing and problem — solving is analyzed with algebraic solutions transferred directly into circuit diagrams.

YOUR COST FOR GENIAC KIT: only $19.95 postpaid. The 1956 Model GENIAC KIT contains: (1) a complete 200-page text, "Minds and Machines"—a basic introduction to computers. (2) "How to Construct Electrical Brains At Home"—a fully illustrated text book on basic computer design theory and circuits with specific instructions for building circuits. (3) Wiring Diagram Manual. A special booklet with full scale diagrams that you can tear out and place on your work bench for easy assembly. (4) Beginners' Manual. Starting from scratch, the manual adds fifteen extra experiments, thoroughly tested using GENIAC components to teach the basic symbols of electric circuits. (5) Over 400 components and parts.

So—mail the coupon for your GENIAC today! (Teachers: take advantage of 10% deduction if ordered for use in institutions). Your money back if not delighted!

ORDER GENIAC ON OUR MONEY BACK Guarantee!

SCIENCE KITS, Dept. PE-56
Oliver Garfield Co., 126 Lexington Ave., New York 16, N. Y.

Please send me:
1 GENIAC Electric Brain Construction Kit and Manuals.
$19.95 (East of Mississippi) .....
$20.95 (Elsewhere in United States) .....
$21.95 (Outside the United States) .....
Returnable in seven days for full refund if not satisfied. I enclose
$.....in full payment.

Name.....

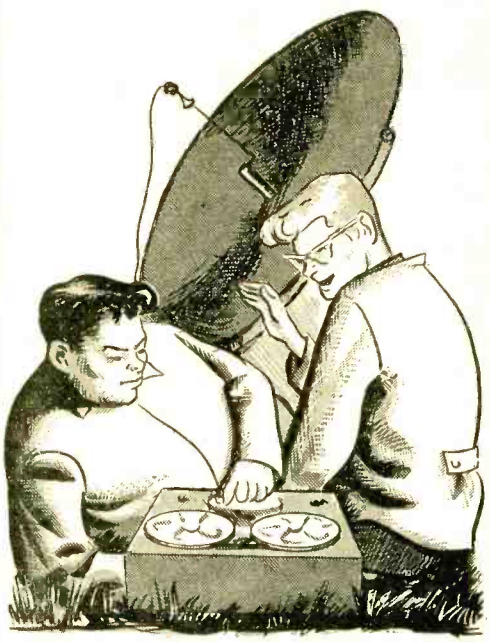
Address.....

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

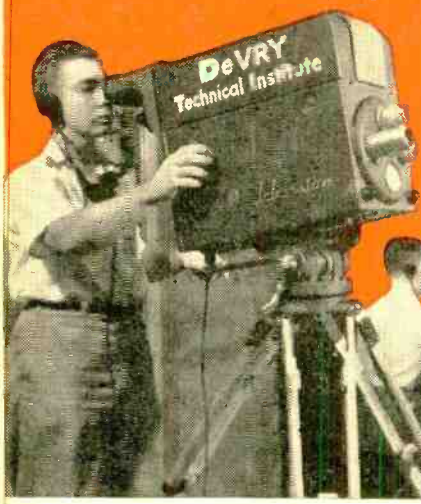
"Hokey-dokey," Jerry agreed. "To begin with, feedback is simply the taking of some of the output of a device and feeding it back into the input. As far as an amplifier is concerned, feedback comes in two different flavors: if the portion of the output signal fed back is 'phased' or timed so that it aids or increases the swing of the input signal, it's called 'positive' or 'regenerative' feedback. Positive feedback increases the amplification and results in greater output. But an amplifier with positive feedback has a strong tendency to favor one frequency over the others and so produce harmonic distortion and nonlinear amplification. Worse yet, when enough positive feedback is applied, the circuit breaks into oscillation at essentially this favored frequency, and the circuit then becomes useless as an amplifier. Generally speaking, positive feedback is a darned nuisance as an audio amplifier—it leads to howling, motorboating, and poor performance; but don't forget that when it comes to oscillators, we must have positive feedback or we don't have any oscillation.

" 'Negative,' 'degenerative,' or 'inverse' feedback is phased so that the energy returned to the input circuit from the output actually opposes the signal voltage acting on the grid and reduces the amplification. This contrariwise relationship between the plate and grid circuits works to advantage, for any hum or noise or distortion generated in the plate circuit tends to 'buck' itself out. The distorting 'zig' in the plate circuit produces an opposite-going 'zag' in the controlling grid voltage that sends through a correcting signal to help iron out the distortion in the output."

"Hey, that's pretty cute: it's as though the



. . . The huge shallow disc was propped up on edge so that its concave side faced toward the hedge separating Jerry's yard from the one next door. . . .



Better Training for a Brighter Future!

Here is one of the most effective ways to OPEN THE DOOR to opportunity in TELEVISION-ELECTRONICS

Here, and above, are typical views in D T I's great Chicago training center—attended by many students from the United States, Canada and the Hawaiian Islands. These men come here to benefit from one of the finest, practical laboratory trainings, of its kind—not only in Television and Radio—but also in Industrial Electronics, Nuclear Instrumentation, and other highly promising branches of today's great, billion dollar Electronics field.

Your future is the *most important thing in your life!* Give it every advantage you can. Find out about the wonderfully promising years facing YOU in America's great, billion dollar field of Television-Electronics . . . once you are properly trained.

And you can now get the very training industry wants, either by attending D T I's wonderfully equipped Chicago laboratories—one of the nation's finest—or by getting laboratory type training in your spare time at home.

Remember—you receive more than just home training from D T I. You get training that has profited from the knowledge and experience gained in preparing thousands of men in D T I's Chicago laboratories.

You get training that includes all of the wonderful features shown to the right. You learn-by-reading from lessons . . . you learn-by-seeing from D T I's exclusive, remarkably effective visual training MOVIES . . . you learn-by-doing from many shipments of electronic parts.

EMPLOYMENT SERVICE

And upon completing either the Home Program or Chicago Laboratory Training, you get the SAME EFFECTIVE EMPLOYMENT SERVICE that has already helped thousands of men to a real job or their own profitable business in Television-Radio-Electronics.

Little wonder so many men express amazement at the results secured through D T I. There's NOTHING ELSE like it! See for yourself. Mail coupon today for the fascinating story about D T I. There's no obligation. The time to act about your future is . . . NOW!

You get laboratory type **PRACTICAL EXPERIENCE** from your own **HOME LABORATORY.** Work over 300 projects.

You build and keep a **5-INCH OSCILLOSCOPE** and **VACUUM TUBE VOLTMETER.** Helps you EARN while learning.

Wonderfully effective, exclusive **HOME MOVIES** help you grasp important points faster, easier, better.

You may also build and keep a **21 INCH TV SET.** D T I offers another home training without the TV set.

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill., Dept. PE-5-M

I would like late facts about the many opportunities in Television-Radio-Electronics, and how D T I can prepare me for my start in this billion dollar field.

Name_____ Age____
PLEASE PRINT

Street_____ Apt.____

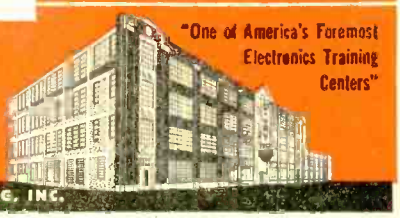
City_____ Zone____ State_____

1000 *DTI's training is available in Canada*

The DeVRY Technical Institute

4141 Belmont Avenue Chicago 41 Illinois

Member of National Home Study Council



"One of America's Foremost Electronics Training Centers"

FORMERLY DEFOREST'S TRAINING, INC.

circuit were correcting all its own faults!"

"Yes, negative feedback has several advantages. It reduces output circuit hum, noise, and harmonic distortion by the same percentage that it reduces the gain. When it's applied as it should be, negative feedback evens up the amplification given to different frequencies and makes an amplifier more nearly 'flat' in its frequency response."

"Negative feedback seems to have everything. What's the catch?" Carl wanted to know.

"The only catch is that it reduces the gain by the same amount that it reduces the distortion. It can only be applied when you have sufficient surplus of gain to sacrifice amplification in order to obtain the other advantages."

"HOW do you put negative feedback into a circuit?" was Carl's next question.

"An easy way to do it with a single-tube amplifier is simply to leave the cathode resistor unbypassed. In this case, the cathode resistor becomes a part of the plate load, and a portion of the plate signal voltage appears between the cathode and ground. The voltage across the cathode resistor also appears in series with the signal voltage on the grid, but it's of a polarity which opposes that signal voltage. Take a 'ferinstance.' Say that the signal swings the negatively biased grid less negative. This increases both plate and cathode current. Increased cathode current increases the voltage drop across the cathode resistor, making the cathode more positive with respect to ground. Since the grid is connected to ground, it also makes the cathode more positive with respect to the grid, or the grid more negative with respect to the cathode. This last action opposes the original signal voltage that was driving the grid less negative."

"The amount of feedback in such a case would be determined by the ratio of the cathode resistor to the plate load resistor, I suppose."

"That's right. An interesting example of 100% negative feedback occurs in the cathode follower circuit in which the plate is grounded, as far as signal voltage is concerned, and the cathode resistor is the entire plate load. In this case, the voltage gain or amplification of the stage is reduced to less than one, but distortion is practically nil."

"I suppose there are other ways of introducing negative feedback."

"Oh, sure. Quite often a lead is run from one side of a speaker voice coil back to the grid or cathode of a preceding stage. By selecting the proper end of the output transformer secondary, you can get a voltage that will constitute 'negative feedback' for any preceding stage. Remember that every time a signal passes through a tube it undergoes a 180° phase shift; so a voltage that would be 'negative feedback' at the grid of one tube would be 'positive feedback' at the grid of a preceding or following stage."

"Then a feedback loop may embrace more than just one tube."

"That's right. It's quite common to feed back for two or three stages."

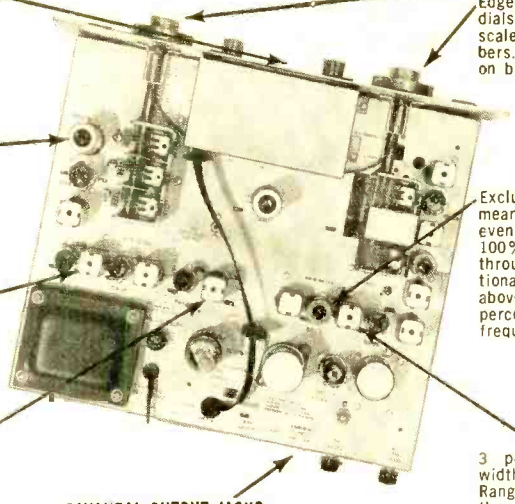
TUNING METER FOR BOTH AM AND FM
Now you can tune distant stations perfectly. Helps you adjust your antenna for best reception.

PLANETARY DRIVE TUNING
Edge lighted lucite tuning dials with separate logging scales. Big easy to read numbers. Quick or vernier tuning on both FM and AM sections.

FM RF SECTION
Highly sensitive cascode front end and heavy copper plated chassis gives 3 microvolts sensitivity for 20 db quieting.

NEW AM DETECTOR
Exclusive H. H. Scott design means distortionless reception even if stations modulate to 100%. High frequencies come through perfectly. Conventional detectors distort AM above moderate modulation percentages, and distort high frequencies.

SUPER SELECTIVE FM IF'S
Such sharp tuning that you can separate stations so close together ordinary tuners would pass them by.



WIDE BAND FM DETECTOR
Radically new design makes drift a thing of the past. Stations **stay** in tune. Strong and weak signals can be tuned with equal ease.

BINAURAL OUTPUT JACKS
from the completely separate FM and AM sections. Monaural output also provided.

WIDE-RANGE AM
3 position adjustable bandwidth including 'Ultra-Wide-Range' position for receiving the full 10 kc frequency range broadcast by the better AM stations. Perfect reception under any signal conditions.

inside story on the

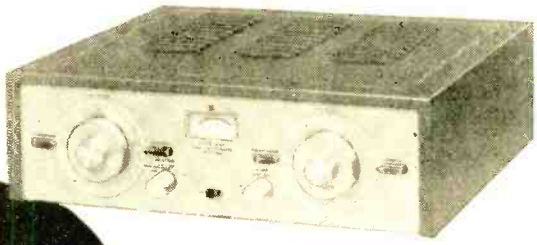
MOST ADVANCED AM-FM TUNER EVER DEVELOPED

Engineered by the same H. H. Scott team that has won every important High Fidelity award, this sensational tuner not only *looks* different . . . it *sounds* different — better than any tuner you've ever heard.

The AM side features radically new detector design . . . it's the first really wide-range AM tuner on the market . . . you actually get fine AM sound to 10 KC! The FM side has 3 microvolt sensitivity . . . you pull in stations you've never heard before.

TECHNICAL SPECIFICATIONS
FM Section: 3 mv. sensitivity for 20 db quieting — 2 megacycle wideband detector — 80 db rejection of spurious cross-modulation response by strong local signals — automatic gain control assures optimum adjustment under all signal conditions — equipped for multiplex. AM Section: 1 mv. sensitivity — 10 kc whistle filter — extended frequency response to 10 kc. Output jacks for binaural — can be panel-mounted with one simple cut-out — beautiful accessory case $9.95* Dimensions in case: 15¼" x 4¾" x 12½".

FREE!
New H. H. Scott Catalog and Hi-Fi Guide. Just off the press. Write for your free copy.



h.h. Scott

"The Professional" Model 330 AM-FM (Binaural) Tuner
Styling and dimensions provide a perfect match to the 99-B and 210-D complete amplifiers. $199.95*
*Slightly higher west of Rockies

H. H. Scott, Inc., Dept. P-5 385 Putnam Ave., Cambridge, Mass. Export Dept.: Telesco International Corp. 270 Park Ave., N. Y. 17

H. H. SCOTT A SOUND INVESTMENT

"I notice you speak about negative feedback being applied to a 'device.' Did you mean to say that?"

"Yes. Feedback is found in a lot more places than audio amplifiers. For example, in a public address system, when the volume is boosted too high, you get positive acoustic feedback from the speaker to the microphone that results in a howl or oscillation. It's interesting to note, incidentally, that this howl usually occurs on a particular note for a given system. Remember we said that positive feedback favored one frequency?

"A FINE example of negative feedback applied to a mechanical system," continued Jerry, after taking a deep breath, "is in the governor of a steam engine. This governor consists of two metal balls attached by hinged rods to a vertical shaft that is rotated by the steam engine. As the balls swing toward or away from the shaft, they control a valve that regulates the amount of steam admitted to the engine. When they're resting next to the shaft, the valve is wide open; and the farther they swing out, the more this valve closes. When the engine tries to speed up, the vertical shaft is rotated faster and centrifugal force causes the balls to swing out, cutting down on the steam and slowing down the engine. If the application of a heavy load reduces the speed of the engine, the balls swing in and open the valve, which restores the speed.

"Feedback even plays an important part in our physical actions. For example, notice what happens when I decide to pick up that twig. My brain sends a message to my hand that starts it moving toward the twig. As my hand moves, my eye keeps measuring the distance that still separates my hand from the little branch and constantly reports this information back to the brain. As the distance grows less and less, the information fed back is acted upon to cause my hand to slow down and finally stop directly over the twig."

"In fact," Jerry concluded, as he rolled over to stop the tape recorder and start rewinding the tape, "feedback plays a most important part in electronic brains, guided missiles, and so on. In all these devices, the data, direction, or movement is constantly being sampled and tested and fed back to the controlling mechanism to answer its unceasing need to know 'How am I doing?'"

As he finished speaking, he started the tape playing through the recorder. At first, the only sound was that of the birds chirping away with amazing volume and lifelike clarity. They sounded as though they might have been perched right on the microphone. Suddenly, though, the shrill complaining voice of Mrs. Selden burst through with a "presence" that made both boys jump. She kept up a constant tirade at her husband: he was clumsy; he was going to break the storm sash; he was not washing the windows clean; etc. All he was heard to say in reply was a patient, "Yes, Martha; no, Martha."

Listening to the voices that scarcely could have been more distinct if they had been talking directly into the mike, Carl's face suddenly took on a very thoughtful look. He

NATIONAL SCHOOLS

proudly presents

FOR MEN WHO WANT TO EARN MORE MONEY

TELERAMA • ALL 8 BRANCHES OF TELEVISION • ELECTRONICS • RADIO

IN ONE DYNAMIC, MODERN SHOP METHOD, HOME TRAINING COURSE

* Registration applied for

Another great advance in **HOME STUDY TRAINING.** Let National Schools, of Los Angeles, a practical Technical Resident Trade School for over 50 years, train you at home by Shop-Method, for today's unlimited opportunities in **ALL 8 BRANCHES** of the Television, Electronics, Radio Industry.

Check all you receive in *One Master Course* at One Low Tuition

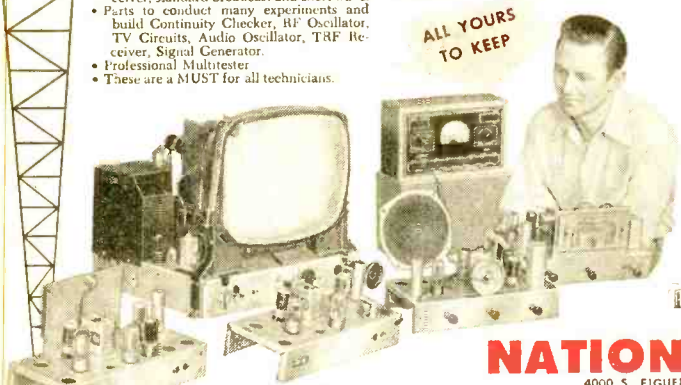
1. **Television — Including Color TV**
2. **Radio — FM and AM**
3. **Industrial Electronics**
4. **Sound Recording and Hi-Fidelity**
5. **Preparation for FCC License**
6. **Automation**
7. **Radar and Sonar**
8. **Communications**

ALL OF THIS MODERN, NEWEST, PRACTICAL EQUIPMENT IS YOURS TO KEEP!

- Parts to Build a modern TV set, including large screen Picture Tube.
- Parts to build a powerful Superhet Receiver, standard broadcast and short wave.
- Parts to conduct many experiments and build Continuity Checker, RF Oscillator, TV Circuits, Audio Oscillator, TRF Receiver, Signal Generator.
- Professional Multitester
- These are a MUST for all technicians.

YOU DO MANY PRACTICAL JOBS. You do servicing, circuit analysis and many other down-to-earth experiments. You build a modern TV set from the ground up . . . with equipment kits we give you, including a new large screen picture tube and professional Multitester, at no additional charge.

EARN AS YOU LEARN! Many of our students earn their entire tuition and more in Spare Time jobs we show them how to do while learning. YOU GET GRADUATE ADVISORY SERVICE, TOO.



L. J. ROSENKRANZ
President of NATIONAL SCHOOLS

This Master-Shop-Method course is completely up-to-date. Here in Los Angeles, the TV and Electronics center of the world, we are able to keep in constant touch with the industries' latest developments. As a student, you will quickly master all phases at home . . . in your spare time. Your earning power will grow with every lesson. Just as thousands of National Schools graduates do every day, you can handle servicing, manufacturing, repairing, hundreds of other jobs, or make good money in your own business. SECURE YOUR FUTURE—NOW. SEND COUPON BELOW.

IN THESE MODERN TV STUDIOS, SHOPS AND LABORATORIES, your Shop Method Home Study Course was developed by experienced instructors and engineers. What an advantage that is to you at home — each lesson is tested, proved, easy to understand. You can master the most up-to-date projects, such as color TV set repair, printed circuits — even prepare for F.C.C. License and industrial electronics without taking a special course. TAKE YOUR FIRST STEP NOW TO A TOP-PAY JOB IN TV, ELECTRONICS, RADIO. SEND COUPON BELOW TODAY.

APPROVED FOR VETERANS AND NON-VETERANS

NATIONAL SCHOOLS

4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF
187 N. LA SALLE ST., CHICAGO 1, ILL.
IN CANADA: 811 W. Hastings St., Vancouver, B. C.

MEMBER

FREE!

Fully illustrated "CAREER" BOOK in TV, Radio, Electronics. AND actual Sample Lesson—yours at no cost, no obligation SEND COUPON NOW—TODAY!

NATIONAL SCHOOLS
TECHNICAL TRADE TRAINING SINCE 1905
Los Angeles, California

GET FAST SERVICE—MAIL NOW TO OFFICE NEAREST YOU!

NATIONAL SCHOOLS, DEPT. R26-56
4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF. OR 187 N. LA SALLE ST., CHICAGO 1, ILL.

Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME _____ BIRTHDAY _____ 19 __

ADDRESS _____

CITY _____ ZONE _____ STATE _____

VETERANS: Give Date of Discharge _____

peeped over the hedge at Mr. and Mrs. Selden, now sitting in their porch swing, and then turned to Jerry.

"Didn't you say applying negative feedback corrected imperfections in the output?" he demanded in a whisper.

"That's right, but so what?"

"Wait here. I'll be right back," Carl ordered, as he left on a stooping run for Jerry's basement laboratory.

He was back very shortly carrying a small extension speaker for the tape recorder. After plugging one end of its long cord into the external speaker jack of the recorder, Carl started crawling with it over to the hedge. Here he set up the speaker so that its cone pointed at the couple in the porch swing only a few feet away. Then he directed Jerry—by means of elaborate motions—to rewind the tape and start it playing again. Jerry carried out the pantomimed instructions and then crawled over to his chum.

"THOSE birds in the hedge certainly are happy today," Mr. Selden remarked, when the first part of the tape started playing. In a few minutes, Mrs. Selden's voice issued through the speaker.

"Where can that woman with such a mean voice be?" Mrs. Selden wanted to know, as she listened to the constant scolding. "If I were her husband I'd tell her off—why, Jim, that sounds like your voice!"

As she continued to listen, a slow flush crept over the face of Mrs. Selden. In the beginning, she had not recognized her own voice; but the familiar words and phrases soon left no doubt in her mind as to who the speaker was. She turned to her husband—whose face was wearing a look that was apprehensive, embarrassed, and reassuring all at once—and looking at him with eyes brimming with tears, she said gently, "Jim, I never realized I sounded like that. I don't see how you put up with me."

"Don't say that, Martha," he replied gently, as he placed an arm about her quaking shoulders. "I don't really mind at all. I know you don't mean it. It's just your way of talking."

"It WAS my way of talking," she corrected, snuggling against his shoulder. "As long as I live, I'll never, never talk to you like that again."

As she finished speaking, she lifted a tear-stained face to her husband's, and the boys beat a hasty, wriggling retreat to Jerry's basement, carrying the extension speaker with them.

"Say," Carl demanded, "are you sure that was *negative* feedback we were using on Mrs. Selden?"

"It must have been," Jerry said, with a broad grin. "You heard for yourself that it was going to improve her performance. Why do you ask?"

"Well, it looked to me as if they were about to break into osculation when we left, and I thought you said only *positive* feedback caused —"

He was not able to finish because Jerry, who hated puns, flipped a loop of the extension speaker cord over his chum's neck and pulled the ends taut. —30—

LETTERS FROM OUR READERS

Parlez-Vous Francais?

■ I enjoy your magazine very much, but would like to see a few articles in French.

ROBERT CLOUTIER
Thetford Mines, Que.

Gosh Bob, we appreciate the fine readership that we have across the border, but this would involve too many problems. Sorry!

Building vs. Operating

■ After reading the November, 1955, issue, I built the "Puzzle-tronics" farmer circuit. I had more fun building it than actually working it.

VIC ANDERSON
Minneapolis, Minn.

Common complaint Vic, similar to the gardener's green thumb. Most readers like to build—often without regard to cost or time involved.

Magic Eye for AR-2 Receiver

■ I'm fixing up a Heathkit AR-2 broadcast receiver and would like to hook up a tuning eye. How complicated is this step, and what do I need?

JOHN ELZEY
Vidalia, La.

Tuning eye assemblies are sold by most radio parts jobbers and distributors. They are referred to as Amphenol Tuning Indicators (Magic Eye) Type MEA-6 and MEA-8, and may be easily installed in any receiver that has an automatic volume control (a.v.c.) line. Full instructions are supplied with the Amphenol kit.

February/March Issue Comments

■ I think credit should be given John T. (what's that stand for?) Frye who dreams up your Carl and Jerry series. His articles help make your magazine a fine one.

JIM BARROW
Carbondale, Ill.

■ There's a boner in your "Boner Box"! A person hunting for old bones is correctly referred to as a paleontologist, not an archeologist.

PETE WELLS, KN4GGJ
Lexington, Ky.

■ I built the plug-in radio (February, 1956, p. 60) and am getting excellent results. I can pick up two stations by simply reversing the plug.

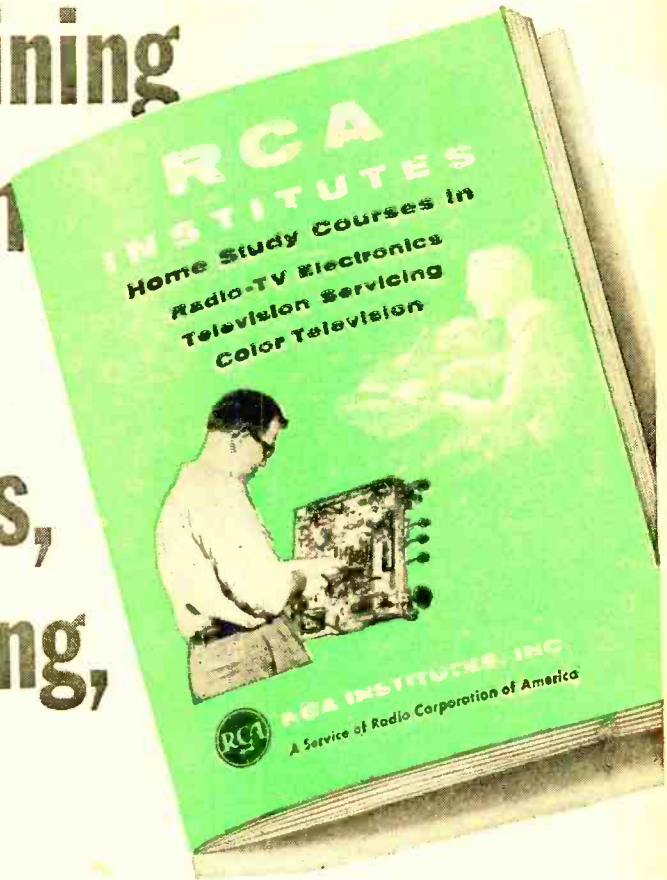
JOE LOFREDDO, KN2PVB
New Hyde Park, N. Y.

■ I question the Jim Caukins story on SSB reception (March, 1956, p. 53) as to who uses upper and lower sideband on 75 meters.

CHARLES CREMER, K5AAG

In the usual order. This is a good time for confession, John; what does the "T" stand for? A loud boo to Mr. Kohler for his poor philology in behalf of OM Wells. Many thanks to KN2PVB.

RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV



SEND FOR THIS FREE BOOK NOW!

The instruction you receive and equipment you get (and keep) will start you on your way. Pay-as-you-learn. You pay for only one study group at a time. This 52 page book contains complete information on Home Study Courses for the beginner and the advanced student.

RCA Institutes, Inc., Home Study EP-64
350 West Fourth Street New York 14, N. Y.

Without obligation, send me FREE CATALOG on Home Study Courses in Radio, Television and Color TV. No salesman will call.

Name .....
Please Print

Address .....

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

IMPORTANT
Be sure to write for RCA Institutes catalog before signing up for any Radio-TV course.

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

May, 1956

In answer to K5AAG, we can only report that Ed Marriner (who is W6BLZ) insists that was the SSB situation when he wrote the article. We might add that practically all east coast SSB stations do operate with lower sideband on 75 meters.

Long-Wave DX

■ I think readers Woolley and Lill (January, 1956, p. 10) have the right idea. Publish some dope on long-wave receivers and DX.

ROGER DAVIS
Orchard Park, N. Y.

■ It would be a very good idea to have some long-wave circuits in POP'tronics.

SAM LARUE
Lodi, Calif.

■ There is good DX between 100 and 400 kc. I agree with Lill and Woolley that long-wave circuits should be included in POPULAR ELECTRONICS.

NELSON BALL
Seaforth, Ont.

We surrender! Long-wave circuits will appear in POP'tronics. However, due to the very seasonable nature of long-wave DX, we are going to reserve publication until the early fall issues. At that time, we will provide plans for a long-wave converter, notes on antennas, and a description of the DX found on these frequencies.

Answers Answers ! ! ! to Inquiries ? ? ?

■ The 52C204 transformer mentioned by reader "X" (March, 1956, p. 12) is from a Hallicrafters 800 series TV set. Replace it with a Merit P3073.

LEE C. SCOTT
Detroit, Mich.

■ Transformer 52C204 is used in the Hallicrafters 810A, 811, 815, etc.; also in the 1025, 14808, and 17824.

R. J. KOLB TV SERVICE
St. Louis, Mo.

■ Specifications on the 52C204 are: two high-voltage windings at 600 and 400 volts center-tapped, one 5-volt and two 6.3-volt windings.

BEN WOLFF
L. I. Electronic Supply Corp.
Levittown, N. Y.

Our thanks to the above writers, as well as to many others who immediately wrote in regarding the mysterious 52C204 part number.

Voice-Operated Garage Door

■ In reviewing my old issues of POP'tronics, I was wondering if the voice control for model trains (December, 1954) could be used to open a garage door—say, with the sound of whistle or car horn?

R. H. HEAVENER
Holland, Mich.

■ I am interested in building a simple circuit and mechanism that will automatically open a garage with a high-frequency whistle (such as a dog whistle).

ZENNY OLSEN
Nashua, N. H.

Control devices operated by specific sounds are quite intriguing. The staff has under consideration

How to CRACK the education barrier

Is there an "education barrier" between you and promotion? Are young college graduates being brought in to fill positions above you?

You can break down that barrier . . . gain real security, responsibility, prestige . . . *surprise fellow employees and win their respect.* You can match yourself against the smartest of the college boys and come out a WINNER. Here's how!

AN HOUR A DAY THE I.C.S. WAY!

If you can spare an hour a day, if you have the determination to make good, if you're willing to invest pennies now for dollars later on—then I.C.S. can help you. You can be a man or woman, young or old, skilled or unskilled. So long as you can understand simple language and illustrated training manuals, you need have no doubts. The I.C.S. hour-a-day plan is SUCCESS-PROVED. You learn while you earn—anywhere, any time.

Just pick the subject you want!

Only I.C.S. offers you such a wide range of subjects to choose from. Drafting. Engineering. Television. Aeronautics. Business. High School. 256 courses in all. *I.C.S. is the oldest, largest home-study school. It is also the best known in business and industry.*

Free catalog plus free books!

When you mail the coupon below, you get a complete catalog on the subject you check with information about employment opportunities, training requirements, etc. And you get "How to Succeed"—36 pages of valuable tips on winning recognition, pay raises, success. Also, a free sample lesson in basic mathematics.

For Real Job Security—Get an I. C. S. Diploma! **I. C. S., Scranton 9, Penna.** Member, National Home Study Council

INTERNATIONAL CORRESPONDENCE SCHOOLS — 65TH YEAR

BOX 62622D, SCRANTON 9, PENNA.

(Partial list of 256 courses)

Without cost or obligation, send me "HOW to SUCCEED" and the opportunity booklet about the field BEFORE which I have marked X (plus sample lesson):

ARCHITECTURE and BUILDING CONSTRUCTION
- ☐ Air Conditioning—Refrig.
- ☐ Architecture
- ☐ Architectural Interiors
- ☐ Building Contractor
- ☐ Building Estimator
- ☐ Building Maintenance
- ☐ Carpentry and Mill Work
- ☐ Heating
- ☐ Painting Contractor
- ☐ Plumbing
- ☐ Reading Arch. Blueprints

ART
- ☐ Cartooning
- ☐ Commercial Art
- ☐ Fashion Illustrating
- ☐ Magazine Illustrating
- ☐ Show Card and Sign Lettering
- ☐ Sketching and Painting

AUTOMOTIVE
- ☐ Auto Body Rebuilding
- ☐ Auto Elec. Technician
- ☐ Auto Engine Tune Up
- ☐ Automobile Mechanic

AVIATION
- ☐ Aeronautical Engineering Jr.
- ☐ Aircraft & Engine Mechanic

BUSINESS
- ☐ Advertising
- ☐ Bookkeeping and Accounting
- ☐ Business Administration
- ☐ Business Correspondence
- ☐ Public Accounting
- ☐ Creative Salesmanship
- ☐ Federal Tax
- ☐ Letter-writing Improvement
- ☐ Office Management
- ☐ Professional Secretary
- ☐ Retail Business Management
- ☐ Sales Management
- ☐ Stenographic-Secretarial
- ☐ Traffic Management

CHEMISTRY
- ☐ Analytical Chemistry
- ☐ Chemical Engineering
- ☐ Chem. Lab. Technician
- ☐ General Chemistry
- ☐ Natural Gas Prod. & Trans.
- ☐ Petroleum Engineering
- ☐ Plastics
- ☐ Pulp and Paper Making

CIVIL, STRUCTURAL ENGINEERING
- ☐ Civil Engineering
- ☐ Construction Engineering
- ☐ Highway Engineering
- ☐ Reading Struct. Blueprints
- ☐ Sanitary Engineering
- ☐ Structural Engineering
- ☐ Surveying and Mapping

DRAFTING
- ☐ Aircraft Drafting
- ☐ Architectural Drafting
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Mine Surveying and Mapping
- ☐ Plumbing Drawing and Estimating
- ☐ Structural Drafting

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Electrical Maintenance
- ☐ Electrician ☐ Contracting
- ☐ Lineman

HIGH SCHOOL
- ☐ Commercial ☐ Good English
- ☐ High School Subjects
- ☐ Mathematics

LEADERSHIP
- ☐ Foremanship
- ☐ Industrial Supervision
- ☐ Leadership and Organization
- ☐ Personnel-Labor Relations

MECHANICAL AND SHOP
- ☐ Gas—Electric Welding
- ☐ Heat Treatment ☐ Metallurgy
- ☐ Industrial Engineering
- ☐ Industrial Instrumentation
- ☐ Industrial Supervision
- ☐ Internal Combustion Engines
- ☐ Machine Design-Drafting
- ☐ Machine Shop Inspection
- ☐ Machine Shop Practice
- ☐ Mechanical Engineering
- ☐ Quality Control
- ☐ Reading Shop Blueprints
- ☐ Refrigeration
- ☐ Sheet Metal Worker
- ☐ Tool Design ☐ Toolmaking

RADIO, TELEVISION
- ☐ Industrial Electronics
- ☐ Practical Radio TV Eng'r'ng
- ☐ Radio and TV Servicing
- ☐ Radio Operating
- ☐ Television Technician

RAILROAD
- ☐ Air Brake Equipment or
- ☐ Car Inspector
- ☐ Diesel Engineer & Fireman
- ☐ Section Foreman

STEAM AND DIESEL POWER
- ☐ Combustion Engineering
- ☐ Diesel—Elec. ☐ Diesel Eng's
- ☐ Electric Light and Power
- ☐ Stationary Fireman
- ☐ Stationary Steam Engineering

TEXTILE
- ☐ Carding and Spinning
- ☐ Cotton, Rayon, Woolen Mfg.
- ☐ Finishing and Dyeing
- ☐ Loom Fixi'g ☐ Textile Des'ing
- ☐ Textile Eng'r'g ☐ Throwing
- ☐ Warping and Weaving

MISCELLANEOUS
- ☐ Domestic Refrigeration
- ☐ Marine Engineering
- ☐ Ocean Navigation
- ☐ Professional Engineering
- ☐ Short Story Writing
- ☐ Telephony

Name_____ Age_____ Home Address_____

City_____ Zone_____ State_____ Working Hours_____ A.M. to P.M._____

Occupation_____

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada. . . . Special tuition rates to members of the U. S. Armed Forces.

a "dog whistle" device operating around 16,000 cycles. Generally speaking, a sound-operated device can lead to all types of complications, unless it is used in a restricted area. In an open yard, it could be actuated by barking dogs, playful children, and the neighbor's car horn. We will continue to work on an ultrasonic system which should alleviate most of the problems likely to be encountered.

Canadian Mail Order

■ I am a regular reader of POP'tronics and am interested in installing my own hi-fi. Would you supply me with some names and addresses of Canadian mail order companies through which I could purchase components?

S. CRAMP
Welland, Ontario

Our apologies to reader Cramp for not having this information at hand. Mail order distribution of radio and hi-fi components is widely used in the States, but we have nothing on Canadian concerns. How about you fellows across the Niagara River speaking up?

Using an Oscilloscope

■ Is it possible to have several articles in POP'tronics on how to trouble-shoot radio receivers with an oscilloscope?

G. W. MAHR
New York, N. Y.

Plans are now being formulated to publish a series of articles on test equipment. Readers may find it of interest to learn that the oscilloscope was the most "wanted" and the most "popular" item of test gear as determined in our recent reader survey.

Garage Door Opener Book

■ Where, oh, where is the Richard-Lawrence Book Co. which is mentioned as the publisher of "Automatic Garage Door Control" (March, 1956, issue, p. 65)? I have written to the incomplete address given in the book review, but the letters have been returned.

EDWARD STOW
Philadelphia, Pa.

Copies of this book may be ordered from Mr. L. R. Chase, 13339 Debby St., Van Nuys, Calif. The price is $1.50. Mr. Chase reports that several installations described in this book have been built in his immediate area. All of them have been working for over one year with no attention outside of lubrication.

Listening on V.H.F.

■ I would like to receive signals around 48 mc. in my car. Could you publish information on mobile equipment to receive stations near that frequency?

F. J. SCAROLA
El Paso, Texas

This request is typical of numerous letters received on the subject of v.h.f. FM reception between 30-50 mc. and 152-156 mc. The POP'tronics staff is pleased to report that a review of equipment for receiving those bands is under preparation.

—30—

Want To Double Your Pay

Get into Radio–TV-Electronics

Get all 3 FREE

FIND OUT what the FCC license means

Your FCC license is recognized by employers as proof of your technical ability.

FIND OUT how the FCC license helps you get a better job or increase your pay on your present job

"Due to your Job-Finding Service, I have been getting many offers from all over the country, and I have taken a job with Capital Airlines in Chicago, as a Radio Mechanic."
Harry Clare,
4537 S. Drexel Blvd., Chicago, Ill.

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with me landing this desirable position."
Elmer Powell,
Box 247, Sparta, Tenn.

National Home Study Council Approved Member

FIND OUT how to get your FCC license in a minimum of time

	License	Time
Harry G. Frame, Box 429, Charleston, W. Va.	2nd Class	13 weeks
Charles Ellis, Box 449, Charles City, Iowa	1st Class	28 weeks
Kenneth Rue, Dresser, Wisconsin	2nd Class	20 weeks
B. L. Jordan, Seattle, Washington	1st Class	20 weeks

MAIL COUPON TODAY! you'll be glad you did

FIND OUT how we guarantee your FCC license

WE GUARANTEE to train and coach you at home until you pass the all-important FCC examination. . . . If you fail to pass after completing our course, we will continue your training without additional cost until you successfully obtain your commercial license.

FIND OUT how employers make job offers like this to CIRE graduates every month

Letter from nationally known manufacturer of high quality AM and FM transmitters, "We are very much in need at the present time of radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer. Salary up to $412 per month to start."
CARL E. SMITH, E.E., Consulting Engineer, President

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk PE-12, 4900 Euclid Bldg., Cleveland 3, Ohio

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
4900 Euclid Ave., Desk PE-12
Cleveland 3, Ohio
(Address to Desk No. to Avoid Delay)

I want to know the facts, without obligation, how I can get my FCC ticket in a minimum of time. Rush me your FREE booklet "How to Pass FCC License Examinations" (does not cover exams for Amateur License) as well as sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information."

PLEASE PRINT CLEARLY

Name ..... Age .....

Address .....

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

FOR PROMPT RESULTS SEND AIR MAIL

Special tuition rates to members of the U. S. Armed Forces

POP'tronics BOOKSHELF

"HI-FI ANNUAL & AUDIO HANDBOOK" by the Editors of RADIO & TELEVISION NEWS. Published by Ziff-Davis Publishing Co., 366 Madison Ave., New York 17, N. Y. 138 pages. Paper bound. Price, $1.00.

This is a carefully chosen collection of top-flight articles on audio and hi-fi culled from the pages of RADIO & TELEVISION NEWS. Material that has appeared in recent years has been selected and regrouped under such chapter headings as: "Preamplifiers," "Power Amplifiers," "Loudspeaker Enclosures," "Selecting Hi-Fi Equipment," etc. Among the provocative pieces are some really choice items: "A Four-Channel Audio Mixer," "Hi-Fi Control Amplifier with 'Expression,'" "An Outboard Bass Booster," "How to Improve Your Hi-Fi Amplifier," "A Musician Looks at Hi-Fi," etc.

The range of topics covered is almost limitless. Editorial treatment is varied. There is enough in this book to appeal to the hi-fi beginner as well as the advanced technician. General information, theoretical discussions, hints on buying, and do-it-yourself instructions are all included.

Recommended: as a "must" for all those who are interested in hi-fi.

"SYNCHROS, SELF-SYNCHRONOUS DEVICES AND ELECTRICAL SERVO-MECHANISMS" by Leonard R. Crow. Published by The Scientific Book Publishing Co., 530 S. 4th St., Vincennes, Ind. 222 pages. Cloth bound. Price, $4.20.

Synchros and servo-mechanisms are widely used in modern electronic applications. Traffic control, signal systems, sonar and radar are a few of the devices that depend on these electronic servants to do man-sized jobs silently, unerringly, and more accurately than any other known method. Understanding such units is essential to understanding electronics. This volume will go a long way in helping readers to gain that understanding.

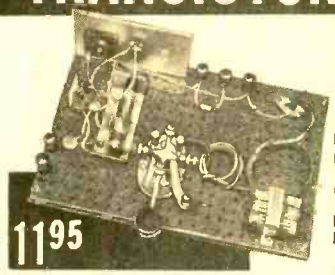
Fundamental circuits are explained, as well as the more advanced applications and devices that have evolved from the basic setups. Advanced students and practicing technicians will welcome the consummate treatment afforded; beginners will find

FREE! LAFAYETTE CATALOG

132 PAGE ELECTRONIC CATALOG

Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA, Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — ALL AT GREAT SAVINGS — For the economy minded servicemen, dealer, engineer and technician. CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.

TRANSISTOR EXPERIMENTERS LAB KIT



11.95

AS SHOWN IN MARCH ISSUE OF POPULAR ELECTRONICS

5 "EASY TO ASSEMBLE" TRANSISTOR DEVICES

1. SIMPLE RECEIVER 2. REGENERATIVE RECEIVER 3. CODE TRANSMITTER 4. LIGHT POWERED RECEIVER 5. CODE PRACTICE OSCILLATOR

Perfect for the beginner or advanced worker. Five circuits designed to demonstrate practical transistor applications. Gain the practical knowledge of transistor application. Interesting and educational to assemble and test — and fun to use. Kit is complete with all necessary parts for assembly-instructions-schematics-and pictorials. Less headphone, scrap metal, tape and solder.

KT-88 ..... Net **11.95**
Headphone-EC-1 ..... Net **1.13**
MS-278 New Supersensitive Earpiece ..... Net **1.95**

13-IN-1 EXPANSION KIT

- WIRELESS MICROPHONE
- ELECTRONIC METRONOME
- HIGH GAIN RECEIVER
- LIGHT-POWERED OSCILLATOR
- SIMPLE PHOTO CELL RELAY
- ELECTRONIC RELAY
- SENSITIVE PHOTO CELL RELAY
- RAIN ALARM

An exciting addition to the KT-88 kit to enable you to continue this fascinating and educational program of instruction, including the making of printed (etched) circuitry. The additional parts, diagrams and instructions (along with the parts in the basic 5-in-1 kit) cover the 8 added projects listed above. You'll be able to do such interesting things as broadcasting through your radio without connecting wires, detect moisture or rain, make light actuated relays and much more. And when you've done all these, you can look forward to more Lafayette expansion kits to increase the utility of the kits you already have. Kit is complete with all parts and instructions. Shpg. wt., 3 lbs.

KT-89 . . . EXPANSION KIT ..... Net **7.50**

Combination Deal

KT-88 and KT-89 . . . Kit bought together ..... Net **18.75**

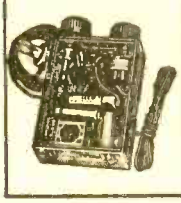
NEW! ALL-PURPOSE DYNAMIC EARPHONE

- **FOR RADIO AND TV LISTENING**
- **FOR SUBMINIATURE, MINIATURE AND TRANSISTOR RECEIVERS**

A sensitive all-purpose earphone designed for your listening pleasure. Combines the range of a dynamic earphone with the performance of its special magnet to give you excellent reproduction. Lightweight and equipped with ear support that slips comfortably over your ear. You can relax! The support is practically invisible — the earphone can't slip out — it can't fall off. Ideal for use with TV and radio sets, amplifiers, miniature and transistor receivers etc. Complete with 3 ft cord. A super value for the price!

MS-278 — 3000 ohm impedence. 1000 ohm DC resistance, with phone tip plugs ..... Net **1.95**
MS-277 — 6 ohm impedance, with phone tip plugs. For Silent Radio and TV Listening or Viewing Net **1.95**
MS-273 — 3000 ohm impedance, 1000 ohm DC resistance, with subminiature phone plug and matching phone jack ..... Net **2.39**
MS-279 — 6 ohm impedance, with subminiature phone plug and matching phone jack. For Silent Radio and TV Listening or Viewing ..... Net **2.39**

2 TRANSISTOR POCKET RADIO KIT



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

KT-68A Complete Kit less earphones. Net **11.80**
MS-250 New Super Power Dynamic Earphone, ideal for Transistor circuit Imp. 8000 ohm, D.C. 2000 ohm **3.95**

NEW MINIATURE 2 GANG VARIABLE CONDENSER

Here is Lafayette's super midget variable! Only 1" x 1" x ½" — 2 gang for transistor super hets! 10 to 208 mmf. on the ant. section. 10 to 100 mmf. on the osc. oscillator section! Self contained variable trimmers. Tunes through 180°. Entirely enclosed in a transparent plastic case! The smallest complete 2 gang variable for super hets in the world! Offers unlimited possibilities to the experimenter.

MS-270 ..... Net **1.95**
MS-274 single gang condenser Capacity 10 to 365 mmf. Net **1.25**

MATCHED COIL SET — For Miniature 2 Gang Variable Cond.
MS-271 Osc. Coil ..... Net **.79 ea.**
MS-272 Ant. Coil ..... Net **.95 ea.**

Lafayette Radio DEPT. 1E

Include postage with order

NEW YORK, N.Y.	100 Sixth Ave.
BRONX, N.Y.	542 E. Fordham Rd
NEWARK, N.J.	24 Central Ave.
PLAINFIELD, N.J.	139 West 2nd St.
BOSTON, MASS.	110 Federal St.

LAFAYETTE RADIO
100 SIXTH AVE., NEW YORK, N.Y.

☐ **Send FREE 132-Page Lafayette Catalog**

Name_____

Address_____

City_____ Zone____ State____

clear explanations of the basic concepts. No less than 171 illustrations help clarify the text.

Recommended: for electronics students and technicians at all levels of technical development.

"LIMITERS AND CLIPPERS" edited by Alexander Schure. Published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N.Y. 64 pages. Paper bound. Price, $1.25.

Another in Rider's "Review Series," this volume discusses all types of diode, triode, and pentode limiters and clippers. Circuit operation is analyzed, and practical uses of circuits are given. The importance of these special circuits in modern electronic equipment is emphasized, and an attempt made to clarify the difference between "limiter" and "clipper"—although the two terms are often used interchangeably. Topics are arranged in logical sequence from the simpler circuits to the more complex. Diagrams and an index add to the book's usefulness.

Recommended: for experimenters and students whose work brings them into contact with these circuits.

"MAGNETIC RECORDING" by S. J. Begun. Published by Rinehart & Co., Inc., 232 Madison Ave., New York 16, N. Y. 242 pages. Cloth bound. Price, $5.00.

Much of the fundamental theory behind magnetic wire and tape recording is explored in this book. The components that make up a recorder are examined, as are representative commercial models of wire recorders, steel-tape recorders, and some of the earliest coated-tape recorders. Various applications of magnetic recording are explained, as well as the methods and equipment used for measuring and testing recorders. Detailed and authoritative, this book may be somewhat "advanced" for the beginning tape hobbyist unless he has a previous knowledge of electronics and some math.

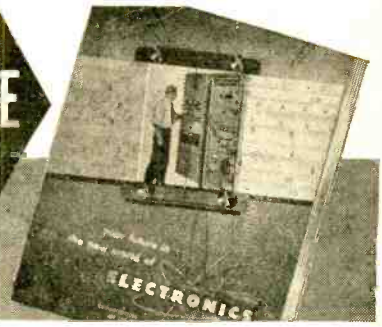
Recommended: as an engineering treatment of the theory, applications, and performance measurements of magnetic recorders.

"DICTIONARY OF ARTS AND CRAFTS" by John L. Stoutenburgh, Jr. Published by Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. 259 pages. Cloth bound. Price, $6.00.

Everything from "aaklae" to "zola" is covered in this exhaustive book whose title is self-explanatory. Prepared by no less an

This book is a Gold Mine Send for it Immediately!

FREE



REVEALS HOW YOU CAN GAIN QUICKER SUCCESS OR TURN YOUR HOBBY INTO A WELL-PAID CAREER IN RADIO . . . TELEVISION . . . ELECTRONICS

Whether you're an amateur . . . a hobbyist . . . or already in electronics . . . Let us show you how to have a bright career in

RADIO! TELEVISION! ELECTRONICS!

TURN YOUR HOBBY INTO A HIGH-PAY CAREER!

Today thousands of electronics hobbyists have an opportunity to turn their hobbies into profits. It's the "Age of Electronics"! Trained men are in crucial demand! You may be "outside" the electronics industries now, working on a job you enjoy far less than experimenting, building, transmitting, receiving; working for less money than is being paid to electronics engineering technicians. But your "true love" is electronics. Why not awaken to your opportunities —now?

ELECTRONICS IS SCREAMING FOR MEN LIKE YOU!

Here are just two of the high-level opportunities available from coast to coast:

"Just about four months have passed since I made my first recruiting trip to CREI. As a result of that visit Messrs. Kohs, Plante and Wenger are now members of the Laboratories and Mr. Kresge soon will be . . . we have some openings now and will have others . . ."—Bell Telephone Laboratories, Murray Hill, N. J.

"Two openings in our Field Service . . . aircraft electronics . . . starting salary is $380 and up . . ." —North American Aviation, Inc., Columbus, Ohio.

COUNTLESS POSITIONS MUST BE FILLED

And only trained men can fill them. You can get your share, if you take time now to gain that indispensable knowledge.

ALL YOU NEED IS ADVANCED TECHNICAL TRAINING

Sure you have some experience. But the fellows with only partial technical knowledge move slowly, or stand still while you—the man with advanced technical training—plunge ahead in the golden world of electronics opportunities.

ACQUIRE NECESSARY TRAINING AT HOME

Use spare-time hobby hours for CREI Home Study as thousands of successful technicians have done since 1927. Get concentrated training in minimum time, then step into a good job and enjoy good pay in the mushrooming electronics industry.

SEND FOR FREE BOOKLET. IT TELLS YOU HOW

How to gain career success in the tremendous electronics industries. It pinpoints opportunities which exist. By 1960, the electronics industries will do no less than $15 billion worth of business per year, not counting military orders. Take TV for example: There are about 36,000,000 TV sets and over 425 TV stations on the air. Color TV is pushing ahead furiously. Electronics is the ONE field of maximum opportunity in this electronic age.

CREI TRAINS YOU IN MINIMUM TIME AT HOME

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 what they say:

"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.

FAMOUS FOR 29 YEARS

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

VETERAN?

If discharged after June 27, 1950, let new Korean 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."

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? .....

.....

.....

MAIL THIS COUPON . . . TODAY!

CAPITOL RADIO ENGINEERING INSTITUTE

Accredited Technical Institute Curricula—Founded in 1927

3224 16th St., N. W., Dept. 125-C, Washington 10, D. C.

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

CHECK FIELD OF GREATEST INTEREST

- ☐ Practical Radio Electronic Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Television Engineering
- ☐ Practical Aeronautical Electronic Engineering

Name .....

Street .....

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

Check: ☐ Home Study ☐ Residence School ☐ Korean Veteran

authority than Mr. Stoutenburgh, a member of the American Museum of Natural History, it should answer many questions on tools, materials, and processes in almost every known hobby field.

Recommended: for all hobbyists and professionals in any of the arts and crafts.

"TAPE RECORDERS—HOW THEY WORK" by Charles G. Westcott. Published by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind. Paper bound. 177 pages. Price, $2.75.

Service technicians, hi-fi enthusiasts, and even those whose modest ambitions do not go beyond recording the baby's first gurgles onto tape—will all find plenty of worthwhile information in this book. Concise and choice bits of data, profusely illustrated, will enhance the user's understanding of the electronics and mechanical portions of tape recorders, as well as provide insight into the tape itself, testing procedures, and the use of sound meters. A detailed chapter on heads will prove particularly interesting to recordists seeking the ultimate in wide frequency response on their home instruments.

Recommended: for all persons using or having occasion to service tape recorders.

"RADIO PROJECTS" by Abraham Marcus. Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. Cloth bound. 74 pages. Price, $3.50.

Already known for his extensive books on radio communications and servicing, Mr. Marcus presents, in this volume, ten "how-to" projects for the rank beginner in radio electronics. The jobs, ranging from "How to Solder" to building one's own superhet receiver and code oscillator, proceed in order of increasing mastery of theory and tools. Photos and schematics are large and clear. Many roads can lead the novice into the field of electronics; the one chartered here is direct and attractive.

Recommended: for beginners who have access to simple tools and parts.

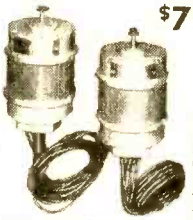
"TELEVISION—HOW IT WORKS" by J. Richard Johnson. Published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. Paper bound. 346 pages. Price, $4.60.

This book fills a big gap between the field of the professional technician or engineer and the area of interest of the experimenter and hobbyist. It is a careful and complete explanation of modern video circuitry and applications, based on the reader's rudimentary knowledge of simple circuit theory. For instance, you must know generally

ESSE is Cleaning House!

Check and Compare these NEW LOW PRICES!

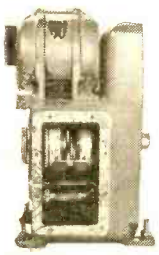
SELSYNS Only $3.95 ea. $7.50 per pair



110 Volt 60 Cycle

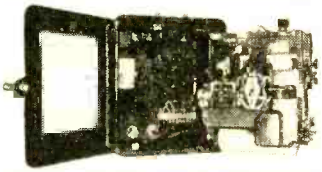
Navy type 5 (approx. 6½" L x 3½" dia.). Original cost $180. Many interesting & useful applications such as remote tuning, beam rotators & indicators, wind direction indicators, etc. Simple to hook to your house current. Low drain for continuous use. Don't pass this value. Order motors, generators, transformers, and differentials all at this price. Ship. wgt. 6 lbs., ea. **$3.95**
Per pair **$7.50**

TORQUE AMPLIFIER NEW ORIGINAL PACK $5.00



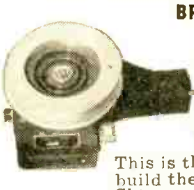
Several hundred dollar value for many useful applications. 1/40 H.P. 110 V. AC motor. Speed and direction of output shaft varies directly with motion of input shaft. The torque is provided by the motor. Aluminum case size 12" x 5⅜" x 7½". Cover for exposed transmission provided. Ship. wgt. 45 lbs. **$5.00**
each .....
Starting capacitor for above motor **$1.00**

LEEDS-NORTHRUP MICROMAX RECORDERS



Strip type recorders used for controlling and recording a wide variety of processes. Used originally for temp. range of 350-550 degrees C. May be changed for other applications. Operates on Wheatstone bridge principle using AC galvanometer movement. Original cost several times our price. Units were removed from demilitarized equipment which in many cases was new. Sold as used and guaranteed. Money back if not satisfied. **$179.50**
Price each .....
Bailey Type recorders—used in same application & ranges as L-N above. ..... ea **$39.50**

RL-42 ANTENNA REEL AND MOTOR BRAND NEW $1.95



⅛ H.P. 240 motor (will also operate on AC) with gear reducer & reversing. This is the one used to build the coil winders. Ship. wgt. 11 lbs. in original packing **$1.95**
each .....
10 for $17.50

APN-1 ALTIMETER

Save! Only $7.95

This is the unit containing the sweep condenser or wohbulator. Freq. 460 Mc. with 14 tubes and dynamotor. Ship. wgt. 23 lbs., excellent **$7.95**

T-17 MICROPHONE $3.95

A regular $15.00 carbon aircraft type mike that cannot be excelled for your mobile work. Shipping wgt. approx. 4 lbs. **$3.95**
Excellent .....

AN/ART-4 DUAL XMITTER $3.95

Another unit found useful for RC models. Operates on 55.5 and 56.75 Mc. All tubes and plastic screen 6 x 30 ft. included. Ship. wgt., in original wood box, 75 lbs. **$3.95**

EXTRA SPECIAL OFFERINGS!!

100 CRYSTALS—All New—$6.95

All new assorted freq. in various types of holders. Many ham bands and not picked for a bargain. Any one worth the total price. 100 only $6.95

AN-104 ANTENNA—New—79c ea.

100-156 Mc. aircraft type. Ship. wgt. 6 lbs. ..... ea. 79¢

FILTER CAP—All New Oil Types

Mfd.	W.V.	Mfgr.	Price
4	600	C-D	$0.75
3X.2	4000	TOBE	.75
.1	3500	GUDEMAN	.75
2X.1	4500	GE	1.50
.12	15000	GE	3.50

VARIABLE CONDENSERS—All New

MMFD.	Mfgr.	Model	Plates	Price
100	Bud	MC-941	31	$0.95
35	Oak	——	5	.50
243	Gold-Plated (as pictured) Freq. Meter Type		27	1.00
Dual 15, with 2-meter Osc. coil			4 ea.	.50
4⅛" dia. 300-1000 Mc. Butterfly			15	2.95

RADIOSONDE XMTR F69/AMT-2

397 Mc. weather balloon job they are using for the RC models. Brand new with the tubes. Size 6⅝" x 5" x 2¾". Ship. wgt. 3 lbs. $1.95

MP-22 MAST BASE—New—$1.95

Mobile heavy type with spring & insulator. Brand new in orig. carton with mtg. hardware. Ship. wgt. 18 lbs. ..... ea. $1.95

R-1/ARR-1 RECEIVER—$1.95

Close out of this popular 220 Mc. converter New (demilitarized) with tubes. Ship. wgt. 6 lbs. ..... Now $1.95

Co-axial Relay for 6-12-24 V.

Use for your mobile applications. New $1.00

238-256 Mc. MOBILE ANTENNA

New $1.25

TU-7, 10, & 26 Tuning Units

For parts or BC-375 Xmtr.
New $2.50; Used $1.95

DYNAMIC Mutual Conductance TUBE TESTERS—Like New— Only $39.50

Portable size 15½" x 8" x 5½" Air Force type tester, having acquisition of $180. Test acorns, miniatures, octals, loctals, etc. Even latest types by adapters. Accepted by Air Force as late as 1952. Like new condition. Ship. wgt. approx. 25 lbs. Each $39.50

BC-AS-229 or 429 Receiver

For the popular low price BC-234 Xmtr. Brand new with dual coil 201-398 Kc. and 2500-4700 Kc. and tubes. Ship. wgt. 19 lbs. ea. $3.95

BC-455-B Receiver—

Command type for 6-9.1 Mc. The hot one complete with tubes. Ship. wgt. 9 lbs.
Used — $3.95
New — $5.95

KEROSENE OR GASOLINE HEATER New—$6.95

The Evans blue flame heater with an output of approx. 50,000 BTU. Ideal for garage or shack where not confined. Cost Govnmt. many times price. Size 10" dia. by 12" high. Shipped in original packing, wgt. 47 lbs. Your price, Brand New $6.95

REMIT SHIPPING CHARGE AND INSTRUCTIONS WITH ALL ORDERS. OTHERWISE ORDER WILL BE SHIPPED EXPRESS COLLECT. ALL ITEMS GUARANTEED TO YOUR SATISFACTION OR MONEY REFUNDED IF RETURNED PREPAID WITHIN 10 DAYS OF RECEIPT. MINIMUM ORDER $5.00

ESSE RADIO CO • 42 WEST SOUTH ST • INDIANAPOLIS 25, INDIANA

what is meant by a "plate circuit" or "phase shift," etc. Assuming you do know what these phrases mean, you can understand most of what this book says about television. Because of its thorough coverage and reliable explanations, the volume may also serve as a handy reference guide for professionals.

Recommended: to all interested in television circuitry who have a grasp of basic electronic theory.

Free Literature Roundup

ELECTRO-VOICE "Circlotron" amplifiers and audio control units are described in a colorful brochure, available on request from Electro-Voice, Inc., Buchanan, Mich. Ask for Bulletin No. 222.

MANY BARGAINS in experimenter's equipment, components, test instruments, kits, replacement parts, and hi-fi units are listed in Lafayette's "money saver" catalog. For your copy, write to Lafayette Radio, 100 Sixth Ave., New York 13, N. Y.

HEATH'S LATEST "flyer" describes this company's complete line of kits for home builders. Recent additions to the roster of do-it-yourself projects include: two hi-fi speaker systems, an AM tuner, elaborate speaker crossover network, c.w.-phone transmitter, and a crystal receiver. Other "Heathkit" products — meters, oscilloscopes, probes, receivers, test instruments —are also described. To obtain a copy, write to The Heath Company, Benton Harbor, Mich.

DETAILED DESCRIPTIONS of 14 models of "VU Magnemite" tape recorders (portable and battery-operated) are given in a brochure available from Amplifier Corporation of America, 398 Broadway, New York 13, N. Y.

SIMPSON TEST EQUIPMENT specifically designed for refrigerators and other appliances is listed in Bulletin No. 3001, while a 7-inch colorscope and a white dot generator are described in Bulletin No. A-103. Both are available from Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

UNIVERSITY'S NEW GUIDE to "PSE" (Progressive Speaker Expansion) gives complete details for step-by-step development of multi-speaker systems. Woofers, tweeters, crossover networks, and enclosures are described. Write for your free copy to University Loudspeakers, Inc., attn: Desk LA32, 80 S. Kensico Ave., White Plains, N. Y. —30—

Hi-Fi record reproduction requires a PRECISION turntable...

THE NEW PRESTO *Pirouette* T-18

made by the world's largest maker of precision recording equipment.

- *Improves record performance tremendously*...delivers professional broadcast quality!
- *Simple operation*—a sideway flick of the control lever selects 3 speeds—33⅓, 45, 78 rpm.
- *Quiet insured!* Precision deep-well turntable bearing.
- *Quality plus!* Extra heavy weight, cast aluminum 12" table covered with non-slip cork.
- *Beautiful design*—smart telephone black and brushed chrome finish.
- *Easy to install*... only rectangular cut-out needed. Easy to buy at only **$66.00**

REVOLUTIONARY 3-SPEED MECHANISM

The *Pirouette* is a miracle of precision design on the inside, embodying the exclusive "flick shift" speed mechanism, with 3 idler wheels mounted on a single movable plate. Insures professional speed accuracy and trouble-free performance.

It's Here!

The New PRESTO K-11 DISC RECORDER

. . . A professional version of PRESTO's all-time favorite K-10 — incorporating the revolutionary T-18 turntable

for only $396.00*

For use as an on-location recorder. It's featherweight with a completely new pick-up arm, fully encased hi-fi speaker system, new panel design, push button controls and famous PRESTO cutting head. Three-speed operation.

Turntable mechanism including recording head and playback assembly available, separately, to fit into your sound system.

**with hysteresis motor $445.00*

Write for latest technical data

PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N.Y.
Canadian Division: Instantaneous Recording Service, 47 Lombard Street, Toronto

HIGH-PAY CAREERS

IN ELECTRONICS — TELEVISION — RADIO

Await Men with COMPLETE Training!

Nationally-recognized, accredited Central training is *designed* to get you into high-paying career positions in the shortest possible time. In addition, Central's "Progressive Plan" is so arranged that each phase of training you complete qualifies you for a more important, better-pay position. In just a few short weeks you are qualified for certain basic jobs. Then, with every additional training phase that you complete, you qualify "up the ladder" for more advanced types of positions. Central offers *complete* Electronics-TV-Radio training leading to an Associate of Science degree, and qualifying you as an *Electronics Engineering Technician!*

Thousands of Central graduates have been placed at almost every technical level in the electronics industry. Free nation-wide placement service.

3 PROVEN TRAINING PLANS

(Choose the one that fits your requirements)

1. HOME STUDY COURSE (with 9 kits of equipment) —Qualifies you for diploma, FCC license, and a variety of electronics jobs (or transfer into advanced resident training).

2. HOME STUDY-RESIDENT COURSE (with 9 kits of equipment)—Home study, followed by short period of resident training. Qualifies you for diploma, FCC license, and a wide variety of Electronics-TV-Radio positions (or continue with advanced resident training). An accredited technical institute curriculum.

3. FULL RESIDENT COURSE —Qualifies you for Associate of Science (A.S.) degree and top-pay employment opportunities as Electronics Engineering Technician. Part-time employment opportunities available for students while training. An accredited technical institute curriculum.

Don't limit yourself! Get the facts on Centrals *complete* training that can take you just as far as you want to go in the electronics technician field. Send coupon *today* for FREE brochure on your opportunities in Electronics.

VETERANS! Central offers courses approved under G.I. Bill

CENTRAL TECHNICAL INSTITUTE

Dept. A-56, 1644 Wyandotte St., Kansas City 8, Mo.

Tell me more about how you can qualify me for a high-pay Electronics career.

Name_____ Age_____

Address _____ Phone _____

City _____ State_____

If Korean veteran, give approximate discharge date _____

WHAT'S THE PE ANSWER?

PURCHASING TEST EQUIPMENT

I am planning on purchasing some test equipment. Will you please tell me which instrument I should acquire first?

ROBERT M. BALL
McGill, Nevada

It is probably safe to say that the most valuable piece of test equipment to have available is a vacuum-tube voltmeter. Nearly as useful is the conventional volt-ohm-milliammeter, or multimeter, having a sensitivity of 20,000 ohms per volt.

The purchase of other test equipment should be dictated by your personal requirements. For example, if you plan to do some radio servicing, you will need a signal generator . . . for TV servicing, a specialized TV signal generator and an oscilloscope. For general experimental work, an audio oscillator, capacitance checker, tube checker, etc., may be considered after the v.t.v.m. or VOM is purchased.

CRYSTAL RECEIVER SELECTIVITY

I have been using a crystal diode radio for experiments. I receive a number of stations but, even though I use a 365-$\mu\mu$fd. capacitor, they are hard to separate. I wonder if you could advise me as to something to put in so as to separate the stations better.

MICKEY O'CONNOR
Cuyahoga Falls, Ohio

The conventional crystal receiver has inherently poor selectivity because only one tuned circuit is used, and the Q of this circuit is low because of the loading effect of the crystal diode. Selectivity can be improved at the expense of output volume by tapping the crystal rectifier down on the loopstick coil. Loopsticks with a low-impedance tap for this purpose are available from a number of parts suppliers.

SELF-GENERATING PHOTOCELL

Just recently, I made a few of the self-generating photocells as described in your January, 1956, issue, and I was wondering if there were any alterations or additions that could be made to boost their output. I was thinking of adding a lens to increase the light intensity, and thus give more output. Do you think this is possible?

JACK PESKOVITZ
Northampton, Mass.

Improvements are continually being made in commercial self-generating photocells. For example, Bell Laboratories reports that they have made cells having an over-all efficiency as high as 11%. Units approaching this efficiency are expensive to buy on the open market and are not readily available at the pres-

ent time, but as demand increases and production techniques are improved, prices will undoubtedly go down.

A lens of some kind could be employed to increase somewhat the output of presently available photocells, including the units described in the January, 1956, issue. However, care must be taken to keep the temperature of these cells within reasonable limits, or they may be permanently damaged.

We will continue to publish information on improvements in self-generating photocells, and have further articles scheduled along the lines of the one appearing in the January, 1956, issue.

KT-66 Vs 6CA7

Which tube (in push-pull) will give me more output—the KT-66 or the 6CA7?

S. LAPKIN
New York, N. Y.

Speaking only in terms of output wattage, a pair of 6CA7 tubes will give more output (35 watts as compared to 30 watts) with a lower plate power supply voltage (375 volts as compared to 450 volts). Total distortion (class AB operation as pentodes) will be a little lower for the 6CA7.

SINGLE SIDEBAND

I was very much interested in the article entitled "Jim Caukins Learns to Tune In a Single-Sideband Station" which appeared in the March, 1956, issue. However, I am confused as to what is meant by "single-sideband." Can you explain it for me briefly?

H. R. SMITH
Stamford, Conn.

In normal AM transmission, the radiated signal consists of a carrier and two sidebands. Each of the sidebands contains all of the intelligence being transmitted, and this information is repeated in the other sideband. Therefore, if we could transmit just one sideband, and no carrier, we should be able to extract all available information from the signal.

Two major techniques are employed to suppress the carrier and one sideband of the transmitted signal. One is called the phase shift method, and the other the filter method. Each system has its advantages and disadvantages, with neither having a clear-cut superiority. Reception is the same for either system, since the transmitted signal in both consists only of one sideband. Usually, either the upper or lower sideband may be selected, as desired.

At the receiver, the carrier must be reinserted before the signal can be detected. This calls for a local oscillator of high stability, and accounts for the fact that a single-sideband signal sounds garbled when received on a conventional receiver.

A single-sideband system has two major advantages. The bandwidth required is only one-half that of a conventional signal, and all the transmitted power is concentrated in an intelligence-producing signal—it is not wasted in a carrier or a second sideband which merely duplicates the information. —30—

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.

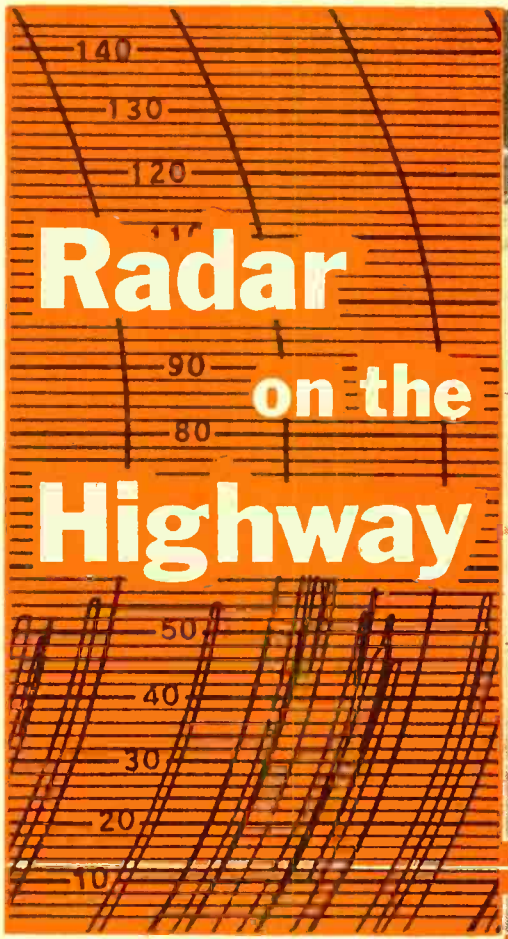
TYPE OF SIGNALS: AM-CW-SSB

FEATURES: Precision gear drives are used on both main tuning and band spread dials.

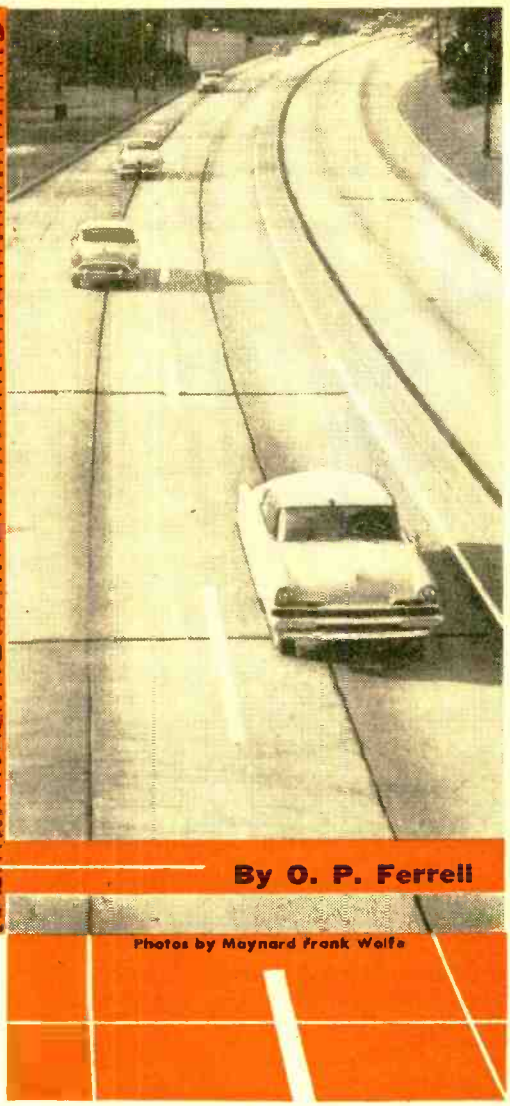
Most talked about receiver on the air . . . This Hallicrafters double conversion selectable side band receiver offers major improvements in stability by the addition of temperature compensation in the high frequency oscillator circuits and the use of crystal controlled second conversion oscillators. 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.



Radar on the Highway



By O. P. Ferrell

Photos by Maynard Frank Wolfe

A POP'tronics Exclusive Report on Radar Speed Meters

ONE DAY SOON you may be speeding along a lightly traveled highway and find that electronics has indeed arrived. In fact, it has arrived to the tune of a wailing siren and a big, flashing red light—*you* have been caught by a radar speed meter. Much to your chagrin, the poor motorist with the flat tire, parked at the side of the road, was really a highway patrol car. A radar broadcast reached out and measured your speed. Simultaneously, a printed record was made that is accepted as irrefutable evidence in 99% of the traffic courts throughout the United States.

This new pattern of speed law enforcement is being subjected to widespread criticism. In an effort to alleviate technical misconceptions, the staff of POP'tronics has prepared the following report. Because of the nature of the material, it has been written as a question and answer survey. The questions are those heard in law courts or sent in by the many readers requesting this article. The answers were obtained from engineers and technicians using radar speed meters, plus several visits by the POP'tronics staff to the one manufacturer whose speed meters are in common use.

Q. How does the radar speed meter work? Is it really radar?

A. Yes, speed meters are radar devices. But they do not operate like the radars our G.I.'s used during World War II. Speed meters are radars using the Doppler shift effect. This effect is best understood when

Most police officers simply mount the radar speed meter on a tripod. Connecting cables permit the readings to be made inside or outside of the patrol car. If the officer is inside the car, he is generally in radio communication with a partner about one mile up the road.

applied to sound rather than to radio waves. It is the change in the pitch of a train whistle, or automobile horn, as it speeds past a stationary observer. The pitch heard by the observer is different from that radiated by the whistle or horn. If the train is approaching, the pitch sounds higher; if it is receding, the pitch will sound lower.

A radar speed meter operates on the same principle. It measures the difference in pitch by sending out a u.h.f. radio wave and listening for the change after it is reflected by the moving car. If the car is not in motion, the radar speed meter does not "see" it. As soon as the car moves, the speed can be measured. The faster the car moves, the greater the change in pitch.

Technically speaking, all radar speed meters operate on 2455 mc. Speed is read as an audio frequency by mixing the continuous wave radiated by the transmitter with the reflected wave from the moving car. A speed of 100 miles per hour is equivalent to a Doppler shift of 731 cycles. The audio frequency may be read directly from a meter, or recorded on paper tape.

Q. Could a radar speed meter measure motion inaccurately?

A. In the vast majority of cases, the speed meter will read within plus or minus two miles-per-hour of the actual speed. Field trials of the equipment by POP'-tronics editors always gave results lower than the car speed by about one or two miles. Because of the principle of operation, it is practically impossible to make a speed meter read more than actual car speed, but a faulty "zero" adjustment could be made. This means that the speed meter would read five to ten miles per hour if no car was intercepting the radio beam.

Q. How does the police officer know if his equipment is operating properly?

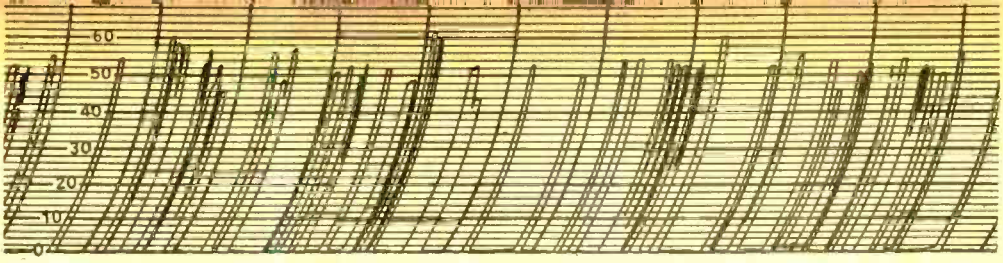
A. Officers are trained to assemble and calibrate the speed meter. In addition, the speed meter has a tuning fork calibrator. It is simply "rung" in front of the antenna. The speed meter will then read. The frequency of the fork will be 7.31 times the miles-per-hour meter indication. This frequency is stamped on the fork and cannot be changed.

Q. Should the motorist make the arresting officer prove his radar is calibrated correctly?

A. If the motorist is positive that his speed was considerably less than that indicated by the meter, it might be worth an attempt. In some states, motorists have a legal right to request this information; in most of the others, it would be a courtesy on the part of the officer. The philosophy employed by most courts and police officers is that the radar speed meter is just as accurate as the speedometer in a patrol car. Speedometer errors are known to exist and often exceed five or six miles per hour OVER actual speed at 60 miles-per-hour.

Q. How many radar speed meters are there, and where are they located?

A. Radars must be licensed by the FCC. At this writing, there are about 1600 radars in use. They are scattered throughout all 48 states. Most of the longer freeway, turnpike, or expressway police patrols have one or more radar speed meters in operation daily.



Q. Can the speed of one car be measured from a police car that is in motion?

A. This is a popular misconception. The radar speed meter MUST be standing still. It should be mounted about three feet above the ground and pointed down the highway. Speed meters cannot be used in moving vehicles.

Q. How does a radar speed meter distinguish between cars?

A. Present-day equipment does not make an attempt to distinguish between cars. This is left to the officer monitoring the equipment. His paper tape recording will register the top speed of the cars closest to the speed meter. He must pick out the speeder visually and correlate it with the meter reading.

Q. How can a speed meter be hidden?

A. There is a variety of ways of hiding speed meters, with the favorite being a cutout in the metal lid of the trunk compartment. This cutout is then covered with plastic and painted to match the color of the remaining trunk lid. The radar looks out through the hole when the police car has stopped at the side of the road.

Q. Would hiding a speed meter be called "entrapment"?

A. In some courts, yes, but this is a legal point now under investigation It is important to note that the State of Ohio requires a notice to be served on the public not less than 750 feet in front of an operating speed meter. Most states will not regard speed meters as "speed traps."

Escaping Detection

Q. Can the radar speed meters be jammed like wartime radars?

A. Yes, but only by operating an illegal (unlicensed by the FCC) transmitter on the same frequency (2455 mc.) as the speed meter. Radio amateurs might "accidentally" jam the speed meter using their 2450-mc. band. In any case, this would be of doubtful advantage since the "jamming"

Police team on the Baltimore-Washington Parkway flag down speeders. A radar detected the speeders about two miles down the road. *(Washington Post Photo)*

A technician from Eastern Industries, Inc., manufacturer of the radar speed meters, checks the recording during the POP'tronics field trials.

equipment would become costly to build and operate continuously.

Q. Could a police officer detect a "jammed" speed meter?

A. Yes, the indicators would either become totally dead, or else they would swing off scale.

Q. Can a speeder leave a trail of aluminum foil to upset the radar?

A. Scattering aluminum foil has no effect on radar speed meters. This type of radar will only react to motion.

The future in radar speed control is seen hanging over a highway. This radar sentinel does not tag or arrest speeders. It feeds data on traffic conditions to police headquarters for evaluation.

Q. What about grounding the car to ground out the signal?

A. There would be no effect whatsoever on the speed meter indication.

Q. What other devices have been used to fool radar speed meters?

A. A wide variety of gimmicks has been sold to the public. They have included special devices to ground the car through the hubcaps and an absorption shield mounted behind the radiator. None of them will have any effect on the speed meter.

Q. Couldn't a microwave detector be built to warn the motorist?

A. Yes, a detector could be built, and several designs were considered during the preparation of this article. All of them are costly to build and have a limited range.

Radar tape being shown to author.

Q. Will POP'tronics publish such a design?

A. If there is sufficient reader interest, we might assign the task to a project engineer for development.

Q. If radar speed meters continue to gain acceptance, what will be the future of this device?

A. Police authorities are now anxious to test several new devices which promise greater control over speeding. One such example is shown in the photograph at the left. The innocent-looking street lamp is actually a complete radar unit. It is beaming radar waves up and down the highway. The information from this radar is fed into a master control station at a local police headquarters. This enables undermanned police departments to dispatch patrol cars to areas where traffic is flowing either too fast or too slow.

Within the next two years, several express highways will be "saturated" with these radars. The data will be reviewed by an electronic computer to measure the flow and density of traffic. An experimental installation will be made on the Merritt Parkway in the area of Westport, Conn., by the end of this summer. —30—

Edison Ham Award to Blind Electronics Genius

ROBERT W. GUNDERSON, 36, a blind New York City radio amateur (W2JIO), has won the coveted Annual Edison Radio Amateur Award for outstanding public service. The trophy and $500 check were presented to Gunderson (at right in the photo) for his work in designing electronic test instruments which operate by sound instead of visual meters—thus opening the amazing world of electronics to the blind. More than 30 types of special equipment are credited to the inventive genius of Gunderson, who is also editor of The Braille Technical Press, the only monthly electronics magazine for the blind.

In addition to publishing this magazine, Gunderson teaches three nights a week at the New York Institute for the Education of the Blind. He also works three days a week as a radio consultant for the Hudson Radio Company, a New York City parts distributor. In his "spare" time, he actually manufactures test instruments for the blind—which operate by making a variety of whistling and clicking sounds.

Among the auditory devices Gunderson has made are: a tube checker adapter, phase meter, *Q*-meter, inductance and capacitance bridges, field strength meter, grid dip oscillator, antennascope, vacuum-tube voltmeter, multitester, distortion analyzer, frequency standards, carrier shift and modulation meters, continuity checker, and a volume level meter.

The annual award, the fourth of its kind to be presented, is made by General Electric, with officials of the Red Cross and the

American Radio Relay League acting as judges. Others in the photo are G.E. executive J. Milton Lang (left), and Herbert Hoover, Jr., the Under-Secretary of State and speaker at the award ceremonies.

Gunderson has been married for 11 years. His wife, who is not blind, serves as secretary-treasurer of his publishing enterprises and helps the electronics specialist lead a full, happy life.

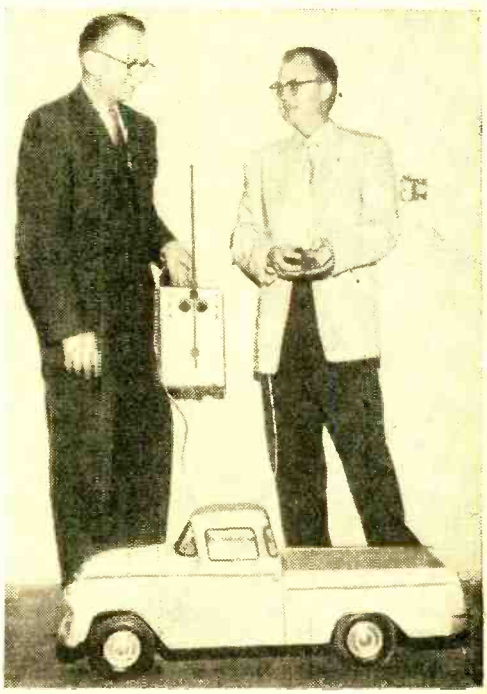
R/C Model Truck Runs Four Hours on Batteries

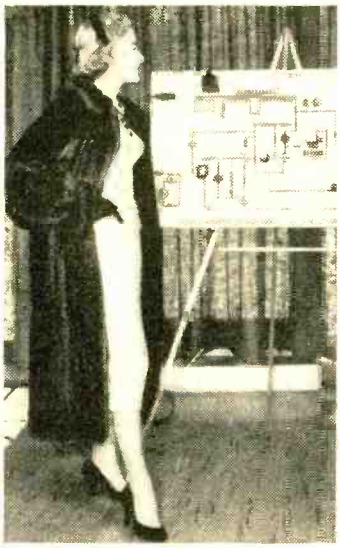
"FELLOW CAME INTO MY OFFICE the other day. Name of John Fletcher. He has a one-fifth scale model of a Chevrolet pickup truck. Made it himself of fiber glass cast from a clay model he molded.

"Complete in every detail.

"If that's not enough, he shows me two boxes, with a radio antenna and a bunch of push buttons. Next thing you know, he pushes a button and the truck lights go on. Pushes another, and the horn honks. Another, and the directional signals blink. A fourth, and the wheels turn. A fifth, and the truck starts off by itself and goes clear across the room. This Fletcher fellow, he stands there smiling, pushing buttons, and the model truck stops, backs up, turns around, honks its horn again, and comes back to my feet, where it parks."

So reports Fred J. Tabery, managing director of the California Hobby Show. Fletcher (at right in the photo) designed and built the R/C rig himself, including the circuitry. Fifteen hundred electrical parts were used. It took him 800 hours and cost about $500. The truck will run for four hours on several dry- and wet-cell batteries.





Electronic Check and Double-Check

WHAT HAS A LADY wearing a fur coat to do with electronics? The schematic being studied by the miss in mink is the brain that will guard her valuable garment when she puts it in storage for the summer.

But how do we know that safety devices are always alert? After all, even electronic watchdogs go to sleep sometimes.

Scully Signal Company answers this problem with a new electronic "Fail-Safe" monitor system that periodically prods itself to make sure it's awake. The circuit generates "make-believe" emergency signals at preset intervals. In effect, it gives itself a scare to see how it responds. If it finds itself asleep or loafing on the job, it sounds the alarm.

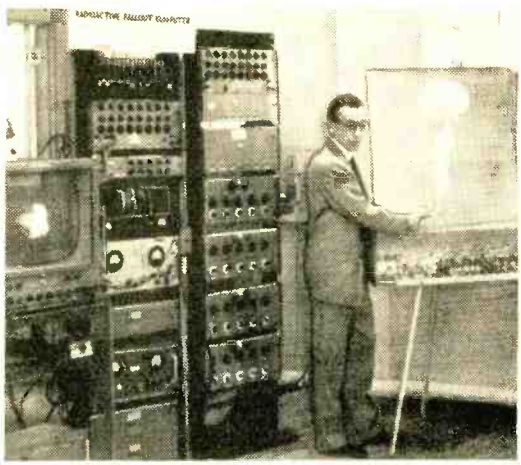
Adaptable to nearly any kind of automatic control, the circuit has already been incorporated in fire detection systems, machine safety controls, furnace flame monitors, liquid level gages, flow systems, aircraft safety devices, burglar alarms, etc. Risks due to failure of electronic safety devices are said to be virtually eliminated.

Safety Computer Forecasts Atomic Fall-out Pattern

HOW "SAFE" IS IT to test an atom bomb? Will wind-blown radioactive dust or charged rain clouds endanger life or crops in inhabited regions?

The National Bureau of Standards recently developed a "portable" analog computer to assist in predicting radioactive fall-out from a nuclear explosion. The fall-out pattern appears instantly on oscilloscope (left of photo) after weather data and the size and type of bomb are "told to" the computer by setting dials. As computers go, "portable" means that it will fit into a truck.

Wind-carried fall-out even from "small" atomic tests has traveled as far as Paris and Tokyo when caught in the "jet stream" of the upper atmosphere.

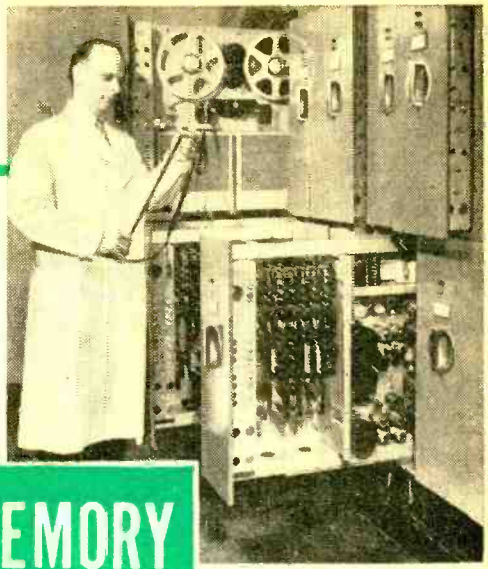


Fountain Pen Radiation Counter

THE SOLDIER looking through a rugged little device can tell at a glance how much deadly gamma radiation his body has absorbed.

Shaped like a fountain pen, this new dosimeter weighs just under two ounces and is simply clipped in the pocket. Unlike other instruments of its kind, it needs no delicate handling or special care. In tests, it worked perfectly after being thrown 20 feet against a solid wall and dropped on a concrete floor. Neither cold nor heat, water nor high altitude affect its operation. The user merely peers through a lens to read the amount of exposure on a clearly visible scale.

Developed by Bendix Aviation Corp., the instrument uses a quartz filament fiber activated by an electrical charge stored in a special aluminum and plastic foil capacitor. As gamma rays ionize the air inside the filament chamber, the quartz fiber moves across the scale.



MAGNETIC MEMORY. J. Wesley Leas, chief engineer of "Bizmac" project, examines magnetic tape in one of many tape files. More than 2,500,000 letters and numerals, or all data in some 8500 of OTAC's parts inventory records, can be filed on a single reel of magnetic tape.

COMPUTER with MEMORY Speeds Inventory

MAKING molehills out of mountains of paper work, "Bizmac" will do in minutes inventory control procedures that formerly took months. Its high-speed memory, an electronic "scratchpad," can "remember" stored data indefinitely and—on signal—release it in millionths of a second.

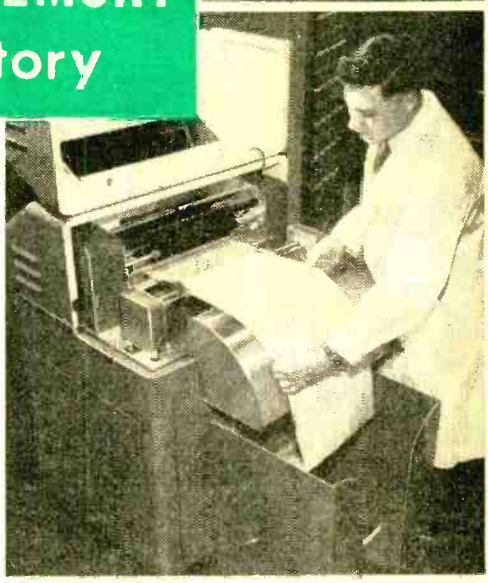
Developed by Radio Corporation of America over a five-year period for standard business operations, this four-million-dollar electronic data-processing system has just been installed by the U. S. Army at the Ordnance Tank-Automotive Command in Detroit. It was designed to perform electronically most of the voluminous clerical procedures involved in OTAC's world-wide stock control program.

Bizmac incorporates approximately 200 units of 13 different but fully integrated types of electronic equipment. Operating at a tape speed of 80 ips, it can electronically "read" or "write" at the rate of 10,000 letters or digits per second.

Input devices prepare and feed information and instructions into the system. Storage devices file data so that it is readily accessible on demand. Processing devices sort and file information, compute, and perform business arithmetic as dictated by instructions. And—last but not least—output devices provide finished copies of information.

Heart of the system is a computer that adds, subtracts, multiplies, divides and "remembers." Up to 4000 instructions—each with up to three parts—can be stored in the computer, which is capable of processing data having both variable and fixed word and message length. Its nerve center is a magnetic core memory matrix—a small, economical, highly reliable assembly of copper wires and magnetic washers.

The vast Tank-Automotive supply program involves control of replacement inventory of more than 200,000 different categories of parts—from nuts and bolts to fan belts and engines—for military combat and transport vehicles. Bizmac is expected to determine—with lightning speed and accuracy—the current supply of an item at any Ordnance depot in the nation, and to compute forecasts of future requirements. —30—



HIGH SPEED PRINTER. Part of "Bizmac," this electromechanical printer makes an original and three carbons of finished paper work. At 600 lines a minute, it will print OTAC's inventory procurements recommendations, shipping orders, etc., involved in parts control program.

Transistor Portable with a *Punch*

By RUFUS P. TURNER

Build this simple receiver and listen to it at home or on the beach without using an external antenna

HERE IS something a little out of the ordinary in a transistorized radio receiver. Although it avoids the complications of a superhet design, it still has good selectivity and does not require an external antenna for quality performance. And it provides loudspeaker operation.

Heart of the receiver is a long, high-*Q*, ferrite-cored coil which serves as an excellent antenna without any external antenna wire. Tuning is accomplished by a 365-$\mu\mu$fd. capacitor in parallel with the whole of the antenna coil, and selectivity is maintained by connecting the crystal detector to a low-impedance tap on this coil. All of the amplification takes place at audio frequencies, so you don't have to worry about poor transistor performance in the r.f. or i.f. region.

Transformer coupling is used in the audio amplifier to provide maximum gain. The push-pull Class B output stage will provide about 110 milliwatts of audio, which is adequate for the average room.

Construction. You can't use a metal cabinet with this receiver, as metal would shield the antenna coil and greatly reduce signal pickup. Use a plastic box about 10½" long, 7" high and 3" deep, or build a wooden box about this size and finish it as desired. (One experimenter built the receiver in a cigar box!) Size is not at all critical, except that the length must be at least 10" so that the horizontally mounted antenna will fit in it.

Mount the amplifier section on a strip

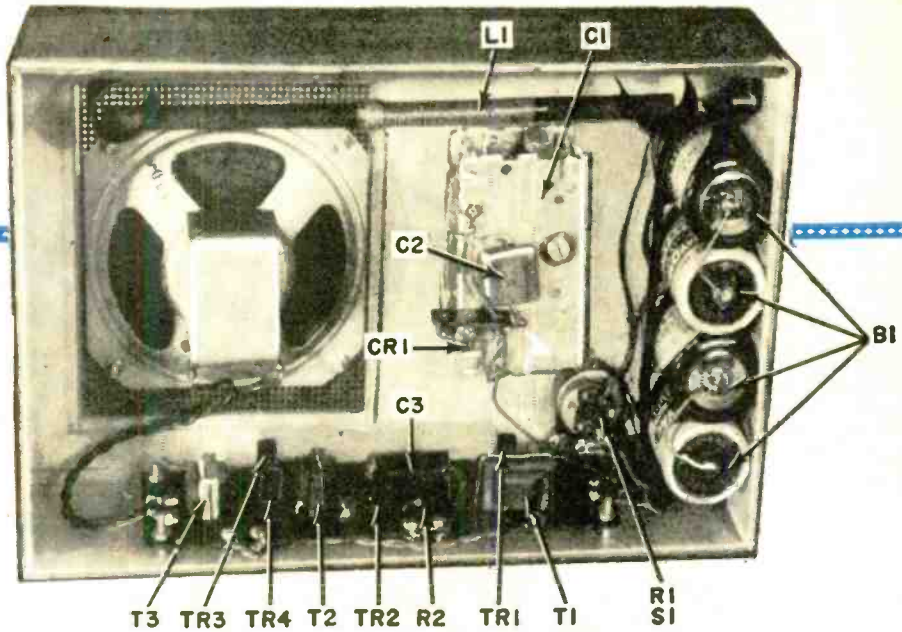
HOW IT WORKS

Most crystal receivers are lacking in selectivity because the crystal detector loads down the tuned circuit, reducing its *Q*. In the antenna arrangement used here, a long core is employed to intercept a maximum of r.f. energy from broadcast stations, and the coil is tapped down to match the low impedance of the detector. Thus, a high *Q* is maintained, and good selectivity results. The coil is wound with litz wire, which is made up of a number of strands of fine insulated wire twisted together. This type of construction reduces the r.f. resistance of the coil, and helps in maintaining a bigh *Q*.

Capacitor *C2* bypasses the r.f. from the detected signal, and the audio passes through the base-emitter circuit of transistor *TR1*. Amplification takes place in this stage, and the signal is coupled to the next stage by transformer *T1*. This transformer matches the output impedance of *TR1* to the input impedance of *TR2*, resulting in maximum power transfer.

The desired portion of the audio signal is selected by volume control *R1* and is passed to *TR2* through *C3*. A high value of capacity is required here because of the low impedance of the base-emitter circuit of *TR2*. Further amplification is provided by *TR2*, which is biased by means of resistor *R2*. Transformer *T2* again matches the output of *TR2* to the input of the push-pull output stage *TR3-TR4*. Base bias for Class B operation of the output stage is provided by the voltage divider *R3-R4*. *T3* matches the output of the push-pull stage to the voice coil of the loudspeaker.

Transistors *TR1* and *TR2* may be replaced by the cheaper CK722's, with somewhat decreased gain. Other transistors could also be substituted, with possibly some change in performance. If such substitutions are made, *R2* should be selected for optimum performance of *TR2*, and *R3-R4* for optimum performance of the output stage *TR3-TR4*.



Interior view of complete receiver, showing location of the major components.

of plastic 1/16" thick, 7" long and 2" wide. Components are held in place by passing their leads through small holes drilled in the strip, and bending the leads over on the other side. Fasten the transformers in place with a loop of wire passed around the core, and through holes in the strip. Twist the ends of the wire together under the strip for good anchoring. Then, pass the transformer leads through separate small holes in the plastic strip. Make all connections under the strip by soldering appropriate pigtails and leads together.

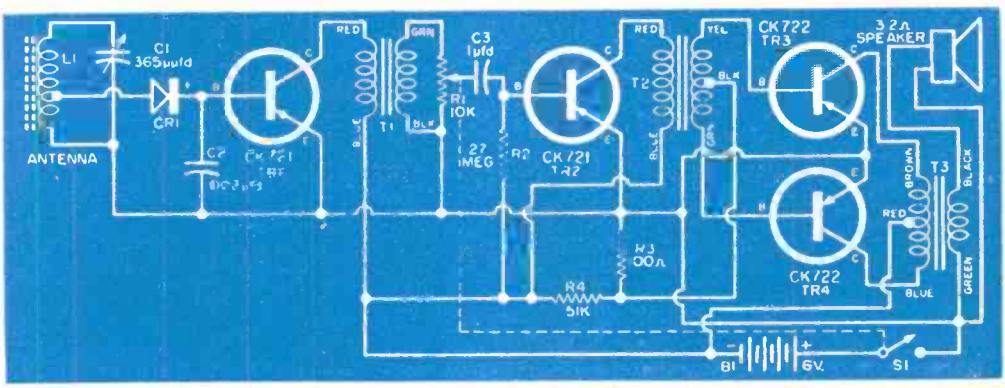
Check and double-check the transistor connections, because wrong wiring can ruin them. Hold the transistor pigtails tightly between the jaws of long-nose pliers when soldering, to avoid damage due to heat. Observe the color coding on the transformer leads: incorrect connections could cause the amplifier to oscillate.

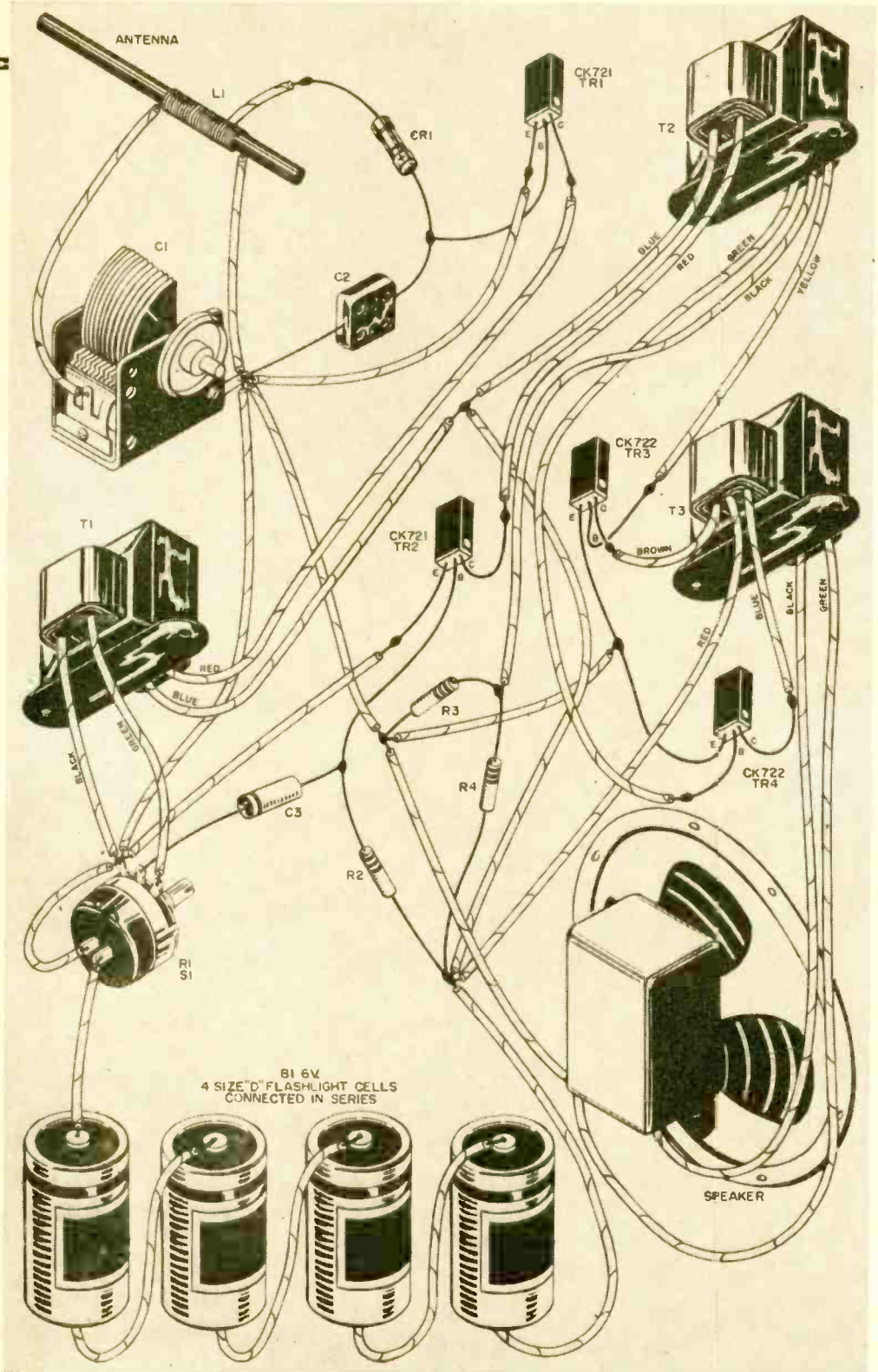
After assembly, mount the amplifier on the floor of the enclosure, as shown in the above photograph.

Now mount the loopstick antenna lengthwise in the top of the case. Use the fiber mounting strips provided for this purpose. Don't use metal brackets of any kind. Install the tuning capacitor *C1* immediately below the antenna, and mount the diode detector and capacitor *C2* on the frame of *C1*. For the tuning dial, fasten a white plastic disc to a skirted Bakelite knob and inscribe it with the broadcast frequencies. Or use a commercial dial.

Cut a hole of the appropriate size for the loudspeaker which you are using, and

Schematic diagram of the portable radio receiver.





Pictorial diagram (on opposite page) and parts list (right) for the complete transistorized receiver.

cover inside with suitable grille cloth. Mount the speaker with *6-32* screws.

You can use your ingenuity in mounting the batteries. The author wired them in series, and then secured them in place with a metal strip fastened to the case at each end with a *6-32* machine screw. Install the volume control (with switch attached) in the approximate location shown in the photo. Wire up the various components according to the schematic and pictorial, and you are in business!

Operation. Calibrate the tuning dial by tuning in various local stations and marking their frequencies on the dial. Or, if you have an amplitude-modulated signal generator available, calibration can be easily carried out by laying the "hot" output lead of the generator across the middle of the antenna. Then set the generator successively to different broadcast-band frequencies, set the receiver tuning dial for peak output at each of these frequencies, and mark the dial accordingly. Adjust the generator output and receiver volume for best audible signal without overloading, as this sharpens receiver response and increases accuracy of the dial calibration.

Actual battery drain in this receiver varies with the sound output, since the final stage operates Class B, but drain will be much less than with a tube set. The specified batteries should give very long life—approaching shelf life if the receiver isn't used more than a few hours each day.

Volume of this little set is adequate to make it useful for the home, in a car, or on the beach. The antenna is slightly directional, so try rotating the receiver for best reception. You'll get many hours of enjoyment as a reward for the few evenings it will take you to build the set. —30—

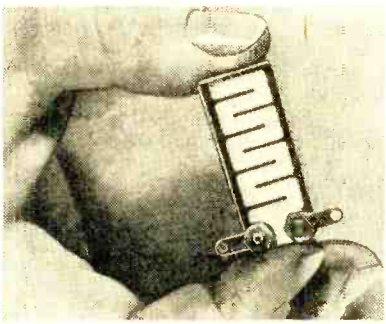
PARTS LIST

B1—6-volt battery (four Size-D flashlight cells connected in series)
C1—365-μμfd. variable capacitor
C2—0.002-μfd. mica capacitor
C3—1.0-μfd., 200-volt, miniature, metalized tubular capacitor (Aerovox P-82Z)
CR1—Germanium diode (Raytheon CK705 or 1N34)
L1—Ferrite-type transistor loop antenna (Miller Type 2000)
R1—10,000-ohm potentiometer
R2—0.27-megohm, ½-watt carbon resistor
R3—100-ohm, ½-watt carbon resistor
R4—51,000-ohm, ½-watt carbon resistor
S1—S.p.s.t. switch installed on potentiometer R1
T1—Transistor driver transformer: primary, 15,000 ohms; secondary, 200 ohms (Argonne AR-107)*
T2—Transistor Class B driver transformer: primary, 10,000 ohms; secondary, 2000 ohms, c.t. (Argonne AR-109)*
T3—Transistor Class B output transformer: primary, 500 ohms, center-tapped; secondary, 3.2 ohms (Argonne AR-119)*
TR1, TR2—CK721 transistors (Raytheon)
TR3, TR4—CK722 transistors (Raytheon)
1—Plastic cabinet, 10½" x 7" x 3" (see text)
1—Plastic strip, 1/16" x 7" x 2"
Misc. machine screws, wire, solder, etc.
**Argonne transistor transformers are obtainable from stock at Lafayette Radio, 100 Sixth Ave., New York 13, N. Y.*

Humidity Sensor Plate for Experimenters

A MINIATURE electronic humidity sensing plate has been developed by El-Tronics, Inc. Operating on a completely new principle, it employs a conducting plastic whose electrical resistance changes in proportion to the relative humidity of the surrounding air.

The humidity sensing plate is envisioned as a boon to electronics experimenters who will be able to design humidity detectors to operate cellar and basement dehumidifiers. Resistance of the plate varies from 1 megohm at a relative humidity of 5% to about 3000 ohms at 90% humidity.



The manufacturer claims that the element may be used with a simple a.c. ohmmeter circuit to register relative humidity continuously. Currents as high as 50 microamperes can be used through the element. Calibration of the sensing plate is also regarded as good, with the plate maintaining accuracy within 3% over long periods of time. The plate will operate within the temperature range of 23° to 175° F without correction.

This humidity sensor has printed electrodes on each plastic face. It measures ⅝" wide, 1½" long, and 1/32" in thickness. The price per unit has not been definitely established at this writing, but the manufacturer believes that the plates will be made available for approximately $7.50. (*Eltronics, Inc.*, 1420 Walnut Street, Philadelphia, Pa.)

Motor Analyzer *Speeds* Auto Repairs

HIT-OR-MISS methods of guessing the cause of car trouble often miss the real defect and hit only the motorist's pocket. Replacing vague diagnosis "by ear," a new electronic device eliminates the guesswork and pinpoints the trouble source in just a few seconds.

Resembling a small portable TV set, the Du Mont Dynamic Engine Analyzer shows the operation of all cylinders simultaneously on the face of a cathode-ray tube. All types of ignition troubles are identified by a change in picture pattern on the TV-like screen. Sticking or burned valves, faulty detonation, vibration and low compression—in short, about 90% of the usual ailments—show up at a glance.

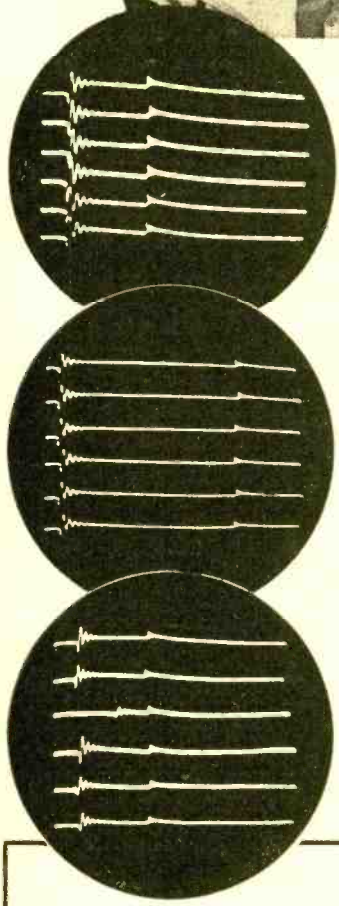
There is no need to go literally "looking for trouble" by pulling the engine apart. The analyzer picks up most of the necessary information from two test leads attached to the ignition wires. These leads can be clipped right over the insulation since capacitive probes eliminate direct contact with "hot" terminals.

Right after bringing his car to the garage, the customer himself can see what's wrong. When the repair job is done, the customer again checks his car against the analyzer to see that the trouble has been properly fixed. Such seeing and believing builds confidence, assures good workmanship and honesty.

Preventive maintenance, the motorist's best bet for saving cash and temper, is greatly simplified and speeded up by this new device. Just clip the leads to the running engine, and future trouble can be spotted long before actual breakdown.

For road tests or tuning up sports cars in the field, this portable analyzer also works in moving cars, powered by the car battery through a converter.

Skilled labor being rare and expensive, garage men find that time savings soon pay the price of this versatile instrument. —30—



Light pattern on TV-type tube quickly pinpoints engine trouble. After repair, another look tells customer that car is properly fixed.

Lines across tube show condition of each cylinder. Vertical line-up of blips (top) indicates correct engine tuning. Length of lines represents 720-degree crank rotation, and shows all four engine cycles.

If center pattern shows on scope, don't start your trip. Long lines before final jog mean badly spaced distributor points. This will cause sluggish pickup and fuel waste, especially at highway speeds.

Out-of-line pattern of third cylinder in bottom picture indicates shorted spark plug. Result: misfiring, vibration, power loss and fuel waste. Diagnosis takes only a few seconds with the new engine analyzer.

Ultrasonics Takes Guesswork Out of Lumber Grading

USING U.H.F. SOUND waves, special electronic equipment is providing more information about wood than is possible with conventional methods of appraising and grading lumber. What's more, the electronic device reveals its data without destroying the wood. Ordinary methods of grading usually involve stress and strain tests to the point where boards break. At that, even the experts can't be too sure—and consequently, structural lumber is usually bigger than it need be. Safety through over-sizing has been effective, but it is not the most economical way of doing things.

The new tester generates signals at a frequency of 500,000 cps. This energy is applied to a quartz crystal placed against the wood to be tested. The vibrations are sent, by this crystal, through the wood and into a second crystal which, in turn, vibrates. These vibrations, converted to an electrical current, are studied on an oscilloscope. Differences between the vibrations

fed into the first crystal, and those generated by the receiving crystal, reveal accurate data regarding the wood's internal structure.

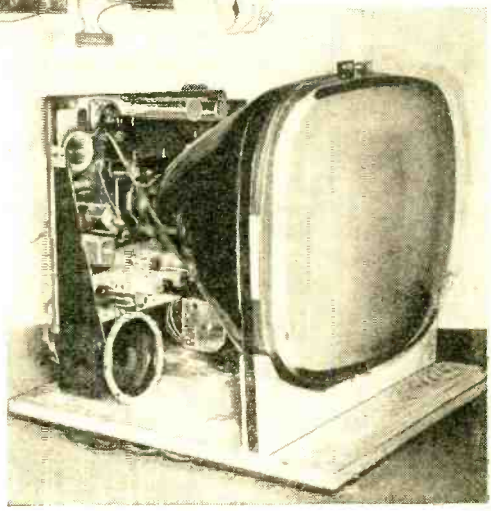
Still in its experimental stage, the equipment was developed, and is being used, at the laboratories of the Timber Engineering Company, Washington 6, D. C., an affiliate of the National Lumber Manufacturers Association.

New Kits for Home Experimenters

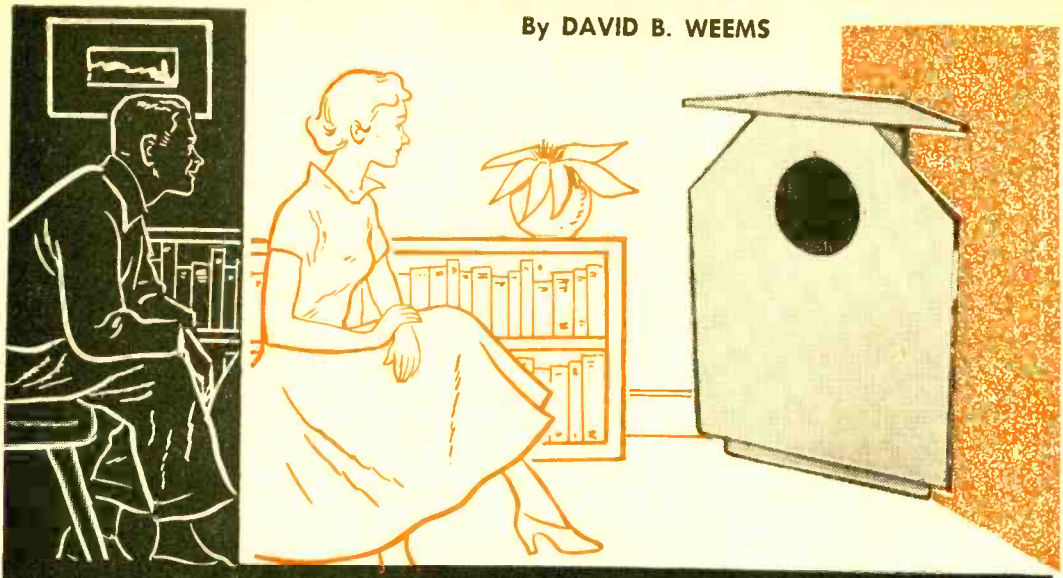
Experimenting with Crow kit (left) makes learning of electronics easy and enjoyable; kit takes beginner from simple to complex circuits. Advanced home builder can use Arkay kit to build his own television receiver (below); this set features modern circuitry, receives all 12 vhf channels.

TWO NEW KITS, designed for home experimenters and builders, cover the range of electronics from basic circuits to a complete 21" television receiver. The former, Crow Model 53, enables construction of magnetic amplifiers, photo-electric controls, flip-flop circuits, electronic counting circuits, and dozens of other assemblies. This kit uses 108 parts to perform 73 related experiments which simplify the teaching and learning of electron tube theory, radio transmitting and receiving, industrial electronic controls, and basic radar and television. Included with the parts is a 400-page instruction manual. (*Crow Electri-Craft Corp., Division of Universal Scientific Co., Inc.,* Vincennes, Indiana.)

Featuring vertical chassis construction and a turret-type tuner, the second kit builds a standard 12-channel receiver. The tuner may be adapted for u.h.f. reception by inserting u.h.f. strips in the turret drum. Other features include vertical retrace blanking and reflex sound i.f. amplifier. High sensitivity, even in fringe areas, is claimed for the finished set. A parts guarantee accompanies each kit. Known as the Arkay Model 14T21, this kit is made by *Radio Kits, Inc.,* 120 Cedar St., New York, N. Y.



By DAVID B. WEEMS



The Mark II - A $3 Speaker Baffle

"ANOTHER day, another dollar." Change that to: "Another *model,* another dollar!"

Herewith, the "Mark II"—a sweet-sounding and certainly the lowest-priced hi-fi enclosure yet made for 12" speakers. Designed for the army of readers who liked the "$2 Speaker Baffle" (POPULAR ELECTRONICS, November, 1955) but wanted to use a 12" speaker instead of the 8" unit that the earlier model housed—the new Mark II costs only $3.00!

Assembling this sonic wonder is simple—but planning it wasn't easy. It amounted to more than just increasing the over-all dimensions by one-third. First calculations for the Mark II produced a bloated monster. So the next step was to redesign the baffle. This took some technical trickery, involving the theory of the acoustic labyrinth. For behind-the-scenes geometry on the resulting audio maze, see the box entitled "How It Works."

Making the Mark II. To build the Mark II, you'll need the greater part of a 4' x 8' sheet of Celotex. This will cost about $2.50. Refer to Fig. 1 as you go over the following instructions. First, nail the back piece ("E") to the sides ("C" and "D"). Next, nail the front ("A") to the sides. Remember to place the rough surfaces of the Celotex on the inside, toward the speaker.

Now, nail the bottom into place. The top panel must wait until last, because the speaker is inserted from the top. If glue is to be used in the joints (which is a good idea), don't use it for the top panel—this would make it practically impossible to change speakers, since you can reach them only by removing the top panel.

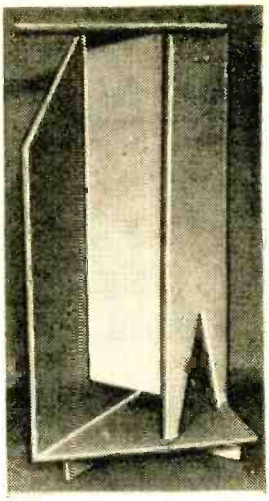
To prevent unwanted peaks in the mid- and high-frequency audio ranges, line the walls of the labyrinth baffle with a sound-absorbent material. The Celotex itself does some good in this respect, but the open tube in the rear of the baffle adds to the number of hard surfaces that serve as the walls of the labyrinth. Ozite rug padding, fiberglass insulation, or anything similar may be used. Cut the material to size and tape it to the walls of the room.

Mark II Sounds Off. The new baffle does a fine job on bass notes. Good results are possible with many types of 12" speakers. A coaxial speaker will, of course, provide more highs—and some listeners may find this necessary for better balance of sound. Others will want to start with a general-purpose, single-cone speaker, and add a separate tweeter later. The Mark II's design allows for such addition without any further changes.

An inexpensive cone-type tweeter may be attached to the back panel so that the highs are squirted up into the corner and then reflected back over the room. Spreading highs in this way avoids the harshness of "focused" treble. Care should be taken to see that the tweeter does not feed the highs into the padding, which would absorb them.

The only trouble you may encounter in using an inexpensive tweeter is that its lack of efficiency can leave an unbalance in favor of the woofer. For best results, the tweeter and woofer should be perfectly matched with regard to efficiency. This isn't always feasible, however, and often a combination must be used whether it is a well-matched one or not.

In such a situation, you can balance the woofer and tweeter by using an "L" pad in the circuit of the woofer (assuming it is the more efficient of the two). Use of an "L" pad is demonstrated in Fig. 2. Typical values for the resistors would be 4 ohms for *R1* and 8 ohms for *R2*. As *R1* is raised in value and *R2* is made smaller, the greater the action of the pad will be in order to reduce the output from the woofer. In the case of an overpowering tweeter, a simple tweeter control may be added as in Fig. 3.



Back view of the $3 baffle, the Mark II. The opening for the speaker cannot be seen in this view because it is on the front panel, which faces away to the left. Access to the speaker mounted in the baffle is obtained by removing the top panel. For this reason, the top panel should not be glued in place, but simply screwed on.

Small Speaker as Tweeter. If a tweeter is not available, any small speaker may be used. Even if its high range is no greater than that of the large speaker, there may be an improvement in over-all sound because of the better distribution of highs. With an ordinary small speaker, a simple high-pass filter will serve as a crossover. Such a filter would require a larger value of capacitance than the 2 μfd. shown in Figs. 2 and 3. As paper capacitors of high values are expensive, a cheap

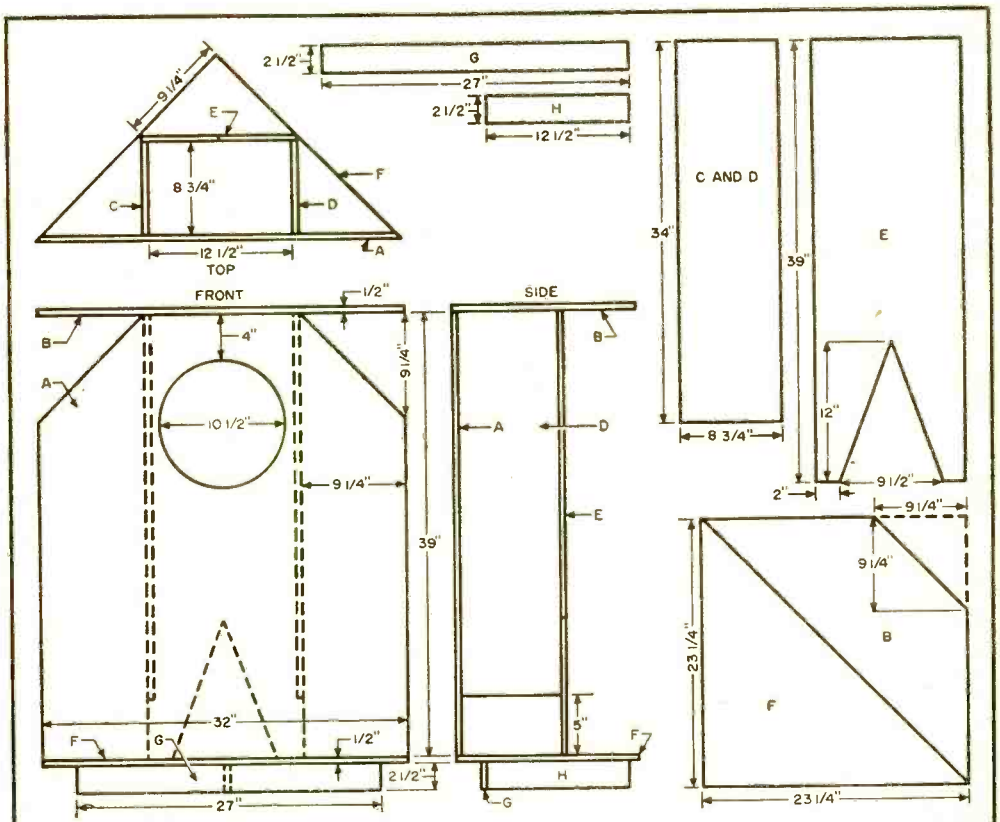


Fig. 1. Complete layout and construction plans for building the Mark II out of a single piece of 4' x 8' Celotex. The only other materials needed are nails and glue.

and effective substitute can be made by using two electrolytics of equal value. Simply tie their negative leads together and use the positive leads for the circuit connection shown in Fig. 4.

A can-type electrolytic may be used, too —its various elements usually have a common negative in the can itself, and connections "A" and "B" can be made directly to two positive terminals of equal capacitance. Typical values for each section may vary from 8 to 20 μfd. If the filter value that is chosen is of the higher figures, the phasing of the small speaker will become more important. Listen carefully as the leads are switched, and you should be able to choose the correct arrangement.

When this enclosure is fitted with a good coaxial speaker, or a balanced woofer and tweeter, it can offer some exciting listening. It has enough presence to please anyone who possesses a critical ear as well as a desire to get the most for his money. —30—

2-WAY SPEAKER SYSTEMS Using the Mark II

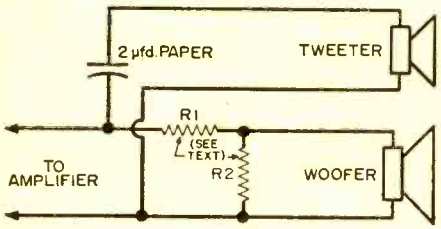


Fig. 2. A typical two-way system for use in the Mark II. Capacitor serves as crossover network. L-pad matches woofer with less efficient tweeter.

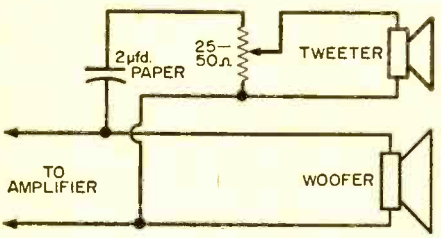


Fig. 3. If tweeter tends to overpower woofer, use potentiometer of values shown to serve as a simple control to regulate output of highs.

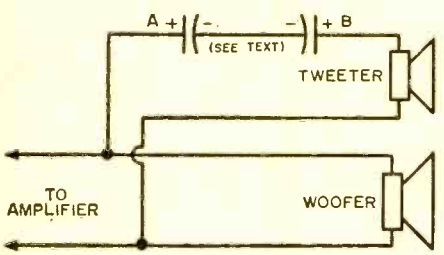
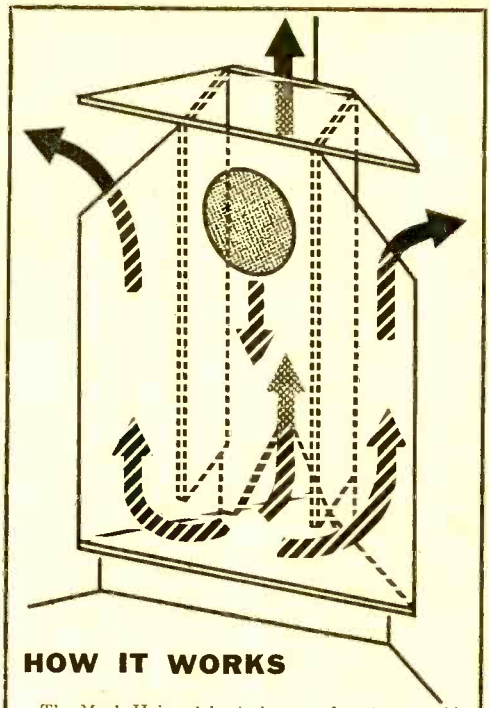


Fig. 4. When a paper capacitor is not available, use two electrolytics, with terminals connected as shown. See text for full details.



HOW IT WORKS

The Mark II is a labyrinth type of enclosure. Air passages created by the maze help load and damp the speaker cone. Loading enables an efficient transfer of acoustic energy (sound) from vibrations in the speaker cone to air mass in the listening room. Damping reduces bass boom by restricting excessive cone excursions at resonant frequency.

A speaker whose resonant frequency is 70 cycles requires an optimum labyrinth length of 4 feet. The labyrinth's cross-sectional area must be at least as great as the radiating area of the speaker cone.

Made for an 8" speaker, the original enclosure used only two open-ended tubes. A third tube was added to the rear of this baffle to utilize space more efficiently. Path length of the added tube is longer than that of the other tubes, tending to broaden the frequency range over which damping is effective. With a wider damping range, the enclosure can accommodate a greater variety of speakers. The triangular openings at the front and the inverted V passage from the main tube to the rear also help in this respect.

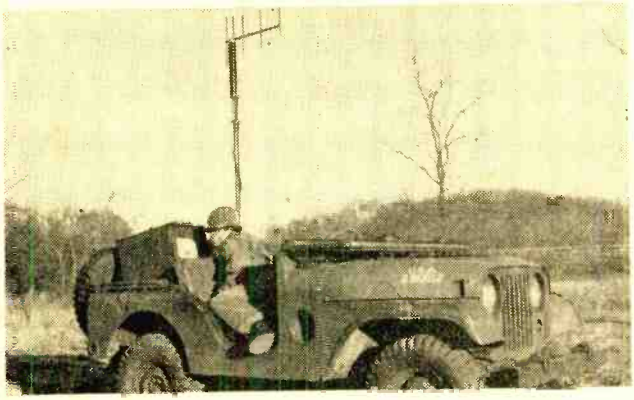
In fact, the range of damping in the Mark II is effective from below 50 cycles to about 75 cycles, which means that any worthy 12" speaker may be used. If a speaker's resonance is below 50 cycles, it will probably not be very noticeable, and damping is not so important. On the other hand, a 12" speaker with a cone resonance much higher than 75 cycles would be of little value in an ordinary enclosure. Some enclosures resonate at about 60 cycles and add to the annoyance of 60-cycle hum from other components. This situation is happily avoided in the Mark II.

"Back"-Mounted TV Transmitter

LIVE VIDEO PICTURES can be sent to distant receivers by means of the Signal Corps' new lightweight TV camera and transmitter. Together, these units comprise a portable telecasting station. Operating from built-in power, the eight-pound camera is held in the hand, while the 47-pound transmitter is strapped across the back. Transmitted images are said to be as good as, or better than, regular TV pictures. Voice messages, to accompany the video, are handled by the Signal Corps' "Handy-talkie" radio. In recent field tests at Fort Monmouth, N. J., camera and radio paired efficiently as reconnaissance eyes and ears.

Pictures up to a mile distant can be picked up by the cigar-box shaped camera; the receiver may be located up to a half-mile away. The camera has four interchangeable lenses, including a wide-angle viewer and a telephoto for distant subjects. It may also be mounted on a tripod and left alone. Thus set up, it serves as a silent sentry, sending continuous visual reports of a given sector to a command post located at a safe distance. Running off a five-cell rechargeable battery, it will operate continuously for two hours. The battery, about one-third the size of a car battery, can be replaced in two minutes' time.

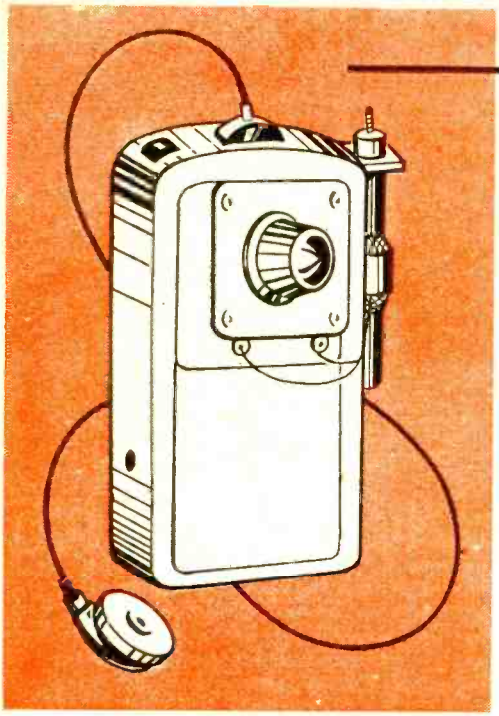
Civilian applications include the system's use by newsmen in covering live events; in air-sea rescue operations; and in many industrial situations. This equipment was built to Signal Corps specifications by the Radio Corporation of America.



Pictures sent from the Signal Corps' portable telecasting system are viewed on receiver installed in jeep. Set uses a 10" aluminized picture tube, is powered by jeep's own electrical system. From jeep, televised pictures can be relayed to higher headquarters, or piped into conventional TV system for general telecasting. Push-button controls at jeep console permit TV monitor to view pictures taken by five different cameramen in the field. In this manner, an entire area can be surveyed quite readily.

Low-Powered Transmitters Will Telecast to Rural Areas

DESIGNED TO MEET the needs of small communities, without television heretofore because of the high cost of conventional telecasting equipment, is a new "package" announced by Philco. Compact and low-powered, the system (shown at right) can be operated by one man. It includes a transmitter, monitoring equipment, high-gain antenna and transmission line, and even the studio building and tower. Local program originating facilities will handle films as well as live shows. Microwave relay devices may be added to the package for picking up network programs originating in large, nearby cities. About 800 communities are expected to be serviced by the new system, which can handle both black-and-white and color telecasts. Transmitted power will be on the order of 150 watts for video, and 75 watts for audio.



This Acousticon hearing aid was modified by adding a loopstick and a midget tuning capacitor.

Radios Made From Hearing Aids

With minor alterations and additions, you can make a radio from a hearing aid

RADIOS that can be put in a pocket, worn on the wrist, or carried in a purse are extremely popular these days. You can go out and buy one of these pocket—or purse-size units, but you'll find it rather expensive. Besides, who wants to *buy* something that you can *make*?

Here are two versions of a midget radio built around a hearing aid. You don't *have* to be hard of hearing to build these devices, but you *will* need a hearing aid in good working order. Perhaps you can pick up a used model for a reasonable price at your local hearing-aid dealer.

In both cases, the hearing aid is used as an audio amplifier and is preceded by a simple tuned circuit to select various broadcast stations. Range will depend on the power of nearby stations, and on the length of antenna employed. In metropolitan areas, you will probably be able to get quite a selection of stations without using any antenna at all. For other places—or inside steel-reinforced buildings—a wire three or four feet long will help.

In each of the units described, the major work is mechanical rather than electrical, so you have plenty of leeway to use your own ingenuity. Different hearing aids will present different problems—the basic suggestions included here should enable you to convert practically any of the hearing aids now on the market to a suitable receiver.

UNIT ONE

By Gary Edson

The first unit involves the conversion of an Acousticon hearing aid. The tuned circuit consists of a Vari-loopstick with midget tuning capacitor such as the Lafayette part No. MS-215 connected in parallel with it. This capacitor is mounted in the space usually occupied by the microphone grille, which is removed; to fill in the extra space between the edges of the capacitor and the edges of the hole in the case, solder in a piece of sheet metal previously cut to shape. For other models, you can easily design a suitable mounting system. Cut off the threaded sleeve on the capacitor unless it is used for mounting purposes, and shorten the shaft so the tuning knob will not stick out too much.

Mount the loopstick by means of an L-shaped bracket bolted to the side of the hearing-aid case. Mount a binding post for an antenna, or merely solder a wire in place after you have determined the proper length.

Connect the parallel coil and capacitor combination to the microphone terminals as shown in the schematic. You will probably note that no detector is employed—detection of the radio signal takes place in the grid circuit of the first audio stage. Volume and tone controls on the hearing aid are undisturbed; they can be used to control sound coming from the earphone. Adjust the coil slug for best performance over the whole band.

A more compact receiver may be devised by using a coil from a 456-kc. i.f. transformer. The coil can be mounted inside the hearing-aid enclosure (without the i.f. can,

of course) but performance will be inferior to that provided by the loopstick. An external antenna is a "must" with this scheme.

UNIT TWO

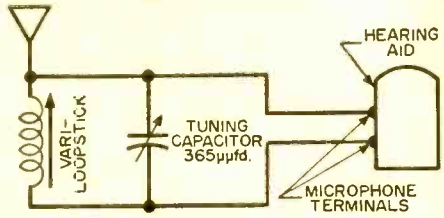
By F. E. Bassett

The second conversion is somewhat more involved mechanically, but has the advantage that you can unplug the tuned circuit and use the hearing aid for what it was originally intended—a hearing aid. Proper switching for this purpose is accomplished in the plug and jack arrangement, as shown in the schematic diagram.

A glance at the photos and diagrams will give you a general idea of the jack and plug assembly. The tuned circuit components, *L1* and *C1*, and the rectifier *CR1* are all mounted inside a plastic tube about 3" long, having an inside diameter of ½". Suitable plugs and washers for the assembly are cut from a sheet of ⅛"-thick Lucite.

To reduce the size of the coil, remove the solder lugs. Then carefully slit and remove the cardboard tube supporting the lugs. Pry open the adjusting screw mounting slightly so that the screw turns freely. This screw, with a suitable tuning knob made from the cap on a can of lighter fluid or other suitable device, is used for tuning the receiver.

Mount and solder the tuner components as shown in the pictorial diagram, being careful not to overheat the rectifier. Cut washers for the plug end and for the snap-in end of the coil, slip the whole assembly inside the plastic tube, and glue the washers firmly in place with plastic cement or acetate liquid. Be sure to bring the antenna lead outside the case before final assembly. Mount a pen clip as shown below.

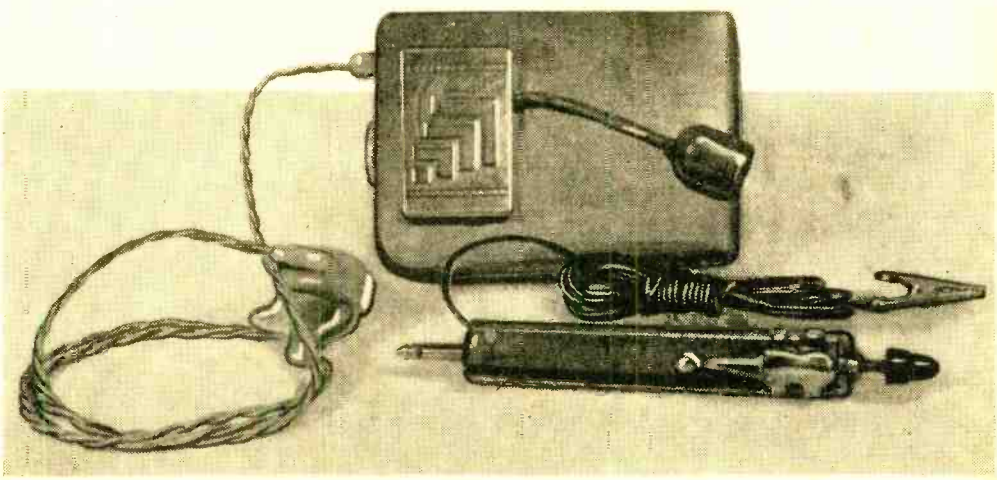


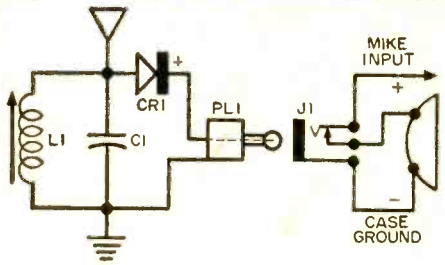
C1—10-365 μμfd. midget tuning capacitor (Lafayette MS-215)
L1—Vari-loopstick with mounting bracket (Graybourne or equivalent) or the coil from a 456-kc. i.f. can (see text)

Schematic and parts list for the first unit.

The converted unit mounted in a shirt pocket, and being tuned by adjusting the loopstick screw.

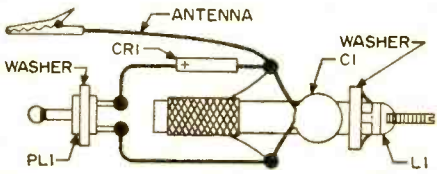
Complete assembly, including loopstick tuning unit and antenna with clip, the hearing aid with jack added for radio operation, and the earphone.





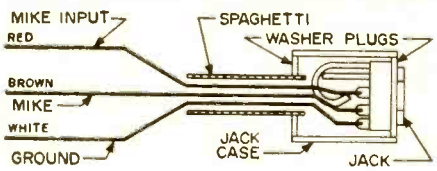
C1—330-μμfd. subminiature ceramic capacitor
CR1—Crystal diode rectifier (CK707, 1N34, etc.)
J1—Miniature closed-circuit phone jack (Telex or Switchcraft)
L1—Slug-tuned loop antenna with threaded shaft (Walsco or equivalent)
PL1—Miniature phone plug (Telex or Switchcraft)
1—Alligator clip
1—Tuning knob
1—Pen clip
1—Plastic tube, approx. ½" i.d. x 4" long
1—Piece of Lucite, 2" square (for washers)

Schematic diagram and parts list for the second conversion described in text.



Pictorial diagram of the tuning unit (above). This assembly mounts inside of a plastic tube.

Cross section of jack assembly (below) shows various connections. Lead colors are optional.



Now wire up the jack as shown in the cross-sectional view, cut suitable washers from the Lucite sheet, and assemble inside a ⅝" length of plastic tubing—gluing the washers firmly in place. It is a good idea to use color-coded leads to make certain that you wire the plug to the hearing aid correctly.

Remove the hearing aid assembly from its case. Unsolder the microphone input lead, and connect the three leads from the plug as shown in the cross section and in the schematic. Protect these three leads with spaghetti tubing. Re-install assembly in case.

With the tuner unplugged, the hearing aid should operate normally. Plug in the tuner, and clip the antenna lead to a metal lamp shade, phone finger stop, or outside antenna. Then turn up the volume, and hunt for stations by turning the coil adjusting screw. You should receive several stations with good volume and clarity.

By eliminating the 330-μμfd. capacitor across the coil, the author was able to tune in a number of ham stations. Try experimenting with different capacitors to see how many short-wave stations you can find.

Happy listening! —30—

Add Your Own Low-Voltage Windings

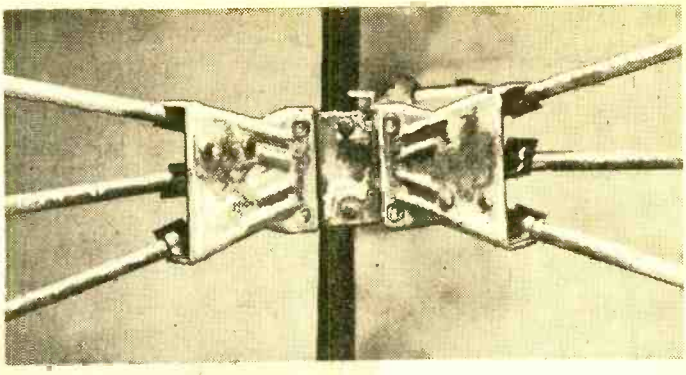
EXPERIMENTERS can often use an extra winding on a transformer to supply additional circuits or odd voltages. With transformers that are not "potted," it is easy to wind on an extra coil.

First, remove the shell, exposing the windings. Cut strips of plastic tape and slip them through the opening to wrap an insulating layer around the present coils. Next, wrap on one turn of wire, energize the transformer, and measure the voltage induced in the one-turn secondary. From this reading, you can figure the turns necessary for the desired voltage. If one turn gives too low a voltage to be measured conveniently, use ten turns (or some other appropriate number), dividing the measured voltage by the number of new turns to find volts-per-turn.

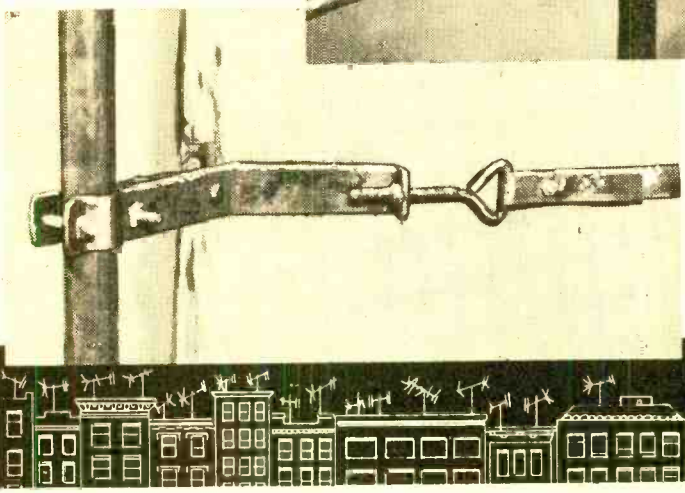
Knowing the number of required turns, figure the length of wire needed, and pick a wire gage safe for the current to be drawn. Cut off a wire of this length, adding a little extra for safety. Poke the wire exactly half-way through the opening previously made in the transformer. Then hand-wrap the required turns, working toward both ends of the wire. The direction of winding does not matter.

Secure the ends with tape and wrap a layer of tape around the new winding. A coating of polystyrene fluid will anchor the winding and give protection from moisture. —30—

The latest plan to prevent midair collisions of passenger aircraft is to augment electronic radar with aural warnings. Cornell Aeronautical Laboratory is working on a radar device that emits a motor noise.



Ordinary weather can cause pitting, corrosion and oxidation effects in front end of an antenna (right) which has been up for a length of time.



Corroded galvanized chimney mount under normal weathering conditions (left). Antenna may topple with first stiff breeze if the mount is not replaced.

Keep Checking That TV Antenna

THE WORST ENEMY of outdoor TV antennas is the weather. Possible damage from high winds, ice and snow is obvious. But more important in the long run is the gradual wearing out of elements and structures during any kind of weather.

Temperature changes, moisture, corrosive gases . . . salt spray on the coast . . . soot in the cities . . . all slowly eat away the receiving surface. And even a gentle breeze will keep antenna elements vibrating, building up stresses in metal parts.

Dull, discolored antenna surfaces may mean that TV signals are being wasted. Severe corrosion can usually be detected by simple wiping. If the deposit is not loose enough to be wiped away, chances are that it will be best to get a new antenna.

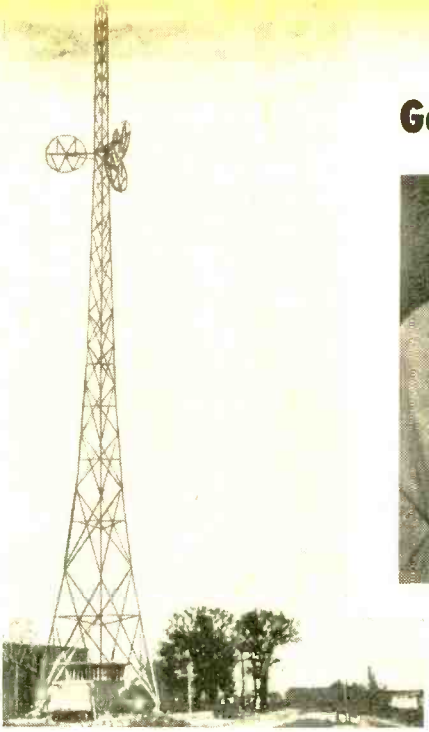
Supporting structures sometimes wear at a faster rate than the antenna elements —being commonly supplied in galvanized or plated steel rather than aluminum. If they should weaken and topple, they can cause serious damage to people and property.

Rust—on a galvanized mast, for example —can be removed with steel wool and a little effort. When only a polished steel surface shows, apply a coat or two of good aluminum paint. Be sure to cover the entire part, not just the rusted portions. If guy wires, chimney straps, or other parts are badly rusted, it might be more practical to replace them—preferably with long-lasting stainless steel or aluminum—than to refinish them.

Inspect transmission lines, lightning arrestor and insulators. When plastic insulating materials crack, TV signals leak off—particularly during rainy or moist weather. Cracked insulation should be replaced. It's also a good idea to check the position of leads, to make sure they are away from gutters and walls.

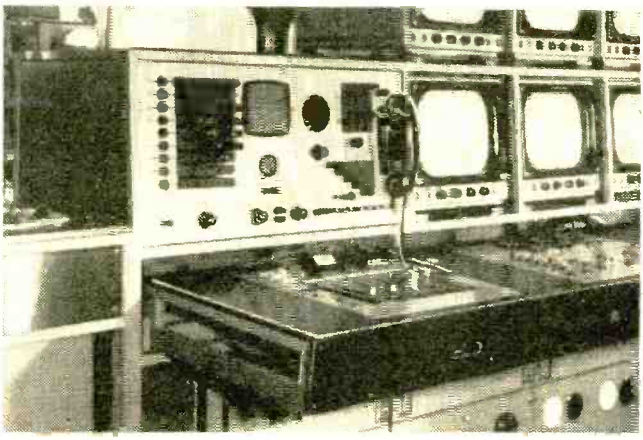
Make it a practice to check your antenna at least once a year against weathering. The small bother or cost may avert more expensive repairs. And you'll get a sure dividend in better TV reception.—*Elliott March*, Tescon TV Products Co. —30—

German Electronics Moves Ahead



City of Hanover now boasts its first wireless telephone system. Left, the antenna which handles u.h.f. signals from the 80-watt transmitter. Above, a motorist uses the transmitter-receiver installed in her car. Push buttons on dashboard select channels for voice messages.

On-the-spot telecasting, particularly of live, outdoor programs, is accomplished with the aid of a specially outfitted "TV Car." Built by the Northwest German Broadcasting System (NWDR), the vehicle is a long truck whose interior is divided into two rooms. One room serves as a studio, with an assortment of tripods, dollies, cameras, etc. The other (a portion of which is shown at the right) is rigged as a control and monitor station, and contains a full complement of standard TV transmitting control equipment. Local video pickups are microwaved by "impulse transmitters" to remote transmitters at fixed sites for general telecasting to TV audiences watching their receivers at home.



Walkie-talkies, operating on v.h.f., facilitate voice communication between points up to two miles of each other. Left, airfield dispatcher contacts pilot of aircraft. Below, technician confers with copter pilot above roar of engine. Device is used widely in repair job situations; crew chief and mechanics can speak to each other easily where direct contact is impossible.

Inserting one of the probes for the watering control into place on lawn.

The moisturemeter is shown here being used to check the condition of the soil in a potted plant. It can also be used to check moisture in a lawn or garden soil, after calibration.

Electronic Gadgets for the Gardener

Give electronics the task of controlling your sprinkler and indicating when your house plants need watering

DID YOU EVER DREAM that the science of electronics might be of help to you in your gardening activities? Probably not—it seems like a rather far-fetched, imaginative, futuristic dream even to consider such a possibility.

But it is not far-fetched—in fact, you can build electronic equipment right now which will aid you tremendously in both inside and outside gardening activities. The first device to be described will actually take over the problem of watering the lawn or garden and perform such watering automatically—keeping the moisture level of the soil at the desired point.

And the second device will permit you to determine, quickly and easily, whether watering is necessary—either outdoors or in your "window garden." This device uses an ordinary meter, a single transistor, and a small battery.

Before going into the actual construction details on these two devices, we should perhaps dwell a little on the basic principles by means of which both devices operate.

Dry earth is a very poor conductor of electricity. In fact, it might be called a fairly good insulator. However, when earth is moistened, the story is different. Its conductivity increases greatly until, with certain types of soil and extremely moist conditions, it can be called a good conductor. In between these extremes, the resistance varies over wide limits.

If we could contrive some method of measuring the soil resistance when we know moisture conditions are optimum, we would have a characteristic which we could use to control external equipment, such as a sprinkling system, or which would give an indication of moisture conditions on a meter. A method for doing each of these is covered in this article. Neither device is complicated, and a detailed knowledge of electronics is not necessary to understand the operation of either. And a lot of construction experience is not required.

So, head for your workbench, get out the soldering iron (a low-wattage one for transistor circuits, please), and build yourself either or both of these gadgets.

WATERING CONTROL

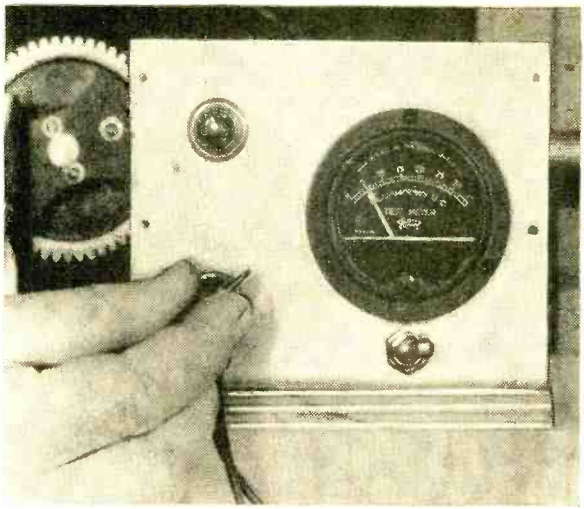
By Walter B. Ford

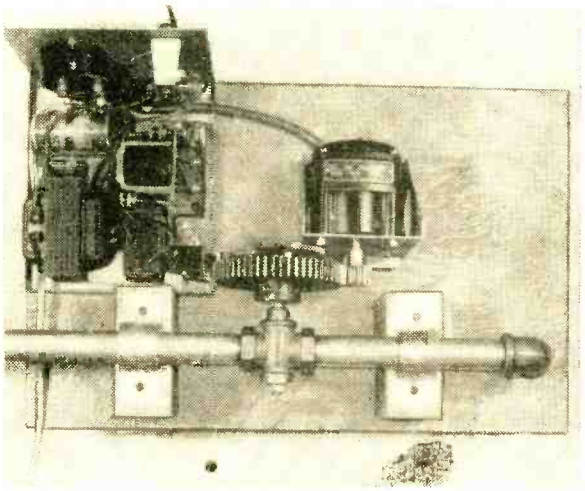
If you are tired of the drudgery of watering your lawn or garden, relax and let this gadget take over. It is highly reliable, constantly on the alert, and will keep the moisture content "just right."

As mentioned previously, this device operates on the principle that the resistivity of the soil changes with varying moisture conditions. We insert two electrodes in the ground at opposite ends of the garden and impress a small d.c. voltage across them, in series with a relay. When there is plenty of moisture present, enough current will flow to keep the relay closed and thus prevent the sprinkler system from operating. Once the ground has dried out, though, the current will drop, the relay will open, and the sprinkler system will start. When sufficient moisture has been soaked up by the ground, the sprinkler will shut itself off.

Basically the system consists of a 24-volt d.c. supply in series with the coil of a sensitive relay, a milliammeter and an adjusting potentiometer. The 24-volt supply is produced by a door-chime transformer and selenium rectifier. When sufficient current flows, the relay is closed and the switching circuit is such that a motor drives the water valve to the "off" position. When the current drops, due to the soil drying out, the relay falls open. This starts the motor, and it continues to run until the water valve is in the "on" position.

Construction of this device is fairly evident from the photographs and pictorial diagram. All components except the motor and valve are mounted inside a suitable box, either aluminum or steel. Exact size is not important—just be sure that it is big enough to hold all the components.



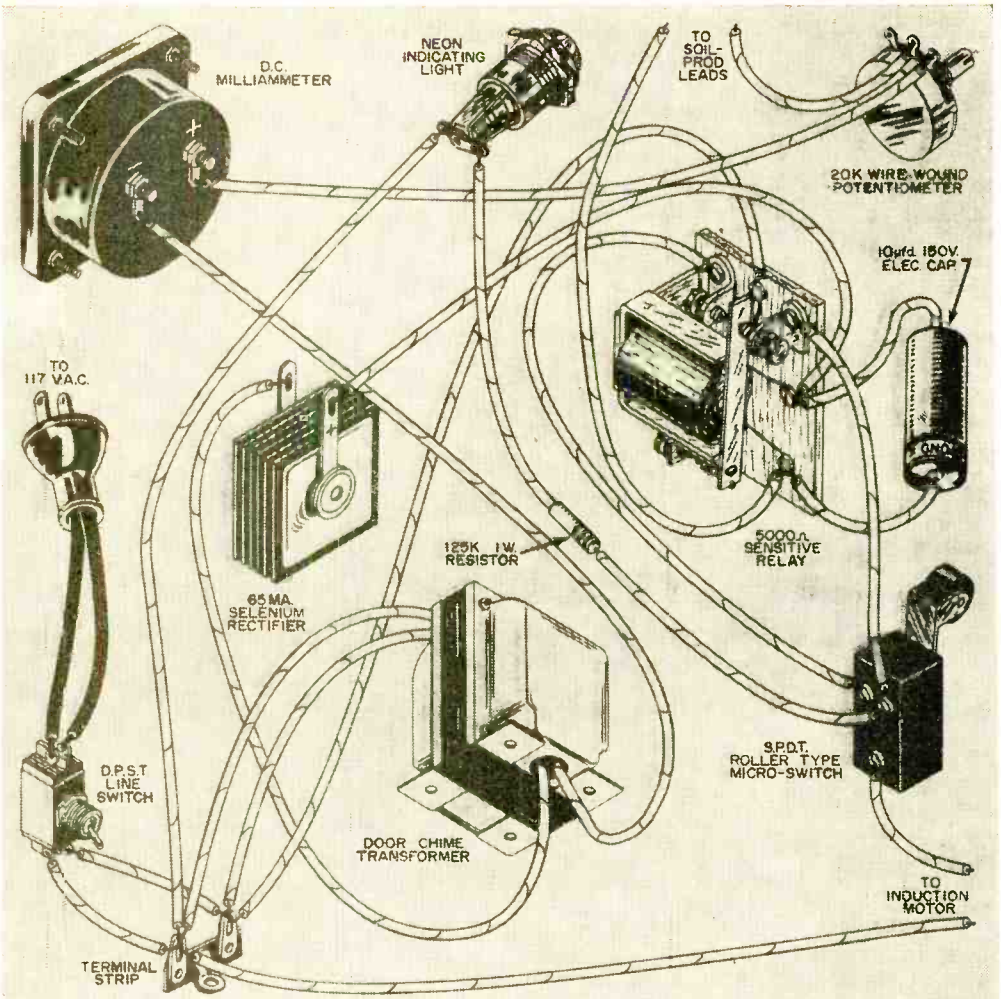


Top, front view of control unit showing the potentiometer being adjusted. Neon indicating lamp is at upper left, "on-off" switch is just below meter. At the extreme left can be seen the large gear with the fiber cam in place. Bottom, interior view shows placement of parts inside cabinet and indicates how motor, gears, and valve are mounted. The pipe and valve are supported on wood blocks of the proper thickness, and are securely held by pipe clamps. The edge of the fiber cam may be seen immediately above the large gear, and the Microswitch and roller just to the left. Mount the fiber cam securely to the large gear with screws, as shown.

The roller-type microswitch is actuated by a fiber cam mounted on the gear driving the water valve. This cam is shaped so that the switch alternates between two positions for each ¼-revolution, since ¼-revolution of the valve is required to turn from "off" to "on" and vice versa. The gear ratio between the motor and valve is not critical—use whatever you can obtain. But be sure that the motor and valve are secure.

Make each prod out of a piece of brass rod about 8" long and 3/16" dia., with a half-inch wood dowel on one end for a handle. Sharpen the other end so it will push into the ground easily and solder on a piece of flexible wire for a lead. Two of these prods are necessary.

Adjustment is made by means of the potentiometer once the unit has been assembled. Select a time when the area to be monitored needs watering, and insert the two prods in the soil at opposite ends of the



1—Small induction motor, such as Holtzer-Cabot, Model RWC-2505, 2 rpm synchronous, available from National Pneumatic Co., Holtzer-Cabot Div., 125 Amory St., Boston 19, Mass.
1—Sensitive s.p.d.t relay, 5000-ohm coil (any value between 4000 and 10,000 ohms should work)
1—Door chime transformer, 24 v. sec.
1—Selenium rectifier, 65 ma.
1—Milliammeter, 0-35 ma. (see text)
1—20,000-ohm wire-wound potentiometer
1—10-μfd., 150 v. elec. capacitor
1—Microswitch, roller arm type, s.p.d.t., available at Herbach & Rademan or Allied Radio Corp.
1—¼ watt neon bulb, socket, and bezel
1—125,000-ohm, 1-watt resistor
1—Set of gears (see text)
1—"Service cock" water valve with head turned to fit large gear
1—Fiber cam mounted on large gear (see text)
1—Metal cabinet (see text)
Misc. wire, solder, etc.

Pictorial diagram and parts list for the automatic sprinkler control system.

garden. Insert them to the desired watering depth probably 3" to 5". With the water valve in the "off" position, rotate the gear wheel with the fiber cam attached so that the cam just releases the microswitch arm; then secure the gear wheel to the valve head and turn the control unit on. The motor should turn the valve to the "on" position where the motor will stop. When the area being monitored has received sufficient moisture, adjust the potentiometer so that the relay closes. No further adjustments should be necessary. You may omit the meter if you wish—it is merely a convenience in making adjustments.

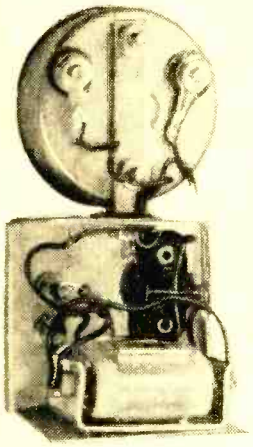
The author has operated this system successfully with the electrodes spaced as far as 100 feet apart. Pull-in current was 4 ma. and drop-out current 1½ ma. for the particular relay used. These values may be varied somewhat by adjusting the tension on the armature spring.

TRANSISTORIZED MOISTUREMETER

By Joseph Chernof

If you just want an indication of the amount of moisture present in the soil, and are not concerned with any control functions, this gadget will serve nicely. It will also give you experience in working with transistors in non-critical circuits.

Essentially, this device measures the current flowing between two electrodes—or probes—inserted in the soil, and thus



Rear view of moisture-meter with cover removed. Construction is extremely simple and should only take a short time. Be sure that you have the battery polarity correct and that the transistor is connected in circuit properly.

gives an indication of soil resistance. With a little experience, you can tell very closely the condition of any type of soil, whether in the garden or in a flower pot in the house. If the indication is that the soil is too dry, it's time to water!

A 15-volt battery impresses a voltage across the probes in series with a resistor and the base-emitter circuit of the transistor. This 15-volt potential causes a current to flow through the soil, the exact value of which depends on moisture conditions. The current, which in general will be rather small, is amplified in the transistor and is read on the meter in the collector circuit.

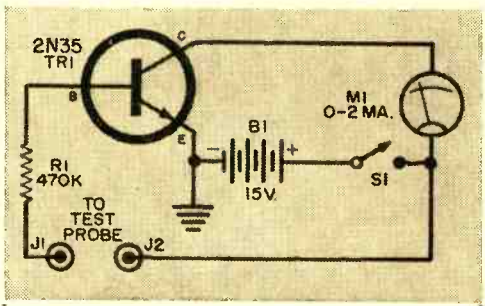
Construction of the probe can be determined from the photograph on page 57. Two 10" lengths of ⅛" brass welding rod are mounted 1" apart on a piece of Plexiglas. This spacing is not at all critical, but is a convenient value to use. Mounting is accomplished by soldering each rod to a standard terminal lug, and then bolting to the Plexiglas. File the opposite end of each rod to a sharp point to facilitate penetration in the soil. The lead-in wires from the probe can be any convenient length, and terminate in standard phone tips which mate with the tip jacks on the front panel.

Mount all components except the meter and transistor socket inside the metal cabinet. Bend an L-shaped bracket, as shown in the photo, to mount the meter above the cabinet. This type of mounting is employed to permit changing transistors easily for experimental purposes, and to allow the meter to be used for other purposes.

The parts placement is not at all critical, and the author's layout does not need to be followed exactly. No heat is generated within the enclosure, so ventilation is no problem.

Resistor *R1* should be selected experimentally, but the value will probably be somewhere in the neighborhood of the value specified. Short-circuit the probes and note if a full-scale reading (2 ma.) is obtained. If not, adjust *R1* accordingly. *R1* will probably have to be changed if a different transistor is employed. Any high-gain transistor may be used, but if you try a *p-n-p* type, be sure to reverse battery connections before turning the switch on!

Exact calibration instructions are difficult, since basic soil resistivity varies widely with the type of soil. As a guide, however, the author found that in his locality a reading of 1 ma. indicated adequate soil



B1—15-volt miniature battery (Eveready #411 or equivalent)
J1, J2—Miniature nylon tip jacks
M1—0-2 ma. meter (Sterling #835 or equiv.)
R1—470,000 ohm, ½-w. resistor (see text)
S1—S.p.s.t. toggle switch
TR1—Type 2N35 n-p-n transistor (see text)
1—Battery holder (Austincraft #411 or equivalent, or homemade holder)
1—Transistor socket
1—Chassis, 2"x1¾"x1¾" (LMB No. MOO or equivalent)
Misc. wire, solder, etc.

Schematic and parts list of moisturemeter

moisture, while a lower value meant that liberal sprinkling or watering was in order. You will have to experiment with the soil in your locality and be guided by indications of moisture content such as feeling and appearance. Once you have played around with this gadget for a while, though, you can give an immediate answer —"to sprinkle or not to sprinkle." —30—

Carry Your Own Piano

Lightweight and always in tune, this instrument makes "silent" music

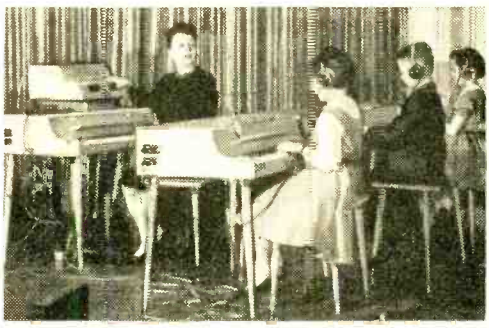
Silent practice saves nerves, hides mistakes. When her playing improves, she'll switch from earphones to speaker.

PIANO-MOVING used to be a good way to develop muscles. But with Wurlitzer now making a lightweight electronic piano, muscle men may have to find some other training occupation.

This "piano" weighs only 72 pounds and is no bigger than a hefty suitcase. In fact, it comes with a luggage-type handle for easy carrying. Yet the piano is no toy. Its keyboard is built to standard dimensions familiar to the practiced hands of any pianist. It covers 64 notes from A (55 cps) to C (2093 cps). Since only classical concert pieces demand a full 88-key range, this keyboard is adequate for informal home playing and elementary teaching.

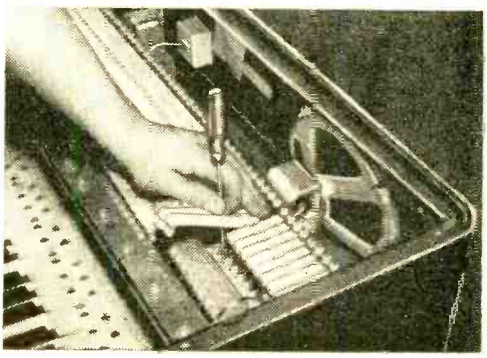
How does it sound? It comes quite close to a regular piano. Avoiding electronic sound generators, the piano uses regular hammers and felt dampers striking tuned reeds. The formants and transients of "attack" and "release," i.e., the marginal sounds at the beginning and end of each note which give every instrument its particular personality, are therefore very similar to those of an ordinary piano. The reeds, like the metal bars of a xylophone, are tuned by their internal stress rather than by externally applied tension. Consequently, this piano, like a bell, never gets out of tune.

Vibrations of the struck reeds alter the capacitance of a pickup circuit feeding into an audio amplifier. The sound then issues from a loudspeaker or through earphones. By variations of touch and working a tone control filter, it is possible to imitate the



Intercom hookup of pianos lets teacher "tune in" on pupils, correct them individually without disturbing others. Concentrating on progress, each student hears only himself or teacher's instructions.

Piano action imitates touch and tone of ordinary piano. Hammers and dampers are aligned by screwdriver, but no tuning is ever needed. Internal speaker is shown; outside speakers can be added.



sound of harpsichord and guitar with this instrument.

The audio amplifier also plays records from a special phono input with an independent volume control, enabling the piano to "play along" with recorded music. In this way, the electronic piano becomes a component of a high-fidelity sound system. Its self-contained speakers are adequate for most uses. Better bass can be obtained by connecting a properly baffled external speaker to the amplifier output.

More surprising than the instrument itself are its possible applications.

Silent Piano Practice. Keat's famous line *"heard melodies are sweet but those unheard are sweeter"* may well have been inspired by someone practicing a piece. The Wurlitzer saves the temper of innocent bystanders when there's a musician in the house. Not until you're good enough to cause applause instead of groans do you turn on the loudspeaker. Until then, you plug in a pair of hi-fi earphones and listen to yourself while no one else can hear you. You actually have a "silent" piano.

Electronic Music Lesson. A new method of music teaching has sprung up with this instrument and is currently creating quite a stir in music schools. As shown in our picture, each pupil listens to himself by means of earphones, undistracted by others in the group. The teacher "cuts in" her master station on the various students, checking their performance. Over an intercom hookup, she corrects each student individually, either by voice or by playing her own piano, without disturbing the others. At the flick of a switch, she can also talk or play for the whole class.

To visitors, the whole classroom seems like a silent movie. Then another switch clicks, the students slip off their earphones, and a total avalanche hits the startled visitor.

Teachers say this combination of individual training and group work gives students maximum stimulation and incentive. Gone is the hated solitude of practice that made group-oriented youngsters shy away from music lessons.

Schools get more out of their staff and space with the new Wurlitzer. A single teacher can attend more students at the same time without sacrificing individual attention. The silent instruments don't disturb next-door classes and also make it possible for many students to practice individually in the same room. No soundproofing is necessary. With these factors in mind, many schools consider the Wurlitzer Electronic Piano, priced around $350, a key to efficient and economical operation.

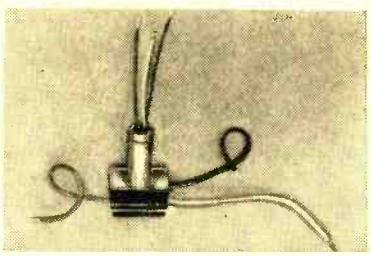
Medical Use. Doctors, knowing that morale is medicine's best ally, tried the Wurlitzer with musical hospital patients. Sitting in bed with the "piano" over their laps, earphones on their heads, ward patients find courage and health through creative enjoyment. —30—

NEW ERA IN HOUSE WIRING

ANYONE COMING HOME at night fumbling for the switch in room after room knows that the electric age has not yet fully conquered the forces of darkness. Now a new device, which is called "Remcon," lets home owners light up the whole house at the flick of a single switch. Later the lights can be turned off individually or as a group. Besides, single outlets or fixtures can be remote-controlled from any number of switches conveniently placed throughout the house.

Start the attic fan from the kitchen; turn it off again from your bedside before going to sleep. Silence the radio in the next room when the phone rings. Turn on the bathroom heater from your bed, control porch and upstairs lights from your chairside—this is Remcon convenience.

Wiring is easy. There are no heavy, shielded BX-cables to cut, bend and string about. The whole system works on six volts, using thin, flexible bell wire that can be "fished" through walls without difficulty. Installation, therefore, is not only fast but is economical as well.

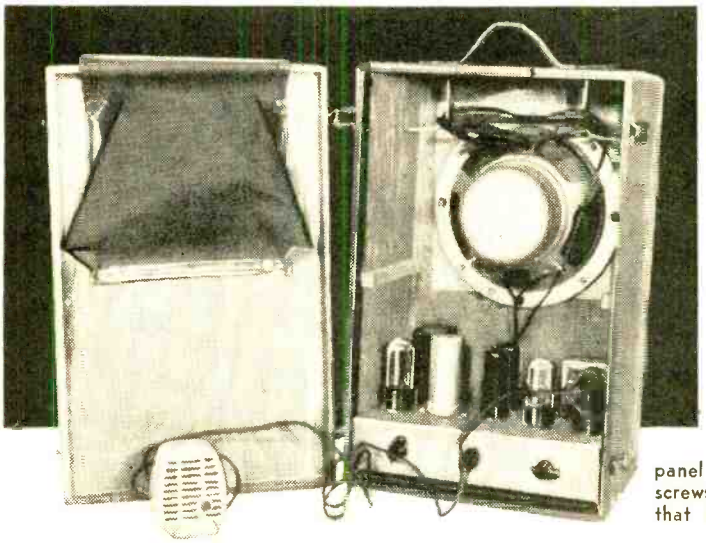


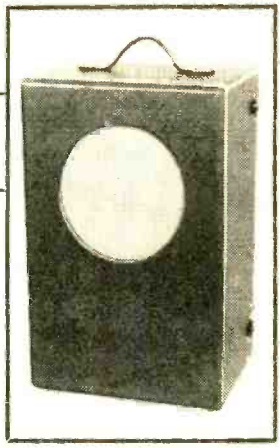
Miniature relay for remote multiple switching has self-contained six-volt transformer and fits into outlet box.

No external 6-volt power supply is needed. Each line forms an independent circuit, a self-contained unit ready for installation at any outlet in the house. The low voltage comes from a miniature transformer built into the switching relay controlling the power line.

Low voltage in lines and switches also eliminates fire and shock hazards. A light switch can safely be placed within reach of children who become frightened in the night. With Remcon, bare feet on the wet bathroom floor no longer invite the undertaker. (*Pyramid Instrument Corp.*, Lynbrook, N. Y.)

Four Components Make Simple PA System





Complete system is mounted in compact, plastic-covered carrying case (above). With microphone connected, it is ready for use (left). Speaker is mounted to front panel of case (below). Note that screws should be short enough so that they don't penetrate plastic.

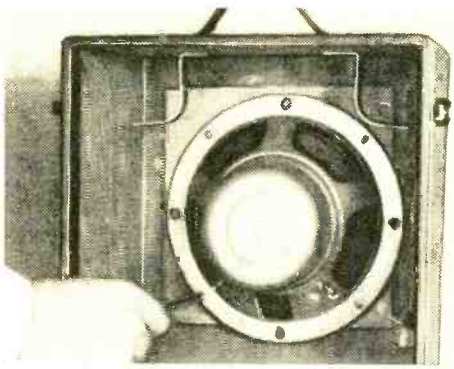
IF YOU'RE looking for an inexpensive sound system, this may be the one you want. It consists of an amplifier, speaker, carrying case and crystal microphone.

The system is built around the familiar six-watt Heathkit Model A-7B amplifier (see POPULAR ELECTRONICS, October, 1954, pp. 30-32). If you prefer an A-7C amplifier, complete with preamp, the input stage must be modified as indicated in the amplifier kit. The new Model A-7D 7-watt amplifier should work equally well, if not better.

You may want to make the carrying case yourself from plywood, but the one used here is an Allied Radio case, 16¾" x 11⅛" x 8⅞". Any good quality 8" speaker will do; the better the quality, the better the reproduction. A Permoflux speaker was found to give excellent results.

Start construction by mounting the speaker in the case. Carefully center speaker over mounting hole, and mark the case through the speaker mounting flange holes. Fasten speaker to case with wood screws that won't pass all the way through the case.

A good trick for centering the speaker is to make a number of marks around the mounting hole about ¾" from the edge. When the speaker is placed over the hole, its relative position can be judged from these marks.



To fit the Heathkit amplifier into the Allied case, bend the horizontal flanges on both ends of the chassis to the vertical position. Insert amplifier, and mark sides of case through the mounting holes in the flanges. Drill the case for two mounting bolts, one on each side.

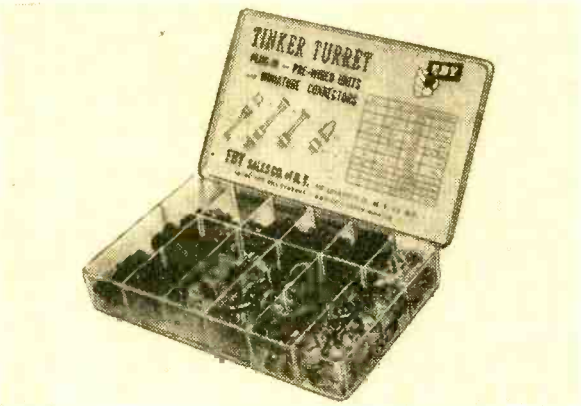
Connect two leads to the speaker voice coil terminals, and connect the other ends of the leads to the output terminal strip on the amplifier. For best results, match amplifier output impedance with that of the speaker. Insert microphone plug into the receptacle on the back of the amplifier. Slip amplifier into case, and secure it with the two mounting bolts.

Your PA system is now ready for use. Just plug it in.—*Allen C. Trainer.* —30—

New Trade Winds for the

A new "see-easy" kit with 12 standard thermistors is now available in a plastic compartment case for quick reference. Specification sheets covering dimensions, temperature-resistance curves and other characteristics of the rod-type thermistors are included. Applications in electronic sensing, control and indicating devices are also described. The dozen thermistors, each individually packaged, cover a resistance range from 25 ohms to 1 megohm. (Friez Instrument Division, Bendix Aviation Corp., Baltimore, Md.)

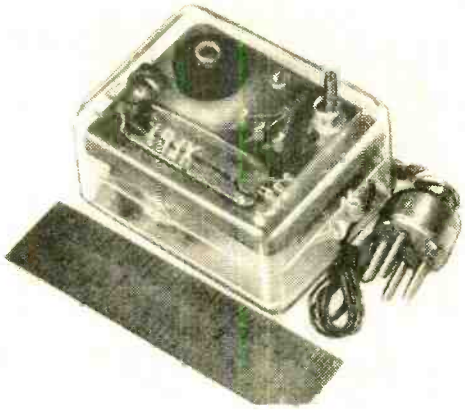
Make your own pre-wired plug-in units and connectors with the Tinker Turret. This kit lets you construct nearly every type of plug-in turret assembly popular in modern modular and unitized circuitry. Here is an assortment of sockets, wafers, spacers and bases to serve as structural skeleton for almost any circuit the engineer, lab technician or home experimenter may dream up. In-line multiple connectors can also be made. Parts are separately available for replacement in packages of twenty. Large kit: $26.33. Small kit containing 20 pieces of each item: $6.60. (Eby Sales Co., 130 Lafayette Street, New York 13, N. Y.)



Checking capacitors without unwiring connections is the time-saving feature of this new service instrument. "Magic Eye" gives immediate indication of "open" down to 20 $\mu\mu$fd. and "short" up to 2000 μfd. Checker comes as prepunched kit, sells for only $11.65. (Allied Radio Corp., Chicago 80, Ill.)

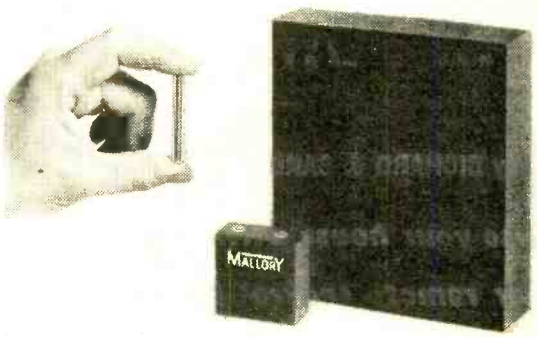
Outdoor hams can always stay within reach with the new ECCO ER-6 low-cost portable transceiver. Tunable to any frequency in the six-meter amateur band, this unit is also ideally suited for emergency or disaster operation. Batteries last for about 100 hours. Push-to-talk switch is mounted either on handset or on transceiver case if military-type headset is used. Price: $49.95

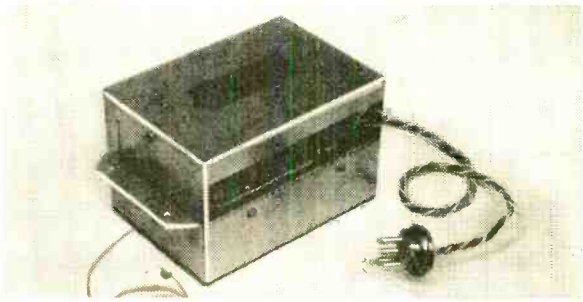
Electronics Experimenter



A new miniature RC receiver weighing only two ounces uses a high-gain transistor relay current amplifier in conjunction with a thyratron detector, operates on 27.255-mc. citizens band. Housed entirely in a small plastic 1¼" x 1½" x 2¼" case, the set is powered by a hearing-aid battery. Transistor is sturdy, has no fragile filament. Life span runs into thousands of hours. On receipt of signal, relay current rises to approximately 3 ma., assuring reliable response. In tests, this Type DX receiver maintained control over a large aircraft model for distances up to 4 miles from the transmitter. (Gyro Electronics Co., 325 Canal Street, New York 13, N. Y.)

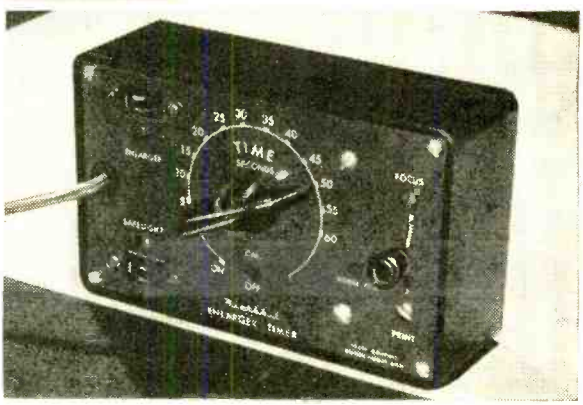
The first really "dry" battery has just been invented. Operating in entirely solid state, no moisture whatever is needed. Vastly prolonged shelf life assures full power after ten years storage. Independent of temperature, cell keeps its strength between 65° below zero and 165°F. Highly efficient, a 1-cubic-inch model generates 200 volts. However, current output is still limited. Both military and civilian uses are planned. (P. R. Mallory & Co., Inc., Battery Division, North Tarrytown, N. Y.)





A new five-channel RC receiver uses 27.255-mc. carrier and audio frequencies fixed between 250 and 400 cps. Low current drain (1.5 ma. at no signal, 4 ma. with signal) prolongs life of hearing-aid battery. It draws only .04 amps from 1½-volt penlite cell. Tested and tuned at factory, receiver seldom requires additional tuning. Complete unit sells for $119.50. Kit less reeds and relays costs $32.95. (CG Electronics Corp., Albuquerque, N. M.)

Heathkit Model ET-1 all-electronic timer automatically controls exposure time of photo enlarger. Dial is calibrated from 5 to 60 seconds. As enlarger turns on, safelight automatically goes off. Hands always remain free for "dodging" without danger of over-exposure. Special "focus" position of control switch leaves enlarger lighted for focusing or masking. Once dial is set, a simple push button starts the timing cycle for each enlargement operation. (Heath Company, 305 Territorial Road, Benton Harbor, Mich.)



Household Remote Control

By RICHARD J. SANDRETTO

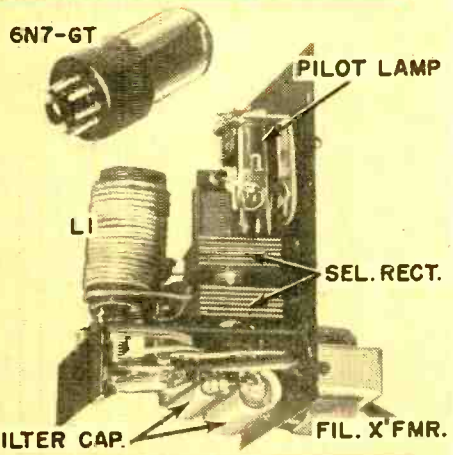
Use your house wiring for remote control by building a "W/W" system

WIRED - WIRELESS remote control. That sounds like magic, doesn't it? And it is, too. But it's a kind of magic that you can easily bring into your own home via the equipment described in this article (and in Part 2, which will appear in next month's issue).

Wouldn't it be fun to control various electric appliances such as radio and TV sets, coffee-makers, toasters, fans, and the like—and even outdoor lighting—without running a maze of control wires? You can do it, of course, by means of conventional radio control—but this runs into money and may require FCC approval. "W/W," on the other hand, doesn't call for any extra control wires, and FCC approval isn't necessary if the transmitted signal is kept low in power.

Wired - wireless, as the name implies, means using the existing house wiring to conduct r.f. control signals from the transmitter to the receiver. You can build very simple and inexpensive equipment to make up such a system.

Best results will be obtained if you use frequencies between 180 and 350 kc. At higher frequencies, radiation is apt to become excessive, while at lower frequencies the signal may be appreciably attenuated by appliances and lights connected across the power line. Also, the dimensions of the tuning coil are increased as the frequency is lowered. With this equipment, the radiation will not exceed FCC specifications if you keep within the suggested frequency range.



Top: over-all view of wired-wireless transmitter. Bottom: interior view, showing location of the major components both above and below the chassis.

Construction. The transmitting unit built by the author will operate at two different frequencies, permitting control of two different operations with the appropriate receivers. Construction is straightforward, as can be seen from the schematic and pictorial diagrams and the photographs. Remember that you're dealing with radio frequencies, and keep all leads as short and direct as possible. If you are only interested in one control operation, you can omit *S2* and *C3*. Similarly, if you'd like to control more than two remote units, other switches and capacitors may be added to tune the tank coil *L1* to the desired additional frequencies.

A 4" x 3" x 5" utility cabinet with a 3" x 3" x 1" chassis was used by the author for the transmitter. However, a larger cabinet is recommended, as it was necessary to mount the filament transformer outside of

the enclosure. Use your judgment—if small size is not absolutely necessary, you'll find the assembly to be somewhat simplified with the larger enclosure, and you can mount the filament transformer inside.

Construction details for the tank coil are given in the parts list. If you want to vary the construction slightly, you can do so, provided that you don't change the over-all value of the inductance. For example, if you use a ¾"-diameter form, put on 240 turns of wire—if the form is 1½" in diameter, use 145 turns. Add several turns if No. 26 wire is used, and subtract several for No. 30 wire. Dip the coil in paraffin or coat with coil cement to hold the wire in place. Mount as far away from metal surfaces and components as conveniently possible. And wrap about 20 turns of hookup wire around the coil for the secondary.

Be sure to use the specified types of ceramic capacitors for *C2* and *C3*. They do not change value with change in temperature, and so minimize frequency drift. Other types may shift in value, causing the transmitter frequency to drift beyond the range of the receiver.

If you want to use several different frequencies, replace *S2* with a switch having the desired number of positions. With *S2* open, operating frequency will be about 340 kc. Shunting various values of *C3* across the coil will give other frequencies. For example, if *C3* is 130 μμfd., frequency will be 290 kc.; 240 μμfd., 240 kc.; and 480 μμfd., 190 kc. Such frequencies would be far enough apart to prevent activation of the receiver by the wrong frequency. Due to variations in hand-wound coils and other components, these frequencies are only rough estimates.

Testing. Check the wiring carefully, then plug the transmitter into the power

HOW IT WORKS

A type 6N7-GT is employed as an oscillator tube, with the frequency controlled by tank coil *L1* and capacitors *C1* and/or *C3*. Plate voltage is provided by a voltage-doubler circuit (*SR1*, *SR2*, *C4* and *C7*). This circuit gives a d.c. output of about 250 volts, depending on the load, which is adequate for this application. Better regulation could be obtained by using larger capacitors for *C4* and *C7*, but regulation is not critical here.

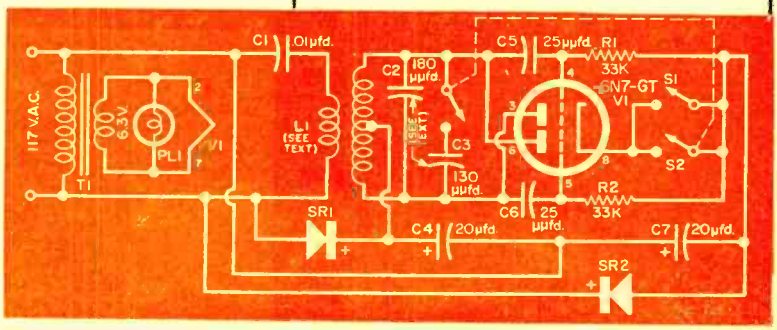
Very little filtering is used, so the voltage at the plates of *V1* will have quite a high ripple content. This does not impair the operation of the device, and provides a means for checking oscillator frequency as indicated in the text. The ripple frequency modulates the oscillator output, and can be heard when a radio receiver is tuned to the oscillator frequency or one of its harmonics.

The secondary winding of *L1* couples the r.f. output of the oscillator to the power line. *C1* is inserted to prevent *L1* from short-circuiting the power line, and has no effect on the r.f. being employed. Transformer *T1* provides heater voltage for the 6N7-GT and for pilot light *PL1*.

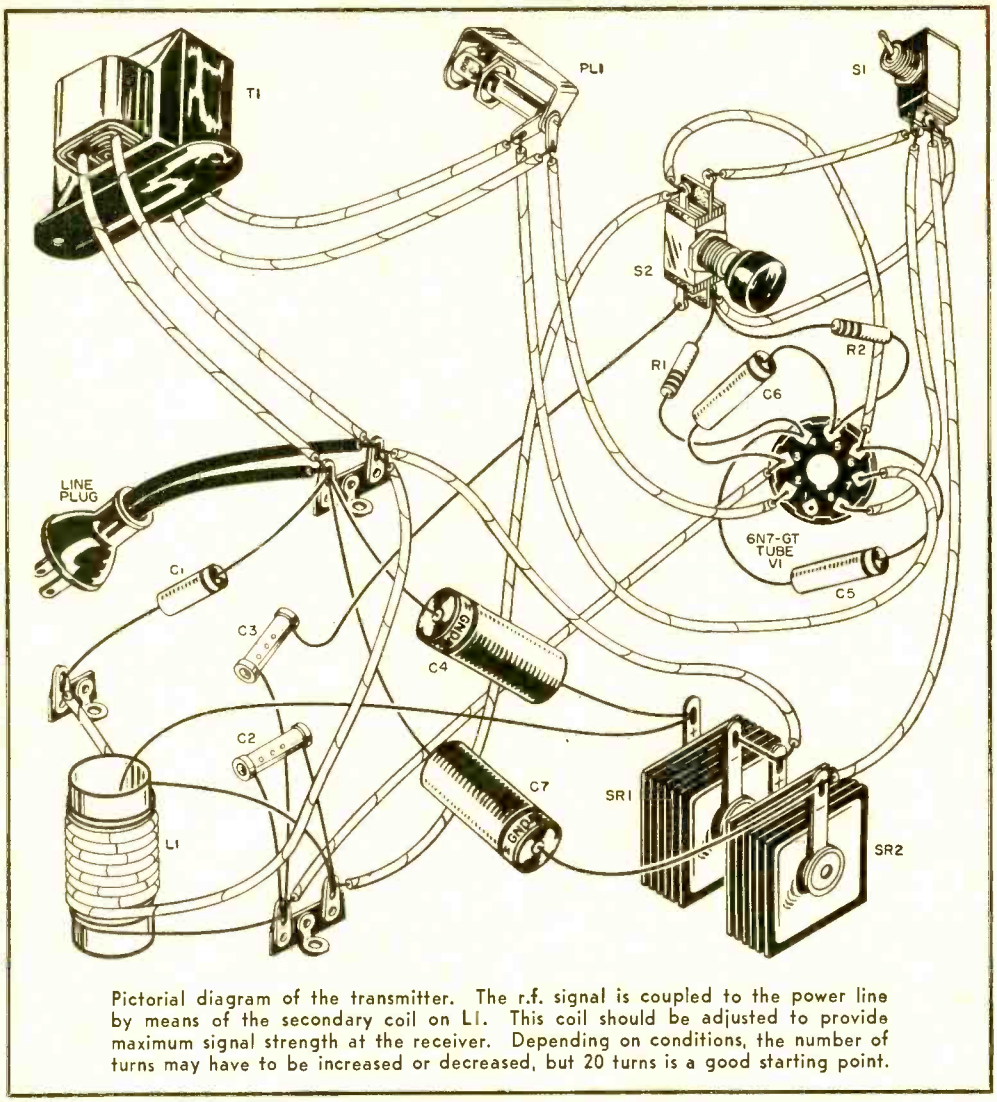
with Wired-Wireless

PARTS LIST

C1—.01-μfd. mica capacitor
C2—180-μμfd. ceramic zero-drift capacitor
C3—130-μμfd. ceramic zero-drift capacitor
(Note: C2 and C3 should be Centralab Type TCZ or Sprague or Erie Type NPO. If exact values specified are not available, make up parallel combinations to give desired capacity. See text.)
C4, C7—20-μfd., 150-volt electrolytic capacitor
C5, C6—25-μμfd. mica capacitor
L1—Primary, 180 turns, center-tapped, No. 28 enameled wire close-wound on 1" waxed cardboard or Bakelite form 2½" long. Secondary consists of about 20 turns of No. 20 or 22 plastic insulated wire wound around the primary. (It may be necessary to increase or reduce the number of secondary turns, depending on local conditions.)
PL1—No. 51 pilot lamp and socket assembly
R1, R2—33,000-ohm, 1-watt resistor
S1—S.p.s.t. toggle switch
S2—D.p.s.t. push-button switch
SR1, SR2—100-ma. selenium rectifier
T1—Filament transformer, 6.3 volts @ 1 amp.
V1—6N7-GT tube
1—Line cord and plug
1—3" x 4" x 5" metal utility box (ICA No. 3817)
1—3" x 3" x 1" chassis
1—Kitchen cabinet handle
Misc. machine screws, wire, solder, etc.



Schematic diagram of transmitter portion of the complete system. For greater versatility, switch S2 may be replaced with a multi-tap switch for selecting several different operating frequencies.



Pictorial diagram of the transmitter. The r.f. signal is coupled to the power line by means of the secondary coil on L1. This coil should be adjusted to provide maximum signal strength at the receiver. Depending on conditions, the number of turns may have to be increased or decreased, but 20 turns is a good starting point.

line and set to a frequency. The tube heater should light, and after a brief warm-up period of about 20 seconds the transmitter should be functioning.

Home radios and amateur communications receivers don't tune below 500 kc. However, the following check can be made to find out if your transmitter is functioning; and if so, on what frequency.

Tune a nearby radio through its range. A very distinct 60-cycle hum will be heard at no fewer than two points on the dial if the transmitter is operating below 500 kc., as it should. The signals heard are harmonics (whole number multiples) of the transmitter's fundamental frequency, which is called the first harmonic (1 times the fundamental). Unless the radio dial is far off, the approximate frequencies of at least two and probably more harmonics can be found.

The kilocycle difference between adjacent harmonics equals the fundamental frequency. For example, a 340-kc. fundamental has a second harmonic of 680 kc. (2 times 340), a third harmonic of 1020 kc., and a fourth at 1360 kc. The second, third, and fourth can be tuned in on a broadcast receiver. Subtracting the 680-kc. harmonic from the adjacent one, 1020 kc., gives 340 kc., which was the frequency of the fundamental.

If a multi-frequency transmitter has been built, its other frequencies can be similarly checked. They should all lie within the approximate range of 180-350 kc.

The construction, adjustment, and application of a wired-wireless receiver will be covered in Part 2. —30—

Tuning the Short-Wave Bands

=with Hank Bennett

THIS MONTH we take pleasure in telling our readers about one of our consistent top-notch reporters: Louis Marcarelli of 99 Willis Ave., Medford 55, Mass. A student at Lincoln Junior High School, Louis will be 14 on September 24.

He DX'es with a war surplus BC-342N receiver, a Hallicrafter S-38C doing standby duty. His antenna is an 80-foot "long wire," 55 feet high, running NE-SW. An enthusiastic s.w. DX'er, he also likes the ham bands, with 20 meters being his favorite. Lou recently passed the Novice examination but has not received his call letters. He is all set for the 15-meter band with a Harvey-Wells transmitter.

Lou owns a tape recorder and has his eye on a DB-23 preselector. To date, he has heard 83 countries. His collection of verifications totals 50, QSL's of *Radio Netherlands* and *Radio Japan* being his best.

By way of preference, his choice of the best DX band is the 31-meter band (9500 to 9800 kc.), and *Radio Australia* is his favorite station. When asked why, Lou replied that he enjoys the interesting programs about Australia, the country and people. He thinks that they have one of the best DX sessions on the air.

Lou became interested in radio two years ago, but it wasn't until February, 1955, that he began DX'ing. Since that time, he has fattened his logbook with all of Central and South America except Bolivia, and all of Europe except Luxembourg, Finland, and Austria.

Hobbywise, in addition to radio, Lou is interested in photography and basketball, and has been able to combine those two by having some of his basketball photographs appear in the Boston area newspapers. Besides being a crack reporter for POPULAR ELECTRONICS, Lou also holds membership in the Newark News Radio Club, the Medford Amateur Radio Club, and is active in civil defense.

Club Notes

The Newark News Radio Club will hold its Annual Dinner on May 12 at the Far Hills Inn, Somerville, N. J. Tickets are $5 each and can be obtained from the dinner chairman, A. J. Koempel, 75 Neptune Ave., Neptune City (Avon P. O.), N. J. Checks may be made out either to Mr. Koempel or Newark News Radio Club.

DuWayne Bostow, Max, N. D., writes that he and two ham friends, K6KRK and K4CHK, are trying to organize an SWL-HAM club. They plan to have a monthly magazine which will contain news about the members and their equipment, schematics of receivers and transmitters, and conversion data. Further information can be obtained from DuWayne.

Another fine radio club is the Universal Radio DX Club with headquarters in Hayward, Calif. The URDXC issues 19 bulletins yearly (monthly, May through September; semi-monthly, October through April) containing s.w. and ham columns. Marvin Robbins, David Morgan, and Bob Hill, Jr. are doing an excellent job editing their s.w. columns, while Ralph Kastner capably handles the ham section. Membership information and sample bulletin are available from Charles C. Norton, 21446 Birch St., Hayward, Calif.

Rolan Riker, 2141 Elm Court, San Bernardino, Calif., writes that the World Shortwave Club, of which he is Editor, wants more members. They issue a monthly bulletin and it is free. For further details, write directly to Mr. Riker.

(*Continued on page* 109)

Louis Marcarelli tunes in on BC-342N receiver. His Bandmaster De Luxe transmitter is at left.

Fully loaded tractor makes its way, without an operator, through plant to shipping room. Route is determined by direction of overhead guide wire, with "Guide-O-Matic" under automatic control at all times. Radio waves are radiated along guide wire by means of small transmitters installed at various spots in the plant. To call a truck, technician activates a transmitter. The truck will come at once to the station from which the signal originated. A "sniffer" receiver box, mounted on the vehicle, picks up signals from the overhead wire. Inside the "sniffer" is a relay system that answers commands instantly. The guide wire may be strung in any number of routes to permit the same truck to perform several errands. "Guide-O-Matic" is powered by a battery which is recharged by an automatic coupler to power lines after each "round trip" is completed.

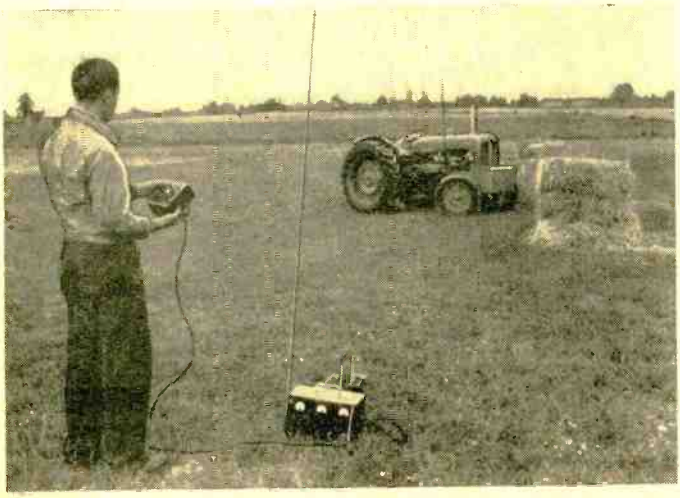
RADIO WAVES GUIDE DRIVERLESS TRACTORS

UNMANNED tractors, doing full-load jobs, are lumbering across factory floors and farming fields, hauling and plowing, trundling through crowded areas, avoiding obstacles, turning and stopping as required—all under the guidance of invisible radio waves sent out by a remotely located transmitter.

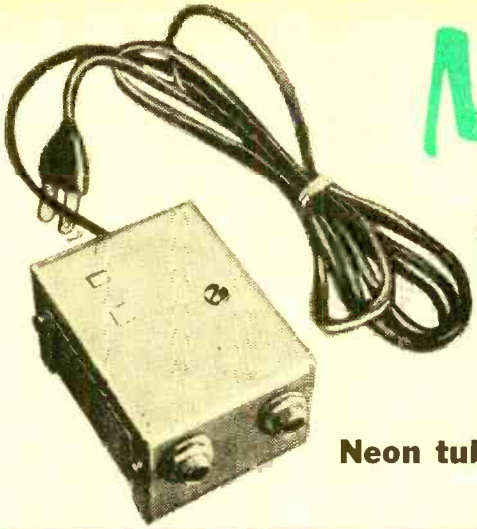
One such robot-like device, developed by the Barrett-Cravens Co., Northbrook, Ill., follows a route set by a guide wire strung from the ceiling overhead. Dubbed "Guide-O-Matic," this tractor has no physical connection to the guide wire; it takes its orders from the high-frequency signals emanating from the guide wire strung out overhead or along the floor.

An agricultural counterpart is the Fordson Major Diesel tractor developed by the Ford Motor Co., Ltd., of England. This heavy-duty vehicle may well be the robot farmer of the future. Operating on 27.12 mc., it uses six audio tone channels to control its six functions—steer left, steer right, clutch out, raise implements, lower implements, and engine stop.

Highlights of these devices are given alongside their respective photos. —30—



Receiver in Fordson tractor has tuned reed output relays for reception of individual signals in any of its six audio channels. These relays, in turn, operate secondary relays to provide excitation from the 12-volt tractor battery to the solenoids connected to actual tractor-driving controls. Colored lights, mounted on tractor, indicate which channel is in use and serve as check on function. Vehicle is activated by instructions given to transmitter located remotely.

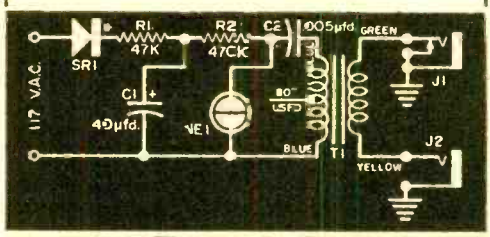


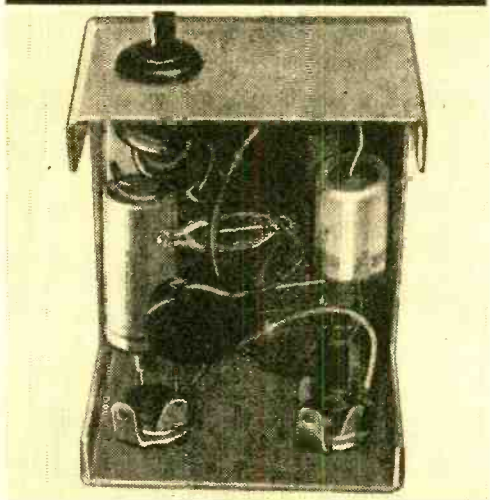
Miniature Tone Generator

Neon tube device meets many needs

PARTS LIST

C1—40-μfd., 150-volt electrolytic capacitor
C2—0.005-μfd. ceramic capacitor
J1—Normally closed phone jack
J2—Open-circuit phone jack
NE1—Type NE-2 neon lamp
R1—47,000-ohm, ½-watt resistor
R2—470,000-ohm, ½-watt resistor
SR1—20-ma. selenium rectifier
T1—Transistor transformer, Utah Type 1755
1—Aluminum box, 1⅝"x2⅛"x2¾"





Looking inside the compact tone generator box.

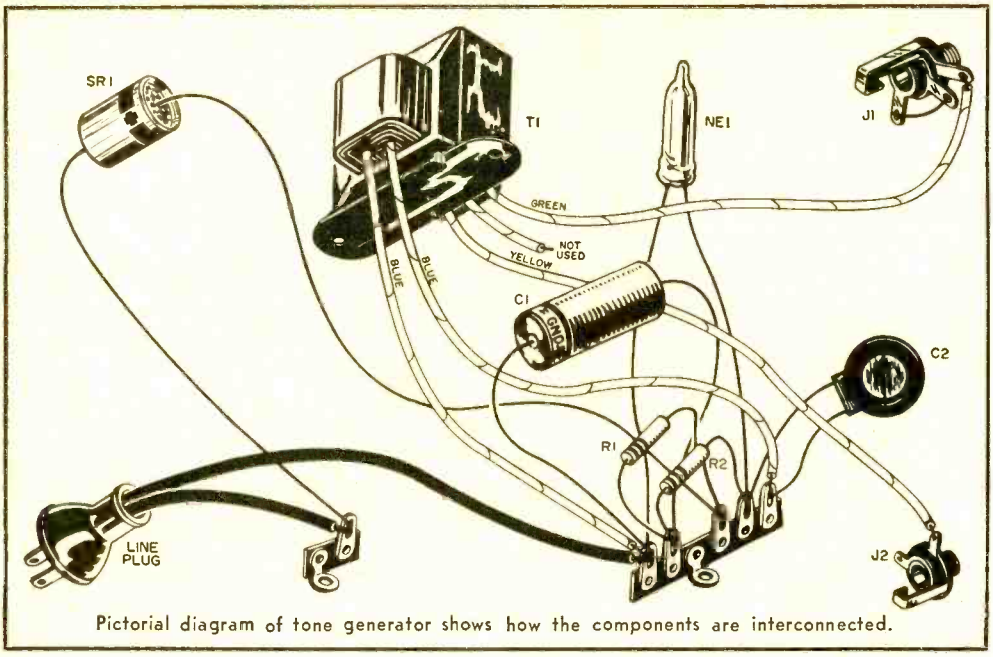
A SIMPLE neon tube tone generator has scores of applications. The audio experimenter uses it to check amplifiers and speakers, the would-be ham needs it for code practice, while the full-fledged ham uses it for checking the modulation of his transmitter.

This unit consists of a power supply, a neon tube oscillator in the so-called "relaxation circuit," and an isolation transformer to prevent electrical shock hazards. The signal heard in a pair of ordinary phones is at a comfortable level. All of these desirable features are built into an aluminum box measuring only 1⅝" x 2⅛" x 2¾".

Assemble the tone generator as shown in the photos. Use jack *J2* for the headphone

HOW IT WORKS

In the wiring diagram, selenium rectifier *SR1*, resistor *R1*, and electrolytic filter capacitor *C1* form the power supply. Current drawn from the supply is very low. The d.c. voltage appearing across filter capacitor *C1* is used to operate the tone generator, which consists of resistor *R2*, neon lamp *NE1*, and ceramic capacitor *C2*. Capacitor *C2* charges through resistor *R2* to a voltage adequate to ignite the neon lamp *NE1*. When *NE1* ignites, it draws a relatively heavy current, discharging *C2* down to a voltage level too low to maintain the discharge through the lamp. At this point, the lamp goes out, *C2* recharges through *R2*, and the cycle is repeated. Since the charging and discharging of *C2* occur at a very rapid rate, *NE1* appears to remain permanently lit. The varying current which results from the charging and discharging of *C2* flows through the primary of the miniature transformer *T1*, and by transformer action causes the tone voltage to appear across the secondary. To change the pitch of the generated tone, a different value of *R2* may be employed. A larger resistor will decrease the pitch; a smaller value will increase it. For a continuously variable pitch control, *R2* may be replaced with a 1-megohm rheostat.



Pictorial diagram of tone generator shows how the components are interconnected.

plug; the other jack is for the plug of the key—when the generator is needed for code practice.

The transformer shown, *T1,* is a Utah Type 1755 miniature transistor transformer. It is mounted by the two projections which fit into narrow slots filed in the top of the box. The projections are bent flush with the box to hold the transformer in place.

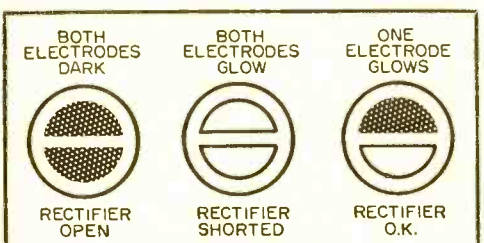
Make and solder all connections carefully. Use small-diameter varnished tubing on all leads where short circuits might otherwise occur. Crowding isn't necessary; there is plenty of room in the box for all components.—*Frank H. Tooker.* —30—

Simple Rectifier Tester Uses Neon Lamp

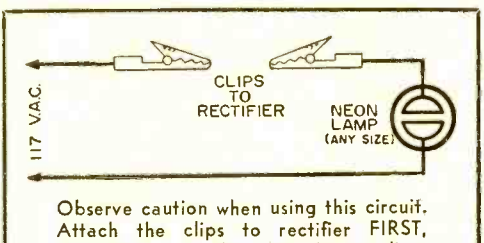
SELENIUM rectifiers may be checked by connecting them to the a.c. power line in series with a neon lamp bulb. This circuit will prevent damage to the rectifier and bulb, regardless of the condition of the rectifier.

The glow of the lamp bulb discloses the condition of the rectifier. If the rectifier is open, no current can flow in the circuit, and the lamp does not light at all. If it is shorted, both electrodes of the lamp glow. When the rectifier is okay, a.c. from the power line is converted to d.c., and only one electrode of the lamp glows. A blinking lamp indicates an intermittent short or open in the rectifier.

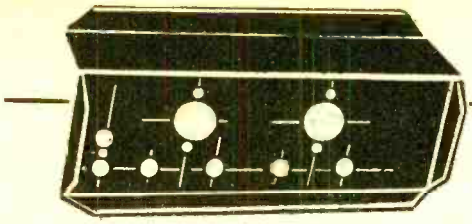
To prevent electric shock when testing rectifiers in this circuit, first connect the clips to the rectifier. Then, plug in the power line. After making the test, pull out the plug before unclipping the rectifier. Follow this procedure with all of your selenium rectifiers and you will be safe.—*Rufus P. Turner.* —30—



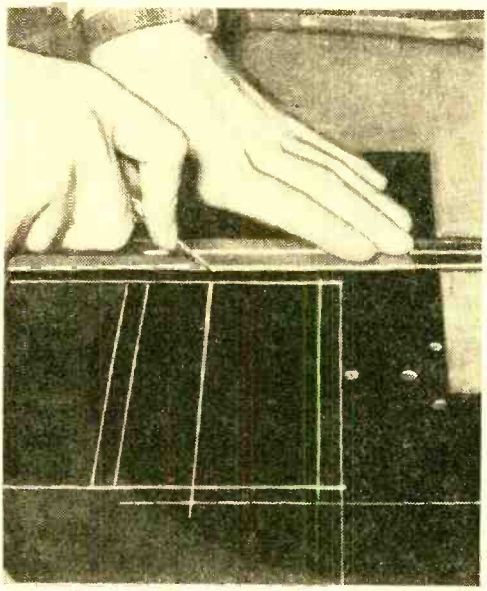
Three selenium rectifier test patterns.

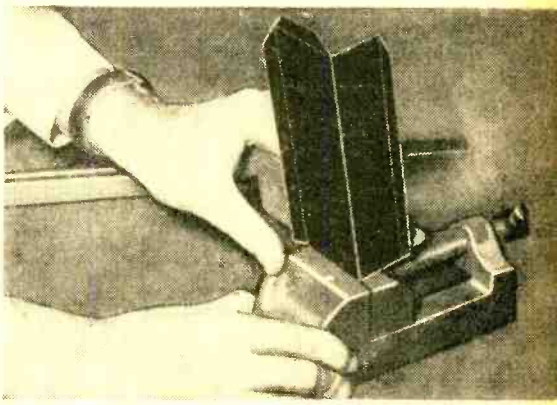


Observe caution when using this circuit. Attach the clips to rectifier FIRST, then plug into the 117-volt a.c. line.



Chassis Are Where You Find Them





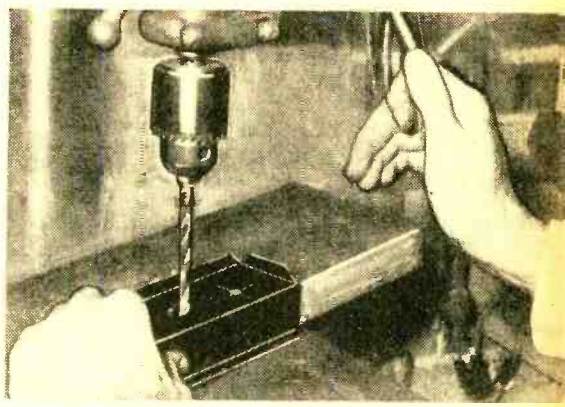
Small drill-press vise is used for bending lip on chassis. Metal plate, pressed against back of chassis, helps in forming angles by hand pressure.

With scriber, straight-edge, and square, lay out guide lines for bending chassis.

SCRAP ALUMINUM often can be worked over to furnish chassis material. One source of such metal is the old transcription platters that you can pick up at your local radio station. Made of top grade aluminum, their thickness is just right for use as chassis. Don't worry about the thin layer of black acetate that coats them—this coating protects the surface until all cutting, bending, drilling, and punching is done. What's more, it's a cinch to make layout marks right onto the acetate.

Once you've laid out your chassis, cut it with a sharp tin-snips. File all edges to remove sharpness and burrs. Then fold the material to shape, as shown in the photos. Form all center bends before working the edges. Use a bench-mounted vise and a small drill-press vise; the larger bench vises have serrated gripping jaws which could damage the soft aluminum.

By pressing a steel bar or piece of hard wood against the projecting aluminum, you can make most of the folds by hand—at least until the bend is nearly completed. Flatten the corner finally by hammering on the steel or wood buffer—never hammer directly on the aluminum; and make sure all bends follow the previously scribed lines.



Drill holes to clear the punch-actuating screw before using tube socket punch. Wood block backs up chassis for drill.

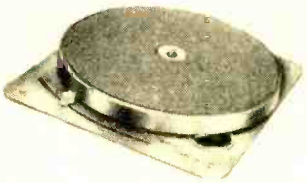
When all folds are made and all holes drilled, punched, and filed, remove the acetate coating by boiling the chassis in water. A few minutes "cooking," and the acetate will peel off readily with tongs or pliers.—*M. P. Johnson,* W3TRR. —30—

what's new in hi-fi

AUDIO ARTISANS, INC.
396 Saw Mill River Rd.
Hawthorne, N. Y.

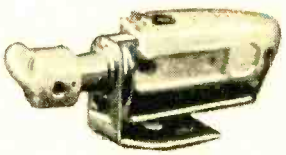
Miniature preamplifier with only three controls performs all the functions required of a preamp-equalizer for hi-fi systems (selector switch, volume, treble, bass, equalization). Self-powered, it has a frequency response of from 20 to over 20,000 cycles. Net price is $44.95.

METZNER ENGINEERING CORP.
1041 North Sycamore Ave.
Hollywood 38, Calif.
Dep't. 14



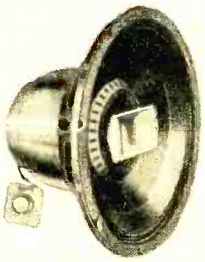
Turntable, lowest priced center-drive unit, handles all sizes of records. Variable speed motor includes new 16⅔ rpm for "talking books." All speeds are adjustable with aid of built-in, illuminated stroboscope. Operation is quiet, with wow and flutter less than .2% rms. Net price is $49.50.

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



Crystal phono pickup eliminates dust from records as it plays. Radium-treated laminate ionizes air around stylus, thus dissipating static charges. Turnover type, for microgroove and 78-rpm discs, Fentone Model p-12At has high signal output and wide frequency response. Net price is $7.25 (including two sapphire styli).

UNIVERSITY LOUDSPEAKERS, INC.
80 South Kensico Ave.
White Plains, N. Y.
Attn: Desk PA-1



15" triaxial speaker is complete 3-way system with woofer, mid-range unit, and horn tweeter. Crossover network is built into speaker housing; two leads from amplifier connect to terminals on speaker. Unit handles up to 30 watts; bass response extends down below 30 cycles. High-frequency level control is included. Net price of Model 6303 is $88.10.

REK-O-KUT CO.
38-01 Queens Blvd.
Long Island City 1, N. Y.

Tone arm of tubular construction is angled to compensate for tracking error in disc playback. Cartridge shell accepts standard pickups, is easily removed. Pressure is adjusted by movable counterweight. Model 120 (for 12" discs) nets for $26.95. Model 160 (for 16" discs) nets for $29.95.

ELECTRO-VOICE, INC.
Buchanan, Mich.

Folded horn enclosure (E-V's "Empire") for 15" speakers can be built from pre-cut pieces in kit. Usable in corner or against wall, the Empire will mount coaxials, triaxials, or separate 2-way and 3-way systems. Net price is $48.00. Finishing kit sells for $5.00. Factory-built and finished version retails for $79.00.

DISC and TAPE REVIEW

—By BERT WHYTE—

YOU MAY have noticed that there has been a rash of recordings lately with exotic titles like *Holiday in Rome, Holiday in Rio, Holiday in Vienna,* etc. It seems that the record companies are bent on taking us on a musical travelog. Most of the material in these records is in the light, popular vein, and it is supposed to be music that is representative of the country which is involved.

If this endeavor meets with indifferent success, it's not entirely the fault of the record company. For while there are works of music in which it is easy to discern a certain national motif, it is more often difficult to find music that is sufficiently derivative or programatic.

In classical music, however, there have been many examples of works which are either directly and consciously nationalistic, or which reflect an easily identified national origin. Many composers, during their travels in various lands, have been influenced by folk music and folk dances; and in their subsequent works, these elements have been heard either as a "flavor or spice," or as deliberate programing.

Spanish Music.

One of the countries to which composers have been particularly attracted is Spain. The folk music of this country, with its strong accent on rhythm, has been the basis of many famous compositions such as Ravel's *Bolero,* Chabrier's *Espana,* and Debussy's *Iberia.* Let's take a musical tour of Spain and review some of the better-known program works in the Spanish idiom.

Two composers, Debussy (the Frenchman) and Albeniz (a Spaniard), wrote scores with identical titles, namely *Iberia.* In spite of the fact that Albeniz is the native son, most musicologists feel that the Debussy *Iberia* is more truly Spanish in flavor! The Albeniz *Iberia* was originally composed as a piano work, but was later rescored for orchestra by Arbos, conductor of the Madrid Philharmonic. It is this colorful, exciting arrangement of *Iberia* that we will talk about.

Albeniz Iberia.

That this work is popular is evident from the five recordings in the LP catalog. Of the five, one is of miserable quality and can be summarily dismissed, another is just fair and hardly worth considering, and the other three are excellent hi-fi recordings.

The best version is the reading by Ataulfo Argenta and the Paris Conservatory Orchestra on a 12" London #LL921. This is an extraordinary record, ranking among the finest-sounding discs ever issued by London. Argenta is a comparatively young Spanish conductor who has made a name for himself in the past few years. He is particularly expert in Spanish repertoire. His reading is noted for its rigid and unswerving emphasis on rhythmic accuracy,

(*Continued on page* 116)

Record of the Month

Howard Hanson—***Cherubic Hymn***
Sinfonia Sacra

Samuel Barber—***Symphony No. 1 in One Movement***

Howard Hanson conducting the Eastman-Rochester Symphony Orchestra with Eastman School of Music Chorus

Mercury MG40014, 12" LP, RIAA curve, $3.98

This is one of the most overwhelming recordings I have ever heard. There's enough sound and fury on this disc to satisfy the most wild-eyed "hi-finatic." All modern works, the Barber will most probably be the hardest to digest with its dissonance and atonality. Nonetheless, it is an exciting piece. The Sinfonia Sacra is a profoundly religious and moving work, and its powerful sonorities are heard with fabulous quality. The prize of all is the Cherubic Hymn. Opening declamations in this work will make your hair stand on end! Combined with choral part, which uses a liturgical text of the old Eastern Orthodox church, the work rises to tremendous heights of power. It is a beautiful, thrilling, awe-inspiring outpouring of fantastically accurate recorded sound. Don't miss this one! —B. W.

More on Tape Recorder Hookups

By RICHARD H. DUBBE

Amplifier has no tape "in" and "out" jacks? Part 3 of series tells how to wire your own!

CAN A HAPPY union be worked out between your magnetic tape recorder and the rest of the hi-fi system if your preamp-control section has no connectors expressly designed for "tape input" and "tape output"?

Consider the system shown in Fig. 1. The preamp-control section may be part of the radio tuner, part of the main amplifier, or a separate unit in itself. In any case, it works in the same way, and the problem of integrating a tape machine into such a system can be solved in the same way.

Systems like this were standard only a few years back. Many are still providing excellent listening today, and will continue to do so for some time to come. If you own such a system, you need not scrap it simply because you have just brought home a new tape machine. It might be better (and cheaper) to add to the preamp-control section facilities for tape input and output. This is not a hard job—if done correctly, it will assure good results in both recording and playback.

Signal Into Tape Recorder. A signal to be tape-recorded must meet four requirements—which have been described in detail in the previous two articles in this series (POPULAR ELECTRONICS, March and April, 1956). To summarize: the signal must be of the correct voltage level; it must be "flat," i.e., it should not have passed through tone or loudness controls on its way to the recorder; its source impedance should be a fraction of the tape machine's input impedance; and the signal should be taken from the hi-fi system so as not to disturb the operation of the system's main amplifier.

What signal level do you need? Most tape machines have two input jacks. One is usually called "Microphone," and is a low-level input. The other, labeled "Radio-Phono," is a high-level input. But the meanings of "low-level" and "high-level" may vary from one machine to another. You must check in each case by consulting the manufacturer's specifications for a particular recorder.

Assume that your machine takes 1 millivolt and .1 volt, respectively, which are fairly typical values. Both inputs, moreover, are high impedance, the mike input being 1 megohm and the high-level input 250,000 ohms, which again are values often found.

The best point from which to take a signal for recording onto tape is at the preamp's selector switch (see Fig. 1). The signal here, in many cases, is on the order of 1 to 2 volts, either from the radio tuner or from the output of the phono equalizer stage. The signal is flat, since it has not yet passed through tone or loudness controls. To pick it up, we can use the "series resistor" method shown in Fig. 2, or the cathode follower circuit shown in Fig. 3.

Series Resistor Hookup. The 1-megohm resistor isolates the tape input from the preamp, so that the stages in the pre-

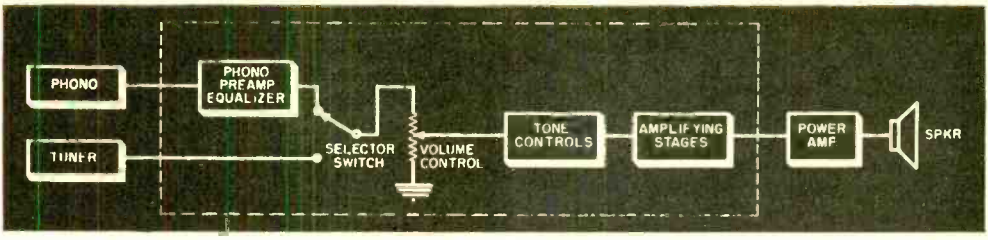


Fig. 1. Block diagram of sound system with only two input jacks. Sections inside dotted line are audio control functions. These circuits may be part of tuner, part of power amplifier, or separate unit.

amp before and after the selector switch are not disturbed. Together, the two resistors form a voltage divider which reduces the 2-volt signal at the selector switch to the 0.1-volt level needed by the tape input. The 50,000-ohm shunt resistor establishes the source impedance at a "medium high" level, permitting you to use a cable up to six feet long.

With this connection, you can feed signals from either the radio tuner or the phono player into the tape machine. At the same time, you can "monitor" the program going onto the tape by listening in the normal way, through your power amplifier and speaker.

In making this hookup, be sure to connect the resistor network to the selector switch "arm" rather than to any other point in the amplifier circuit. This not only enables you to select between "tuner" and "phono"—it also assures that no d.c. voltage will be fed into the tape recorder. Such a thing could happen, conceivably, if you tried to record directly from the output plate of the tuner or of the phono preamp-equalizer. The selector switch comes after the coupling capacitors in the plate circuits of previous stages, and thus has no d.c. voltage on it. Connecting the resistors to the selector switch will also assure that the signal to be taped will not pass through the main amplifier's volume control before it gets to the recorder. This assures that monitoring listening level will not affect recording signal level.

Cathode-Follower Hookup. If you have room on your preamp chassis, plus the tools and skill to do the job, you can add a cathode-follower stage (Fig. 3) to provide a low-impedance tape take-off point. This is the best method for feeding signals from the hi-fi system into the recorder. In addition to low output impedance, it has other advantages.

The signal enters the cathode follower at a very high impedance, which means that the new tube's operation will not "load" the original preamp. What's more, the signal entering the cathode follower can be a large fraction—from one-half to three-quarters—of the signal taken at the tape take-off point. This is handy when the available signal at the selector switch is not much larger than the signal needed to drive the tape recorder. For example, assume that the tape input requires a signal of .5 volt, and the available signal at the selector switch is only 1 volt. The cathode follower will do very nicely, whereas the resistor method described earlier would cut down on signal voltage by 10 or 20 times.

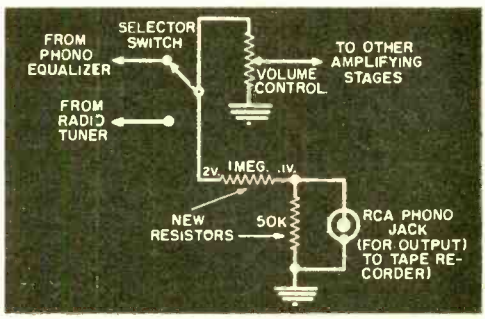
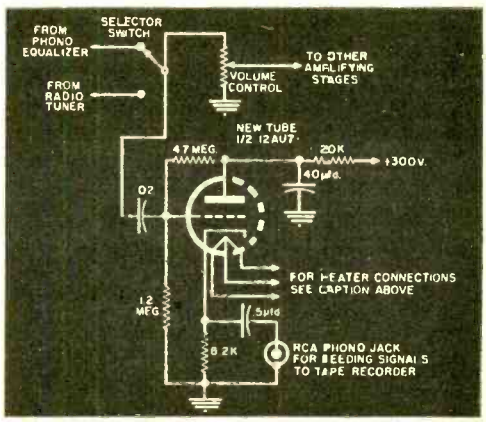


Fig. 2. Series resistor hookup for modifying system shown in Fig. 1 to provide tape take-off point.

Fig. 3. Cathode follower is best method for wiring new tape take-off point. To operate 12AU7 tube on 6.3 volts, tie pins 4 and 5 together; connect, with pin 9, to 6.3 volt source. To use on 12.6 volts, connect pins 4 and 5 to that source; ignore pin 9.



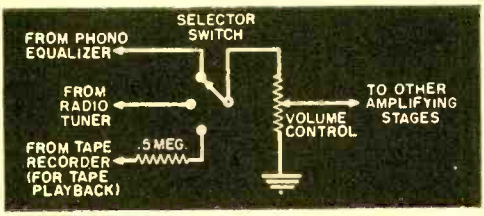


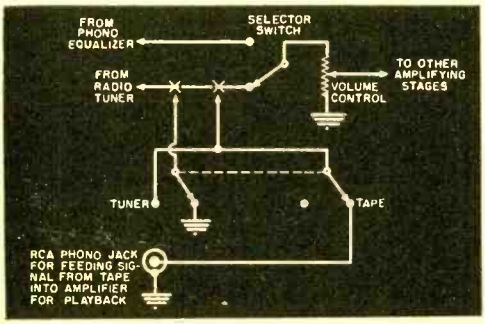
Fig. 4. Selector switch with spare position can be used for feeding tape playback signals into the hi-fi system. Add jack and resistor, as shown.

And, of course, being of low-impedance output, the cathode follower permits you to run a connecting cable of any length from preamp to tape recorder.

The cathode-follower circuit shown in Fig. 3 is built around one-half of a twin-triode tube, type 12AU7. Wiring and values of parts are designed for low-distortion operation with this tube type—and no other. Other triode types may be used as cathode followers, but each may require new parts values. One caution: make certain that the power supply in your preamp will furnish the extra heater and plate current to run the added tube. Usually the heater current is more critical, since the tube will draw very little plate current—only 1 or 2 milliamperes. The heater will draw .3 ampere at 6.3 volts.

Recording with Microphone. Now that we have the means of getting the radio and phono signals onto the tape, what about "live" recording? One excellent method is to unplug the cable from the preamp to tape machine, and plug your microphone in the appropriate tape input. This is especially desirable if you are using a low-level mike. You can, of course, provide yourself with a new input jack for the microphone on the preamp, and new switching to cut the mike in and the other cable out when you want to make live recordings. But you're apt to run into hum and other noise troubles, with the low-level mike signal going through jacks, switches, etc., on the preamp.

Fig. 5. If selector switch has no spare position, add new switch (double-pole, double-throw) to connect tape playback signals into hi-fi amplifier. All switches are shown in tape playback positions.



Tape Playback. To get the signal from the tape machine into your hi-fi system, so that you can play back tape recordings through your amplifier and loudspeaker, is the next concern. Assume that the tape machine has an output jack intended for an "External Amplifier." This point may be the actual final output of the tape machine, if it is without a power amplifier and speaker of its own, or the required output jack may be located ahead of the tape machine power amplifier and speaker, as it is on many recorders.

In either case, you can expect a signal at that jack of something like .5 to 1.5 volt. The impedance, however, varies all over the lot, ranging from high impedance—100,000 ohms or more—through medium high—at 10,000 ohms—down to cathode followers and output transformers with low impedance. Always check it. If the impedance is high, be sure that the input you feed into, on your amplifier, is well up —250,000 ohms or more.

The actual connection will be simple if your selector has a third, open position as shown in Fig. 4, which is the case with many preamps now in use. A series-isolating resistor of about .5 megohm, as shown in the drawing, is a good idea for reducing the loading effect of the tape output if the tape output is high impedance. This involves a small reduction in signal, as shown. With a cathode-follower output on the tape machine, no isolating resistor is necessary.

But suppose your preamp has only the two input channels which are used for radio and phono signals, as shown in Fig. 5. Some additional switching will be necessary. A convenient way to incorporate it is indicated in the drawing. You need add only an input jack, and a double-throw double-pole switch. Remove the wire at the "Radio" position on the selector switch, and connect it to one side of the new switch. The lead from the tape jack goes to the other side. The center of the switch then goes to "Radio" position on the selector.

To play tape, you switch your original selector to "Radio" and turn the new switch to tape. When the new switch is in the tape position, the radio is grounded to avoid "crosstalk" through the switch capacity, which might otherwise make radio signals faintly audible while you were listening to tape.

The next article in this series will explain mixing facilities, and will cover some other odds and ends of technique in using tape in a hi-fi system. —30—

Build This Novel Signal Blinker

THIS fluorescent blinker light has many practical uses, and is an unusual and attractive novelty. A 6-volt lantern battery will flash the blinker for about 100 hours, while a 6-volt "hot-shot" battery will last about 1000 hours.

The model was built from salvaged parts; the design shown does not need to be followed. Some constructors may want to put the mechanism in a square box with the light mounted in a metal reflector on one side.

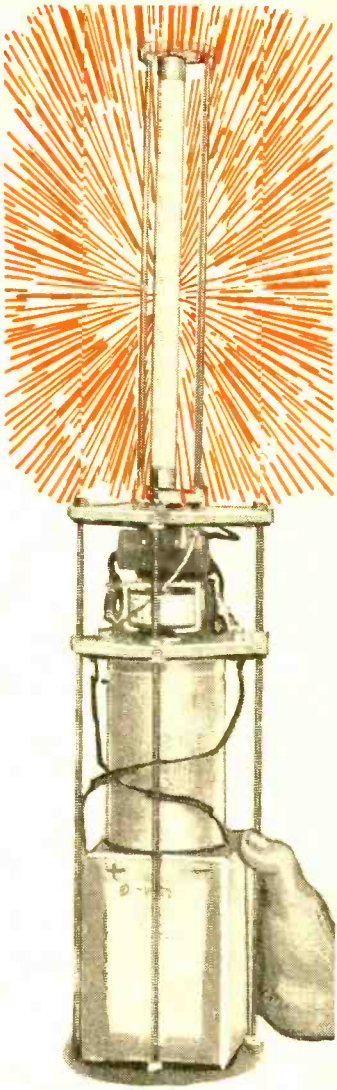
Relay coil resistance determines the length of the timing cycle; 110 ohms gives a pulse interval of about 1.5 seconds. For shorter intervals, values as low as 30 ohms may be used. The relay is not at all critical, and almost any type with normally closed contacts will work if the coil resistance is between 25 and 200 ohms.

The 2000-μfd. low-voltage capacitor used in parallel with the relay coil was removed from a 6-volt d.c. power supply. Size of this capacitor affects the timing cycle—its capacity may vary from 1000 to 4000 μfd. The larger the capacity, the longer the delay.

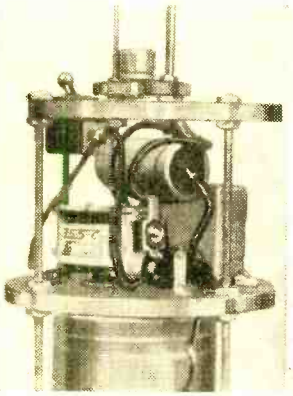
In the model shown, parts are mounted on scrap 3/16" Lucite discs. The outside cover was made out of a piece of hard cardboard (fiberboard), formed and glued to the shape of a cylinder. Parts may be mounted in a metal or wooden box; dimensions should be chosen to conform to the available parts.

Altering the relay spring tension will vary the timing cycle. Too much will rapidly exhaust the battery, while too little may result in the contact points wearing out. Proper adjustment can be determined by experiment.

In a typical application, the blinker may be set up on a pier where it will keep flashing hour after hour to direct a boat back to the landing at night. It can be used as a warning signal for cars in case of a breakdown along the highway (for such an application, a red bulb is preferable). It will also serve as an emergency light for marking an aircraft landing field, as a beacon to guide hunters or fishermen back to camp, or as an advertising novelty.—*Lyman E. Greenlee.* —30—



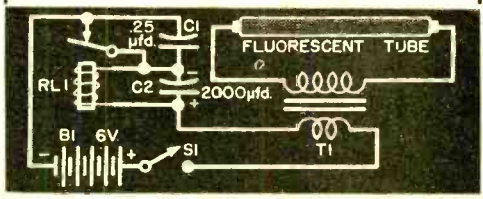
Completed unit in operation. Note that it is small enough to be carried around conveniently.



Timing relay and various other parts are shown in close-up view. Size of capacitor may vary, depending on timing delay wanted.

Parts List

B1—6-volt lantern battery
C1—0.25-μfd., 200-volt capacitor
C2—2000-μfd., 15-volt capacitor
RL1—Single-pole relay, 100-ohm coil, contacts normally closed
S1—S.p.s.t. toggle switch
T1—Audio output transformer



THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

IN DISCUSSING HOW a transmitter works, in the April *Transmitting Tower,* we learned about the way in which a typical crystal oscillator functions. This column will continue from that point.

We know that high-frequency crystals are extremely thin and fragile, which is why most amateur crystals are ground to oscillate in the 3.5- and 7-mc. bands. Crystal-controlled output is obtained on higher frequencies through the process of frequency multiplication.

Frequency Multiplication. The oscillator diagrammed in the April column is easily converted into a frequency-multiplying oscillator. All that need be done is to tune its plate tank circuit to an integral multiple (harmonic) of the crystal frequency, instead of to its fundamental frequency. The oscillator will then deliver output at that frequency.

Here is a simple explanation of how a frequency multiplier works. The oscillating plate current pulses fed from the tube to the tank circuit are so distorted that they contain a great deal of harmonic energy. Thus, when the tank circuit is tuned to one of the harmonic frequencies, it extracts the energy of that frequency from the plate-current pulse and delivers it to the load.

When you work K9AMD, Hillsboro, Ill., you talk to Miss Carole Hoover. The parakeet's name is "CQ." Equipment shown includes a Johnson Viking II transmitter and WRL Globe King 500. See "News and Views" (page 108) for details on a 100% ham family.

As might be expected, a frequency multiplier is not as efficient as a straight amplifier. (This oscillator functions as an oscillator plus amplifier.) A frequency doubler is about half as efficient as a straight amplifier, a frequency tripler about a third as efficient, a quadrupler about a quarter as efficient, and so on.

Another way in which a crystal can be used to control a very high frequency signal is to make it oscillate on an *overtone** of its fundamental frequency. Almost any good crystal can be made to oscillate on its third overtone in a circuit designed to accentuate this mode of oscillation. Specially ground ones can be made to oscillate on their fifth, seventh or even higher overtones, to produce frequencies of 100 mc. or more. Overtone crystals handle much less power than fundamental ones; they must be used in very low power oscillators.

Returning to our typical crystal oscillator, it can handle a plate power input up to possibly 20 watts on the 3.5- and 7-mc. bands without danger to the crystal. It will deliver up to 10 watts to the antenna on these bands. Under favorable conditions, this is sufficient power to make many contacts, although a bit more power will increase the percentage of calls made that are answered.

On the higher frequency bands, however, the output of any one-tube transmitter that I know of is too low for reliable communications, except over very short distances. What we need is an amplifier to boost the output of the oscillator to a respectable level.

R.F. Power Amplifier. Figure 1 is the diagram of a typical, low-power, radio-frequency power amplifier. Depending upon the tube used and the plate voltage available, it is capable of handling a power input of 30 to 90 watts on the amateur bands up to 30 mc. The r.f. power amplifier differs essentially from the oscillator in that there is no crystal and no feedback loop between the amplifier's input and output circuits.

* The term *overtone* is used instead of *harmonic* to describe these crystals, because they do not oscillate on exact integral multiples of their fundamental frequencies.

Radio-frequency energy is fed from the oscillator to the amplifier tube control grid via *C1*, both to be amplified and to control the output frequency. Obviously, it is very important that the amplifier cannot self-oscillate. Otherwise, it could easily emit a signal on a frequency of its own choosing, instead of on the crystal frequency.

The screen grid in the amplifier tube helps prevent self-oscillation by reducing capacity coupling between the grid and the plate to a very low value. In addition, the amplifier is constructed so as to minimize accidental couplings between its input and output circuits that might sustain self-oscillations.

Tuning an Amplifier. Before describing how to tune an amplifier, let's point out one fact. Although the amplifier diagram shows a *pi*-network output tank circuit, instead of a parallel-tuned circuit such as was used in the oscillator plate circuit, this has no particular significance. A parallel-tuned circuit can be used without changing the basic operation in the least. The *pi*-network tank circuit is shown so that we can explain its adjustment in a logical manner.

Probably the most useful accessory one can have in learning how to tune a transmitter is a 117-volt light bulb. Connect it to the output terminals of the transmitter in place of the transmitting antenna. Then you can see the effect of each transmitter adjustment.

Select a bulb with a power rating equal to between 70 and 100% of the rated power input of the amplifier being tuned. A 25- or 40-watt bulb is satisfactory for use with a 25- to 40-watt transmitter. A 40-watt bulb is also satisfactory for an input up to 60 watts, and a 50- or 60-watt bulb is satisfactory for a 75-watt transmitter, and so forth.

Disconnect both the amplifier plate and screen connections from the power supply. Turn on the filament supply for both the oscillator and amplifier tubes. After the tubes have reached operating temperature, turn on the oscillator and press the transmitting key. Adjust the oscillator plate capacitor for maximum amplifier grid current.

Naturally, maximum grid current will flow only when the oscillator plate circuit is tuned to resonance. For this reason, the designers of small transmitters often omit the oscillator plate meter and depend on the amplifier grid-current meter to indicate proper oscillator tuning. To make this safe, the oscillator plate and screen voltages are adjusted so that the tube cannot dissipate excessive plate power at any setting of the tuning capacitor. The exact amount of grid current is then controlled by slightly detuning the oscillator tuning capacitor.

After the oscillator is tuned, reconnect the amplifier plate and screen supply leads, and set the *pi*-network capacitors, *C6* and *C7*, to maximum capacity (plates completely meshed). Turn on plate power and press the key. Undoubtedly, the amplifier plate current will be very high, and the output bulb will remain dark.

In other words, all the power fed into the amplifier is being dissipated as heat on the plate of the tube. Immediately tune *C6* for the sharp dip in amplifier plate current. When this is done, the output bulb may glow, at least dimly. Open the key to allow the tube to cool off. Decrease the capacity of *C7* a small amount. This will increase the plate current again. Retuning *C6* will dip the current once more, although not to as low a value as before, and the output bulb will glow more brightly.

(*Continued on page* 107)

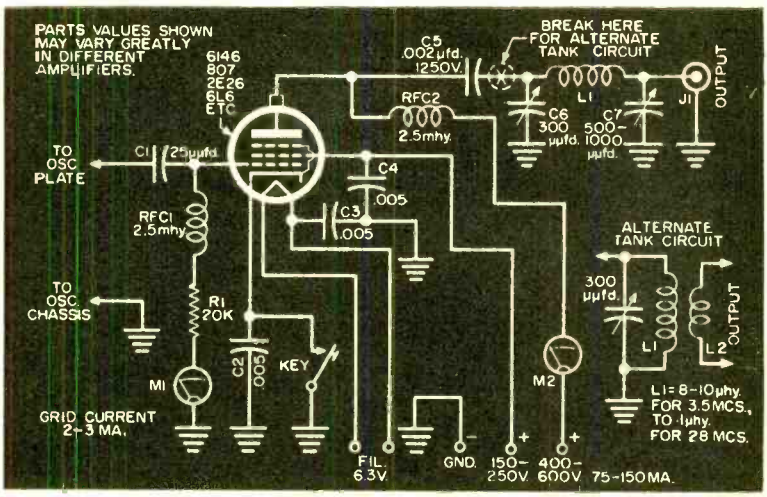


Fig. 1. Diagram of typical, low-power, r.f. power amplifier. When driven by a suitable oscillator, and connected to a suitable power supply, it is capable of up to 90 watts input—depending upon tube that is used.

Complete microwave station dangles from this Air Force "egg beater" to be taken to hard-to-reach location. Within two hours after arrival, station will be sending radar data over six radio frequencies that may be split into 24 telemetering or 72 two-way voice channels. (Photo courtesy Motorola, Inc.)

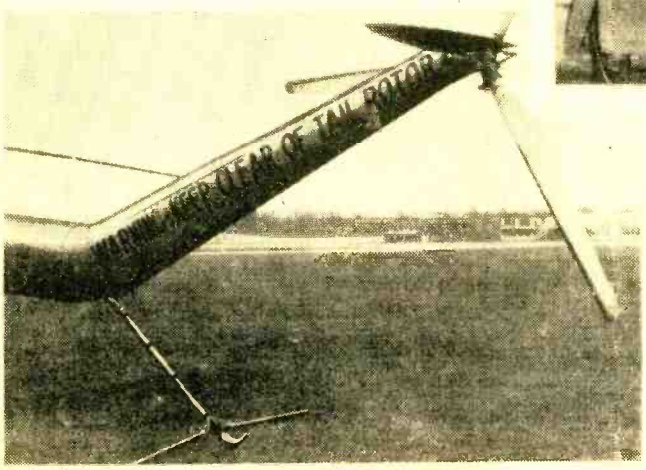
HELICOPTERS—Electronics' New Workhorses

FLYING has always been closely linked to electronics. Normally, electronics is the servant of aviation, guiding aircraft through the skies, keeping them abreast of the weather and setting them safely down.

Here we have turnabout man-bites-dog news about aircraft doing chores for electronics. The helicopter above hauls a complete microwave station to an inaccessible site, where it can be put in operation within two hours. Below, airborne TV transmits bird's view of highway and harbor traffic to ground-based control stations.

Helicopters hovering at high altitude may soon be relaying TV over wide areas and sending radar data or defense commands over wilderness or water where no ground stations are feasible.

Flying low, helicopters plot field strength at treetop level to pick optimum receiving locations. —30—



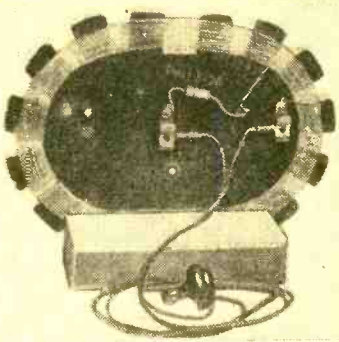
TV camera installed in 'copter gets over-all view of traffic situation in successful British experiment. Camera and transmitter are mounted on stretcher for easier handling (top right), allowing camera to peek out the side door. Bottom picture shows transmitting antenna attached to helicopter's tail

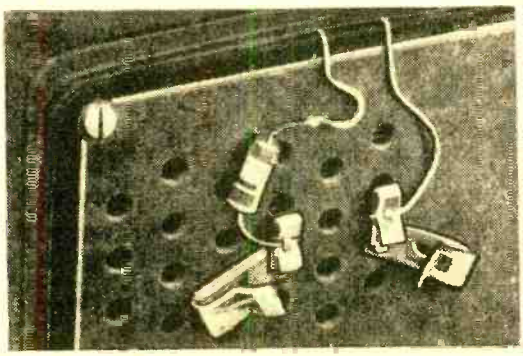
Three Ideas for an Emergency Receiver

IF YOUR table radio has a loop antenna, any of the three versions of the simple crystal adapter described in this article will allow the set to be used in an emergency. If your radio becomes inoperative due to tube or parts failure, or if the electric power is cut off for any reason, you can still hear one or more local stations.

The cigar box version of the adapter is a simple hookup. Wind tightly 20 turns of No. 22 or No. 24 cotton-covered enameled copper wire around the outside of the box. Secure the coil ends, and bring the two ends into the box through small holes. Electrically connect the circuit as shown in the wiring diagram.

Note that the loop and the variable ca-

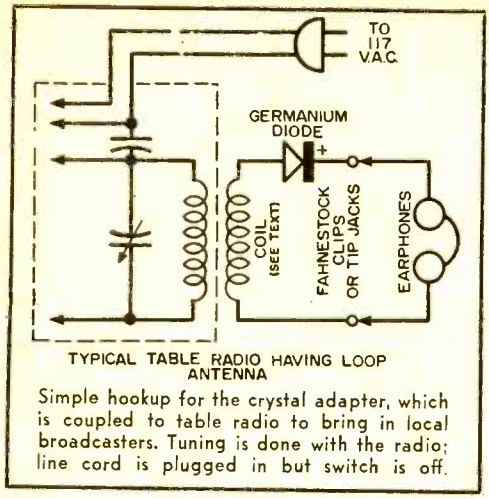




CIGAR BOX. At top, left, you can see the cigar box version of the crystal adapter in operation. Pickup coil is wound around outside of box near bottom. Earphones can be stored in box when they are not in use (top, right).

LOOP ANTENNA. A loop was salvaged from a junked radio and tacked to a wood base to create the version of the adapter shown above.

WRAP-AROUND. Twelve turns of wire are wound around outside of radio cabinet close to loop antenna, and covered with Mystik tape for protection (left). Earphone is not shown.



TYPICAL TABLE RADIO HAVING LOOP ANTENNA

Simple hookup for the crystal adapter, which is coupled to table radio to bring in local broadcasters. Tuning is done with the radio; line cord is plugged in but switch is off.

pacitor in the radio act as a tuner using the power lines as an antenna. When the crystal adapter is placed close to the loop, the adapter picks the signal off the table radio, detects it, and feeds it to the earphones. It's not necessary to turn on the radio—just be sure the line cord is plugged into the wall outlet.

This cigar box version allows the earphones to be stored in the box.

A loop antenna version of the crystal adapter is the cheapest. Salvage a loop antenna from a junked table radio and tack it onto a 5" x 2" x 1" wood base. A Fahnestock clip is soldered to one loop terminal, and one lead of a germanium diode is soldered to the other loop terminal. Mount a second Fahnestock clip on the loop frame. See photo for further details.

If the loop you use for this version of the adapter has an antenna winding on it, you can clip the leads and unwind the antenna winding. In any case, be sure that you use the large winding for your adapter.

The wrap-around adapter is simply a pickup coil around the outside of the radio cabinet as close to the back—near the loop antenna—as possible. Wind 12 turns of No. 24 cotton-covered enameled copper wire around the cabinet using bits of transparent Scotch tape to keep the coil from loosening. Apply wide Mystik tape over the coil to conceal it and protect it from damage.

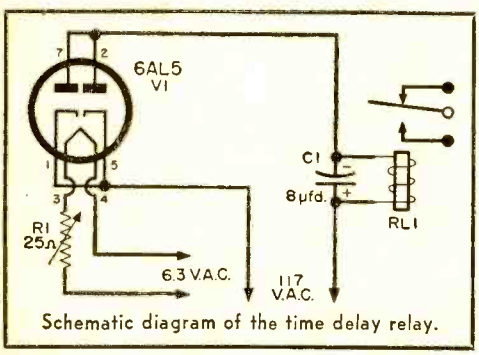
Two pairs of Fahnestock clips are mounted onto the back of the cabinet using small machine screws and nuts. Connect one end of the coil to one pair of clips, and then connect one lead of a germanium diode to the other pair of clips. Solder the remaining lead of the diode to the remaining coil end, and the job is finished.

When using the table radio in a normal manner, the wrap-around coil has little or no effect on the operation of the loop—provided that the earphone is disconnected. —*Arthur Trauffer.* —30—

Inexpensive Time Delay Relay

ANYONE who peruses an electronics parts catalog in search of time delay relays usually finds these units to be rather expensive. Thermostatic tube types are much cheaper, but their delay time is fixed and it may deviate as much as 25% from a rated value.

This circuit offers a continuously variable delay of from approximately 5 to 50 seconds, and can be constructed for less than $5. Equally important, its reset time is faster than for many commercial units.

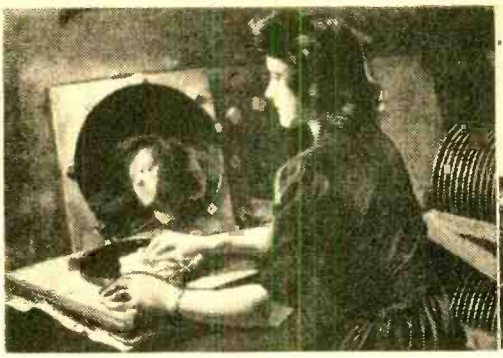


Schematic diagram of the time delay relay.

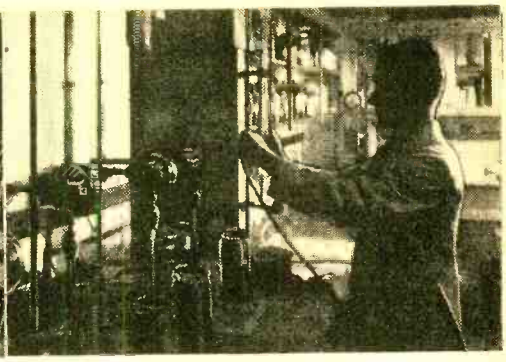
Warm-up time of the tube determines time delay. This is controlled by the resistance of the potentiometer, which will range from 0 to 25 ohms—depending on the amount of delay required. If resistance is greater than 0 (zero) ohms, the tube will operate at a lower than normal temperature.

When the cathode of the tube reaches its proper temperature, current is made to flow through the relay coil, causing the relay to close. Capacitor *C1* bypasses 60-cycle a.c. components of the rectified 117 volts a.c. Thus, the relay is completely "chatter-proof," and no "buzz" is transmitted to the chassis on which it is mounted.

To assure accurate delay intervals, the tube should be "cooked." In other words, a tube should be used which has been operating in another circuit for a long period of time. If the time delay is not to be held to close tolerances, a brand-new tube will also work, and it will eventually settle down to a consistent delay operation.—*Norman V. Becker.* —30—



Aluminum discs are polished to mirror finish before automatic processing for coating of acetate lacquer. The high polish assures uniform coating.



Rigid control of high-quality lacquer is maintained in Presto chemical laboratory. Much research is done on lacquer coating methods and compositions.

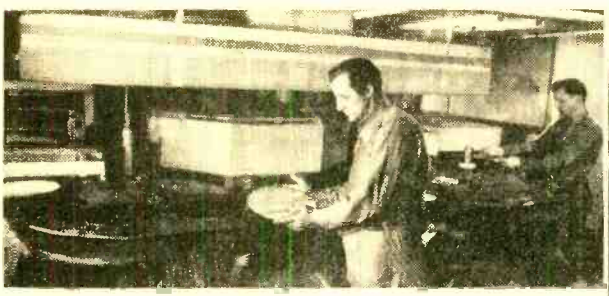
Home Recording Disc

Marriage of Aluminum and Acetate

THE BLANK recording disc is to phonograph records what unexposed film is to photographs. Any record groove ever played with a pickup was originally cut on a recording disc. This is as true today, in the age of high-fidelity tape masters and LP records, as it was in the days of Caruso and acoustical recording.

On the old-fashioned disc, the groove was formed in wax. But the modern disc is made of a special acetate lacquer compound on a metal base. It is much less destructible than a wax disc—an important advantage for home recordists. Repeated playbacks with a high-grade pickup will not mutilate the groove.

From the processing of the aluminum blank through the compounding of the lacquer to the coating, aging and inspection of the surfaces, the manufacture of a modern recording disc is a task for perfectionists. The accompanying photographs, taken at the Paramus, N. J., plant of Presto Recording Corporation, show some of the steps in the making of a high-quality lacquer disc. —30—



Automatic conveyor carries disc blanks through coating and drying operations with controlled temperature and humidity. Lacquer is dispensed in chamber at left. Discs are then racked and stored.

Careful inspection and grading come next, after which records are punched (right) and labeled.

Hi-Fi

By H. H. FANTEL
Associate Editor

Off-beat enclosures prove to be on-beat for hi-fi!

IN RECENT YEARS, new shapes in loudspeaker enclosures have bowed in, sounded off, and remained to stay. Some are variations on conventional designs, others are crossbreeds of two or more basic baffle concepts. Still others involve newly applied acoustical principles. Most have unusual names and a few are rather bizarre in appearance.

They range from moderately priced kits and regular production models to elaborate custom installations obtainable only on special order. Their ingenious design principles and outstanding performance have earned them acceptance and admiration even among those skeptics who came to scoff but stayed to listen.

CUSTOMIZED SUPER-SYSTEM: The Varkon

Looking somewhat like an airport control tower, the "turret" on page 88 is the design of George Varkonyi, from whom the "Varkon" system derives its name. Inside this enclosure are two horns, two infinite baffles, and no less than eight separate speakers.

The bass section is an exponential horn with curved rather than angled surfaces to reduce reflection. This continuous curvature, especially at the mouth—where bass enters the room—is claimed to eliminate false bass coloration. The horn reaches its large mouth area with excellent projection. Driven by a heavy 15″ woofer, it covers the deep bass (30 to 150 cycle) range.

A separate horn is used for the upper mid-range (2000 to 5000 cps). Unlike all the other elements in this system, the horn —fed by a compression driver—is deliberately directional. This single point source of sound, surrounded by a diffuse and non-directional over-all range, creates an illusion that makes individual instruments and soloists stand out against the background. This pseudo-dimensional effect, however, must be used with discretion. For this reason, a separate "presence" control is provided to adjust the amount of "highlighting" given to soloists.

The sound from this horn "swims" on the output of four 8″ speakers. Set in angles on an infinite baffle, the 8″ units cast an even sonic sweep from wall to wall in the 150 to 2000 cps region. To complete the system, two 2″ cone tweeters fan out the extreme highs (5000 cps and above). Separate bass and treble controls help match the system to room acoustics.

Since the Varkon handles up to 50 watts, a living room the size of a barn is no problem to this super-speaker system. Like a Cadillac, the Varkon is "just loafing" where the smaller fry might be chugging a little on the high-amplitude hills.

DONE WITH MIRRORS: Hegeman System

There is nothing sensational in the appearance of what resembles a slightly over-sized night-table. What stops you is the sound—not because it's "spectacular" —but because it's so natural. Violins, for instance, instead of having the steely gleam that often passes for "hi-fi," actually sound like violins! Other instruments, as well as the human voice, emerge from this reproducer with disarming candor. At low levels or high, with a string quartet, a piano, a full symphony orchestra, or jazz band—this illusion of reality persists.

The trick is done with "mirrors." Polished wood surfaces covered with alumi-

Hybrids

num foil split the beam of specially treated mid-range and tweeter units. The beam is then fanned out into vertical and horizontal wave-trains. Multiple room reflections in both planes then surround the listener with a sound field analogous to that in the concert hall.

Mr. Hegeman, himself both musician and engineer, believes firmly in this "space factor" as the key to musical realism. The results bear out his theory: instead of "coming out of a hole," the music "just seems to be there" in the room. Critical damping, maintained over the whole frequency range, results in fine transient response. This adds to the clarity and definition of the sound.

The system comes in two separate cabinets. They can be stacked atop one another, or set as much as six feet apart. Mid-range and treble units are housed in the small box, which also contains the sound reflector. The larger box is a twin exponential horn for combined front and back loading of the woofers.

Three 6½" woofers serve as bass drivers. Their combined radiation area approximates that of a 12" speaker. Yet their small mass furnishes a transient response which, according to the designer, cannot be achieved with mechanical structures of larger size. What's more, the small woofers save space. Their shallow depth permits the whole bass unit—three drivers and 12 feet of exponential horn—to be tucked into a 26" by 18" by 30" box.

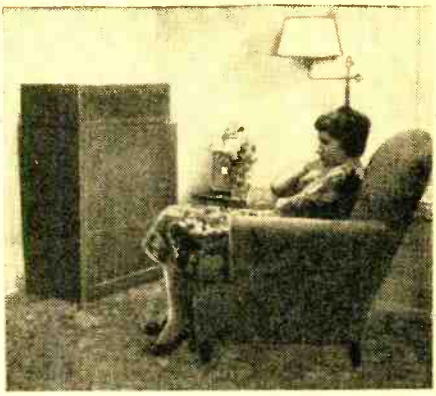
The combination of front and back loading takes the response of these units down to a solid and powerful 30 cps. Air-loading, plus special cone-stiffening, prevents cone breakup, frequency doubling, and other types of harmonic distortion. Crossover frequency is low enough to prevent intermodulation distortion.

The Hegeman system clears the high-amplitude hurdles at full 30-watts power with no audible strain. At triple fortissimo, it still sounds sweet.

NEW SPECIES: The Karlson Coupler

Cross-breeding seems to pay off in audio as well as in farming. The hybrid is not just a mixture of the good qualities derived from its mixed parentage; often it has surprising qualities of its own.

This is true of the Karlson "Coupler," which is part horn and part Helmholtz resonator—but, for the most part, is its own unique self. These elements are combined to produce a unique enclosure. Since they overlap both in function and structure, they give this enclosure a "personality" all of its own. The Karlson may claim, rightfully, to be an entirely new design principle. It can be used with any speaker, including coaxials.

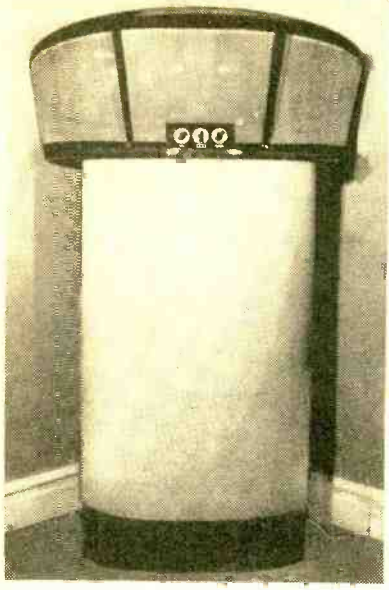


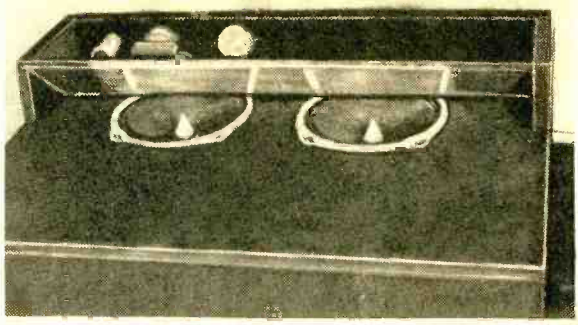
Relatively new on the hi-fi scene, the enclosures described in this article are enjoying a rapidly growing popularity among music lovers. Upper left on opposite page, the Acousti-Magic, a labyrinth enclosure assembled from a kit. Directly above, the Hegeman system, whose speakers are made only for one enclosure.

As in a horn, air-loading remains effective throughout the audio range—helps any speaker attain better transient response and low harmonic distortion. Mounted on a slanted board, the speaker gains acoustic support from both front and rear air chambers. This combined loading works wonders with even relatively inexpensive speakers.

The back wave is returned through a port into the front chamber to reinforce front radiation. Radiation areas of this port combine with the speaker itself to produce, in effect, an impedance transfer between these sound sources and the tapered aperture. Consequently, this aperture acts as a large, massless cone—capable of tremendous excursion with no distortion. Its natural impedance is close to that of the air itself to assure a maximum efficiency in the transfer of acoustical energy. What's more, the dovetail opening acts as a treble disperser, covering an angle of about 120 degrees.

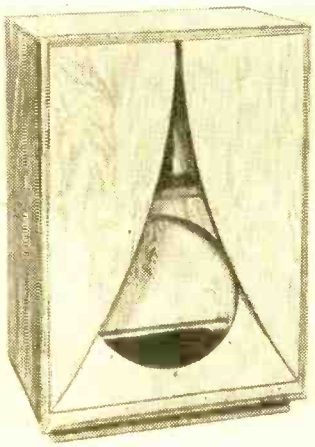
Available in models for 8", 12", and 15" speakers, the Karlson also comes in inexpensive kit form. Despite its good bass characteristics, the 8" model is only about 1 cubic foot in volume. The larger models are also fairly compact.





Most elaborate of the hybrids is the Varkon system pictured at the left; enclosure houses eight speakers. Above, the tweeters in the Hegeman system; highs are beamed against reflecting surface which spreads them uniformly into room.

"Swallow-tail" opening of Karlson enclosure (lower left) transfers bass notes from speaker with remarkable efficiency. Below, the installation of Jim Pollock, Charlotte, N. C. Pollock built his own version of the Read "Fold-a-flex."



THE LOWER DEPTHS
Air Coupler

This enclosure is designed specifically to reinforce bass in the 16-150 cps regions. Intended as an ultra-low bass supplement to already existing installations, the "Air Coupler" is essentially a group of pipes of different length, formed by simple partitions within the box.

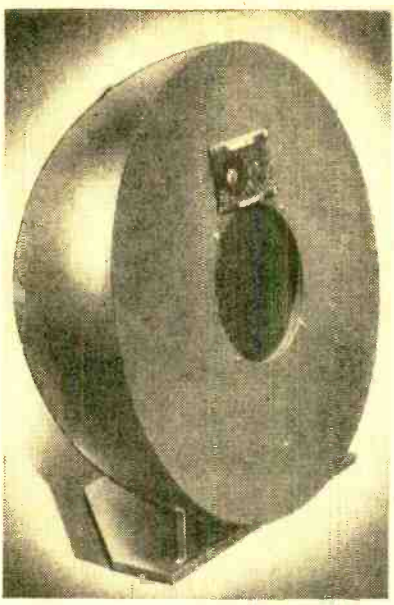
Together, these pipes provide a broad resonance (low *Q*). Their air columns assure efficient coupling of the low frequencies to the air of the listening room—to compensate for the low-end deficiency of many speaker systems. With this relatively simple air coupler, the response of hi-fi systems can be extended to the lower threshold of hearing, where sound is actually more felt than heard. This adds a feeling of body, solidity and power to the very low notes.

Because of its shape, the Air Coupler is sometimes dubbed a "tone coffin." However, listeners have found that its appearance need not be at all lugubrious if it is built into the floor, into a table, or simply stuck behind some furniture. The Air Coupler is available in kit form.

THE CHAMELEON:
Read "Fold-a-Flex"

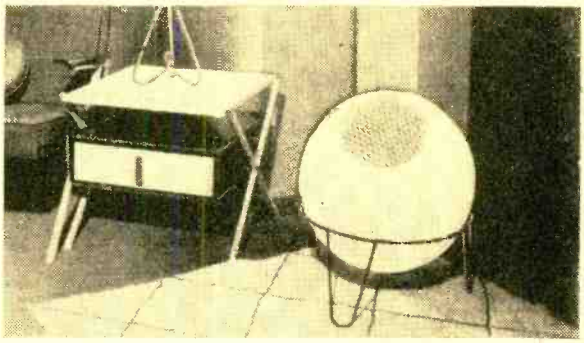
Undoubtedly the most versatile enclosure ever designed, the Read Fold-a-Flex* has swinging interior panels allowing almost instant conversion from folded horn to in-

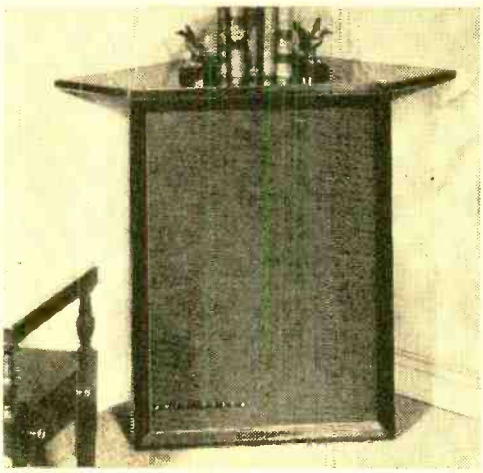
*Patent pending.

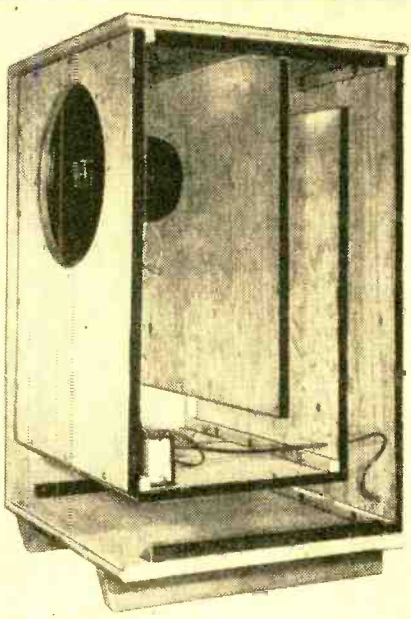


Bozak "Kettledrum" was early experiment in new enclosure design. Although its sound output was remarkable, its shape and size discouraged most home listeners. Production was ultimately discontinued.

A completely round globe, which is considerably smaller in size than the Kettledrum, is the Bonn Sonosphere below. At lower left is the National Catenoid, a variation of the folded horn principle.







Internal structure of Acousti-Magic labyrinth reveals the extended path taken by the speaker's back wave. This load aids speaker response to a great degree. In Stromberg-Carlson labyrinth (the original enclosure of this type), the path is slightly different, but achieves the same end result. Any type of speaker may be used in such an enclosure.

finite baffle or tunable bass reflex. Moreover, the Fold-a-Flex can assume intermediate hybrid stages between horn and resonator.

By varying the resonant cavity and its port, which opens into a horn-like duct, you can adjust the "back load" to meet various speaker requirements and to alter the horn flare. Performancewise, this means adaptability to any room acoustics, any speaker, and any individual tonal preference. It also means limitless challenge for inveterate hi-fi experimenters.

INFINITY BALLED UP:
Bonn Sonosphere

Right on the ball is Mr. Bonn, who puts a speaker right *in* a ball. The idea is a switch on the infinite baffle principle. While the conventional infinite baffle had to be very large to absorb all the back radiation from a speaker, the Sonosphere reflects all the back radiation toward its center like a focusing mirror. There the sound waves

THE HYBRID DIRECTORY

VARKON	George F. Varkonyi 116 Pinehurst Ave. New York 33, N. Y.
HEGEMAN	Hegeman Laboratories 176 Linden Ave. Glen Ridge, N. J.
KARLSON	Karlson Associates, Inc. 1610 Neck Road Brooklyn 29, N. Y.
AIR COUPLER	General Apparatus Co. 334 East 32nd St. New York 16, N. Y.
FOLD-A-FLEX	(Not yet in production)
SONOSPHERE	Plastilex Products Co. 6515 North 10th St. Philadelphia 26, Pa.
CATENOID	National Co. 61 Sherman St. Malden 48, Mass.
ACOUSTICAL LABYRINTH	Stromberg Carlson Co. Rochester 3, N. Y.
Acousti-Magic Labyrinth (kit)	Acoustical Development Corp. Box 572 Hempstead, N. Y.

oppose each other and simply cancel out (see illustration). This makes it possible to get rid of them in a much smaller space and prevents the formation of standing waves. Moreover, the stiff plastic-foam walls themselves swallow up most of the sound. Functionally, this enclosure has all the virtues and faults of infinite baffles (see POPULAR ELECTRONICS, February, 1956).

The sphere rests on a wrought-iron ring base and can be turned to let the speaker opening face in any desired direction. Acoustic effect can thus be varied. The optimum location is easily spotted by a marked boost in bass. Weighing only six pounds, and standing only 21 inches tall, the Sonosphere can be easily carried about the house. It takes any 8" speaker or can be ordered with a Phillips Duotone Model 9770M, whose requirements it matches precisely.

The baffle can also be hung from the ceiling like a chandelier to save space. In very small rooms, with the walls near enough to give acoustic support to the suspended baffle, this arrangement is both practical and acoustically justified. A corner enclosure in a very small room sometimes sets the room resonance ringing. The suspended baffle avoids this possibility.

HORN TWISTS: The Catenoid

Taking the bull by the horn is National's way of tackling the enclosure problem. The National "Catenoid" is simply a variant of the exponential horn shape. It takes its name from the mathematical term "catenary," which describes the curve of this horn flare. For the benefit of geometry addicts, it is defined as a hyperbolic cosine curve.

Its claimed advantage over other horn shapes lies in its gentler taper in the apex region, where the speaker is located. This results in more uniform acoustic loading over a wider frequency range. Besides, the Catenoid is cheaper and easier to build than a true exponential horn. Neither, however, are jobs suitable for Sunday carpenters.

The Catenoid horn is the heart of National's three-way speaker system, where it covers the 35-300 cycle range. The entire system is distinguished by good balance, smoothness, reasonable size, fine styling and finish.

THE AMAZING MAZE: Acoustical Labyrinth

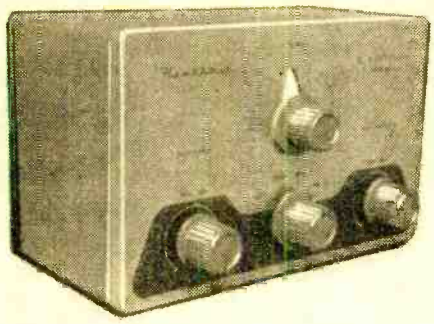
Patented by Stromberg-Carlson, the "Acoustical Labyrinth" puts a section of straight tube behind the speaker for uniform loading. The back wave of the speaker enters into a flared duct, approximating an exponential horn in its flare rate, but with straight vertical sides. The open end of this tube is located directly below the speaker. Both speaker and labyrinth opening "look" directly into the listening room.

Absorption also enters into the picture. The wall material swallows all frequencies above 300 cps, letting only the lower tones emerge at the mouth. Thus, the duct acts as a mechanical crossover, preventing phase interference between front and back wave that might lead to ragged mid-range response.

Many listeners, interested in the performance of the labyrinth, have shied away from attempting to construct its maze-like interior. Fortunately, this task has now been made relatively simple and inexpensive by a new kit. Known as "Acoustic-Magic," this kit contains all precut panels, both interior and exterior as well as hardware, grille cloth, and instructions for assembling a labyrinth.

Harried audio fans, trying hard to keep up with all the latest wrinkles, may groan at the thought of new baffle types adding more confusion to the profusion. But most of us feel that, aside from the music itself, much of the fun in audio comes from always trying something new. Even if some of the new enclosures look like flying saucers from the outside and a rat-maze from the inside, they are welcome evidence that audio is still one of the liveliest arts where almost anything can happen and eventually does. —30—

New Life for Your Short-Wave Receiver



Front view of the QF-1 after assembly.

Use a "Q-Multiplier"

By

HERB S. BRIER

IF YOU USE a communications receiver costing less than $150, you can probably improve its selectivity—or station separating ability—far beyond your wildest dreams. All you need is a simple device called a "Q-multiplier." As the name implies, it will multiply the *Q* (in the i.f. stages of the receiver) and provide that additional selectivity needed to separate stations on the crowded short-wave bands. By simply flipping a switch on the front panel, the Q-multiplier will also reject one of the interfering signals. Would you like to know more about this marvelous unit? Well, then, read on and be informed.

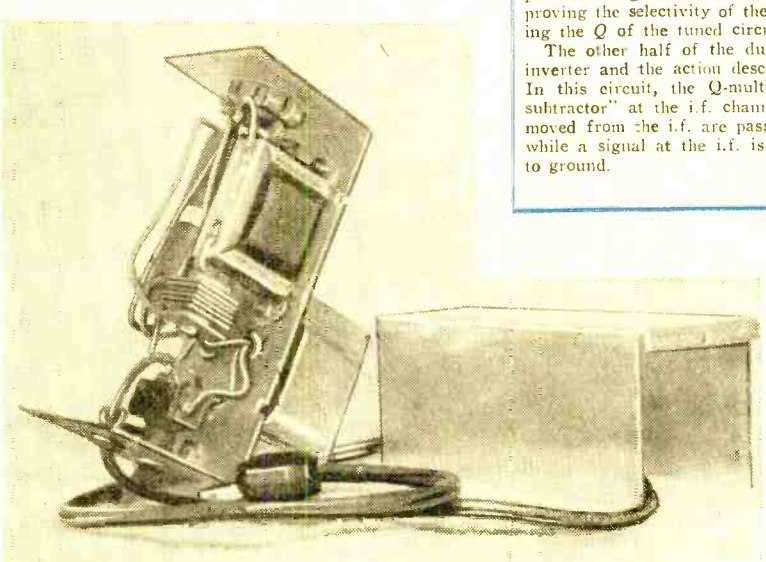
Your ham band editor has been interested in the Q-multiplier since the original design was announced seven years ago. About four years after its inception, Bill Scherer, W2AEF, introduced the multiplier to the ham ranks. Since that time, three kits—or complete units—have been

HOW IT WORKS

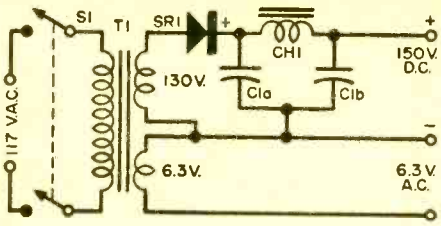
A single connection is made between the Q-multiplier and the i.f. strip in the communications receiver. The Q-multiplier will effectively "load" the i.f. strip to achieve the results described in the article.

Heart of the Q-multiplier is a resonant circuit tuned to the i.f. of the receiver with which it is to be used. One half of the dual triode tube is regeneratively connected to the tuned circuit. The coupling is so arranged that signals slightly removed from the i.f. will be bypassed to ground. Signals at the i.f. are vastly amplified due to the regenerative process. Regenerative amplification is akin to improving the selectivity of the i.f. channel by increasing the *Q* of the tuned circuits.

The other half of the dual triode is used as an inverter and the action described above is reversed. In this circuit, the Q-multiplier looks like a "Q-subtractor" at the i.f. channel. Signals slightly removed from the i.f. are passed through the receiver while a signal at the i.f. is nulled out or bypassed to ground.



Simple power supply which permits the operation of the QF-1 in conjunction with a.c./d.c. receivers. See text for details.



Schematic diagram and parts list of the power supply for use with the QF-1.

C1a/C1b—Dual electrolytic capacitor, 16 ufd., 150 volt
CH1—7-hy., 15-ma. choke
S1—D.p.s.t. toggle switch
SR1—65-ma selenium rectifier (Miniature 20-ma. type may be substituted if desired)
T1—Transformer, 125 volts @ 15 ma., and 6.3 volts @ 0.6-amp. (Stancor PS-8415 or equivalent)

available to the public. I have been experimenting with the Heath Q-multiplier which is known as the Model QF-1.

The kit is very easy to assemble and should require little more than a single evening's work. Front panel controls include all of the manual adjustments necessary to operate the Q-multiplier properly with any communications receiver in the moderate price category.

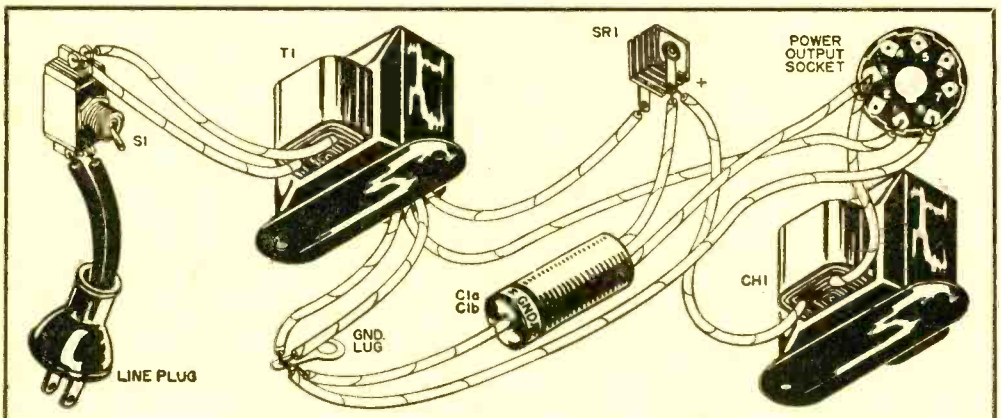
In testing the Heath QF-1 on receivers that cost from $75 to $200, an immediate improvement in selection was apparent. Phone and ham band c.w. signals could be copied with the QF-1 in operation that were totally unreadable before because of interference. The improvement is more noticeable in the less expensive receivers—simply because there is more room for increasing the station separating ability. The Q-multiplier can be of greatest value to the more expensive receivers through the use of the nulling out feature. This is a reversal of the *Q* multiplying function in that the QF-1 rejects a particular radio frequency instead of amplifying it. Full instructions on how to use the Q-multiplier accompany the kit plans.

A power supply is required for the QF-1, although the Heath receiver Model AR-3 will accommodate the multiplier without modifications. In other receivers, it will be necessary to borrow power through the accessory socket on the rear skirt. A convenient point to pick up the required voltages (if the accessory socket is not supplied) is from the audio output tube socket. Check the receiver wiring diagram and instruction manual before making any connections.

Power requirements are so simple that a small supply can be constructed for a few dollars. The one diagrammed above is adequate for the job. It is built into an aluminum box with the components mounted on one piece of the box while the other acts as a shield. Wiring up this power supply is simplicity in itself and no trouble should be encountered if the pictorial is followed.*

The Q-multiplier will remarkably increase the phone selectivity of such receivers as the SW-54 and S-38 series. It can improve c.w. reception, but in receivers that do not have a separate b.f.o. there will be a tendency to suppress the beat note of the c.w., making it sound mushy. —30—

* When using the Q-multiplier and power supply in conjunction with an a.c./d.c. receiver, it is important to watch for accidental shock. Such shock can occur through the shielded cable connecting the Q-multiplier to the receiver. To eliminate this possibility, isolate the connector from the receiver chassis—in other words, do not ground the shielded cable to the receiver. Bypass the shielded cable to ground through a 0.01-mfd., 600-volt capacitor. Check your receiver diagram FIRST!



Pictorial diagram of the power supply shows how parts are interconnected.

Dig That REEL Flat Response!

By CARL KOHLER

IT *had* to happen sometime.

As an ex-musician, whose union withdrawal-card has gathered dust in the company of a tarnished cornet, I've long entertained the certainty that sooner or later I would saunter into my electronics jobber's store for a handful of transistors—and emerge lugging a late model tape recorder.

It finally happened a couple of weeks ago. So I wasn't a mite surprised at all when friend wife caught me crooning fondly over a professional magnetic tape recorder. In fact, I was *prepared* to be caught.

Friend wife batted her inscrutable brown eyes and stood as motionless as a Mohawk war lord while I fiddled with the push-button keyboard and nervously threaded tape into the instrument.

"We already *have* a movie projector," she said, finally, in the disillusioned voice of a long-suffering woman whose hubby has just brought home their fourth pool-table. "We need another projector like we need another circuit around this humming warren of wire. If you're going to fling the long-green in all directions, why can't you, at least, throw it away on something we haven't yet blown fuses on?"

I dredged up an insincere chuckle.

"Now, relax. If you'll just tune down the verbal impedance and favor this fine instrument with a—"

"Relax, he says." She smiled a thin smile of self-pity, and snatching up one of the reels from the coffee table, held a foot of tape against the light—her film-editing squint working overtime. "Grüss Gott!" she yelped, "No pictures on the film even! The boy buys a big, fat, expensive projector and plans to run unexposed, undeveloped film through it yet!"

"This . . . is . . . a . . . tape . . . recorder," I said in cleanly geometric English. "Stop acting like a ward matron in a funny house and give a listen." I turned the recorder to 'on,' jabbed the *playback* key, and the soothing, full-toned chords of the overture from *La Boheme* swelled into the room—courtesy Wilhelm Furtwangler, the Vienna Philharmonic, and electronic-hi-fi enchantment.

"Isn't *that* a darb now!" I whispered, under the dramatic sweep of the orchestration.

She dropped beside me, watching the 1200-foot reel of tape slowly rotating to the accompanying surge of melody.

"Phonograph music on a strip of paper! My gosh, isn't that the craziest ever!"

"Plastic, magnetized tape," I corrected.

"B-But we already *have* a phono—"

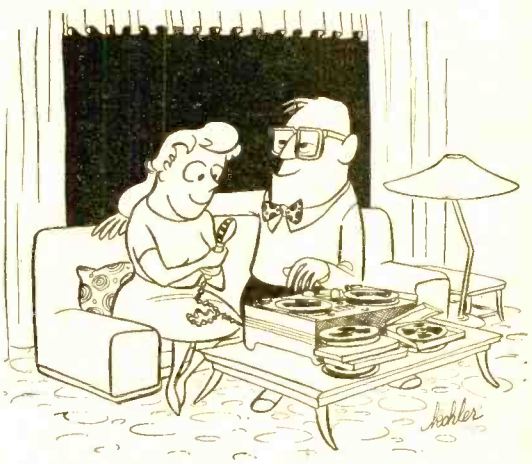
I hoisted an interrupting hand.

"Lady, you haven't heard *anything!* You are about to ear-witness one of the magics of the electronic age!" I switched reels, putting a blank one into the recorder. Thrusting the wide-range, cardioid microphone in front of her awe-stricken face, I flicked the "record" button and bent a companionable leer upon her. "Say something," I invited.

"W-What'll I say?"

"Oh, give with a profound thought, a crisply new idea, a cleanly enunciated series of well-chosen words worthy of the occasion."

"I—I feel kinda silly!" she shrilled, gaping coyly at the mike. "Uh . . . *hello,* there! (titter) Gee, does this thing really . . . I mean . . . oh, I don't know *what* to say! It seems so foolish! (titter)."



. . . Thrusting the wide-range, cardioid microphone in front of her awe-stricken face, I flicked the "record" button. "Say something," I invited . . .

"Thank you, Miss Verbal Fumble of 1956," I said, and stopped the tape. Reversing the reel and watching the counter-dial, I played it back after I was able to start it from the approximate beginning. Together, we sat listening.

". . . *Miss Verbal Fumble of 1956,*" finished the tape playback. I stopped the tape, snapped off the recorder.

"Oh, that's *simply* marvelous!" she cooed.

"It's fraught with possibilities," I admitted. "Armed with this rare instrument, one

. . . Her favorite is a snide bit of unfair tape recording called "What A Husband Sounds Like At Seven-Thirty When Unexpectedly Awakened" . . .

might enjoy all manner of merry fun and elaborate mischief. Surely, you'll agree that, heretofore, we've led rather dull lives; and purchasing this quality precision instru—"

Friend wife transfixed me with the pitiless stare of the natural-born, dyed-in-the-balance-sheets bookkeeper. "Before you wax sickeningly poetic about it, boy, let's hear what this little sound-caper does to the budget. Come on, all bush-beating aside: what's the damage?"

"Might as well hang for a horse-thief as be heel-twitching high for candy snatching," I quipped, my effort at light, gay-hearted whimsey momentarily putting me in the Noel Coward league . . . for valorous attempt, if not notably successful comedy. "As dear, old penny-pinching dad used to put it," I continued, somewhat desperately stalling for time and a good out, "quaality is—" here, I slathered a phoney, nasal Down East twang into my golden, South Los Angeles native dialect, and did my absolute darndest to grin engagingly with a bucolic twist of lip, "—as quaality costs, heh, heh, heh!"

"What's the *cost,* heh, heh, heh?"

I told her.

"GREAT GALLOPING BANKRUPTCY!" she screeched, her attention riveted upon the recorder with much the same awe the Conquistadores must have regarded golden Inca altars. "Here comes macaroni three times weekly!"

"I'll eat like a bird," I vowed solemnly.

"What do they build into these gismos to make them small invested-fortunes—pure platinum mainsprings or something?" Quickly and deftly, she swept a fly off the polished surface of the instrument before his feet could bruise the gleaming finish.

"Well, this model has four separate heads," I stated, importantly. "And those four heads—"

". . . together with *your* two make six," she chimed. "And what's that got to do with the high price of pretty music, hah?"

Ignoring her cruel thrust, I continued to list the definite advantages of a really professional tape recorder.

"Well, when you reach the end of a track, there's no need to fuss with changing reels. With an erase head and a record-playback head for each track—you merely touch the conveniently built button and, presto, the tape reverses its motion recording. Or it plays back the second track without further fiddling or bother."

"Bully for old four-heads, here!" She drew the drapes to protect the gleaming instrument from the harsh effects of smog-filtered sunlight. "Don't quit when you're winning. What else does this sing-box have that I can shout praises about to the other old folks when we get to the poorhouse, Buster?"

That did it.

"Not that it'll mean any more to you than International Morse means to a pack of symbol-deaf aliens from another galaxy, but I could mention that this baby has a hysteresis motor independent of line voltage fluctuations, electromagnetic dynamic braking, two high-impedance and one low-impedance input . . . and the whole works is relay-operated and triple-fused against improper operation, which it'll only get over my stone-cold dead body." I paused to change the air in my lungs and glare intensely.

Abashed, humbled and probably wondering what I was talking about (but not certain it hadn't been something vastly, terribly important beyond her frail grasp upon things electronic), she sat contritely in my lap and gazed at the recorder with much the same expression as I imagine the aborigines must have had when they spotted their first aircraft. Then, she turned the wonderment on me.

(*Continued on page* 125)

AFTER CLASS

GAS TRIODES AND TETRODES

OF THE two classes of gas-filled triodes and tetrodes—hot-cathode and cold-cathode types—the hot-cathode tube is used most often in industrial electronics. Although the internal construction of a typical *thyratron,* as it is called, is substantially different from a standard vacuum tube, its schematic diagram is very much the same. The thyratron has an electron-emitting cathode, a grid of sorts, a plate or anode, and a gas such as mercury vapor, hydrogen, or argon in the space inside the envelope. Presence of gas is shown by the black dot within the circle.

Much essential information about a tube's behavior can be determined from its grid-plate characteristic curve. You can make up this curve by watching how the plate current of the tube is governed by the voltage on its control grid. A vacuum tube is generally set up in a test circuit like that shown in Fig. 1(A); then you vary grid voltage and observe the resultant plate current changes on the milliammeter. Try this with a thyratron and you'll have to sweep up the remains of the tube and the meter with a very fine broom!

The first lesson to learn about a thyratron is that it can *never* be operated without a plate load of the correct value. While the grid of a vacuum tube is something like a smooth water valve that continuously controls the flow of fluid, that of a thyratron more closely resembles a safety plug in a sprinkler system. Once it pops—watch out! The only way to stop the resulting torrent is to turn off the main valve.

Suppose we experiment with an FG-81 thyratron connected in the circuit of Fig. 1(A)—except that we add a suitable plate resistor between point A and the negative terminal of the milliammeter. Before applying heater voltage, we should make sure that the movable arm of *R1* is set to the left, so that a full 10 volts of negative bias is applied to the control grid. Then we adjust *R2* to make the voltmeter *M2* read exactly 100 volts; this is the anode voltage.

Now we warm up the tube and begin to move the wiper of *R1* to the right, gradually making the control grid less negative as read on *M1*. Surprisingly, the plate circuit milliammeter which read zero to start still shows no deflection, even though the grid is becoming less and less negative. The grid voltmeter *M1* moves from —7 volts, to —6 volts, to —5 volts, to —4 volts and still no plate current flows!

Then, with startling suddenness, when the grid voltage arrives at about —3 volts, the plate milliammeter surges upward to about the same value it would reach if the

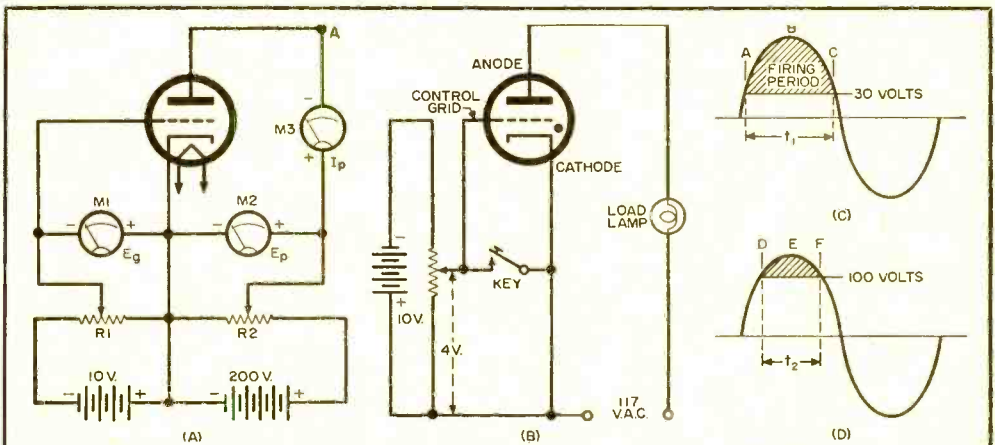


Fig. 1. (A) Test circuit for checking vacuum-tube characteristics. (B) Circuit of thyratron with a.c. on plate and key for shorting out grid bias. (C) Waveform when thyratron fires at 30 v. on plate. (D) Waveform when firing potential is 100 v.

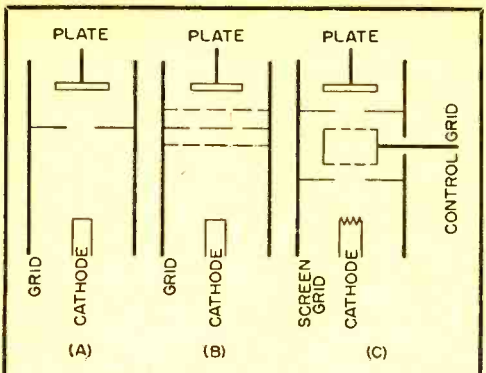


Fig. 2. (A and B) Basic cross-sections of two representative types of thyratrons. (C) Electrode structure of a screen-grid thyratron.

thyratron were replaced by a closed switch! And as though this weren't enough of a surprise, we now find that running the bias back to the full negative setting of — 10 volts has absolutely no effect upon the plate current. The switch has been closed and that's that! To turn the thyratron off, we have to remove the anode voltage entirely.

What good is a tube that behaves like a one-way switch? Well, let's think about all the ways in which self-latching relays are utilized—for a thyratron is evidently the equivalent of such a relay. We find latching relays in burglar alarms, fire alarms, liquid level controls, thermostats, pressure-regulators, and many other similar control circuits. Is a gas tube superior in this respect to ordinary magnetic relays?

To close a magnetic relay, we must apply the activating voltage to its coil for at least 1/60 of a second. Furthermore, faster relay operation demands higher current flow during the application of the energizing voltage. In a thyratron, on the other hand, the grid voltage must be brought up to the firing point only for a time long enough to cause ionization of the gas in the tube. This time is on the order of a *few microseconds at the most.* Also, the current taken from the control voltage source is negligible. Hence, even if it had no other application, the thyratron would more than justify its existence just by being a fast-acting, zero-current-drain, self-latching relay.

But we don't have to stop here! There's a very simple way to make a thyratron automatically unlatch itself when the control grid voltage is more negative than the firing potential. Figure 1(B) illustrates a circuit in which the thyratron will fire when the key is pressed but, upon the release of the key, both the thyratron and load lamp will be extinguished. The secret lies in the use of a.c. as a source of anode voltage. When the key is pressed, the negative bias is shorted out and the thyratron lights the lamp; when the key is released, bias is restored, and within 1/60 of a second or less the anode voltage dips to zero as the a.c. reverses. This effectively removes the anode voltage long enough to permit deionization of the gas and the return of the circuit to its inactive condition.

In experimental and low-current industrial control circuits, we often find the older gas-filled triodes replaced by more modern shield-grid thyratrons (gas tetrodes). Tubes like the FG-95 and the 2050 are favored over their triode antecedents because of the absence of pre-conduction grid current. In the triodes, this phenomenon robbed the driving source of power, ruined the potential sensitivity of the system, and often caused the thyratron to bring about its own demise by excessive grid current. By including a shield-grid in the tube, the control grid is kept out of the stream of ions and electrons from the cathode during conduction. This results in virtually no grid current and permits the use of a high grid resistance to obtain excellent sensitivity to small grid voltage changes. In most circuits, the shield grid is externally connected to the cathode by means of a jumper between pins on the tube socket.

When a.c. is used as an anode source, a thyratron need not act merely as a switch—it may serve as a quantity-control device as well. In Fig. 1(C) the control grid voltage has been set at — 1 volt, and the thyratron begins to conduct when the anode voltage reaches 30 volts (point A)—extinguishing when the anode potential again falls below this point. The conduction time is *t1.*

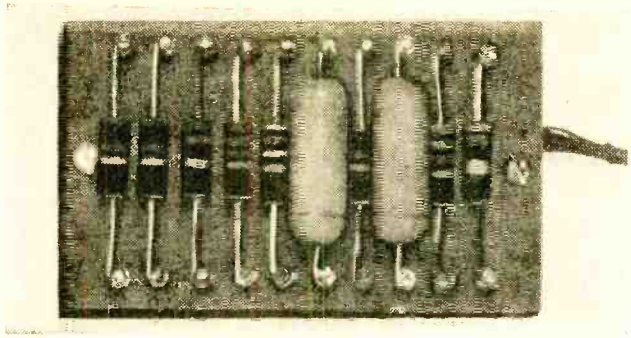
Contrast this with Fig. 1(D). As the control grid voltage is — 3 volts, the anode potential must reach 100 volts to start conduction. This results in a much shorter conduction period, *t2.* The total power transferred to the load in the second case is substantially smaller than in the first case because of the shorter conduction period.

In practical circuits, a variation of a volt or two in the grid circuit may control tens of amperes in the anode or load circuit.

QUIZ

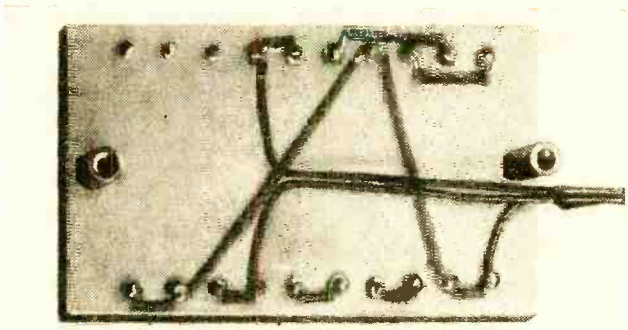
1. Why can't you operate a thyratron without a load in its anode circuit?
2. Why is a thyratron often referred to as an "all-or-nothing" tube?
3. How does a shield grid in a thyratron improve the tube?
4. How does the use of a.c. anode voltage affect the operation of a thyratron?
5. How does the time-interval of anode current flow affect the power transferred to the plate load?

(Answers appear on page 116)

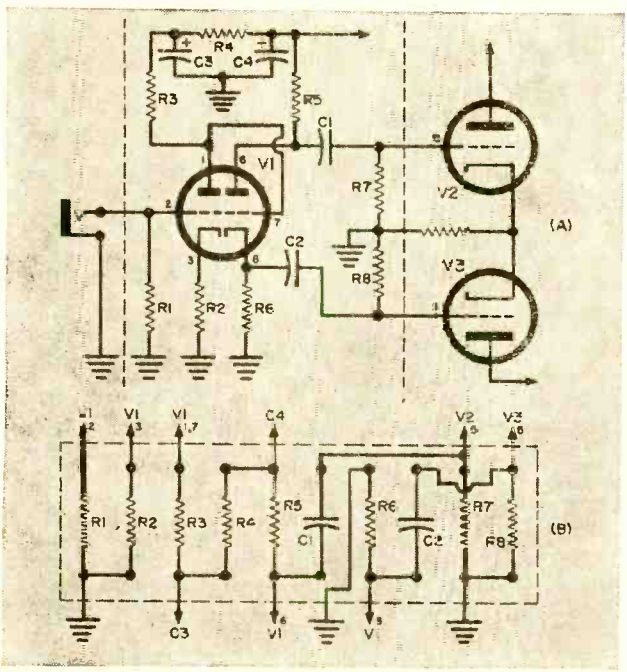


Mounting Boards Simplify Wiring

YOUR home-built equipment can have that professional look if you use made-to-order resistor mounting boards. Neat, practical and inexpensive mounting boards can be easily constructed from strips of Formica. Get the kind that's sold to cover counters and table tops. It's a phenolic-base material 1/16" thick with good insulating properties, and can be readily worked with a hacksaw and a hand drill. Cabinet-makers and building supply houses will usually furnish scrap pieces at little or no cost.



Above, front and rear views of mounting board. Below, the resistors and capacitors within dashed lines of schematic (A) are shown mounted and interconnected (B) on mounting board.



The first step in making a mounting board is to draw a sketch of the location and electrical connections of the parts to be mounted. Cut out a strip of Formica about one inch wider than the longest resistor or capacitor, and long enough to allow about 5/16" between each part plus 3/8" at each end. The Formica can be cut without chipping with a 32-teeth-per-inch hacksaw blade.

Cadmium-plated machine screws (4-40 x 1/2") are used for the terminals. Drill the holes for the terminals with a No. 41 drill 1/4" in from the edge of the strip with a spacing of 5/16". These holes need not be tapped as the screws will cut their own thread in the material. Drive in the screws from the back, so that about 1/4" of the thread protrudes on the part side of the strip. Then cut off the heads.

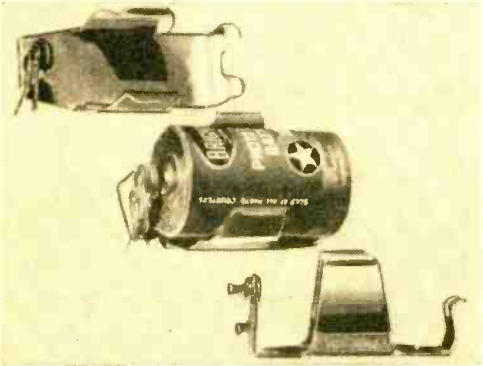
Jumpers between the terminals and leads to the tube sockets are soldered to the terminals on the rear of the mounting board. The resistors and capacitors are then mounted on the part side by wrapping their leads around the terminals and soldering.—*Allan M. Ferres.* —30—

TOOLS and GADGETS

ALUMINUM BATTERY CLIP

Shown in the photo is a battery clip designed to hold a single size D flashlight cell. It is formed from a single piece of aluminum in a three-stage punch press operation. After forming, the clip is heat-treated to add flexibility to the aluminum.

Employed successfully by Goldak for several

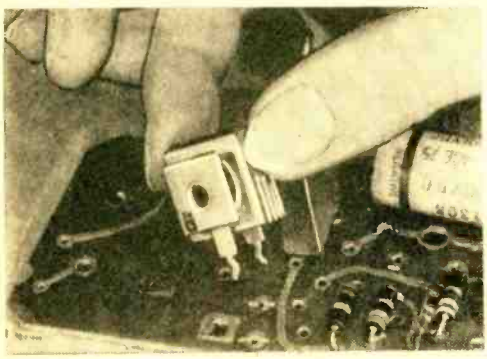


years in its own pipe and metal locating equipment, and in Geiger and scintillation counters, this clip is now being offered for general use. (*The Goldak Company*, 1544 West Glenoaks Blvd., Glendale 1, Calif.)

RECTIFIER FOR PRINTED CIRCUITS

Featuring special snap-in terminals, Radio Receptor's new miniature selenium rectifier is designed for use with printed wiring boards. The terminals will snap into a printed board easily but with sufficient mechanical rigidity to hold the rectifier firmly in place, making soldering necessary only for good electrical contact.

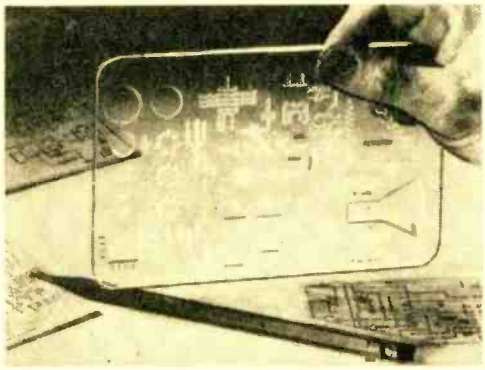
The rectifier is being produced in half-wave



stack types 8Y1B and 8J1B, rated at 30 ma. and 65 ma., respectively, at off-the-line voltages, with a capacitive load in an ambient temperature of 45° C. Both of the stacks mount in 3/32" diameter holes spaced on 27/64" centers. (*Radio Receptor Co., Inc.*, Semi-Conductor Division, 251 West 19th St., New York 11, N. Y.)

"ELECTRONICS DIAGRAMMER"

It's possible for those with no drawing experience to make professional-looking circuitry plans in a matter of minutes with this

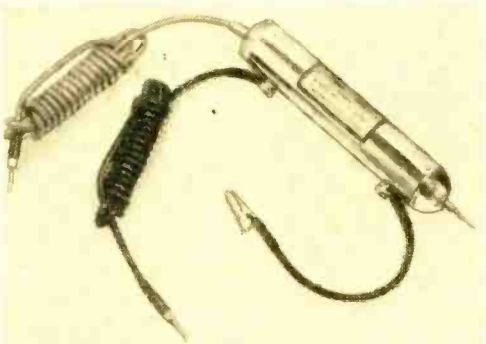


new "electronics diagrammer"—just by running a pencil, pen or stylus through any combination of its dozens of sharply engraved electronics symbols. Need for all other drafting instruments is eliminated.

Every necessary component of the most commonly used electronics symbols is included on the rigid transparent vinyl template, which measures only 4½" x 6½" x .040". The sides of every symbol are beveled to provide extreme ease and accuracy. Price is $3.00, postpaid. (*A. Lawrence Karp*, 16 Putnam Park, Greenwich, Conn.)

VOM SIGNAL-TRACER PROBE

Model 262 VOM signal-tracer probe permits checking of horizontal and vertical blocking oscillators, drive to horizontal-output tube,



output from horizontal sweep circuit, local-oscillator operation, i.f. signal, audio stages, etc. It also allows top-chassis checking of most a.c. waveforms in a TV receiver.

Ruggedly constructed and durable, the Model 262 has a gold-plated steel housing with color-coded Lucite ends. It may be used with any 20,000 ohms-per-volt VOM. You put it in operation simply by plugging it into the VOM

(*Continued on page* 104)

MEN WITH MECHANICAL SKILLS:

CAN YOU MEET THIS CHALLENGE?

Mechanics Creed

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

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

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

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

GO PLACES FASTER ON THE ALL VOLUNTEER TEAM

THE U.S. AIR FORCE

PASTE COUPON ON POSTCARD

M-40-PE2

And Mail To

Airman Recruiting Information Branch
Box 2202
Wright-Patterson AFB, Ohio

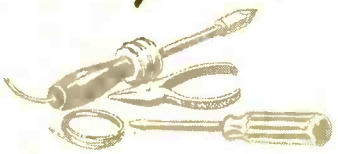
Please send more information on my opportunities for enlisting in the U. S. Air Force. I am between the ages of 17-34 and reside in U.S.A. or possessions.

Name_____

Address_____ Age____

City_____ Zone____ State____

build your own **HEATHKIT**



. . . and have fun doing it!

Every Heathkit comes complete with detailed step-by-step instructions and large pictorial diagrams that insure successful construction—even for the beginner. Enjoy both the satisfaction and the economy of "building it yourself."

Circuit boards cut assembly time in half

1% resistors insure instrument accuracy.

High impedance and high sensitivity.

Attractive styling—functional design.

etched circuit vacuum tube

voltmeter kit

MODEL V-7A

$24.50

SHIPPING WT. 7 LBS.

In addition to measuring AC (rms), DC, and resistance, the modern-design V-7A incorporates facilities for peak-to-peak measurements. These are essential in FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, at 4,000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X 1 megohm. A db scale is also provided. Polarity reversing switch provided for DC measurements, and zero center operation is within range of the front panel controls. Employs a 200 microampere meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit boards insure fast, easy assembly and result in reliable operation. Circuit board is 50% thicker for more rugged physical construction. 1% precision resistors used for utmost accuracy.

Heathkit

HANDITESTER KIT

MODEL M-1

$14.50

Shpg. Wt. 3 lbs.

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 microampere meter for sensitivity of 1000 ohms per volt. Handy and portable. Will fit in your coat pocket, tool box, glove compartment, or desk drawer.

Heathkit **VOM KIT**

20,000 ohms/v. DC and 5,000 ohms/v. AC sensitivity. Ranges (AC and DC) are 0-1.5, 5, 50, 150, 500, 1500, and 5000 v. Direct current ranges are 0-150 ua, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide center-scale readings of 15, 1500 and 150, 000 ohms. DB ranges cover −10 db to +65 db.

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

MODEL MM-1

$29.50 Shpg. Wt. 6 Lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.*
BENTON HARBOR 5, MICHIGAN

Heathkit 3" oscilloscope kit

ETCHED CIRCUIT

Push-pull vertical and horizontal amplifiers.

Light weight and small size for portability.

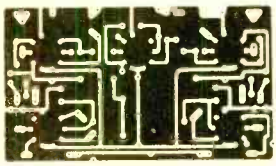
Good sensitivity and broad frequency response.

Etched metal circuit boards for simplified assembly.

Attractive panel and case styling.

MODEL OL-1

$29.50 Shpg. Wt. 14 Lbs.



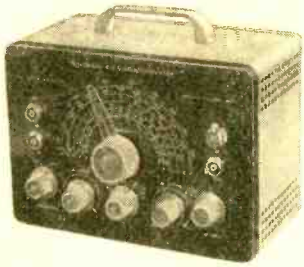
This compact little oscilloscope is just the ticket for use in the ham shack or home workshop. Measures only 9½" H. x 6½" W. x 11¾" D. Weighs only 11 pounds.

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

Cathode-follower output for isolation.

No oscillator calibration required.

Covers 160 kc to 220 mc (including harmonics).



Heathkit signal generator kit

This signal generator covers 160 kc to 110 mc on fundamentals in 5 bands. Calibrated harmonics extend its usefulness up to 220 mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 microvolts. Output controlled by both a continuously variable and a fixed step attenuator. Audio output may be obtained for amplifier testing.

MODEL SG-8

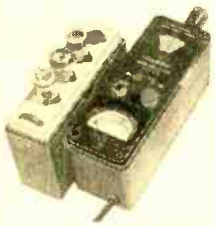
$19.50

Shpg. Wt. 8 Lbs.

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

Heathkit grid dip meter kit

This extremely valuable instrument is a convenient signal source for determining the frequency of other signals by the comparison method. Range is from 2 mc to 250 mc. Uses 500 ua meter for indication, and is provided with a sensitivity control and headphone jack. Includes prewound coils and rack. For hams, experimenters, and servicemen.



MODEL GD-1B

$19.50

Shpg. Wt. 4 Lbs.

Heathkit ANTENNA impedance meter kit

Used in conjunction with a signal source, the Model AM-1 will enable you to measure RF impedance. Valuable in line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. A 100 microampere meter is employed. Covers the impedance range from 0 to 600 ohms. An instrument of many uses for the amateur. Easily pays for itself through the jobs it will perform.

MODEL AM-1

$14.50 Shpg. Wt. 2 Lbs.

HEATH COMPANY A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 5, MICHIGAN

Heathkit

vfo

KIT

- ☆ 6AU6 electron-coupled oscillator.
- ☆ 0A2 voltage regulator tube for stability.
- ☆ Smooth-acting illuminated dial.
- ☆ Easy to build and attractively styled.

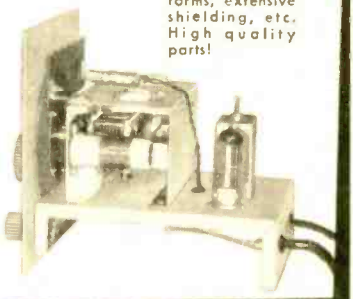
MODEL VF-1 **$19.50***

Shpg. Wt. 7 Lbs.

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

Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

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



Heathkit CW amateur transmitter kit

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

MODEL AT-1

$29.50*

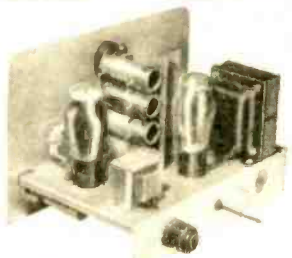
Shpg. Wt. 15 Lbs.

Single-knob band-switching for 80, 40, 20, 15, 11 and 10 meters.

Plate power input 25-30 watts.

Panel meter monitors final grid or plate current.

Best dollar-per-watt buy on the market.



SPECIFICATIONS:

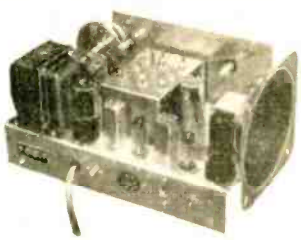
RF Amplifier Power Input	25-30 watts
Output Connection	52 ohms
Band Coverage	80, 40, 20, 15, 11, 10 Meters
Tube Complement:	
5U4G	Rectifier
6AG7	Oscillator-Multiplier
6L6	Amplifier-Doubler

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

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

Transformer-operated power supply for safety and high efficiency.

Heathkit COMMUNICATIONS TYPE all band receiver kit



$27.95* MODEL AR-3

Shpg. Wt. 12 Lbs.

CABINET: Fabric-covered cabinet available. Includes aluminum panel, speaker grille, and protective rubber feet. Measures 12-1/4" W. x 6-3/4" H. x 7-3/4" D. No. 91-15. Shpg. Wt. 5 Lbs. $4.50.

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

Features good sensitivity and selectivity. Separate RF and AF gain controls—noise limiter—AGC—VFO, headphone jack—5" PM speaker and illuminated tuning dial.

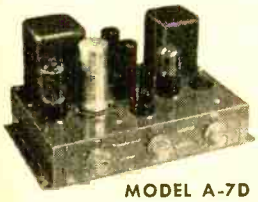
SPECIFICATIONS:

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

HEATH COMPANY *A SUBSIDIARY OF DAYSTROM, INC.*

BENTON HARBOR 5, MICHIGAN

HEATHKIT ECONOMY 7-WATT HIGH FIDELITY



amplifier kit

MODEL A-7D

$16.95* Shpg. Wt.

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

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

Free 52-Page 1956 Catalog

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

HEATHKIT BROADCAST BAND

receiver kit

MODEL BR-2

Shpg. Wt. 10 Lbs.

$17.50* Less Cabinet

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

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

HEATHKIT HIGH FIDELITY

fm tuner kit

MODEL FM-3

$24.50*

Shpg. Wt. 7 Lbs.

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

MAIL TO **HEATH COMPANY** *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 5, MICH.**

order blank

From _____

_____

_____

PLEASE PRINT

SHIP VIA

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

QUANTITY	ITEM	MODEL NO.	PRICE

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

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.

in place of a conventional test lead. (*Futuramic Co.*, 2500 West 23rd St., Chicago, Ill.)

3-D BINOCULAR MAGNIFIER

Fine tolerance and precision work can be done easier, faster and more accurately with this 3-D binocular magnifier. Called "Magni-Focuser," it gives needle-sharp vision—greatly enlarged and in the third dimension. Normal vision may be resumed by raising the head slightly.

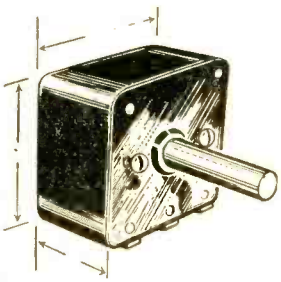
The "Magni-Focuser" is lightweight, relieves eye-strain, and leaves both hands free to work. An adjustable headband insures comfort. Models which magnify from 1½ times at 20" to 3½ times at 4" are available, with prices ranging from $10.50 to $12.50. (*Edroy Products Company*, 480 Lexington Ave., New York 17, N. Y.)

RIGHT-ANGLE TUBE SOCKETS

Tubes can be mounted parallel to printed-wiring boards by means of space-saving Aerovox right-angle tube sockets. Providing a marked reduction in height and depth of printed wiring assemblies, these sockets are equally adaptable to hand- or machine-insertion methods. Terminals are of adequate length to slip into printed-wiring holes and be dip-soldered. Both 7- and 9-pin sockets are available in four different versions. (*Aerovox Corporation*, Pacific Coast Division, 2724 South Peck St., Monrovia, Calif.)

SUBMINIATURE VARIABLE CAPACITOR

Measuring only 1" x 1" x ⅝", the subminiature two-section variable capacitor now available from Lafayette Radio, is said to be the smallest variable capacitor of its type in the world. It is designed for use in miniature superhet circuits.



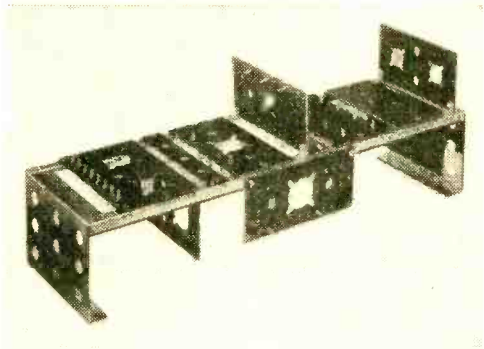
Capacity in the r.f. section is 9 to 290 $\mu\mu$fd., the oscillator section 7 to 129 $\mu\mu$fd. Capacity curve is $\pm 2\%$ with a Q above 6000 in the broadcast band. The entire unit is sealed in a hi-impact plastic case. Selling for $1.95, it is furnished with two subminiature padders. (*Lafayette Radio*, 100 Sixth Ave., New York 13, N. Y.)

"MIDGET" SCREWDRIVERS

The new "Midget" series of "Quick Wedge" screw-holding screwdrivers will hold, start and drive No. 0 to No. 4 wood screws and bolts, and No. 2 to No. 4 sheet metal screws. Two sizes are available: #1253, with a 3" blade (and spring pocket clip), at $1.25; and #1258, with 8" blade, $1.50. (*Kedman Company*, 233 South 5th West, Salt Lake City, Utah)

3-D CHASSIS KIT

Combining versatility in assembly variations with time-saving simplicity, the PMP 3-D chassis kit was designed to provide complete flexibility for the design and development engineer in the construction of prototype models. Use of quality components in this low-cost



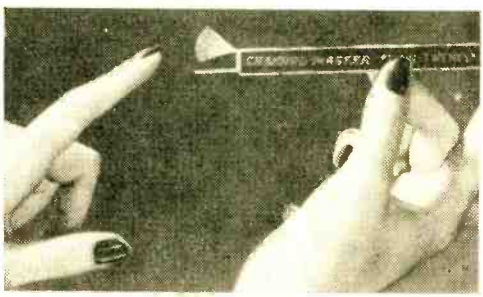
kit insures maximum electrical and mechanical stability.

Mounting plates may be positioned in a variety of combinations, and allow use of many different types of tubes. Capacitors, controls and components are easily mounted through the many holes provided. Two or more kits may be joined together for more complex prototypes. (*Precision Metal Products Co.*, 41 Elm St., Stoneham 80, Mass.)

FLEXIBLE TV TRANSMISSION WIRE

"Twin Twenty" and "Challenger" transmission wire, made with 20 wire strands per conductor, is claimed to be the softest, most flexible transmission line ever produced. It is easy to work with and highly break-resistant. Both brands offer a complete range of web thicknesses, including 55, 80 and 100 mil.

Colorfully and attractively packaged, "Twin-Twenty" is marked with a deep impression



every ten feet so that you can quickly and accurately unwind what you need from the spool. It is available in silver or brown, while the "Challenger"—lower priced line—is available only in brown. (*Channel Master Corp.*, Ellenville, N. Y.)

—30—

Electron Tubes With Energy Like The Sun

SOLAR ELECTRONICS

To insure only top quality merchandise Solar Electronics "set tests" each electron tube in powerfully loaded chassis!

Here Is Our New Guarantee Policy:
Money back within 5 days of receipt of merchandise PLUS 5 year free factory replacement.
ALL TUBES ARE CODED BY MONTH AND YEAR!

FREE INTRODUCTORY GIFTS *Clip This Ad*

With every order of $15 or more—one 6SN7GT, one 6W4GT, 5 assorted resistors, 5 assorted attractively colored tube cartons; or with every order of $30 or more—1 RCA Cheater Cord, 5 assorted resistors, one 6SN7GT, one 6W4GT, one 6K6GT and Vidnire 2 set Coupler.

FREE BONUS OFFER!

Model 625K

A terrific Eico tube Tester or TV FM Sweep Generator FREE when you buy $200 worth of receiving tubes or more within 60 days at Solar. **Tester or generator may be bought outright from Solar for $33.50.**

ANTENNA SPECIALS

COMPLETE OUTDOOR
ALL CHANNEL CONICAL $8.45
Includes: 3 element antenna with crossbar, 5 ft. seamless aluminum mast chimney mount or 7" wall bracket, 8 stand offs, 50 ft. or 300 ohm wire. State your need! List $15!

NEW INDOOR ANTENNA $3.75
Brings in UHF and VHF. Use on top of TV.
List $9.95.
YOUR PRICE

USED TV SETS

Picture tube guaranteed to work.

	Table Model	Console
10 inch set	$17.50	$20.00
12 inch set	$22.50	$25.00
14 inch set	$27.50	$30.00
16 inch set	$32.50	$35.00
17 inch set	$36.00	$38.50

19", 20", and 24" Sets—Prices on request.

FAMOUS MAKE TEST EQUIPMENT!

TUBE TESTER KIT $33.25
In carrying case! Factory wired, $44.95.

VACUUM TUBE VOLTMETER KIT $24.95
Factory wired, $37.50.

FLYBACK TRANSFORMER and YOKE TESTER KIT $21.75
Factory wired, $31.75.
Test Equipment Factory Guaranteed For One Year!

ALL PARTS SHIPPED F.O.B. HARRISON, N. J.

EASY TERMS!

We pay all postage or freight in U.S.A., Territories and APOs. 25¢ handling on orders less than $5. Please send 25% deposit with C.O.D.'s. Remember! Your money cheerfully refunded within 5 days if you are not completely satisfied.

Visit our tube and parts showroom next time you're in Harrison. A free gift awaits you!

PICTURE TUBE SPECIALS!

Brand New—RCA Licensed—One Year Guarantee

Type	Price	Type	Price	Type	Price	Type	Price
10BP4 or A	$11.25	16AP4 or A	$18.95	16JP4 or A	$18.75	19DP4 or A	$23.50
10FP4	$14.95	16CP4 or A	$18.95	16LP4 or A	$18.75	19FP4	$24.25
12LP4 or A	$13.95	16DP4 or A	$18.75	16KP4	$18.50	20CP4 or A	$24.50
12QP4	$13.95	16EP4	$19.45	16RP4	$18.50	20DP4 or A	$24.50
12JP4	$13.25	16GP4	$19.25	16ZP4 or A	$19.25	21AP4	$27.95
12UP4	$14.95	16HP4 or A	$18.75	17BR4	$19.85	21EP4A	$27.50
12BP4 or A	$15.95	16JP4 or A	$18.75	17CP4	$20.85	21FP4	$28.25
14CP4	$15.95			17GP4	$21.25	21YP4	$28.25
15DP4 (for Dumont)	$17.95			19AP4	$23.95	24AP4	$44.95

All Picture Tubes shipped F.O.B. Harrison, N. J.

BIGGEST VALUES! BIGGEST SELECTIONS!

PARTIAL LIST ONLY!

Type	Price	Type	Price	Type	Price	Type	Price
0A2	.67	6AC7	.65	6SN7GT	.53	12SH7	.59
0D3, VR150	.90	6AF4	.85	6SQ7	.37	12SJ7	.44
0Z4	.44	6AG5	.50	6SS7	.43	12SK7	.43
1A4P	.30	6AG7	.75	6T4	.89	12SL7GT	.59
1A7GT	.45	6AH4GT	.65	6T8	.65	12SN7GT	.53
1AZ2	.65	6AH6	.65	6U8	.73	12SQ7	.35
1B3GT	.63	6AK5	.57	6V3	.77	12V6GT	.44
1R4P	.88	6AL5	.38	6V6GT	.44	12X4	.35
1C5GT	.45	6AN4	1.25	6W4GT	.38	14A5	.90
1OSGP	.40	6AN8	.99	6W6GT	.55	14A7	.44
1E7GT	.40	6AQ5	.45	6X4	.35	14B6	.39
1H4G	.35	6AS6	1.50	6X5GT	.35	14E6	.59
1H5GT	.45	6AT6	.38	6X8	.75	14E7	.59
1L4	.47	6AU4GT	.70	6Y6G	.49	14F7	.59
1L6	.53	6AU5GT	.60	7A4	.44	14F8	.69
1LA6	.55	6AU7	.85	7A5	.53	14N7	.69
1LA6	.55	6AV5GT	.65	7A6	.44	19BG6G	1.10
1LB4	.55	6AV6	.36	7A7	.44	19T8	.64
1LC6	.51	6AX4GT	.85	7B4	.43	24A	.35
1LH4	.55	6AX5GT	.59	7B5	.40	25BQ6GT	.75
1LN5	.51	6B8	.75	7B6	.44	25CU6	1.10
1N5GT	.53	6BA6	.45	7B7	.44	25L6GT	.45
1R5	.58	6BA7	.55	7B8	.44	25W4GT	.42
1S5	.41	6BC5	.50	7C4	.44	25Z5	.39
1T4	.49	6BE6	.46	7C5	.44	25Z6GT	.35
1T5GT	.57	6BF5	.42	7C6	.44	26	.48
1U4	.55	6BQ6G	1.10	7E5	.59	27	.29
1U5	.41	6BH6	.52	7F7	.59	32L7GT	.53
1V2	.63	6BJ6	.49	7F8	.69	35	.32
1X2	.65	6BK5	.75	7H7	.69	35/51	.33
2A7	.50	6BL7GT	.69	7J7	.69	35A4	.44
2X2A	.55	6BN4	.60	7K7	.69	35B5	.48
3A4	.55	6BQ6GT	.75	7N7	.54	35C5	.48
3A5	.55	6BQ7	.80	7X7	.69	35L6GT	.45
3AL5	.48	6BY5G	.60	7Y4	.39	35W4	.35
3AU6	.48	6BZ7	.80	7Z4	.39	35Z4	.35
3BC5	.36	6C4	.35	12AT6	.38	35Z5GT	.35
3BN6	.65	6C8G	.50	12AT7	.65	37	.30
3CB6	.56	6CQ6G	1.10	12AU6	.42	39/44	.35
3Q4	.45	6CU6	.90	12AU7	.52	50A5	.44
3Q5GT	.55	6C6	.45	12AV6	.38	50B5	.48
3S4	.52	6F6	.40	12AV7	.73	50C5	.48
3V4	.52	6H6	.42	12AX4GT	.67	50L6GT	.45
4BQ7	.92	6J4	1.50	12AX7	.69	75	.40
4BZ7	.97	6J5	.38	12AZ7	.65	76	.40
5AQ5	.52	6J6	.50	12B4	.65	77	.40
5J6	.60	6K6GT	.38	12AB6	.45	78	.40
5U4G	.45	6L6	.65	12BA7	.59	80	.35
5U8	.68	6S8GT	.74	12BE6	.45	84/6Z4	.41
5V4G	.56	6SA7	.44	12BH7	.59	117L7GT	1.39
5X8	.78	6SC7	.50	12BY7	.64	117N7GT	1.29
5Y3	.29	6SF5	.60	12CU6	1.09	117P7GT	1.29
5Y4G	.35	6SH7	.43	12K7	.49	117Z3	.35
5Z3	.40	6SJ7	.43	12Q7	.44	117Z6GT	.60
6A7	.55	6SK7	.44	12SA7	.43	807	1.49
6AB4	.45	6SL7GT	.53	12SG7	.59	1619	.59
						9002	1.19

TO QUANTITY USERS!

Your initial order of $150 or more entitles you to our special 10% discount or free Deluxe "60" Remington Razor. State your choice. This offer **not** good if you are taking advantage of free tube tester or generator offered elsewhere in this ad.

SOLAR ELECTRONICS

Post Office Square
Harrison, N. J.

ESsex 4-5300

HELP WANTED

In this section of the **Transmitting Tower**, the names of persons requesting help and encouragement in obtaining their amateur licenses are listed. To have your name listed, address a request to Herb S. Brier, W9EGQ, % POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y.

Larry Saliny (15½), 397 E. 3rd, So. Pleasant Grove, Utah.

Curtis Ricketts, 110 East Church, Booneville, Miss., needs help in code and theory; also would like to receive a few QSL cards.

Harold C. Jennett, Jr., 8261 Leander Ave., Detroit 34, Mich. (college student) wants to be reassured that it does not require $400 to $500 worth of equipment to enjoy ham radio.

Michael F. Clowry, 682 Corbalis Pl., Yonkers 3, N. Y.

Larry Ross (14), 2460 Traymore, Cleveland 18, Ohio (phone: YE 2-4968) wants help, especially in learning the code.

David L. Bergdahl (15), 113 Elmwood St., Valley Stream, L. I., N. Y.

Charles Gross, 3731 Palacios St., Dallas 12, Texas, has completed a course in radio and TV, but needs a little help in getting his license.

Louis Shore, 624 E. Pine St., Trevose, Pa.

Thomas F. Elwood (42), 22 Butler Place, Rosebank 5, Staten Island, N. Y. (has phone). He and five friends would like help in obtaining their amateur licenses.

Richard Crowe, 430 S. Pleasant St., Montpelier, Ohio, and **James Lochart**, 210 So. Monroe, Montpelier, Ohio. These boys are working together to obtain their licenses.

Ronald Young, 65 Philadelphia St., Buffalo 7, N. Y.

James E. LaFoy, 244 Maple St., Hopeville, Ga.

Robert H. Kimball, 58 Ford St., Ballston Spa, N. Y., wants pen pals of both sexes and will answer all letters.

Mrs. Van Foxhill, 424 Cedar St., Camden 2, N. J., needs help and encouragement desperately. Her husband is K2QOM, but he just proves what poor instructors most husbands are in teaching their own wives.

Elwood Rhoddy, Aylesford R.R. #3, Kings Co., Nova Scotia, Canada.

Michael Coffey (14), 4541 N. 12th St., Phoenix, Ariz.

John F. Shaeffer, 32 Ennis Ave., Bedford, Ohio, needs help with code.

John Ronald Pavlik (15) R.D. #1, Eldora, Box 384, Monongahela, Pa. (phone: 4984-R3).

Bob Beyer, 2389 Charney Rd., University Heights 18, Ohio.

Faye Reid (12½), Umbrella Ranch, Peyton, Colo., would like to have some advice on choosing equipment.

Ray Allen (17), Sterling, Mich., needs help on code and regulations and theory.

Anthony De Louisa, 34 Monroe St., New York 2, N. Y., wants to know what books to study, and what equipment is needed.

Glenn C. Jensen (32), 607 N. Ferncree Rd., Orlando, Fla., needs help in getting his Novice ticket.

Southern Valley Stream DX Club, T. Richard Bentley, Sec'y., 116 Locust St., Valley Stream, Long Island, N. Y. This is a new club, and new members are wanted.

Raymond Allen Leverette, Box 219, Llano, Texas, needs help on code.

Robert L. Conger, P. O. Box 107, Ansley, Nebraska, (37), would like some help in learning code.

Allan Henn (14), Route 1, Terril, Iowa, wants help in code and theory.

Mickey Groh (15), 521 White Springs Rd., Geneva, N. Y., needs help in theory.

Harvey Chinn, 3405 Avenue H, Brooklyn 10, N. Y., is trying to obtain his General Class license.

Michael Bosie, 154 Wayne St., Perth Amboy, N. J., would like some help on code.

Joseph S. Zucker, 68 Phillips St., Wollaston 70, Mass., needs help on code.

Lee Carroll (11), 11 Grand Central Ave., Amityville, L. I., N. Y., would like help in both code and theory.

John C. Demuth SWL-W8, Box 177, Bowerston, Ohio, wants help on radio theory.

Richard Shafer (14), 18 Whitney Ave., Pompton Lakes, N. J., is learning basic theory.

Robert Wells (13), 1850 S. Chautauqua, Wichita, Kansas (phone: MU 6-7479) wants some help on code and theory.

Dick Powers (16), 3170 Farrand Rd., Clio, Mich., needs help in code.

Russell Pillsbury, R.D. #3, Jamestown, N. Y. (phone: Jamestown 6-6386).

Robert Conn, WN1IIO, 72 Taft Ave., W. Newton 65, Mass., needs some assistance in general theory.

Pete Farrell (16), Delbarton School, Morristown, N. J., needs help on code and theory.

Donald Auderer, 6414 Texas Ave., Houston, Texas.

Carl Markle, Jr. (15), 844 East 342 St., Willoughby, Ohio, wants some help on code.

Wilmer Berger (16) Box 77, Eganville, Ontario, needs help on code.

Jim Crocker, 8100 Foothill Blvd., Sunland, Calif. (phone: Florida 3-7142) needs help to pass his license code exams.

Bob Barteau (16), 3761 Adie Rd., St. Ann, Mo., wants to pass his Novice test.

Walter H. Bowers, Jr., 209 Riverside Rd., Baltimore 21, Md.

Gary Miller (15), 9533 Houghton, Whittier, Calif.

Gary Lynn Erland, Box 256, Newhall, Iowa, is working for his ham license, and needs help to get his General ticket.

Gordon Kiefer (14), 138 Brunswick St., San Francisco 12, Calif., wants help in learning code.

Robert Rosen, 192 Norfolk St., Bangor, Maine, needs help on code.

Edward J. Dean, (40), 4095 W. 58th St., Cleveland 9, Ohio, is interested in help from Cleveland amateur hams.

John B. Sindelar, Box 236, Ipswich, So. Dak.

To help prospective amateurs obtain their Novice licenses, the Radio-Electronics-Television Manufacturers Association offers a set of code records (recorded at a speed of 33⅓ rpm) and a Novice Theory Course for $10.00, postpaid. The complete course or more information on it can be obtained from RETMA, Suite 800, Wyatt Building, 777 Fourteenth St., N.W., Washington 5, D. C.

The Transmitting Tower

(*Continued from page* 81)

Repeat this tuning process as necessary to produce the rated amplifier plate current when *C6* is adjusted for minimum plate current. Observe how the output bulb gradually gets brighter during the tuning process.

Measure the amplifier grid current from time to time as the amplifier plate circuit is being tuned. Keep it at its rated value by appropriate adjustment of the oscillator tuning capacitor.

The process of tuning is the same on the different bands, although the adjustments do become more critical as the frequency of operation is increased. Also, the 28-mc. output from most two-stage transmitters is only about half of what it is on the lower frequency bands.

The primary reason for this loss of 28-mc. output is that the oscillator does not deliver sufficient 28-mc. output to drive the amplifier tube properly; therefore, the oscillator is usually tuned to 14 mc., and the amplifier is operated as a frequency doubler to 28 mc., with the consequent loss of power output.

More elaborate transmitters contain an additional amplifier/frequency-multiplying stage between the oscillator and output amplifier, which makes this compromise unnecessary.

After becoming familiar with tuning the transmitter into a light bulb, the transmitting antenna may be substituted for the bulb. Depending upon the antenna, the correct settings for *C6* and *C7* may differ considerably from those found correct for use with the bulb. But the tuning procedure will be exactly the same for either type of load.

A final tip: always operate a transmitter into a load, a dummy antenna for testing, and a radiating one for making contacts. Otherwise, excessive currents and voltages are developed in the plate tank circuit, and the tube screen current becomes dangerously high. Either condition invites damaged components and ruined tubes.

Beam Antenna Handbook

Beam Antenna Handbook, by William I. Orr, W6SAI, Radio Publications, Inc., Danbury, Conn., ($2.70), should have a place on the bookshelf of any amateur interested in antennas. Even if you are not planning on putting up a beam, it will tell you what happens to a radio signal when it is radiated into space from any kind of anten-

na; and if you are thinking about building a beam antenna, the *Beam Antenna Handbook* will tell you what to build, where to get the materials to build it, how to build it, and what it will do when it is finished.

Of special interest to Novices and others who wish to give 21 mc. a whirl is the constructional details of a simple and effective two-element beam, using inexpensive, easily obtained material. Its 5-db gain will triple the effective power of the transmitter feeding it.

News and Views

Carole Hoover, K9AMD, 401 East Wood St., Hillsboro, Ill., writes: "I began working for my Novice ticket quite suddenly last May and got my call letters in June. I kept on studying through the summer and passed the General exam on August 18. Since receiving my license, I've had more fun than I imagined possible.

"I still work c.w. (code) occasionally, but 3915-kc. phone is my favorite frequency where I love to ragchew. I also like 14 mc. for DX—if I'm lucky. I need 12 more states for my Worked-All-States certificate, and I love to get QSL cards.

"I guess it was the enthusiasm of my dad Dan, W9VEY, and my brother Danny, W9EZA, to whom I am grateful, that got me interested in amateur radio. Mom (Goldie) got the radio fever from us last summer. In August, she became KN9AXS. She now has her Technician Class license and is working on her General Class license. So the Hoovers are a 100% ham family.

"The parakeet in the picture (on page 80) was a gift to me from Danny on my 20th birthday last June. 73."

Charles Hanley, 2625 35th Ave., San Francisco 16, Calif., says: "Thanks a million for putting my name in the February 'Help Wanted.' The day after POPULAR ELECTRONICS came, I got a reply from Curt Olofsson, W6GTY, who is also a reader of our magazine; with his help, I hope to have my Novice license within a month. I also got a very fine letter from Wayne, KN4GUK, Greensboro, N.C. 73."

Russ, KNØCJO, 4660 S. Franklin, Englewood, Colorado, says: "The rig here is an AT-1 with an S-85 receiver. So far, I have worked 14 states, all on 40 meters. If anyone has any ideas for increasing the output of the AT-1, I'd like to hear them. Also, I'll be glad to schedule anyone needing a Colorado contact. 73."

Karl Thurber, K2IKZ, 247 Hamilton Rd., W. Englewood, N. J., has another solution to the problem of putting up an antenna in a limited space. "When I lived in an apartment, I constructed a regular 40-meter dipole (66 feet long) fed in the center. I ran more than half of it through the apartment and dropped the rest out of the window. Even with half of the antenna inside a metal-frame building, it worked fine. At my new location, I have worked 40 states and 30 countries on 40-meter c.w. 73."

Whit Russell, KN4EEK, 310 Segrave, Daytona Beach, Fla., reports: "In four months on the air, I have worked 44 states, all confirmed. Most of them were worked on 40 meters, although I also work 80 and 15 meters. Best DX is Oregon on 80, North Dakota on 40, and Puerto Rico and Colombia on 15 meters.

"My station uses an SX-99 receiver and a mighty 50-watt transmitter. Antennas are an 80-meter 'long wire,' a three-element vertical and a doublet on 40 meters, and a two-element beam aimed west on 15 meters.

"I'd like schedules with WN7's and WN1's. I QSL 100%, get 90-95% return. Oh yes, I passed my Conditional exam today. 73."

Dick Megyese, WN8COA, 18854 Ruth, Melvindale, Mich., writes: "I agree with Mickey, KN9BBO, on the importance of a good receiver (*Transmitting Tower*, January, 1956). Although my SX-99 is not quite as selective as his SX-96, I made 101 contacts in 24 states on the 80-meter band between December 26, 1955, and January 26, 1956. My transmitter is a Johnson 'Adventurer,' and the antenna is a coaxial-fed doublet. My frequency is 3722 kc., and my best DX is PJ2CJ, Curacao.

"You can print my full address. I like to get mail. 73."

Warren Herzog, KN5CNA, 6722 Calhoun Rd., Houston 21, Texas, has done well with simple equipment. "I've had my Novice since last September. With 22-watts input to a 6L6 oscillator, feeding a dipole 14 feet high, I have worked 13 states and Canada. My receiver is an S-19R, plus a Q-multiplier. I operate on 7187 and 7192 kc. By the time I am 14, next month, I hope to have my General license and my new 6146 rig built.

"I'll answer all letters I receive. 73."

Stan Brunk, KN9ATY, 43 North Glenview, Lombard, Ill., says: "I am 15, and I have been on the air about 2½ months. My transmitter is an AT-1, and my receiver is an Allied 'Ocean Hopper.' My antennas are two 'long wires.' I do my DX'ing between 4:00 and 6:00 a.m. My states-worked total is 30, with 26 of them confirmed. Best DX is Oregon and Vermont. 73."

Once again, we are out of space; so I'll be looking for you at the same spot next month. Keep your letters and pictures coming. 73.

Herb, W9EGQ

Tuning the Short-Wave Bands

(*Continued from page* 69)

This month we are featuring reports of stations that carry regular ENGLISH sessions, as well as other stations that are not often reported. All times shown are Eastern Standard, based on the 24-hour system.

Afghanistan—YAK, Kabul, 9975 kc., is being noted Saturdays at 1200-1240. This one might be pulled out from beneath the telephone stations, press, and c.w. (*CS*)

Argentine—LRY *Radio Belgrano*, Buenos Aires, is now using this frequency, replacing 9760 kc. It is usually covered by 4VB but is audible Sundays at 2100-2200 when 4VB goes off early. (*JRL*)

Australia—VLC17, 17,840 kc., Shepparton, has a daily xmsn at 1515-1715 beamed to New Zealand and the South Pacific areas. VLC9, 9615 kc., has ENGLISH to Western North America daily at 1014-1115 with news at 1030, and at 2220-2330 with news at 2245. VLW9, 9610 kc., Perth, can be noted after VLC9 s/off. It is heard at 0845-1000. The schedule to South and Southeast Asia is now 0859-1230 on 15,315 kc. and 11,900 kc., at 0859-1000 on 7220 kc., and at 1129-1230 on 7240 kc. (*JB, LM, TL*)

A real challenge for any DX'er is *Radio Puckapunyal* on 7850 kc. This Army station, 60 miles north of Melbourne, is heard on Tuesdays only from 0430 with music and news. (*NNRC*)

Belgian Congo—*Radio Congo Belge,* OTM-2, 9380 kc., Leopoldville, is noted at 0030-0130 with close at 0130. Announcements are in French and Flemish. They feature light music, popular and Latin American tunes. Identity at 0100. (*JB*)

OTC, 9655 kc., Leopoldville, provides excellent reception during the evening hours relaying ORU, Brussels, at 1800-2000. (*FG*)

Brazil—*Radio Nacional,* PRL-7, 9720 kc., Rio de Janeiro, is usually at good level in the east, 1800-0000. Latin-American music is often featured at 2200-2250. (*LM, BS*)

Radio Jornal do Commercio, ZYK32, 11,825 kc., Recife, is heard easily with music around 2100. (*LM*)

British Honduras—During a recent visit to the station, it was learned that the call sign of ZIK2, Belize, 3300 kc., has been deleted. The official call is BHBS. Schedule is 1300-1415 and 1900-2230. News is given in ENGLISH, then in Spanish. Variety of programs. (*JF*)

British North Borneo—*Radio Sabah,* Jesselton, 7237 kc., can be heard at 0600-0650. A BBC news relay at 0600-0612 precedes the musical portion of the xmsn. (*CS*)

Bulgaria—Sofia, 9700 kc., has programs to North America daily at 2000-2030 and at 2300-2330. On Tuesdays, Thursdays and Saturdays, they present concert music at 1930-2000. The station identifies as *This is Sofia, Bulgaria Calling.* (*AB*)

Burma—*The Voice of Burma,* XYZ, Rangoon, 4775 kc., has a musical program similar to *The Voice of Indonesia.* This one is heard until 1000 s/off in ENGLISH. Try to get it on Sundays. (*PF*)

Canada—CHOL, Sackville, 11,720 kc. (replacing CKRZ, 6060 kc.), and CKLO, 9630 kc., operate in European Service daily at 1500-1635 (ENGLISH at 1530-1600). CKLO parallels with CHAC, 6160 kc., at 1955-2035 in ENGLISH service to North America. (*JB, HS, SW, DB*)

Ceylon—The commercial service of *Radio Ceylon,* Colombo, 11,770 kc., is heard at 2030-2100 with music and commercials; BBC news relay at 2100-2110; more music follows. This xmsn is beamed to India and is in ENGLISH. Colombo also noted on 9620 kc. at 0830-0900 in ENGLISH, with music. (*GQ, GA, JD*)

Denmark—OZF, Copenhagen, 9520 kc., has a weekly DX program on Tuesday at 2115, with a repeat at 2245. (*SW, LM*)

Ecuador—HCJB, Quito, 15,115 kc., *The Voice of the Andes,* has one of the consistently best signals from South America. It can

be noted around 1900 and 2100 in ENGLISH with programs of a religious nature. (*RM, BB*)

Egypt—Cairo, 9475 kc., carries an ENGLISH program at 1300-1345 with music and news. At 1345, it goes into French, and at 1400 into Arabic(?). On 11,674 kc., Cairo can be tuned after 1330 in Arabic. It identifies as *Huna El Kahera.* (*LS, CM*)

Finland—Helsinki has ENGLISH news at 0600, 1430, and 2200; over OIX4, 15,190 kc.; OIX2, 9555 kc.; and OIX5, 17,800 kc. (*FG, DQ*)

France—Paris has no ENGLISH sessions to North America at present, but it can be noted at 1830-2000 on 9685 kc. or 11,700 kc. in the Caribbean beam, or at 1500-1600 on 11,700 kc. in ENGLISH to Great Britain. (*DQ*)

French Equatorial Africa—Brazzaville, 11,970 kc., carries an ENGLISH session at 1835-1850. This is one of the best signals from Africa. *Radio AEF* plans to start operation with a 25-kw. xmtr during 1956 in the tropical band (3000-5000 kc.). (*WH, MS*)

French West Africa—The Federal Network of *Radio Dakar*, 5935 kc., has an excellent signal to 1805 s/off daily. They have ENGLISH news at 1745-1800 on Tuesdays, Thursdays and Saturdays. (*SW*)

Radio Dakar Afrique was noted in French at 0128-0200 on 4880 kc. (*JB*)

Greece—*Radio Athens*, 9607 kc., is noted some days at 1700-1730 with Greek program, news and music. It announces as *Edeo Radiofonikos Stathmos Athinon Vrakeon Kimaton* (This is Radio Station Athens, the Voice of Greece). Forces BC Station, Athens, 7422 kc., is at good level to 1700 close and at 0000-0230; varied programs of popular and Greek folk music. Call is *Edeo Athinae, Kendrikos Radiofonikos Stathmos Enoplon Dynameon Ellados* (This is Athens, the Central Station of the Greek Armed Forces). Forces B/C Station, Larissa, Thessaly, opens at 0000, closes at 0200, with programs similar to FBS, Athens. This one, on 6752 kc., announces as *Edeo Larissa, Thessalia, Radiofonikos Stathmos Enoplon Dynameon, Ellados* (This is Larissa, Thessaly, Radio Station of the Greek Armed Forces). (*PM*)

Haiti—4VEH, *La Voix Evangelique*, Cap Haitien, 9666 kc., is asking for reports to: East and West Bible Mission, Box 1, Cap Haitien. They carry religious programs after 2000. (*LM*)

ABBREVIATIONS

BBC—British Broadcasting Corp., London, England
BC—Broadcasting service or station
kc.—Kilocycle
kw.—Kilowatt of power
mc.—Megacycle
s/off—Sign-off of station when going off the air
s/on—Sign-on of station when coming on the air
xmsn—Transmission from a radio station
xmtr—Transmitter which is used by radio station

Radio Commerce, 4VC, Port-au-Prince, 9485 kc., has been heard well at 2200-2245 in ENGLISH. (*WB*)

4VEA, Cap Haitien, 6100 kc., is now using its new 1-kw. xmtr at 0515-0830 daily except Thursdays and at 1700-2130 daily except Wednesdays and Thursdays. It can be heard at 2100-2130 after *Radio Sweden* signs off at 2100 on 6095 kc. This xmtr is also used for 4VWI, 15,390 kc., at 0835-0930 (Sat. to 1030) and at 1500-1700 on Saturdays and Sundays beamed to Europe. (*SW*)

India—*All India Radio*, Delhi, 11,690 kc., is noted at 0830-0930 with ENGLISH news, talks, and music. S/off at 0930. (*CM*)

Indo-China—*The Voice of Viet-nam*, Saigon, 6165 kc., can be heard on the West Coast at 0035-0130 with records. (*PF*)

Israel—*The Voice of Zion*, 4XB31, Tel-Aviv, 9008 kc., carries an ENGLISH session around 1630. (*WH*)

Italy—Rome, 9710 kc., parallel with 6060 kc., operates to North America daily with ENGLISH at 1915-1930, French to 2000. News in Italian follows at 2000. Reports should go to Box 320, Rome. (*LM, AB*)

Ivory Coast—*Radio Abidjan*, 4945 kc., has been operating with an output of 10 kw. and is asking for reception reports. They close in French at 1730; again at 2330. (*WRH, GD*)

Japan—JOB5, Tokio, 15,235 kc., is being

SHORT-WAVE CONTRIBUTORS

Gary Alexander (*GA*), Chariton, Iowa
Anson Boice (*AB*), New Britain, Conn.
Billy Brown (*BB*), Elizabeth Pa.
David Bergdahl (*DB*), Valley Stream, N. Y.
John Beaver (*JB*), Pueblo, Colo.
Bill Berger (*WB*). Fairfax, Okla.
Ed Chittenden (*EC*), Richland, Mich.
Gerry Dexter (*GD*), Waterloo, Iowa
John Desloge, Jr. (*JD*), St. Louis, Mo.
Bill Evans (*BE*), Port Arthur, Ontario
John Fuller (*JF*), Ottawa, Ontario
Phil Finkle (*PF*), Burbank, Calif.
Bryan Greene (*BG*), Clifton Forge, Va.
Fred Gatz (*FG*), Lancaster, N. Y.
Bob Hatter (*RH*), Syosset, N. Y.
William Hutchinson (*WH*). Baltimore, Md.
Robert Johnson (*RJ*), Hampton, Va.
Frank Longenecker (*FL*). Hollywood, Calif.
Jane & Roger Legge (*JRL*), McLean, Va.
Ted Levecque (*TL*), Bracebridge, Ont.
Charles Maxant (*CM*), Baldwin, N. Y.
Jim Marsh (*JM*), Stroudsburg, Pa.
Louis Marcarelli (*LM*), Medford, Mass.
Mike Meltzer (*MM*), Syracuse, N. Y.
Paul Mathieu (*PM*), Southbridge, Mass.
Richard McDonald (*RM*), Memphis, Tenn.
David Quarterson (*DQ*). Farrell, Pa.
George Quay (*GQ*), Allentown, Pa.
Rolan Riker (*RR*), San Bernardino, Calif.
Bill Schultz (*BS*), North Arlington, N. J.
Charles Sutton (*CS*), Toledo, Ohio
Harwood Shepard (*HS*), Auburn, N. Y.
Larry Seidman (*LS*). Brooklyn, N. Y.
Mario Stutterheim (*MS*), Baltimore, Md.
Steve Smith (*SS*), Binghamton, N. Y.
Vincent Staffo (*VS*), Herkimer, N. Y.
DuWayne Bostow (*DU*), Max, N. D.
Ron Young (*RDY*), Chelmsford, Essex, England
World Radio Handbook (*WRH*)

widely reported. It is good on the West Coast at 1800 with ENGLISH news. (*FL*)

Jordan—Jordan BC Service is now scheduled on 6060 kc.; in Arabic at 0000-0100, 0700-0800, 1100-1500; ENGLISH at 0630-0700, 1015-1100. (*WRH*)

Mozambique — CR7BF, Lourenco Marques, 11,745 kc., has been noted in ENGLISH at 2315, 0000-0200, 0730-0815, and 1000-1130. Programs are made up of music, commercials, weather, and time signals. (*JB, BG*)

New Zealand—*Radio New Zealand*, Wellington, closes at 0115 instead of at 0100 on 11,780 kc. and 11,830 kc. It re-opens at 0130 instead of 0115 on 9540 kc. and 6080 kc. Xmsns are beamed to Australia on 11,830 kc. to 0115 s/off, to the Pacific Area on 11,780 kc. to 0115. At 0130, 6080 kc. and 9540 kc., xmsns are beamed to the Pacific area. (*JB*)

Nigeria—Lagos, 4800 kc., has "National Program" at 1600-1700 with ENGLISH news and commentary at 1600-1625. Another xmsn starts at 0000. (*CS*)

Norway—LLG, Frederikstad, 9610 kc., has "Norway This Week" at 2100-2120 (Sundays) and at 0000-0020 (Mondays). (*TL*)

Panama—HOLA, *Radio Atlantico*, Colon, 9505 kc., carries ENGLISH at 1730. (*GD*).

Peru—OAX4T, *Radio Nacional*, Lima, 9562 kc., is a good music station around 1900; in Spanish at 2200. (*WH, FL*)

OBX4P, *Radio Miraflores*, Mirafiores, is now on 6257 kc. An ENGLISH program of music and commercials can be heard Wednesdays at 2000-2200. (*JRL*)

Philippines—*The Call of the Orient*, DZH8, 11,855 kc., and DZH7, 9730 kc., Manila, carry ENGLISH news at 0100, 0500, 0900, 1830, and 2330, with other ENGLISH programs at 0330, 1945, and 2300. Address is The Far Eastern BC Co., P. O. Box 2041, Manila. (*CM, RR, JB*)

Portugal—Lisbon is being heard in ENGLISH to Portuguese Goa on 15,125 kc. (CSA36) at 1200-1245 with news at 1220. A new outlet of 11,840 kc. duals with 9776 kc. (CSA26) to Africa, Brazil at 1630-1900. (*RR, DU, JRL*)

Portuguese India—*Radio Goa*, CR8AD, 9610 kc., can be heard some Saturdays at 0900-0945 with music and commercials in ENGLISH. (*CS*)

South Korea—HLKB, Pusan, 7935 kc., has an ENGLISH session at 0600-0700 with a commentary at 0600-0615. (*CS*)

Spain—*The Voice of Spain*, Madrid, now operates on 9360 kc., 9695 kc. (new), and 11,815 kc. (new), at 1715-2000 (-2200 on 11,815 kc.) to Latin America. (*JRL*)

This station transmits to North America in ENGLISH, daily, at 2215-2300, 2315-0000, and 0015-0100. The 1800-1845 xmsn has been dropped. The North America service is on 9360 kc. and 6135 kc. (new). (*SW, JB*)

Radio Mediterraneo, Valencia, 6995 kc., is often heard afternoons to 1830 close with varied Spanish programs. The call is *Transmite Radio Mediterraneo de Valencia de la Sociedad Espanola de Radiodifusion*. Reports can go to Avenida Morques de Soleto, nr. 2, Valencia, Spain. (*PM*)

Spanish Guinea—Santa Isabel, 7160 kc., has ENGLISH on Saturdays at 1430-1500, news at

1440-1455. It announces as *Emissora de Radio de Santa Isabel de Fernando Po.* (*CS*)

Sweden—SBU, Stockholm, 9620 kc., has a new request program entitled "Smorgasbord" at 2100 on Wednesdays. Requests may be sent to "Smorgasbord," *Radio Sweden*, Stockholm 8, Sweden. (*VS*)

Switzerland—The Swiss S.W. Service has a DX program on Thursdays at 2100-2115 on 6165 kc., 9535 kc., and 11,865 kc. (*RJ, DB*)

Syria—Damascus, 9555 kc., can be heard in ENGLISH at 1630-1730. (*DQ*)

Tanganyika—Although not yet reported in the USA, Dar-es-Salaam, 5050 kc., is being heard in England at 1310 with BBC news, at 1315 with local news and weather reports. Identity at 1330. (*RDY*)

Tangier—*D U X Radio* (new), on 12,000 kc., is a Swedish station and is being heard at 1330 in the commercial service. Reports should be mailed to *D U X Radio*, Stockholm, Sweden. (*RDY*)

IBRA Radio, 9774 kc., carries ENGLISH at 1630-1705. Schedule is said to be 1630-1700, except 1645-1700 on both Tuesdays and Fridays. (*SW*)

The Evangelical Voice of Tangier, WTAN, 9490 kc., has been heard late afternoons around 1600-1813 close-down. They are now using 10 kw. in afternoons, 2½ kw. in mornings. Reports go to Station WTAN, British Post Office Box 219, Tangier, Morocco. (*EC, WH, PM, MM*)

Thailand—HSK9, Bangkok, 11,670 kc., is in ENGLISH to North America at 2315-0015 with news at 2325-2340. The interval signal is chimes. (*CS*)

Turkey—TAT, Ankara, 9515 kc., has ENGLISH to North America at 1815-1900. Lesser known stations on the air include: The University of Ankara on 7050 kc. with 500 watts, and on 6280 kc. with 1 kw.; the Technical School at Istanbul on 7000 kc. with 50 watts. (*RR, BE, JM*)

Vatican City—ENGLISH can be heard daily at 1000-1015 and at 1315-1345 on 7280, 9646, 11,685, and 15,120 kc.; on Tuesdays at 1100-1130 on 11,685 and 15,120 kc. (*SS*)

Windward Islands—*The Windward Islands BC Service* has been noted at 1800-2120 s/off with music and BBC news relays, on 3395 kc. It is also reported on 17,745 kc. This station is located in Grenada, British West Indies. (*GQ, WH*)

—30—

Help Offered

Tommy Kneitel, 97-10 62nd Drive, Rego Park 74, New York, offers to help any DX'ers with their problems on communications stations (telephone, coastal, point-to-point, aero, etc.). He can supply frequencies, location, mailing addresses and other miscellaneous information on many of these stations, whether on voice or c.w. Drop him a line; he'll be glad to help. Be sure to include stamped, self-addressed return post card.

SPRING STOCKTAKING SALE!

Electronics! Tools! Optics! Audio!

WORLD FAMOUS KIT KING $1 KITS

FREE! ANY ITEM PRICED $1 OR LESS FREE WITH EACH $10 ORDER!

☐ **PRINTED CIRCUITS KIT.** Asstd. printed circuit boards w/1% precisions. A-B resistors, Transitron diodes, H-sealed oils. Wt. ½ lb. Reg. $15. **$1**

☐ **TEN HI-FI KNOBS.** Asstd. Cronaname 1¾" knurled bakelite, aluminum inlay types. TUNING, AM, FM, BASS, TREBLE, PHONO. In poly bags. Wt. ½ lb. Reg. $3.30. **$1**

☐ **12 AC/DC LINE CORDS.** For all electrical uses! W/ sturdy molded plugs. Stock up at this low price! Wt. 1 lb. Reg. $3. **$1**

☐ **30 ASSORTED BULBS.** Miniature, radio, TV, instrument, flashlight types. 1.1, 2.5, 3.5, 4 & 6 volts. Reg. $4. **$1**

☐ **60 KNOBS.** 15 styles: radio, TV, appliance, instrument; knurled and push-on; some set-screw types. Some 50¢ ea. Wt. 1 lb. Reg. $12. **$1**

☐ **175 ft. HOOKUP WIRE.** Seven 25 ft. rolls, #18 to #24. Asstd. colors, stranding, insulation. Wt. 2 lbs. Reg. $4. **$1**

☐ **12 VOLUME CONTROLS.** Asstd. popular values; 10 ohms to 0.5 megs. Switch & WW, too! Wt. 1 lb. Reg. $11. **$1**

☐ **G-E PREAMP KIT.** Chassis, condensers, resistors, wire, socket, schematic for famous equalizer (less 6SC7 tube). Wt. 1 lb. Reg. $4.50. **$1**

☐ **150 RADIO PARTS.** Large asst. wire, moulded, paper, disc ceramic, micas, resistors. Pre-cut leads. Wt. 3 lbs. Reg. $17. **$1**

☐ **25 TUBE SOCKETS.** Subminiatures, 7, 9-pin miniatures, 4 to 8-pins. Mica-filled & ceramic. Some shield base. Wt. 1 lb. Reg. $9. **$1**

☐ **60 MICA CONDENSERS.** Postage stamp types, 25 values .0001 to .01 mf. to 1200 WVDC. Silver, 5% too! Wt. ½ lb. Reg. $21. **$1**

☐ **20 WIREWOUND** power resistors; 5 to 50 watts. Asstd. values to 20,000 ohms. Clarostat, Ohmite, IRC; tubular, candohm, sanded. Wt. 2 lbs. **$1**

☐ **10 FP & TWIST-LOCK ELECTROLYTICS.** 8 to 100 mf., to 450 V. Multiple sections, too! Wt. 3 lbs. Reg. $14. **$1**

☐ **60 CARBON RESISTORS.** Insulated. 35 values! 15 ohms to 10 megs. ½, 1 & 2 w. 1 & 5% too! Famous A-B included. Wt. ½ lb. Reg. $18. **$1**

☐ **50 CERAMIC CONDENSERS.** Tubular, disc, button, standoff types. 5 mmf. to .01 mf. up to 1000 volts. Wt. ½ lb. Reg. $14. **$1**

☐ **B2M SUN BATTERY.** Converts sunlight energy to electrical. For transistor projects. . . . . **$ 1.50**

☐ **30 DISC CERAMICS.** Popular makes; 10 types, 56 mmf. to .01 mf., to 5 KV. TV men take note! Reg. $7. **$1**

☐ **100 COIL FORMS.** Ceramic & bakelite forms in a wide variety of shapes and sizes. Wt. 2 lbs. Reg. $25. **$1**

☐ **50 INDUCTORS,** coils, chokes, RF, ANT., OSC., peaking, IF. Many slug tuned, too! Builders' must! Wt. 2 lbs. Reg. $17. **$1**

☐ **60 TUBULAR CONDENSERS.** 25 values! .00035 to 1 mf., up to 6000 V. Oils, too. Wt. 2 lbs. Reg. $10. **$1**

☐ **3 CRYSTAL DIODES,** 1N34, 1N48, 1N51. Poly bag assortment of popular diodes. Biggest diode buy ever! **$1**

☐ **4 SILICON DIODES.** Sylvania, Western Electric. 1N21, 1N22, two 1N23. Three of most used types. Reg. $8. **$1**

☐ **40 MOLDED CONDENSERS.** Best known makes! Asstd. values, .0005 to 0.1 mf. up to 1000 V. Wt. ½ lb. Reg. $13. **$1**

☐ **8-PC. NUTDRIVER KIT.** Plastic handle; 3/16, 7/32, ¼, 5/16, 11/32, ¾, 7/16" steel socket wrenches in plastic case. Wt. ½ lb. $3.50 value! **$1**

☐ **2000 PCS. HARDWARE.** Woodworking, radio-TV, shop screws, springs, grommets, etc. Hundreds of items. Wt. 2½ lbs. Reg. $15. **$1**

☐ **60 TERMINAL STRIPS.** Wide variety; 1 to 9 solder lugs, tie points. Set builders' must. Wt. 1 lb. **$1**

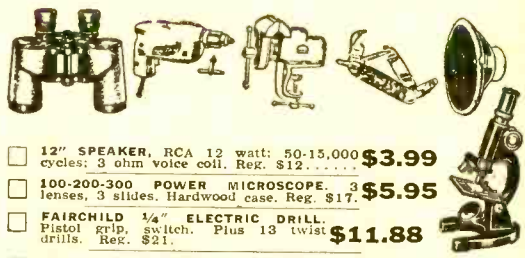
☐ **15 ROTARY SWITCHES.** Experimenters, note! Varied asst. single & dual gangs. Wt. 2 lbs. Reg. $17. **$1**

☐ **10 PANEL SWITCHES.** Asstd. micro, toggle, push; mobile types, too! Some worth $2. Wt. 1 lb. Reg. $12. **$1**

☐ **20 PRECISION RESISTORS.** Carbo-Film. Asstd. standard values, 1 watt 1%. Pre-cut leads. Wt. ½ lb. Reg. $17. **$1**

☐ **20 INSTRUMENT KNOBS.** Scoop! Ten types; knurled, pointer, skirted. Brass inserts w/set screws. Wt. 2 lbs. Reg. $7. **$1**

☐ **8 TUBULAR ELECTROLYTICS.** Assortment of popular values; 8 to 100 mf., up to 450 volts. Wt. 2 lbs. Reg. $6.50. **$1**



☐ **12" SPEAKER,** RCA 12 watt; 50-15,000 cycles; 3 ohm voice coil. Reg. $12. . . . . **$3.99**

☐ **100-200-300 POWER MICROSCOPE.** 3 lenses, 3 slides. Hardwood case. Reg. $17. **$5.95**

☐ **FAIRCHILD ¼" ELECTRIC DRILL.** Pistol grip, switch. Plus 13 twist drills. Reg. $21. **$11.88**

☐ **SUN BATTERY HANDBOOK.** 9 chapters, 74 pages, circuits, theory . . . . . **$ 1.50**

☐ **SUN POWERED TRANSISTOR RADIO KIT.** Sun battery, loopstick, transistor, diode, cabinet, instructions . . . . . **$ 6.88**

☐ **30 POWER "STARGAZER" TELESCOPE.** Gleaming chrome. 6½" extends to 13". Reg. $12. . . . . **$ 5.99**

☐ **BENCH/TABLE VISE.** Quality steel; 1¼" jaws. Reg. $3. . . . . **88c**

☐ **5 IN 1 SCOUT KNIFE** and sharpening stone set. Reg. $3.50 . . . . . **$ 1.00**

☐ **6" HOBBY BLOCK PLANE.** Easy-grip, light, sturdy. Reg. $2.50 . . . . . **$ 1.49**

☐ **6-PC. JEWELERS SCREWDRIVERS** for miniature work. ±0 to ±5. . . . . **$ 1.29**

☐ **6 MAGNETIC SCREWDRIVERS** w/wall rack. Shockproof. Reg. $3.50. . . . . **88c**

☐ **12 SWISS NEEDLE FILES.** Asstd. sizes for miniature work. Reg. $5 . . . . . **$ 2.29**

☐ **15 SHEETS SANDPAPER** 9x10" flint, Ex. Fine to Ex. Coarse. Reg. 75c **44c**

☐ **3-PC. SANDER-POLISHER KIT.** Fits ¼" electric drills. Reg. $2.50 . . . . . **$ 1.09**

☐ **6" LONG-NOSED PLIERS** w/side cutters. Drop forged steel. Reg. $1.88 . . . . . **77c**

☐ **7x35 BINOCULARS.** I.F., coated prism lenses. All metal, w/pigskin case, straps. Reg. $37. . **$ 19.90***

*Plus 10% F.E. tax

FREE! NEW BARGAIN FLYER!

HOW TO ORDER — Check items wanted. Return entire ad with check or MO. Include sufficient postage, excess returned. C.O.D. orders 25% down. Rated, net 30 days.

Name . . . . . (Please print)

Street . . . . .

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

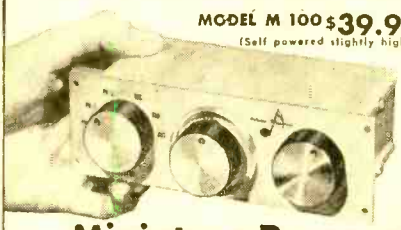
Enclosed $ . . . . . for kits; $ . . . . . for postage.

LEKTRON SPECIALTIES
28 GARDINER ST. CHELSEA 50, MASS.

INSTALLING YOUR OWN HI-FI?

Don't overlook the advantages of a good separate Preamplifier!

MODEL M 100 $39.95
(Self powered slightly higher)



AT LAST! A quality equalizer-preamplifier at a price you can afford . . . Outperforms units costing twice as much. Low noise, low distortion, and high gain . . . Record noise and distortion filter . . . Exclusive TREBLE PRESET . . . Full equalization and tone compensation . . . Takes standard magnetic pickups, radio tuners, tape recorders, etc. . . . Sturdy, well built, attractive . . . Specifically designed for complete Hi Fi recording and playback control . . . Available at all leading dealers. . .

- COMPLETE CONTROL OF EQUALIZATION, TONE AND SIGNAL
- INPUTS FOR ALL PHONO PICKUPS, TUNERS, TAPE, ETC.
- EXTREMELY LOW NOISE, HUM AND DISTORTION.
- VARIABLE RECORD NOISE AND RUMBLE FILTERS.
- SELF POWERED AND UNPOWERED MODELS.
- SPACE SAVING, SIMPLE TO OPERATE.
- RUGGEDLY BUILT.

Miniature Preamplifier by Audio ARTISANS, Inc. 396 MILL, HAWTHORNE, NEW YORK

SEE YOUR DEALER OR WRITE FOR SPECIFICATIONS

Disc and Tape Review

(Continued from page 75)

which is as it should be in this type of music. His tempi are quite brisk, considerably faster than those of the other conductors of the work, and his phrasing and dynamics are highly expressive and of unquestioned authority. Yet for all his emphasis on pacing the work right, he doesn't lose sight of the melodic line and the exceptional beauty of the score. The fact that Argenta elicits such a fine convincing performance from a French orchestra is further evidence of his skill in this idiom.

As far as sound is concerned, the Argenta version is one of those super-spectacular hi-fi "dazzlers" . . . a real showpiece! Since its issue about a year ago, this recording has been quite consistently used as a demonstration record. And well it might be . . . with its myriad percussive effects. Percussion runs the full gamut here, from the clear bell-like tinkle of the triangle, and the sharp transients of the tambourine, the explosive energy of cymbal and snare drum to the taut solidity of tympani smash and the weighty "whump" of a huge bass drum. This is a record which will more than give its share of enjoyment on a small system, but which really comes into its own on a big-speaker hi-fi system. The other orchestral elements are equally well reproduced, as the sweet-sounding, clean-lined strings, the big brazen brightness of the brass, and the richly resonant woodwinds demonstrate.

Not the least of the plus virtues of this London disc is the superb balance between the various choirs, and the persuasively

GAS TRIODE AND TETRODE QUIZ

(Questions on page 96)

1. When a thyratron fires, its internal resistance drops close to zero. Absence of a load would produce a virtual short circuit across the voltage source. 2. The plate current of a thyratron does not gradually rise with increasing positive grid voltage. At a certain critical point, it stops being an open circuit and becomes a "closed switch." Thus, it is either on or off, never in an in-between condition in d.c. circuits. 3. A shield grid takes the control grid out of the ionic and electronic plasma in the tube; this reduces the grid current and permits much greater sensitivity with increased tube safety. 4. With a.c. on the plate, a thyratron no longer behaves as a self-latching relay; it now responds to on-off grid voltage changes. 5. The longer the interval, the greater the power in the load. Maximum transfer is reached when anode current flows for a full half-cycle of a.c. source voltage.

"live" sound afforded by the "just right" reverb of the acoustic environment. Frequency range and dynamics are about as wide as you'll find on any record, and distortion was just about non-existent.

Strangely, Argenta's closest competitor, Enrique Jorda, is also heard on a London disc. On one of London's low-priced LD series of 10" records, this is a remarkable buy. But it suffers from incompleteness and sound which, while good, is considerably less opulent than that of the Argenta disc. Jorda is another specialist in the Spanish repertoire, and it would be rash hair-splitting to praise Argenta's reading over Jorda's, or vice-versa. Jorda is a little slower in tempi, a little more conservative in dynamics; but in spite of these minor points, his reading is authoritative and enjoyable.

The third recording brings together Toldra and the Lamoureux Orchestra on a 12" Epic record. This is a distant third in the *Iberia* sweepstakes, as Toldra has considerably less understanding of the score and can't match the fire and brilliance of the other two readings. His attacks and ritards are quite ragged, and precision is the very bulwark of a work like *Iberia*. And the sound of the Epic disc is variable. Some excellent brass work is outweighed by the edgy tone of the strings and the occasionally "tubby" bass. Acoustic perspective was good but at the expense of much inner orchestral detail.

Summing up . . . truthfully it is "no contest" with the outstanding Argenta disc. But readers on a budget will not be disappointed with the low-priced Jorda version. The Epic disc just qualifies as hi-fi, and is too variable for serious consideration.

Debussy's Iberia. This is much better known and more popular than the Albeniz version. Nine recordings of the Debussy have made their appearance in the LP catalog, with no less than five versions reasonably hi-fi in sound quality. In manners of performance, there are good readings by Inghelbrecht on the Westminster label, Ormandy on Columbia, Ansermet on London and Monteux on Victor. It would be an almost impossible task to single out one for top honors.

Inghelbrecht is an acknowledged authority on Debussy, but so is Ansermet. While there certainly are differences in their respective interpretations, when juxtaposed these differences are not startling. So far as tempi, dynamics, orchestral balance are concerned, there are nuances and subtleties typical of each conductor. But in the over-all picture their ideas are along similar lines, and each does a splendid job.

And one cannot overlook Ormandy or

Monteux. Their readings, while less authoritative or profound, nevertheless result in eminently satisfactory performances. Maestro Toscanini has also recorded *Iberia,* but sad to say, this is a rather disjointed reading with break-neck tempi; it gives one an uncomfortable feeling that the old man wanted to get the whole thing over with as quickly as possible.

In the sound department, the issue is more clear-cut. The Westminster disc enjoys a considerable advantage over its nearest competitor—which is the Columbia Ormandy recording. The Westminster disc has good clean strings, nice crisp brass, very lovely, mellow, typically good French woodwind sound, and accurate percussion—there is just a little over-accentuation in the latter department which throws the recording slightly out of balance. The engineers have managed to clothe the sound in nice spacious acoustics without loss of detail. One of the added virtues of the disc is a very wide dynamic range, important in repertoire of this type.

Stereotape Review

TEMPO NUEVO

Concertapes Orchestra,
Heads-In-Line Stereo

5" reel, 7½ ips, NARTB equal, $7.95

Some of the best and cleanest stereophonic sound I have ever heard is on this little reel. In the Latin-American vein, its numbers include My Shawl, Tempo Nuevo, The Cricket, Take-It-Easy Mambo, *and* Calypso. *The orchestra does nobly in very clever arrangements which were designed to augment the stereo effect. As far as direction is concerned, this is just about the tops. If you close your eyes and envision what a normal orchestra setup for this kind of repertoire would be, your ears will positively confirm that each instrument is in its properly appointed place. With the ultra-wide frequency and dynamic range, and the rather close-to recording, the sound is simply sensational in its "liveness." Tape hiss was practically inaudible, and all in all, a big step forward has been taken in stereo!*

The Ormandy reading has typical Columbia "Academy of Music" sound. The fabulous Philadelphia Orchestra string tone is recorded a little overbright for my taste, especially in the first violins. Middle register sound—especially the brass—is particularly clean and well-recorded, this factor being a distinguishing feature of many Philadelphia recordings. The percussion is only fair. I have long felt that there is one hurdle the Columbia engineers have

not been able to overcome, and this is in the matter of bass and percussion. Whether it is hall acoustics or the cutter or cutter amplifier that is responsible, I don't know . . . but things like tympani and bass drum do not have the sharp, articulate cleanness nor weight of impact, nor really low fundamental sound that many other labels do.

The Ansermet/London recording is one of the oldest recordings in their catalog. In spite of this fact, there is some pretty good wide-range sound, with perhaps the excellent acoustic perspective being the most praiseworthy item. Over-all sound is definitely not up to London's high standards today, but if you should prefer this disc for the Ansermet performance, the sound will not be too unpleasant to your ear! A word of caution might be in order here . . . because of the age of this recording, it is highly possible that London will issue a new recording of the work before too long. So, if Monsieur Ansermet is the boy you want for the Debussy *Iberia,* it might be prudent to wait a couple of months before making any purchases.

The sound of the Toscanini and Monteux versions is fair . . . just barely qualifying as hi-fi; and neither is outstanding in any particular respect.

A newcomer to the field is a recording by Edward Van Beinum with the Amsterdam Concertgebouw Orchestra, on an Epic label. This disc has much to recommend it, not the least of which is some absolutely superb playing by the Concertgebouw, long one of Europe's most distinguished orchestras. Unfortunately, the Van Beinum performance is little more than routine. This is a pity, considering the good playing and the sound—which is quite acceptable modern hi-fi. There is still some edginess in the Epic strings and a tendency to be a little overpowering in the bass end, but otherwise it is a satisfactory recording.

Ravel's Bolero. The most famous of all the Spanish-derived music is, of course, Ravel's inimitable *Bolero.* Available recordings of this work were completely reviewed in an earlier issue, so we will do no more than list a number of the recordings in order of quality, and bring you up to date on any new versions.

There are now 16 recordings of the work in the LP catalog. One of these is a new Westminster version which has excellent if somewhat overdone sound, but the performance by Branco is outshone by a number of others. Then, there is a version on the Camden label, an old Victor 78-rpm transfer; I suspect that this is the old Serge Koussevitsky/Boston Symphony per-

formance, which was the tops in its day.

The best versions of the Bolero are . . . in order . . . Paray/Mercury, Ansermet/London, Cluytens/Angel, Koussevitsky/Boston (a new and later recording than the Camden just described) and, finally, Munch/London.

Chabrier's Espana. Another very famous Spanish-type work is Chabrier's *Espana,* a warhorse which is consistently on today's symphony programs. A short piece, this is rousing, exciting music, and certainly could not be mistaken for other than Spanish in inspiration. The work is full of fine percussion sounds dear to the hearts of hi-fi fans. Snare drum rattling, triangles a-tinglin', clacking transients of castanets, the brazen smash of cymbal, delicate plucked tracery of harp, and the robust thud of the bass drum . . . all are in abundance in this work.

Is it popular? Ten recordings in the LP catalog should be good testimony to that fact! And believe it or not . . . most of the recordings are very hi in the fi. The work makes such a good demonstration vehicle that most companies who record it put their best foot forward, and try to make a prestige recording to show off their skills. We don't have the space to delve thoroughly into each of these recordings, so we'll list and comment on the top four versions of Chabrier's *Espana.*

Paul Paray and the Detroit Symphony on a Mercury record are the winners in both the matters of sound and performance. All the percussion previously described is heard with spine-tingling realism. Everything is ultra-clean, wide range in frequency and dynamics . . . this is a real sonic tour-de-force!

Hard on Paray's heels is the version by Arggeo Quadri on the Westminster label. Quadri gives a competent if not outstanding performance, but the value in the Westminster lies in its superb sound . . . with some of the biggest bass drum thumps you've ever heard!

Ormandy and his Philadelphians are next in line on the Columbia label, with good sound and excellent performance. And Von Karajan, on Angel, brings up the rear with a recording which is sonically exciting; but he lacks the drive and the ability to make it as thrilling a performance as some of the conductors do. Mention should also be made of the old Sir Thomas Beecham reading on Columbia; while dated in sound, it is a superlatively good performance.

That's about it for this issue . . . at some future date we'll pursue the study of Spanish or Spanish-derived music still further, as well as do a little musical exploring in other countries. —30—

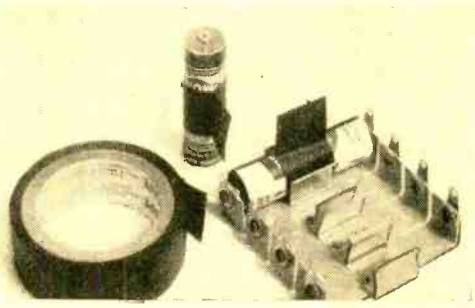
TIPS and TECHNIQUES

BETTER BATTERY HOLDERS

The battery holders shown here are just what the doc ordered for transistor work. However, they can be improved in two ways by the use of a little ¾"-wide or 1"-wide adhesive tape.

First, the metal clips on the holders hold the cells pretty tight, and it isn't very hard to slash the fingers while removing the cells from the clips. By putting adhesive tape around the center of each cell and leaving a flap for a finger-grip, as shown, you can pull the cells out of the holders safely with no danger of cut fingers.

Second, the sharp metal edges on the clips sometimes cut through the thin paper wrappers on the cells. When that happens to more than one cell at a time, the result



is a short between the two cells involved. The tape reduces this danger. —*A.T.*

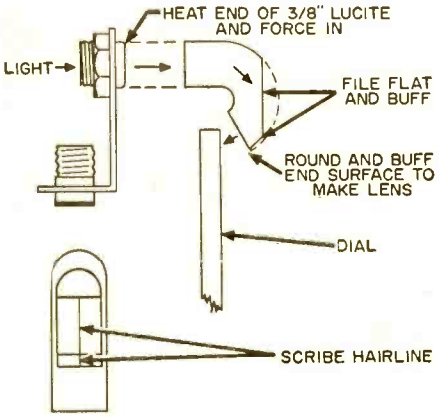
LIGHTED DIAL INDICATOR

A homemade lighted dial indicator hairline can be made from a ½" vertical mount, 7/16" jewel assembly. First, mount the nut of the jewel assembly in a vise and knock the red jewel out with a center punch and hammer.

Next, take a piece of ⅜" Lucite and rotate it over an alcohol lamp until pliable. Gently bend the Lucite back in a "U" shape.

Hold it in this position and let it cool slowly. If it is not held, it will snap back into its original position like rubber.

Cut the Lucite to proper length and trim



to clear the dial. Heat the end and force it into the red jewel hole. After it has cooled and set, trim off the bottom portion with a coping saw and file in a rounded surface to form a lens. Also file the front portion as shown in the diagram. Now buff the assembly on a buffing wheel. It may be necessary to sand the file marks first.

When the unit is installed, the light from the lamp will tend to follow the Lucite, thus focusing a spot on the dial numbers and at the same time lighting up a line which you may now scribe in the center of the flat surfaces. This should be done last so that the hairline will be even with the dial lines and numbers. —*E.H.M.*

CHASSIS FROM COFFEE CAN

A satisfactory substitute for a ready-made chassis is an empty one-pound coffee can. The one in the photo was used for building a phono preamplifier. When in-

verted, the can's bottom served as the top of the chassis, and was punched for tube socket and capacitor can mountings. The

lid of the can was a "natural" for a bottom plate to the chassis.

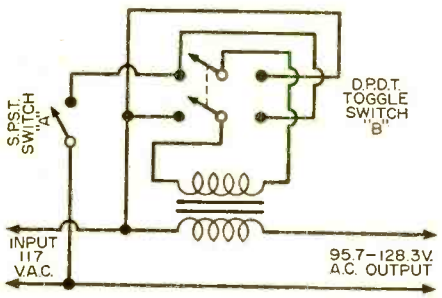
Ample room is provided inside the can for building many types of experimental circuits. The snug fit of the lid protects all parts from damage and dust. —*W.B.R.*

ADJUSTABLE LINE VOLTAGE

How many times have you complained that the line voltage was too low in the evening and too high during the day? Perhaps you have wondered if there were a simple way to get the correct voltage to operate your electronic equipment.

In laboratories, a Variac is generally used to increase or decrease the line voltage. For the experimenter, it is far more economical and simpler to use the hookup shown in the diagram—a filament transformer secondary in series with the 117-volt line. By changing the phase of the primary of a filament transformer, the secondary voltage can be increased or decreased with respect to the nominal line voltage.

A 6.3-volt filament transformer will add 6.3 volts to the line or subtract 6.3 volts from it. By series connection of the 6.3-volt and 5-volt filament winding, an additional 11.3 volts may be applied to the line or subtracted from it.



With switch "A" open, the voltage to the equipment will be nominal line voltage, generally 117 volts a.c. By closing switch "A" and operating the d.p.d.t. toggle switch, the line will be increased in one position and lowered in the other—depending on the phase, thus giving 95.7 volts or 128.3 volts a.c.

A small 3-amp. filament transformer will be sufficient for a receiver; larger equipment, such as a transmitter, should have a 10-amp. filament transformer. —*E.H.M.*

RESEALING CHEMICAL JARS

Manufacturers of cements, solvents, and other chemicals used in the electronics workshop seal their products with "shrunk" plastic caps that fit tightly over the screw cap and bottle to make an airtight seal. With such a seal, volatile chemicals may be kept for months or even years without ap-

preciable deterioration. Once the seal is broken, however, the chemical may deteriorate in a few weeks, even with the screw cap tightly in place.

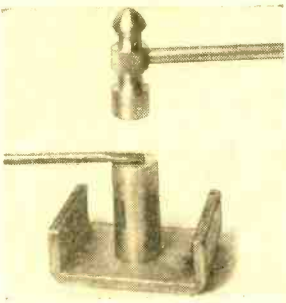
You can reseal such chemicals with an airtight seal as good as the original by using a short piece of plastic-base Scotch

electrical tape. Use at least a ¾" width and cut a piece long enough to encircle the cap and bottle twice. Pull the tape as you apply it, stretching it slightly to insure a snug, airtight seal.

This method is also good for sealing bottles of less volatile liquids for long-term storage or for packaging and shipment. It not only seals the bottle but prevents the cap from loosening. —*L.E.G.*

IMPROVISED "ANVILS"

Iron cores and U-frames, salvaged from junked electrodynamic speakers, make handy little "anvils" for the shop or radio bench. The photo shows an "anvil" having a metal core ¾" in diameter and 1¾" high, and mounted in a U-frame, which was removed from a speaker having a burned-out field coil and a damaged cone.



The iron frames around the field coils are usually made in two pieces which are spot-welded or soldered together. If spot-welded, separate the two halves of the frame by driving a cold chisel into the joints, or saw through the frame using a hacksaw. Then simply pull the iron core out of the field coil. If the frame is soldered together, melt out the solder with a blowtorch, or simply saw through the frame with a hacksaw, or use a cold chisel to break the soldered joints.—*A. T.* —30—

Dig That Reel Flat Response!

(*Continued from page 94*)

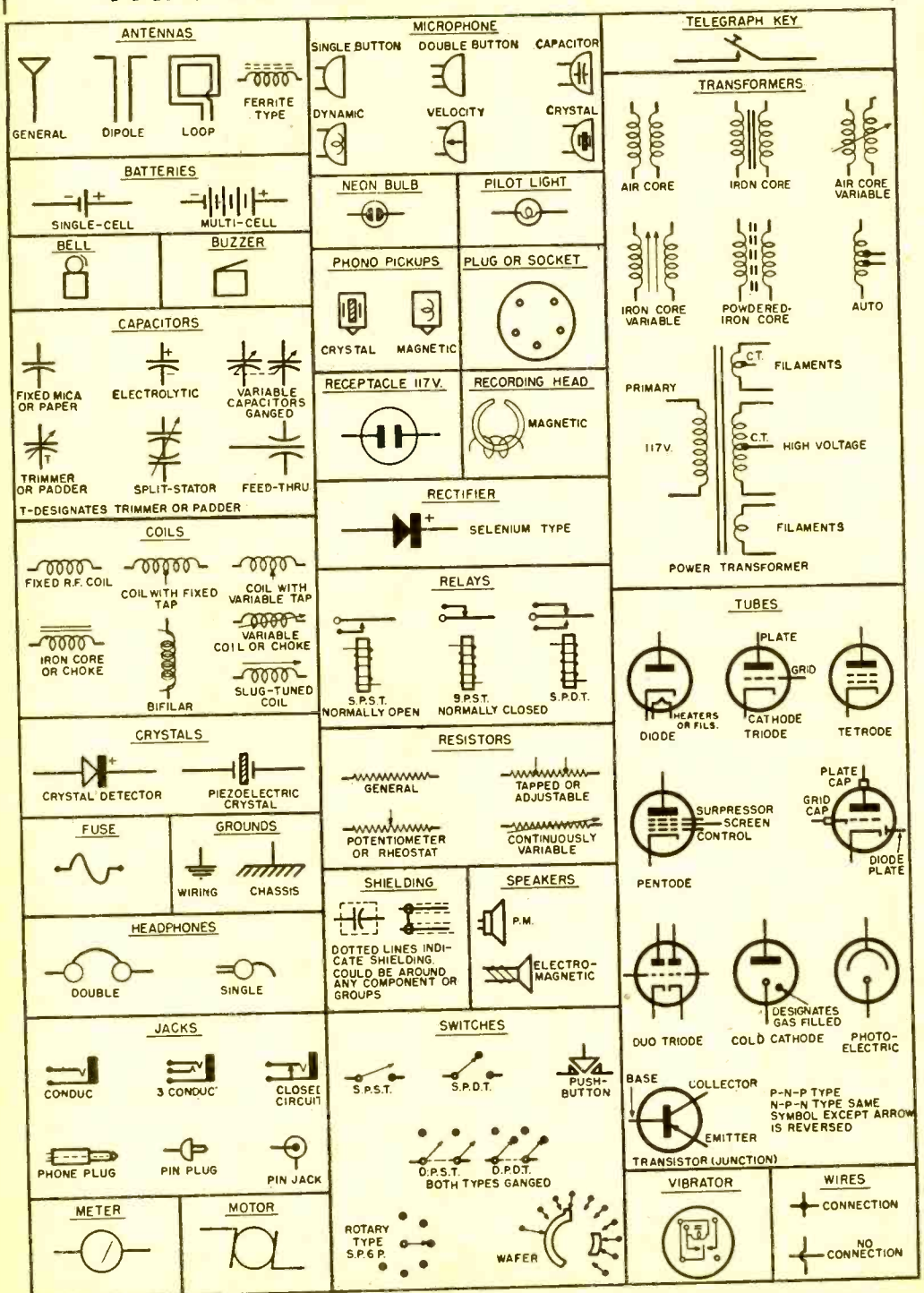
"I guess you know just about everything there is to know about these things, huh?"

I tried not to bridle proudly. "Oh, I wouldn't say *that* exactly," I hedged. "But, with pliers and soldering iron and a faithful copy of POPULAR ELECTRONICS, I think I can promise to keep things humming."

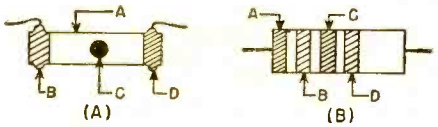
A lot of gibberish and an equal amount of good stuff has passed through the recording heads since then. We've found many, many uses—both entertaining and sheerly functional—for the tape recorder, and have learned much. I've used it to record lectures, concerts and meetings at my R/C club. Friend wife, after getting the hang of it, has used the instrument for recording various club meetings, club entertainments, and to begin cataloging some of her favorite social and family clambakes into a very fascinating (if somewhat occasionally discomforting) library of human interest and events. To date, the growing library contains gems like *The Afternoon Mother Arrived From Michigan; The Night Carl Dominated The Party Thrown For Chuck Bradley's Fortieth Birthday; Disconnected Conversation With The New Neighbors;* and a weird little thing comprised of ungodly sounds entitled simply, *Noises Recorded In The Backyard At Night.*

As a night-worker who is not at his best until he's taken aboard several gallons of coffee around eleven in the morning, I feel justified in my present plan to secretly destroy her favorite—a snide bit of unfair recording called *What A Husband Sounds Like At Seven-Thirty When Unexpectedly Awakened.* My groggy responses generally indicate a cretin badly in need of either rest or strong stimulant, and I'm tired of listening to callous friends snicker at the playback performances. However, I have a surprise which I plan to unload one of these nights. It's titled: *One-Sided Comments From A Wife Who Thinks Her Husband Is Still Listening To Her.* A real wowser calculated to put her in her place! —30—

STANDARDIZED WIRING DIAGRAM SYMBOLS



RESISTOR COLOR CODE



RETMA COLOR CODE CHART

COLOR	VALUE	MULTIPLIER
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1000
Yellow	4	10,000
Green	5	100,000
Blue	6	1,000,000
Violet	7	10,000,000
Grey	8	100,000,000
White	9	1,000,000,000

TOLERANCE CODE

Gold—±5% Silver—±10%

No Color—±20%

The ohmic value of a resistor can be determined by means of the color code. There are two standard methods of indicating this value.

In Fig. A, the body (A) and end (B) indicate the first and second digits of the value while the dot (C) indicates the multiplier to be used. The tolerance of the unit is indicated by the end color (D). For example, if the body (A) is green the number is 5; if the end (B) is grey the second number is 8. If the dot (C) is red the multiplier is 100 or two zeros should be added. The resistor is then a 5800 ohm unit. If the end (D) has no color, the tolerance is ±20%.

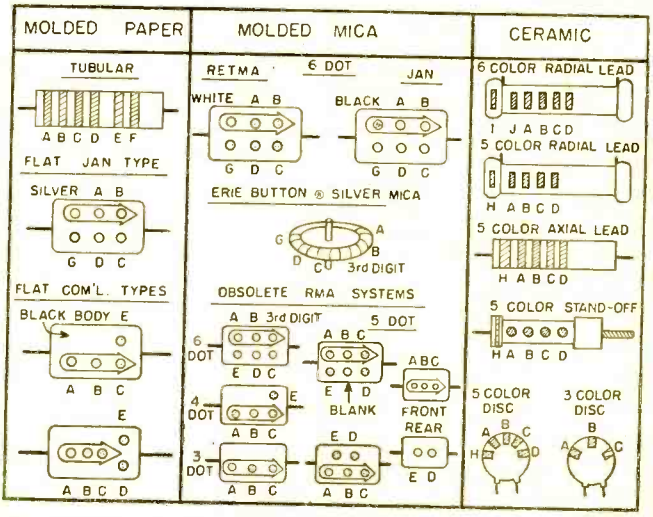
In Fig. B, the first two stripes indicate the first two digits; the third stripe the multiplier; the fourth stripe the tolerance. Thus, if stripe (A) is green, (B) is grey, (C) is red, and (D) is silver, the resistor is a 5800 ohm, ±10% unit.

CAPACITOR COLOR CODE

	MOLDED PAPER		MOLDED MICA		CERAMIC	
Color	Multiplier	Tolerance	Multiplier	Tolerance	Multiplier	Tolerance
Black	1	20%	1	20%	1	20% or 2.0μμfd.*
Brown	10		10		10	1%
Red	100		100	2%	100	2%
Orange	1000		1000	3% (RETMA)	1000	2.5% (RETMA)
Yellow	10,000	5%	10,000		10,000	
Green				5% (RETMA)		5% or 0.5μμfd.*
Blue						
Violet						
Gray					0.01	0.25μμfd.*
White		10%			0.1	10% or 1.0μμfd.*
Gold	0.1	5%	0.1	5% (JAN)		
Silver		10%	0.01	10%		
None		20%				

*Capacitance less than 10μμfd.

Capacitance is given in μμfd. Colors have same values as on resistors, except as indicated in tables. Colors (A) and (B) are for first two digits; (C) is for multiplier. (D) is for tolerance. (E) and (F) give voltage rating in hundreds of volts; (E) is used only for ratings less than 1000 volts, (E) and (F) for first two digits of ratings 1000 volts or more. Values of colors for (E) and (F) are same as in resistance values. (G) is class or characteristic of capacitor, (H), (I), and (J) give temperature coefficient. (G), (H), (I), and (J) are not listed in the tables, since this information is seldom needed by the average home builder.



Classified

RATE: 50¢ per word. Minimum 10 words prepaid. July issue closes May 3rd. Send order and remittance to: POPULAR ELECTRONICS, 366 Madison Avenue, N. Y. C. 17.

FOR SALE

TUBES-TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed 1st Quality Top Name Brands Only. Write For Free Catalog or call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

USED Television sets $14. Jones, 1115 Rambler, Pottstown, Penna.

SECRET Beam Transmitter, New, Five Mile Range, White & Infrared, Portable, Flashlight battery operation. Includes Signal Gun, Gunstock, Tripod, Infrared Goggles, Remote Control, Carrying Case, Manual. Government paid over $50. Yours for only $10 postpaid. Illustrated Signal Corps Manual 50c. Surplus, Box 118, Jersey City 4, N. J.

TAPE Recorded Code Courses. None other comparable, stamp for full particulars. Tapecode, Box 31, Langhorne, Pa.

"20 CRYSTAL Set Plans" (SW record 5800 miles), catalog and "Radiobuilder" magazine—25c. Laboratories, 328-L Fuller, Redwood City, California.

HI-FI 16" Transcriptions Catalog 25c. Transcriptions, 166 Barkley Ave., Clifton, N. J.

TV Trade-In Sets; Philco, RCA, Emerson, others. List available. 10"—$12; 12" to 17"—$15 up. Washtek Service—Dept. PE, 956 Southern Blvd.—Bronx, N.Y.

TRANSISTORIZED 900 Volt Continuous Supply For Geiger Counter Runs From Flashlight Batteries. $9.30 TV Parts Build It. Parts List and Transistorized Counter Diagram $1.00. George's TV, Savannah, Mo.

DIAGRAMS—Repair Information! Radios, Amplifiers, Recorders $1.00. Televisions $1.50. Send Make, Model, Chassis. (Air-Mail + 20¢) TV Miltie, Box 101-PE Hicksville, New York.

LARGE Electronics Manufacturer selling parts inventory Below Cost. Terrific package of expensive parts including: 2½" Triplett or Simpson—50 Microamp Meter; Drawn Alum., Chrome Top Case; Metal Chassis to fit case with tube sockets; 2—Sub-Miniature Vacuum Tubes Plus pots, phone jacks, handles, aluminum knobs, resistors, battery holders, wire, rotary switches, radio and test equipment diagrams and parts list. All parts guaranteed Brand New. A sensational $35.00 Value—All For Only $11.95 C. O. D. Money refunded if not satisfied. Limited number of packages only. Order Today from R. C. Controls Co., Box 560, North Hollywood, California.

ELECTRONIC Hobbyists—Engraved plates for panel boards, meters, dials, indicators. Stainproof, heat resistant, non-corroding plastic. Write your needs M&M Engraving Service, Box 775, Delair, N. J.

ARMY Field Telegraph Set, New including Key, Headphone, Manual, Carrying Case $10 postpaid. Surplus, Box 118, Jersey City 4, N. J.

FOUR selected pocket radio plans, 50¢. Cook, 4003-E Roosevelt, Midland, Texas.

TRANSISTOR Pre-Amp $9.95. F-M Pocket Radio Kit $3.95, Tubes $5.95, Earpiece $5.95, Transistor Two Band Radio With Earpiece $25.95. Three Electronic Questions Answered $1.00 and Stamped Envelope. Ekeradio Electronic Developments, 646 No. Fair Oaks, Pasadena, Calif.

ELECTRIC Guitars. Amplifiers, parts, wholesale, Free Catalog. Carvin, PE287, Covina, Calif.

TELEPHONE Transmitter. Hand set type. Suitable for inter-house phones, speakers or any communication purpose. Delivered two for $1.00. No C.O.D.'s. Telephones. Dept. C-229. 1760 Lunt, Chicago, 26.

HEADSETS, Trimm Radio, Professional Type, complete, 3.00 postpaid. Cagan Sales, Box 1152 Rochester 3, New York.

RESISTORS, Stackpole, 1 watt 5%, 16 most popular sizes, total 100 resistors 2.50 Prepaid. Cagan Sales Box 1152 Rochester 3, N. Y.

ELIMINATE Radio T.V. control noise. T.V. glass haze with 2-New Wonder Chemicals. Both $1.00. De-Victor Laboratory, Columbia, Missouri.

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 54-E5, Springfield Gardens 13, N. Y.

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.

TUBES and equipment bought, sold and exchanged. For action and a fair deal write B. F. Gensler, W2LNI, 56 Crosby St., N. Y. 12N, N. Y.

INVENTIONS WANTED

INVENTIONS wanted. Patented; unpatented. Global Marketing Service, 2420 77th, Oakland 5, Calif.

BUSINESS OPPORTUNITIES

TO $100.00 Weekly. Sparetime, Home Operated Mail-order Business. Successful "Beginner's" Plan. Everything Supplied. Lynn, 10420-E National, Los Angeles 34.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

FREE Booklet "Money-Making Facts" tells mechanically-inclined men how to start sparetime business at home. Lee Foley Company, Columbia Heights, Minnesota.

$70 WEEKLY—home, spare time. Simplified mail bookkeeping. Immediate income—easy! Auditax, 34757Y, Los Angeles 34.

HOW And Where to raise capital. Free details. Advance, Box 1377-HD, Miami 8, Florida.

EMPLOYMENT INFORMATION

JOBS—High Pay. South America, the Islands, U.S.A., foreign countries. All trades. Clerical, labor, engineers, drivers, others. Women also. Fare paid. Application forms. For information Write Section 92B, National Employment Information. 1020 Broad, Newark, N. J.

TAPE RECORDERS

TAPE Recorders. Tapes. Unusual values. Free Catalog. Dressner, 69-02F, 174 St., Flushing 65, N. Y.

TAPE Recorders, Tapes; Wholesale Prices. Kerstin, 215 East 88, New York City 28.

INSTRUCTION

U. S. Civil Service Tests! Training until appointed. Men-Women, 18-55. Start high as $377.00 month. Many jobs open. Qualify Now! Get Free 36-page illustrated book showing salaries, requirements, sample tests. Write: Franklin Institute, Dept. R 23, Rochester, N.Y.

MINERALS & PROSPECTING

GEIGER Counter and Metal Detector Kits. Inexpensive, Educational. Free Literature. Electronic Applications, Dept. B, 5024 Lee Highway, Arlington 7, Va.

SCINTILLATION Counter, transistorized, no tubes or vibrators. 1"x1½ crystal, 2 flashlight cells, weighs only 2 lbs. complete. $389.00, guaranteed. Revolutionary. Write Ute Company Inc., 200 So. 4th, Montrose, Colorado.

GEIGER Counters, Kits and complete models. New 1956 models. Free Literature. Dealers wanted. Geiger Counters, Dept. E-47 Station A., P. O. Box 111 Hartford, Conn.

PATENTS

HERMAN Lewis Gordon, Registered Patent Attorney, Patent Investigations and Opinions, Warner Building, Washington 4, D. C.

MISCELLANEOUS

THREE Line Rubber Stamp $1.00. Free Literature. F. Cuny, 1101 Franklin, Gretna, Louisiana.

RULE Others With Thoughts. Full Course. (Adults.) $2. Delmar Wisdom, 846-S8 Sunnyside, Chicago 40.

NEED Money? We'll mail you $100 to $600 in complete privacy. No fees—no signers—no deductions. Easy monthly payments. Nobody knows you're borrowing. Write for Free Complete Loan Papers. Postal Finance, Dept. 662H, 200 Keeline Bldg., Omaha 2, Nebraska.

INTERNATIONAL Tape — Respondence Members Wanted. U.R.C. Box 147, Chicago 50, Illinois.

TELEVISION

Master the latest, up-to-the-minute TV and Color TV developments.

You can Earn to $5,000-$10,000 a year in TV servicing after a few short months. Education or age is no barrier. Find out how you can EARN WHILE YOU LEARN in our big Shops and Laboratories. You work with the latest equipment. Waste no time with Non-Essentials, Math or Design Theory. Complete information in our new FREE booklet. Approved for veterans. Free Placement Service.

Write WESTERN TELEVISION INSTITUTE Dept. P56
341 W. 18th St. Los Angeles, Calif.

VHF AM-FM RADIO

Supersensitive sub-miniature tube set receives television, FM broadcast, CAP, and amateurs without antenna or ground. Tunes from 75 mc. to 150 mc. Similar models available in frequency bands from 27 mc. to 225 mc. Pocket size—measures only 2" x 2" 2¾". Highest quality components used. Specify battery or AC model. Use with any magnetic headphone or can be connected to audio amplifier for loudspeaker operation. Thousands in use by amateurs, experimenters, and civil defense. Factory wired and tested chassis complete with special tube only $5.98 postpaid. In kit form $3.98. Postage extra on COD orders. New transistor audio amplifier for extra loud reception only $2.00 including transistor.

SPRINGFIELD ENTERPRISES
Box 54-E Springfield Gardens 13, N. Y.

Shrinks Hemorrhoids New Way Without Surgery

Science Finds Healing Substance That Relieves Pain — Shrinks Hemorrhoids

For the first time science has found a new healing substance with the astonishing ability to shrink hemorrhoids and to relieve pain—without surgery.

In case after case, while gently relieving pain, actual reduction (shrinkage) took place.

Most amazing of all—results were so thorough that sufferers made astonishing statements like "Piles have ceased to be a problem!"

The secret is a new healing substance (Bio-Dyne*) —discovery of a world-famous research institute.

This substance is now available in *suppository* or *ointment form* under the name *Preparation H.** Ask for it at all drug counters—money back guarantee.

*Reg. U.S. Pat. Off.

Announcing Dramatics Script Writing Elec Radiotelephone

FCC FIRST CLASS PHONE

tronics

After 18 years successfully training men for radio and television, the Don Martin School is now offering a home study course available to you at your own home. This is the same course that has been so successfully taught at our resident school.

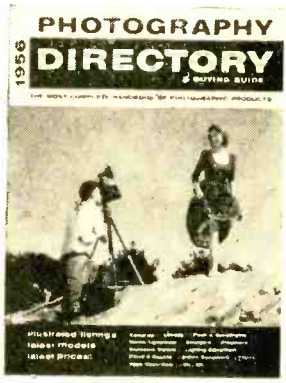
Write the **DON MARTIN SCHOOL** Dept. PE
1653 North Cherokee Hollywood 28, California

Sales T.V. Direction Lighting Stagecraft Cinematography

NEW THIS YEAR!

special feature on color . . .

in the



NOW ON SALE

Everybody's shooting color! And this year, the PHOTOGRAPHY DIRECTORY & Buying Guide includes a new special feature on color materials, products and their uses. Color fans can't afford to be without it!

And See What Else You Get In The 1956 Photography Directory

- Over, 1,000 Illustrations—of the latest cameras, lenses, filters, films and papers, processing materials, movie, lighting, stereo and projection equipment and other accessories.
- Complete Product Information—descriptions, prices, data, manufacturers' name.
- Informative Articles—specially prepared by the editors of POPULAR PHOTOGRAPHY. They'll help you choose the right equipment and accessories to take better pictures.

Be Sure to Get Your Copy of This Biggest and Best Photography Directory & Buying Guide

AT ALL NEWSSTANDS AND CAMERA STORES—ONLY 50c

1956 PHOTOGRAPHY DIRECTORY & Buying Guide
366 MADISON AVE., NEW YORK 17, N.Y.

ADVERTISER'S INDEX

Superior's new Model 670-A

SUPER-METER

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

SPECIFICATIONS:

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

ADDED FEATURE:

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

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

$28.40

Superior's New Model TV-60

20,000 OHMS PER VOLT

ALLMETER

Includes services never before provided by an instrument of this type.

Read and compare features and specifications below!

- Giant recessed 6½ inch 40 Microampere meter with mirrored scale assures accuracy and easy-reading. All calibrations are printed in large easy-to-read type. Fractional divisions are easily read with the aid of the mirrored scale.
- The line cord, used only when making Capacity measurements, need be plugged in only when using that service. It is out of the way, stored in its pliofilm compartment at all other times.
- A built-in Isolation Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.
- Selected, 1% zero temperature coefficient metalized resistors are used as multipliers assuring unchanging accurate readings on all ranges.
- Use of the latest type of printed circuit guarantees maintenance of top quality standard in the production runs of this precise instrument.

SPECIFICATIONS

8 **D.C. VOLTAGE RANGES:** (At a sensitivity of 20,000 Ohms per Volt) 0 to 15 75 150 300 750 1500 7500 30,000 Volts
7 **A.C. VOLTAGE RANGES:** (At a sensitivity of 5,000 Ohms per Volt) 0 to 15 75 150 300 750 1500 7500 Volts.
3 **RESISTANCE RANGES:** 0 to 2,000 200,000 Ohms. 0-20 Megohms
2 **CAPACITY RANGES:** 00025 Mfd. to .3 Mfd., 05 Mfd. to 30 Mfd.
5 **D.C. CURRENT RANGES:** 0 75 Microamperes. 0 to 7 5 75 750 Milliamperes. 0 to 15 Amperes
3 **DECIBEL RANGES:** — 6 db to + 18 db + 14 db to + 38 db + 34 db to + 58 db.

R.F. SIGNAL TRACER SERVICE: Enables following the R F signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems

- A new improved type of high-voltage probe is used for the measurement of high voltages up to 30,000 Volts. This service will be required when servicing color TV receivers.
- Simply plug-in the R F. probe and convert the Model TV-60 into an efficient R.F SIGNAL TRACER permitting the measurement of stage-gain and cause of trouble in the R.F. and I F. circuits of A.M., F M., and TV receivers.
- Plug in the Audio probe and convert the Model TV-60 into an efficient AUDIO SIGNAL TRACER. Measure the signal levels and comparative efficiency of hearing-aids, public-address systems, the amplifier sections of Radio & TV receivers etc.

Model TV-60 comes complete with book of instructions, pair of standard test leads; high voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe Pliofilm bag for all above accessories is also included Price complete. Nothing else to buy. Only

$52.50

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-228, 3849 Tenth Avenue, New York 34, N. Y.

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

☐ **Model TV-60... Total Price $52.50 $12.50 within 10 days. Balance $8.00 monthly for 5 months.**

☐ **Model 670-A . . . Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months**

☐ **Model TC-55 . . . Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.**

☐ **Model TV-50 . . . Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.**

Name_____

Address_____

City_____ Zone____ State_____

We invite you to try before you buy any of the models described on this and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

Superior's New Model TC-55

Streamlined TUBE TESTER

QUICKLY AND EFFICIENTLY TESTS RADIO AND TV TUBES INCLUDING: SEVEN PIN MINIATURES; EIGHT PIN SUBMINARS, OCTALS AND LOCTALS; NINE PIN NOVALS

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."

The Model TC-55 comes complete with operating instructions and charts. 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.

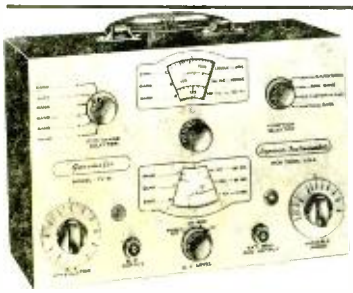
CHECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS.

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.

ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATIONS.

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

$26.95



Superior's new Model TV-50

GENOMETER

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

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

7 Signal Generators in One!

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

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

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

BAR GENERATOR: The Model TV-50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

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

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

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

Only . . . **$47.50**

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

We invite you to try before you buy any of the models described on this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

FIRST CLASS
Permit No. 61430
New York, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the U. S.

POSTAGE WILL BE PAID BY —

MOSS ELECTRONIC DIST. CO., INC.
3849 TENTH AVENUE
NEW YORK 34, N. Y.