

24 Pages of Construction Projects

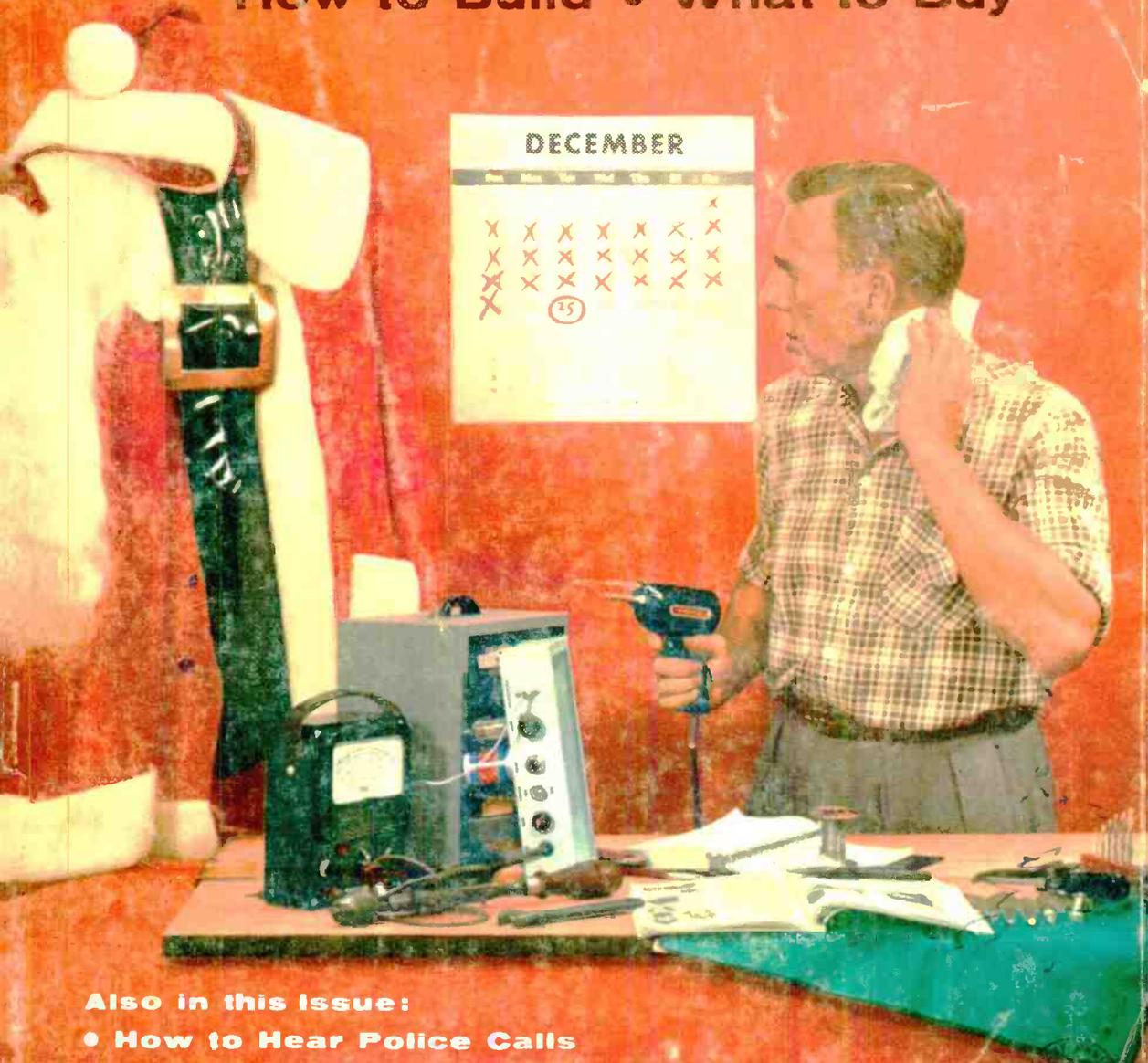
# POPULAR ELECTRONICS

DECEMBER 1956

ANC

35  
CENTS

## Low-Cost Xmas Toys How to Build • What to Buy



Also in this Issue:

- How to Hear Police Calls
- How to Use a Hi-Fi "Loudness" Control
- How to Find Treasure With a Metal Locator

**why the**  
**Collaro**  
**RECORD CHANGER**  
**belongs in your**  
**High Fidelity System**



**Minimum  
Noise and  
Distortion**

Balanced, heavy 4-pole motor . . . balanced pulley and coupler reduce rumble to an inaudible minimum. Automatic muting switch and R/C network eliminate 'clicks.'

**Accurate  
Speed & Pitch**

Collaro quality control limits for the RC-456 are less than 0.25% rms wow and 0.1% rms flutter measured at 33 1/3 rpm . . . unmatched by any other record changer.

**Jam-Proof**

Collaro safety-clutch prevents damage even if tone-arm is held or moved during change cycle.

**Four Speeds**

Plays all 78, 45 and 33 1/3 rpm records . . . plus new types designed for 16 2/3 rpm speed.

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Intermix**

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For playing records individually or for selecting and playing specific bands and parts of a record.

**Simple  
Installation**

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**... Plus**

- ★ Rapid change cycle independent of record speed.
- ★ Automatic 'shut-off' after last record.
- ★ Simple, one-knob speed selection.
- ★ Gentle, straight-spindle record handling.
- ★ Interchangeable, plug-in cartridge shells.
- ★ Heavy, rim-weighted turntable for flywheel action.
- ★ Automatic idler-disengage prevents idler flats.



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\$14.90 wired & tested \$12.50 kit form

#### VOLOMETER — EMC Model 104

This precision-engineered instrument features a 4 1/2 inch, 50 microampere meter, with alnico magnet... with 3 AC current ranges to 3 amps and three resistance ranges to 20 megohms.

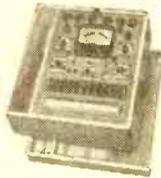
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#### MUTUAL CONDUCTANCE TUBE TESTER — EMC Model 206 P

One of the finest pieces of tube testing equipment at a price comparing favorably with emission-type testers. This completely flexible model using lever-type switches offers extremely accurate results with ease of operation.

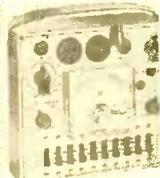
\$83.50 (hand rubbed carrying case)



#### TUBE TESTER and REJUVENATOR — EMC Model 209

Miniaturized instrument gives fast, absolutely accurate checks for tube quality, shorts, leakages, continuity, and opens on all modern and future tubes... uses standard emission test for quick readings on modern, 3 1/2" plastic meter. \$38.50 in hand rubbed carrying case.

\$35.90 (hammerstone metal case)  
\$25.90 kit form



#### VACUUM TUBE VOLTMETER — EMC Model 106

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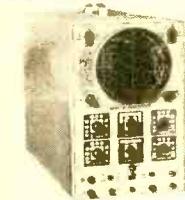


#### WIDE BAND OSCILLOSCOPE FOR COLOR AND MONOCHROME TV EMC Model 601

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# POPULAR ELECTRONICS

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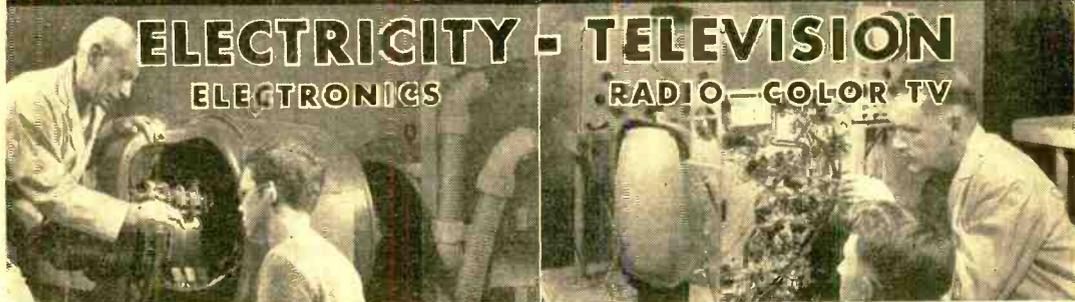
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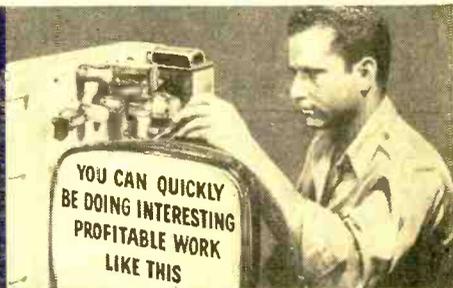
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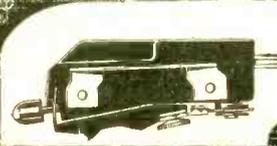
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You can obtain  
fine music reproduction  
from your conventional  
phonograph with the



SHURE

## "Twin-Lever" Ceramic Phono Cartridge

The WC10 "Twin-Lever" Improvement Cartridge will dramatically improve the tone quality of your conventional home phonograph—will actually make it better than new! The low price of the "Twin-Lever" permits anyone to enjoy the luxury of faithful reproduction of recorded music.

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It is easily installed in any tone arm with standard 1/2" mounting centers. Needle replacement can be accomplished in seconds—without tools—with the cartridge in the arm.

### MODEL WC10

List Price..... \$9.50  
with two sapphire needles

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List Price..... \$34.00  
with a 1-mil diamond and  
a 3-mil sapphire needle



*The Mark of Quality*

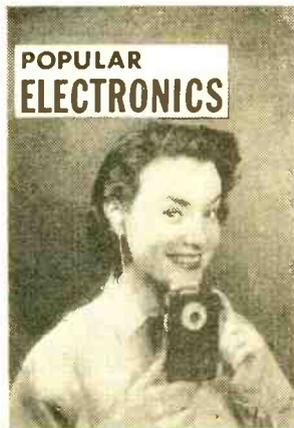
"IN ELECTRONICS SINCE 1925"

**SHURE BROTHERS, INC.**

Microphones—Electronic Components

214 HARTREY AVENUE • EVANSTON, ILLINOIS

## COMING NEXT MONTH (JANUARY)



(ON SALE DECEMBER 20)

Look for construction details on a simple short-wave converter, the "Economy" tube tester, and a transistorized superhet that requires no outdoor antenna. Three experiments which utilize sun batteries or solar cells will also be described.

You will be interested to know that electronic technicians now "make noise" in special sound chambers to find how much racket both instruments and human beings can stand. Don't miss the "Whys and Wherefores of Watts" which should help you to understand hi-fi better. And if you want to locate those rattles in your car, try clamping our speaker/coffee can arrangement to your dashboard.

## IN THIS MONTH'S RADIO & TELEVISION NEWS

(DECEMBER)

- Electronic Aids for Small Aircraft
- Listening Tests for Speakers
- An Experimental Hi-Fi System
- All-Transistor Amateur Transmitter
- A Light Bulb Volume Expander-Compressor
- A "Densitimer" for the Darkroom

Always say you saw it in—POPULAR ELECTRONICS

LOOKING FOR JOB SECURITY AND SUCCESS?

# LET MY STUDENTS AND GRADUATES TELL YOU

## ABOUT MY TRAINING—

**NEW! NEW!**

### NEW! COLOR TELEVISION TECHNICIAN COURSE

*Sylvania Now Sponsoring  
RTTA's Color TV  
Technician Course*

One of the nation's largest electronics manufacturers and marketers Sylvania Electric Products Inc. in its continuing effort to cooperate with independent service dealers is now sponsoring the RTTA Color Television Technician Course.

The Color Television Technician Course is being made available to authorized Sylvania Dealers throughout the 48 states who are interested in expanding their knowledge and experience in Color TV servicing.

Learn the latest. Be prepared for your share of those profits! RTTA's Color TV Servicing Course brings you the most complete, up-to-the-minute data and procedures for the servicing and maintenance of all Color TV receivers and equipment. The 14 lesson course guides you through the development and transmission of the composite color TV signal, and includes troubleshooting and servicing methods. The same step-by-step, easy-to-follow approach used so successfully in our other courses.

### HAS OWN BUSINESS



I have a shop at home and have been working on radio and TV after working hours of my regular job. I average \$50 a week for this part time work. RTTA training helped me in making extra money and giving me experience in the electronic field.

Richard Hennis, Little Rock, Ark. 6/30/54

### SERVICE MANAGER



I manage two radio and television shops, one here and one in Pompano Beach. RTTA training increased my knowledge of TV circuits and showed me new, quicker methods of repairing. Lessons as presented are very concise and clear.

William Phillips, Fort Lauderdale, Fla.

### REPAIRED EVERY SET



RTTA training helped me to understand TV more thoroughly. I have repaired every set that I was called on to repair. 6/21/54

Andrew Busi, Jr., Iselin, Pa.

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



## —ABOUT MY EQUIPMENT

YOU GET ALL THIS EQUIPMENT



"... a money making little gem."

I have completed kit #6 and was amazed at how it works. I showed it to a friend of mine and he asked me to set it up for one of the picnics his social club was having. That sure is a money making little gem.

John Fernandez, Fresno, Calif. 6/7/54

"We get excellent pictures..."

I would like to compliment you on an excellent and complete course. We get excellent pictures on my TV set from WSYR (Syracuse, N.Y.), approximately 110 air miles away. The set is working good and I have had to replace only three tubes since I assembled it two years ago.

Larry H. Stafford, Kingston, Ont., Canada 7/8/54

"... very good reception..."

I have really enjoyed the course and have come a long way in TV servicing. I am getting very good reception on my TV station considering that the nearest VHF station is 120 miles.

J. W. Hanlon, Jr., Henderson, Texas 7/13/54

## YOU, TOO, CAN GET A BETTER-PAYING JOB IN THE EVER-EXPANDING RADIO-TELEVISION-ELECTRONICS FIELD

Why limit yourself and your earnings because of your lack of training. Learn AT HOME in your SPARE TIME to be an electronic technician, television repairman, or studio technician. You don't need any experience whatsoever. Many students earn enough in their spare time to pay for the entire course.

After you finish my Radio-FM Television Course or FM-Television Course you can have, if you want it, two weeks of laboratory training at my associate resident school in New York City—AT NO EXTRA COST.

If you have had previous radio and television experience you can take my practical TV Studio Technician Course to qualify for a good-paying job in a TV studio.

Write to me today and let me show you how you can begin now to put yourself on the road to a better future.

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Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

- Color TV Course
- Radio-FM-TV Technician Course
- FM-TV Technician Course
- TV Studio Technician Course

**VETERANS!**

Write discharge date

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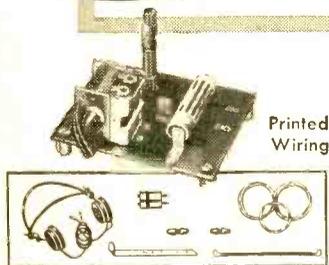
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### Fascinating knight-kit TRANSISTOR RADIO KIT

Model S-765  
only  
**\$435**

Experiment with the marvel of transistors! Printed circuit mounting board simplifies assembling. Just mount components, solder a few connections and enjoy excellent AM broadcast reception. Compact, fits in palm of your hand; operates from single penlight cell that lasts for months. Complete with all parts, transistor and penlight cell. Easy to assemble. Shpg. wt., 2 lbs.

Model S-765. Net only ..... **\$4.35**  
S-266. Accessory kit; 4000 ohm double headphones and all parts for outdoor antenna. Net. .... **\$3.15**



### knight-kit TWO-WAY INTERCOM SYSTEM KIT

Model S-295  
only  
**\$1475**

Easy to build—ideal for home or office. Consists of Master and Remote unit, each with press-to-talk switch. Remote can be left "open" for distant answering or baby-sitting. In "closed" position, Remote remains private, but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. With tubes and 50-ft. cable. (Up to 200-ft. may be added.) Each unit 4 3/4 x 6 1/2 x 4 3/4"; antique white finish. For AC or DC. Easy to assemble. 7 lbs.

S-295. Net only ..... **\$14.75**

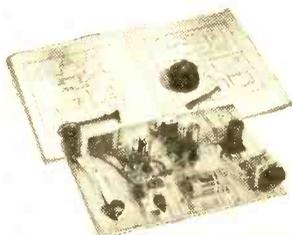


### knight-kit "SPACE-SPANNER" BANDSWITCHING RECEIVER KIT

Model S-243  
only  
**\$1595**

All-new 2-band receiver, easy to build—a great value. Band-switch selects thrilling short wave, including amateur, aircraft, police and marine radio (6 to 18 mc), and standard broadcast. Highly sensitive regenerative circuit. Has 4" PM speaker and beam-power output for strong volume. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build. 7 x 10 1/2 x 6"; for 110-120 v. 50-60 cycle AC or DC. Shpg. wt., 4 1/2 lbs.

Model S-243. Net only ..... **\$15.95**  
S-247. Matching cabinet for above \$2.90

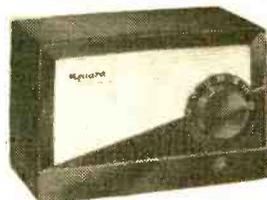


### knight-kit 10-IN-1 LAB KIT

Model S-265  
only  
**\$1265**

Instructive, fascinating! Enables you to build any one of 10 circuits: Broadcast receiver for headphone reception; Phono Oscillator to play records through any radio; Phono Amplifier; Code Practice Oscillator; Signal Tracer; Electronic Timer; Relay, etc. Includes tubes, all parts, instructions (less photo-tube and socket, and headphone). Ready to build. For 110-120 v., 50-60 cy. AC. 10 lbs.

Model S-265. Net only ..... **\$12.65**  
J-112. Headphone for above .... **\$1.05**  
C-100. Antenna Kit for above ... **\$1.05**



### knight-kit "RANGER II" AC-DC SUPERHET RADIO KIT

Model S-735  
only  
**\$1725**

Build this top quality table model radio at low cost! Tunes full AM broadcast, 540 to 1680 kc (includes police calls). Features Alnico PM dynamic speaker; automatic volume control; sensitive Superhet circuit; handsome plastic cabinet. Easy, step-by-step assembly. Complete with punched chassis, all parts and tubes, speaker and smartly styled bakelite cabinet (6 x 9 x 5"). For AC or DC. Shpg. wt., 8 lbs.

Model S-735. Net only ..... **\$17.25**



### IDEAL KIT FOR THE HAM

Model S-255  
only  
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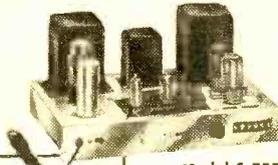


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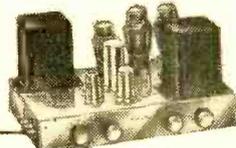
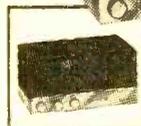
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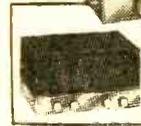
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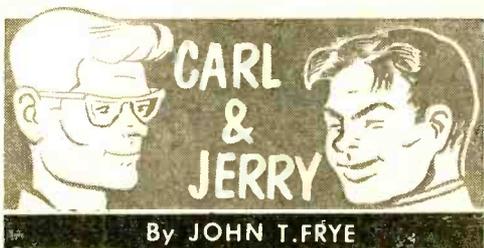
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"Hey, Jer," Carl finally drawled, "do you have trouble staying awake in that second period assembly?"

"Sure do," Jerry said with a reminiscent yawn. "Guess neither of us needs to do much studying in there, and there's nothing else to do. Even the surrounding scenery is no good. Did you notice the girls who sit on both sides of me? Real beasts!"

"Naw, I don't pay any attention to girls," Carl said, just a trifle too emphatically; "but I wish we had something to do in there. If we could just talk to each other some way—"

He stopped speaking as Jerry suddenly swung his feet to the floor and sat upright on the creaking couch. "That's an idea!" Jerry exclaimed. "Why don't we build a couple of little transmitters and receivers and chew the fat during that period instead of wasting time?"

"Well, I dunno," Carl said doubtfully. "We'd have to use code instead of phone, and it would have to be doggoned quiet code at that. You know how still that crabby old Miss Dean keeps things in that study hall. I've seen her send kids to the office just for shuffling their feet."

"Yeah, that's right," Jerry said thoughtfully. "We couldn't use earphones, even the hearing-aid type. She would certainly spot something like that."

"If we just had some system so we could feel the signals instead of hear them—" Carl started to say.

"**THAT'S IT!**" Jerry interrupted. "We'll use a low-frequency note to modulate the transmitter. The receiver will amplify this and feed it to a diaphragm-type ear-phone with the diaphragm taped right



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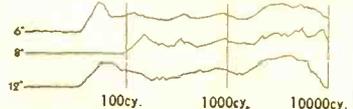


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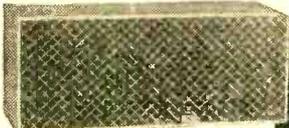
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**Carl & Jerry** (Continued from page 10)

against a sensitive portion of the skin. With a little practice, we should be able to interpret the buzzing sensation produced by dots and dashes just as well as we could if we were hearing an audible note."

"What kind of transmitter and receiver will we need?"

"Transistor types in both cases in the interest of small size and low battery drain," Jerry promptly said. "I think the receiver should be a regenerative detector with a couple of stages of audio behind it to furnish plenty of drive to the earphone—or perhaps we should call it a 'skinphone.' The transmitter will consist of an r.f. oscillator modulated by a low-frequency audio oscillator. We'll key this audio oscillator and let the r.f. generator run all the time. Since we'll only be working over distances of a few dozen feet, no antennas will be necessary."

"What kind of a key can we use?"

"A tiny one made with a couple of pieces of spring brass will be good enough. The leads from this can run through a shirt sleeve so that the key can be concealed in the palm of the hand and worked by simply squeezing the contacts together. After all, we won't be sending thirty-five words per minute. When the key isn't in use, it can be slipped back inside the shirt sleeve."

"Well, let's get started!" Carl suggested, hopping off the bench. "I want to have this thing ready to go by Monday, and if we don't run into some bugs that need ironing out, it will be the first time."

**THIS TIME** was no exception. The receivers gave no trouble, but the transmitters made up for it. Even at the low frequency used—around 550 kilocycles—the oscillators were sluggish. They tried several circuits before they found one that was stable in performance and would accept modulation from the low-frequency oscillator. Finally, though, by late Sunday afternoon the problems were all apparently licked, and the boys were ready for a trial. Each boy had a small earphone, with its cap removed, taped to the inside of his upper right arm so that the face of the diaphragm was flat against his skin. A tiny transmitter was carried in one shirt pocket, a small receiver in the other.

"Are you ready?" Jerry asked, as he looked across the laboratory at Carl.

"Fire at will!" Carl answered.

Jerry started squeezing the "key" concealed in the palm of his hand, and Carl finched and began to giggle. "Hey, that tickles!" he announced, "but I can make

(Continued on page 16)

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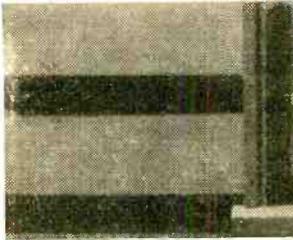
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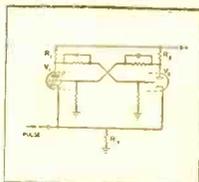
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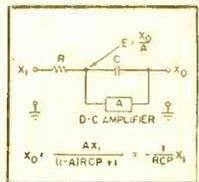


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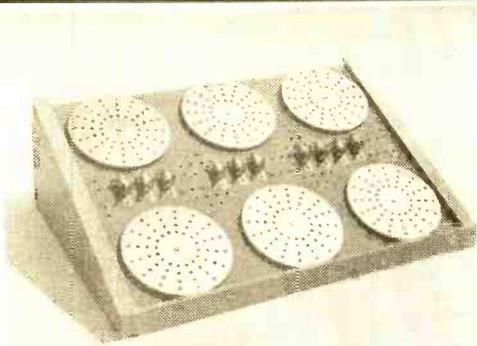
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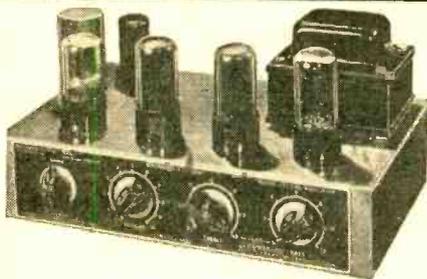
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 Rapid Reading PS6  
 Construction of Robots PS7

Please send me GENIAC Kit. \$19.95 (Add 80¢ West of Mississippi or \$2.00 Outside U. S.)

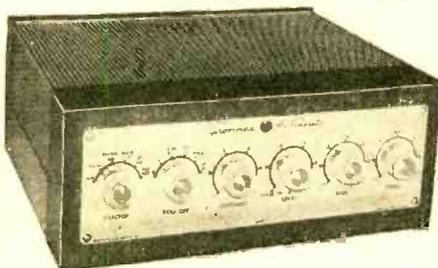
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10-day money back guarantee on all Kits

## Carl & Jerry (Continued from page 12)

out your 'CQ' all okay. Try something else now."

Jerry began tapping out the dots and dashes to ask: "Can you read this?" And he jumped in turn as Carl promptly came back with the "dit-dah-dit" of "received okay" followed by the "dah-dit-dah-dit" that means "yes" in the code used by amateurs. In the few minutes remaining before supper, the boys found that they could easily work each other up to about a hundred feet. Then they had to lay their new playthings aside.

The next morning their mothers did not have the least trouble getting them started off for school; but oddly enough, the boys did not walk together as they usually did. Instead, they went down opposite sides of the street, with faraway looks in their eyes and their right hands working spasmodically.

IT WAS during the second period study hall that they had the opportunity to give their brainchild the acid test. As soon as the bell had rung and everything was quiet, Miss Dean started her gimlet-eyed stroll through the aisles. Just as she walked past Carl's desk, Jerry tapped out: "What a sour-puss!" He did not need to feel the buzzing acknowledgment against his arm; Carl's heaving shoulders told clearly that he had got the message.

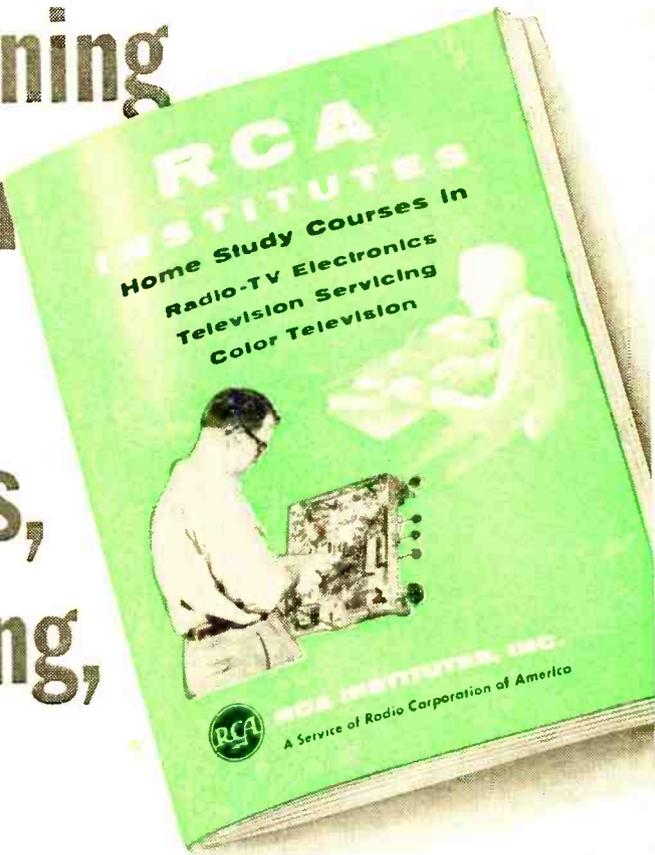
The boys had a real picnic during the study period sending messages back and forth. Every boy is a lodge brother at heart, and the fact that what they were doing was secret and entirely unnoticed by others in the room added tremendously to the flavor of the accomplishment. Time went very fast, and just before the end of the period, the voice of the principal boomed through the loudspeaker on the wall announcing: "Instead of going to your next class or study hall, all students will proceed to the auditorium for a special program to be presented by Professor Karns of the psychology department of our state university."

The boys' study room was directly across the hall from the auditorium; consequently Carl and Jerry were in the vanguard of the thundering herd that surged through the doors of the auditorium. As a result, they were seated in the second row from the stage when the curtains parted. A dapper man wearing pince-nez glasses stepped to the proscenium and said:

"Good morning, students. The program that you will see now is going to be a little unusual. To some of you it will be

(Continued on page 20)

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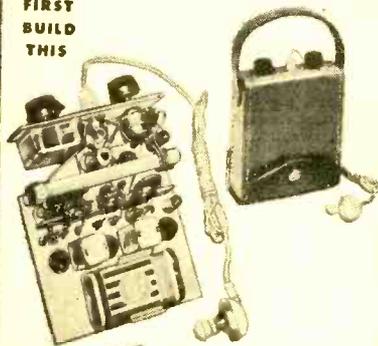
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## 4 AND 6 TRANSISTOR SUPERHET KITS POCKET AND HOME RADIOS FOR SPEAKER AND EARPHONE OPERATION

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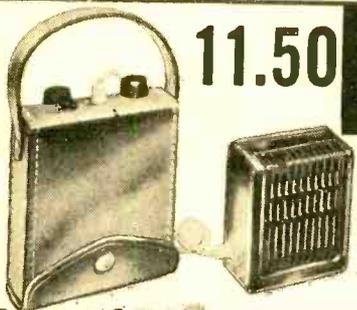
POCKET SIZE: 4" L x 3-5/16" W x 1" D BUILT-IN ANTENNA! REQUIRES NO EXTERNAL ANTENNA OR GROUND!

Lafayette engineers have designed this fascinating 4-transistor superhet receiver kit in a unique and interesting form. It is, by itself, a completely self-contained, pocket sized personal portable set which operates a miniature earpiece so only you can hear; by plugging into the KT-96 kit listed below, it is instantly converted to a full 6-transistor home radio, complete with speaker for the entire family to enjoy. The set is completely subminiaturized and utilizes the new, radically different Argonne "Poly-Vari-Con" ultra miniature 2-gang variable condenser. You will be delighted with the truly subminiature parts, from the variable which measures only 1-1/16" square x 5/8" deep, to the tiny I.F.'s and electrolytics. The chassis measures only 4" L x 3-5/16" W x 1" D. You'll be amazed at its performance. Circuit features use of 4 transistors (2 high frequency and 2 audio type) plus a germanium diode, 2 I.F. stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective set covering the entire broadcast band. Requires no outside antenna or ground connection. The kit is furnished complete with transistors and all parts, including battery and chassis already drilled and punched. The earpiece and carrying case are accessory items, not supplied. All necessary pictorial and circuit diagrams are furnished with simple, easy-to-follow instructions. Shpg. wt., 2 lbs.

THEN  
BUILD  
THIS

**19.95**

- KT-94 Kit ..... Net 19.95
- MS-311 LEATHER CARRYING CASE ..... Net 1.95
- MS-260 Super power dynamic earpiece ..... Net 3.95
- MS-278 Economy earpiece ..... Net 1.95



**11.50**

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• CONVERTS 4-TRANSISTOR KIT INTO A 6-TRANSISTOR HOME RADIO WITH SPEAKER

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### FM-AM TUNER KIT

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

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#### SPECIFICATIONS

**FREQUENCY RANGE:** FM 88-108MC, AM, 530-1650 KC, ANTENNA INPUT; FM, 300 ohms, AM Ferrite loopstick and high impedance external antenna. **DISTORTION:** Less than 1% at 20,000 cps, AM  $\pm$  3 db 20 to 5000 cps. **SENSITIVITY:** FM, 6 UV for 30 db quieting, AM, Loop sensitivity 80 UV/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 8 db down; 375 KC FM discriminator peak to peak separation, AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLIMENT:** 2-12AT7, 1-6BE6, 1-BA6, 2-6AU6, 1-6AL5 plus selenium rectifier. **SIZE:** 5 1/4" high x 9 5/8" wide x 9 1/2" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Attractive etched copper-plated and lacquered finish. Less metal case. Shpg. wt., 9 lbs.

KT-100 ..... Net 34.95  
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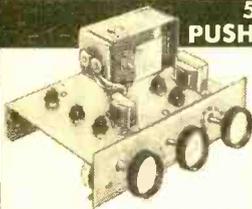
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KT-117—Complete Kit.....Net 18.45



**5 TRANSISTOR  
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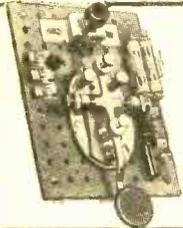
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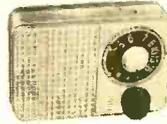
**2,000 ohm per Volt on AC & DC**

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



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**Carl & Jerry** (Continued from page 16)

quite interesting. Others will find it dull. What you think of it does not really matter. You are going to be permitted to take part in an experiment in what is known as 'Extra Sensory Perception.' There is a growing belief in some quarters that a certain amount of information can be transferred from one mind to another without the aid of any of the usual senses. To check the validity of this belief, our psychology department is conducting experiments, such as the one in which you are about to participate, at various high schools and keeping a careful record of the results. Out of these experiments, we hope to arrive at some definite conclusions as to whether there actually is such a thing as 'ESP' or not.

"To go on with the experiment, I shall need an assistant. Experience has taught me that it is useless to call for volunteers from a high school group; so I'll draft one of you. Let me see now. The tall young man wearing glasses in the second row looks like a bright chap. Will you please come up here, young man?"

**H**ANDS on all sides, even those of his buddy, boosted a reluctant Carl to his feet and shoved him out into the aisle.

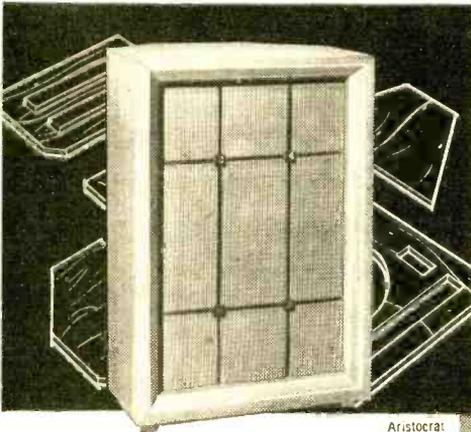
He walked awkwardly up the steps to the stage and faced the professor.

"Don't look so frightened," the professor said jovially. "This is not going to hurt a bit. You are familiar with the names of a deck of playing cards?"

"Yes," Carl said in a small hoarse voice.

"Fine! I want you to stand right here at the front of the stage facing the audience. On the elevated screen at the back of the stage I'll show a card at a time with this projector. As each card shows on the screen, I want all of the students to concentrate on its name and suit as hard as they can for five full seconds. At the end of that time I shall strike this little bell, and I want you to name the first card that comes into your mind. For example, you may say, 'Ace of diamonds,' or 'Nine of clubs,' or whatever card is in your mind at the second you hear the bell. What we shall be trying to do is to transfer the knowledge of the card directly from the mind of the audience to your mind. A young lady back in the wings—she is too pretty to have on the stage because she would distract attention from the experiment—will keep a careful record of each card shown and the cards you name.

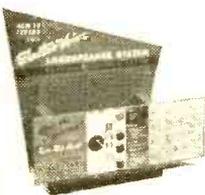
"But let me warn the audience not to expect too many correct identifications. The odds against your correctly naming



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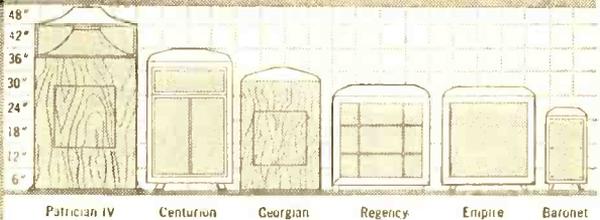
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Paul Reichert, West Salem, Ohio	2nd Class	10 Weeks
Harold Phipps, LaPorte, Indiana	1st Class	28 Weeks
John J. Johnson, Boise City, Okla.	2nd Class	12 Weeks
James Faint, Johnstown, Pa.	1st Class	26 Weeks

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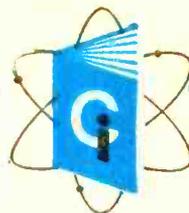
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**Carl & Jerry** (Continued from page 20)

even one card are tremendous, and it is against these mathematical odds that we are competing. If you can better the law of probability by just a little, it will be significant."

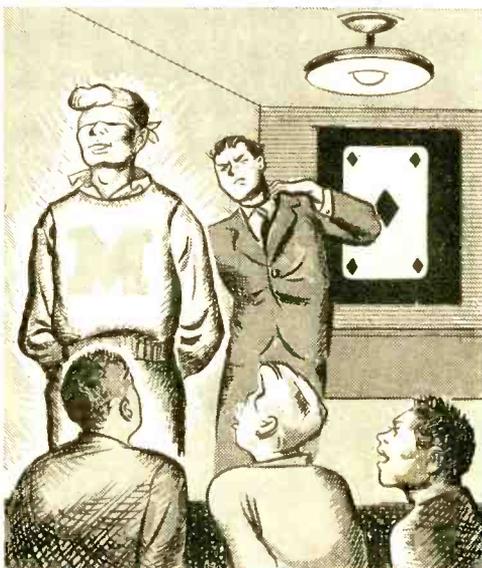
**J**ERRY was watching Carl closely, and he saw the latter's mouth draw into a straight line that meant he was not taking at all kindly to the glib man beside him. Jerry did not like him either. He sounded too much as if he were trying to be "cute," as though he were talking down to his youthful audience.

The lights were lowered, and suddenly a huge queen of spades appeared on the screen above and behind Carl. With a sudden inspiration, Jerry squeezed the little brass contacts already held in the moist palm of his hand to spell out "QS." As he finished the last dot, the bell tinkled and Carl promptly said in a loud voice: "Queen of spades!"

"An astounding, auspicious beginning!" the professor exclaimed. "Let's try another."

He flashed the seven of hearts on the screen. Jerry immediately tapped out "7H," and Carl called out: "Seven of hearts!" the instant he heard the sound of the bell.

"This places too much of a strain on coincidence," the dapper man said in a suspicious, harried voice. "Maybe you can see some reflection of the screen, or perhaps some smart aleck in the audience is sig-



. . . The scientist flashed card after card on the screen, and Carl called off each one correctly . . .

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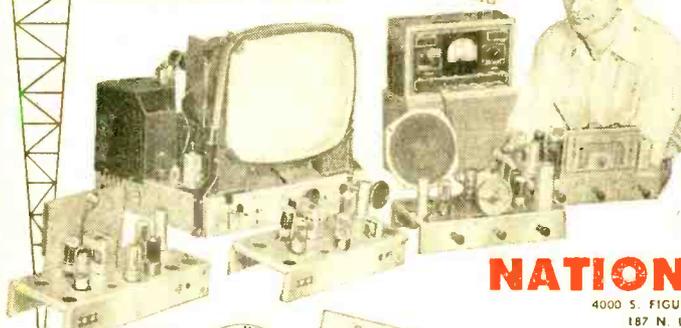
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**Carl & Jerry** (Continued from page 22)

naling you in some fashion. Would you mind letting me blindfold you?"

"Go right ahead," Carl said in return.

**A**FTER A MOMENT of indecision, the scientist won over the fashion plate, and the professor removed the handkerchief that was peeping meticulously from his breast pocket and securely blindfolded Carl. Then he went back to his projector and flashed the jack of spades on the screen. Carl easily translated the dots and dashes of "JS" buzzing against his arm into the name of the card. Desperately, the scientist flashed card after card on the screen, and Carl called off each one correctly.

By this time the professor was so disturbed and puzzled that he had forgotten all about his appearance. Frantic fingers run through his hair had left it tousled. He tugged at his shirt collar as he walked slowly around Carl, looking at him with deep, incredulous interest.

"I just can't believe it!" he muttered. "One-hundred-percent correct identification! Young man, can you explain how you perform this feat?"

"I just did what you told me to do," Carl said blandly. "I simply called out the card that was in my mind when the bell sounded. Guess it must be a kind of telepathy, or something."

"Or something' is right," Professor Karns fervently agreed. "I must take you down to the university with me and give a demonstration of your phenomenal ability to my colleagues."

"Aw, I don't think I could do that," Carl objected, as he started backing toward the steps leading down from the stage. "I don't like to mess around with this sort of thing. Makes me feel kind of creepy."

"But you owe it to science!" the professor argued. "If we can repeat this experiment, my account of it will appear in every scientific journal in the world."

"I'll think about it," Carl said, hastily going down the steps.

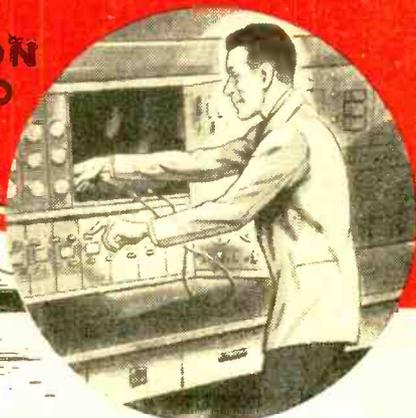
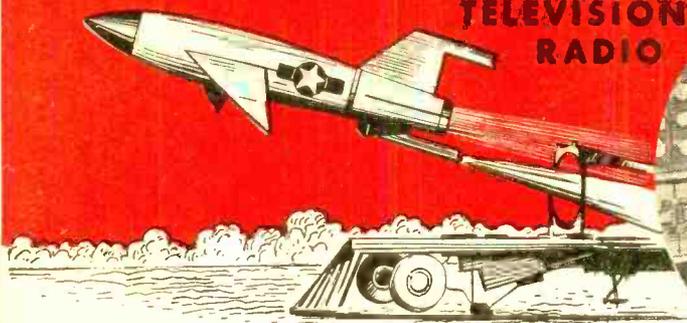
**T**HE ASSEMBLY was dismissed, and as Carl and Jerry walked along the hall Jerry whispered:

"That was a lot of fun, but it certainly means that we'll not dare wear these contraptions to school again. And don't ever breathe a word about them. If it is ever found out how we helped ESP, you and I are going to be the guests of honor at the darndest tar-and-feathering party you ever saw; and I can just see Professor Karns lading out the hot tar right now!"

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# LETTERS

## FROM OUR READERS

### Found: Parabolic Dishes

■ In answer to the letter in your November issue, I think that Electronicraft, Inc., Bronxville 8, N. Y., has some paraboloids available. These range in diameter from 17 to 48 inches and could probably be used to duplicate the *Carl and Jerry* experiments in the May 1956 issue. I have no information on prices, so suggest writing directly to Howard Sevanties at the above address.

R. CAMPBELL  
Morristown, N. J.

### Speak-O-Phone Needle Wanted

■ I am in quest of information as to where I can obtain a Speak-O-Phone fiber needle. This is a personal phonograph that was made under Patent No. 1421045.

M. G. JACOBSEN  
Walla Walla, Wash.

### More Comments on L.W. DX

■ Thanks for the interesting article on long-wave DX in the October issue. It sure provided me with much needed information. By the way, I find that NSS operates around 20 kc. and 165 kc. in addition to the channel on 121.95 kc. Can any

of your readers give the exact frequency of NLK that can also be heard around 20 kc.?

JAMES V. HAGEN  
Glen Rock, N. J.

### More Mystery C.W. Stations

■ I have heard a station using the call SRF sent in code on the broadcast band for over a year. Perhaps others have heard it and can give me an explanation.

V. LINGBLOOM  
Elsie, Nebr.

■ This may sound like a second OAB—since I hear a station signing SRF on the lower edge of the broadcast band. I am using a Hallicrafters S-40 and think that the SRF call is sent at about three words a minute.

ROBERT L. COOKE  
San Jose, Calif.

*This appears to be another one of those aircraft beacons operating around 530 kc. Most broadcast receivers will pick up these signals if tuned to the lowest possible part of the dial (speaking in kilocycles). Does anyone have information on the location of SRF?*

### "After Class" Format Approved

■ I feel that the information I get from *After Class* articles greatly increases my over-all knowledge of general electronics. I would like to see

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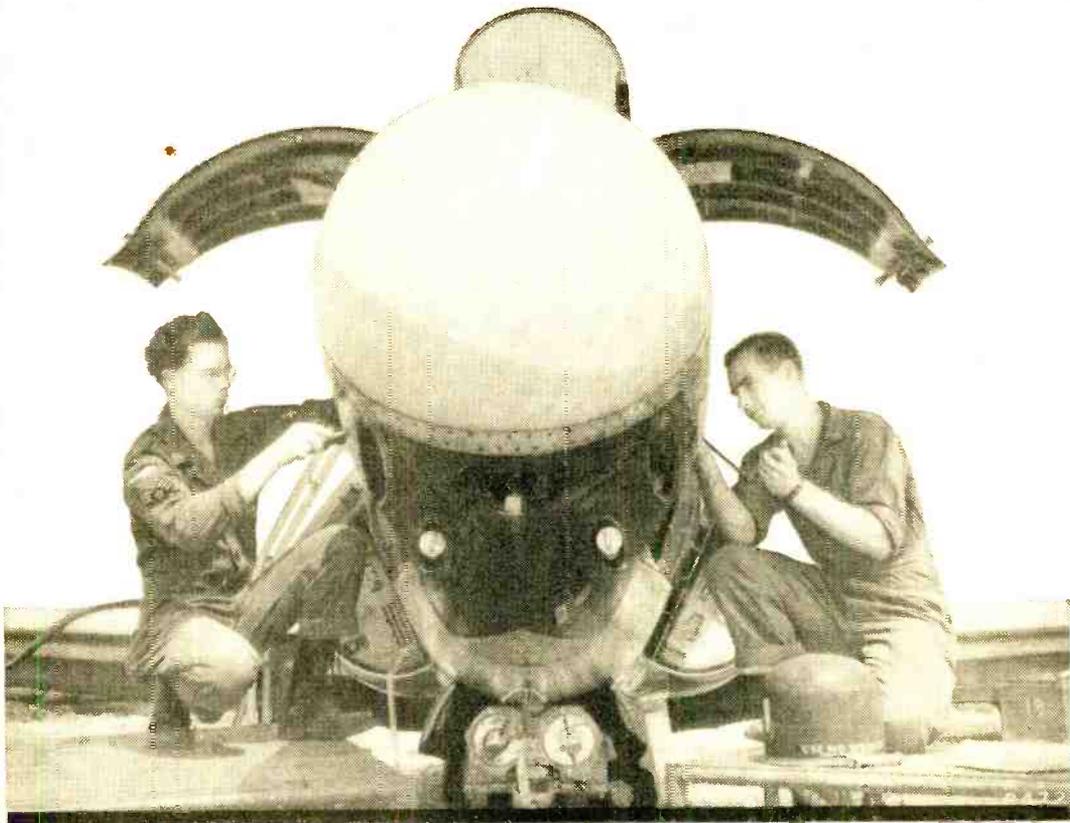
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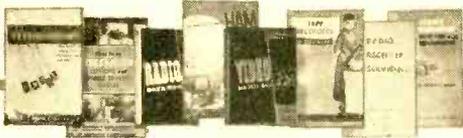
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## Letters

(Continued from page 26)

more material on computers and automation with details of circuitry.

JOHN N. LANDON, ETI  
N. Hollywood, Calif.

■ Please accept my congratulations. Few publishers allow space today for items that could possibly be evaluated as only experimental material. Is there anything more on electrets (August issue, page 85)?

BOB ERB  
Columbus, Ohio

■ This is my vote for *After Class*. The "different" material is enjoyable. Please keep the quiz since it is a good test on basic theory retention.

BOB FULLER, W9CJT  
Indianapolis, Ind.

■ Find your new *After Class* feature material extremely interesting.

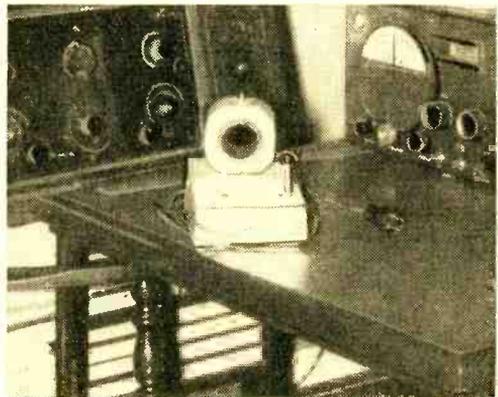
A. D. CRAIG  
Detroit, Mich.

■ Think your *After Class* section is really stepping out into very interesting fields. I am also interested in printed circuits, so add my vote for more material along those lines.

J. E. AULD  
Miami, Fla.

## Magnetizer Works Fine

■ I built the magnetizer-demagnetizer on page 57 of the August 1956 issue, and came to the conclusion that it works—though I found it necessary to make some parts substitutions. By the



way, some catalogs show the Stancor FC-10 as the focus coil used in the RCA model 630TS TV sets. I guess this was the replacement number.

B. KININGHAM  
Springfield, Ill.

## Printed Circuits—More! More!

■ This is an enthusiastic reaction to the mention in your September issue of the possibility of continuing the series on printed circuits.

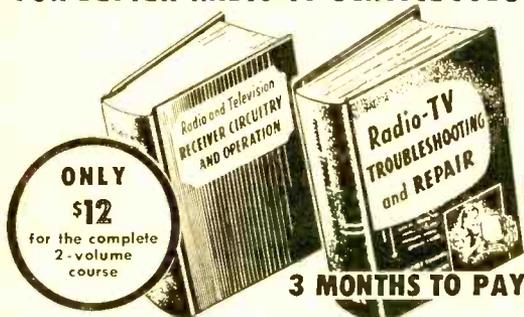
GARRY GLASGOW  
Ann Arbor, Mich.

Fine, Garry. Any more votes?

-30-



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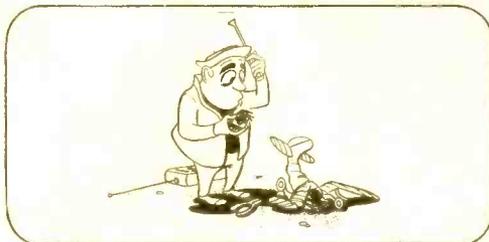
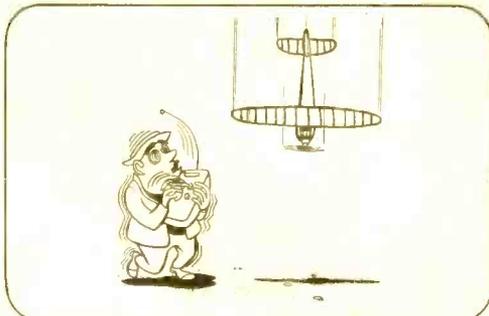
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Plastic case size 7 1/2" x 2 9/16" x 6 3/4" h. Shipped dry charged. Fill with 1.265 sp. g. sulphuric acid. Ship. wt. 8 lbs. **\$3.95**  
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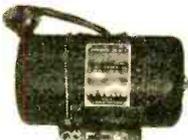
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"HOW TO MAKE GOOD TAPE RECORDINGS" by C. J. LeBel. Published by Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y. 151 pages. Cloth bound, \$2.50. Paper bound, \$1.50.

This new handbook contains up-to-the-minute information of interest and value to all tape recordists. The author—secretary of the Audio Engineering Society—writes with accuracy and clarity on how recorders work, selecting a recorder—as well as the tape itself, using the recorder, microphone and studio techniques, editing, stereophonic tape, and putting together your own tape-recorded show. Illustrations, a glossary, and an index round out a very compact volume.

*Recommended:* to all tape hobbyists.

"SUPERHETERODYNE CONVERTERS AND I-F AMPLIFIERS" by Alexander Schure. Published by John F. Rider Publisher Inc., 116 W. 14th St., New York 13, N. Y. 56 pages. Paper bound. Price, 90 cents.

Circuits designed for mixing, converting, and i.f. amplifying in superheterodyne receivers are covered in this volume, which is No. 12 in the publisher's "Electronic Technology Series." The approach is non-mathematical and yet manages to cover theory, design, and performance. Among the topics included are tracking, alignment, a.v.c. and d.a.v.c., conversion efficiency, and the Miller effect.

*Recommended:* for those studying superheterodyne receivers as well as practicing technicians.

"ELECTRONIC TUBES, CIRCUITS, AND DEVICES" by Lewis Blevins. Published by Universal Scientific Co., Inc., 1102 Shelby St., Vincennes, Indiana. 620 pages. Paper bound. Price, \$4.50.

This is a big volume, packed with solid theoretical and practical information covering basic tube types, principles of operation, generator circuits, r.f. characteristics and control circuits. A brief introduction to basic radar, television, computing, and v.h.f. circuits is included. Designed as a learner's textbook, this book is valuable for its straightforward and simplified ex-

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You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television.

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

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

### FROM OUR MAIL BAG

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

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

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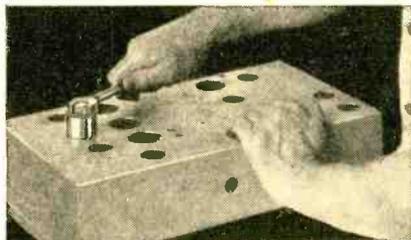
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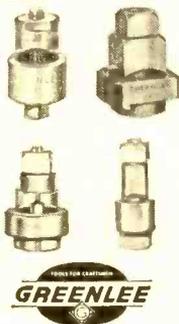
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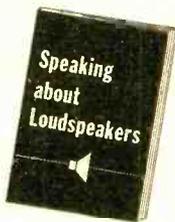


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## Bookshelf

(Continued from page 32)

planations, its numerous practical experiments, and its abundant illustrative material.

*Recommended:* as a basic text for those who have already mastered fundamentals.



"RADIO-ELECTRONIC MASTER," 1957 (21st) edition. Published by United Catalog Publishers, Inc., 110 Lafayette St., New York 13, N. Y. 1546 pages. Price, \$2.95. (Available from electronics parts distributors.)

This annual catalog has become, in the course of years, an industry-wide reference volume. Containing 1546 pages, it is the largest electronics catalog ever published. Over 125,000 items—from simple components to complete equipment—of 350 manufacturers are covered. The Master gives detailed descriptions, specifications, and prices, and more than 11,250 illustrations are included. The buying guide's detailed set of indexes pinpoints products as well as manufacturers.

*Recommended:* as a valuable guide to all who buy, sell, design, or service electronic parts and equipment.



"RIBBONS OF SOUND" by Karl A. Barleben. Published by Book Dept., U. S. Camera Publishing Corp., 9 E. 40th St., New York 16, N. Y. 126 pages. Paper bound. Price, \$2.50.

This compact volume could serve as an introduction to the correct techniques and use of home tape recorders for many users with little or no previous technical background. Among the topics covered are the manufacture of tape, different kinds of tape, how the tape recorder works, recording and editing techniques. Of special interest is a separate chapter on microphones, affording a treatment of this topic not generally found in beginner's books on recording.

*Recommended:* for the beginner at tape recording.



"INVERSE FEEDBACK" by Alexander Schure. Published by John F. Rider Publisher Inc., 116 W. 14th St., New York 13, N. Y. 56 pages. Paper bound. Price, 90 cents.

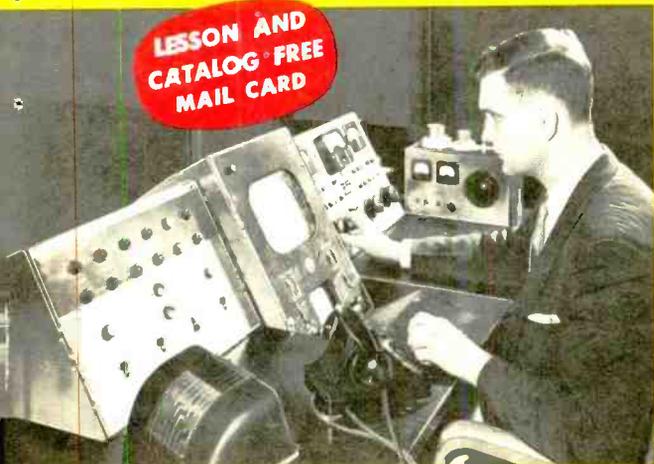
Volume 15 in Rider's "Electronic Technology Series," this book explains the principles and uses of inverse feedback as applied to a great variety of electronic devices. Stability of performance, automatic control, and control of frequency response are some of the accomplishments

(Continued on page 37)

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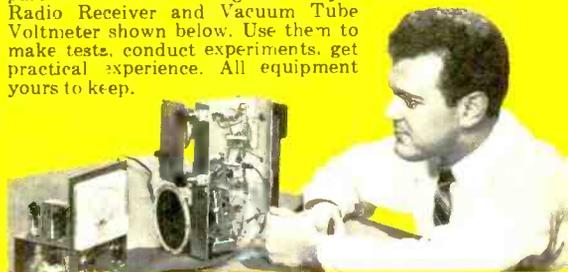
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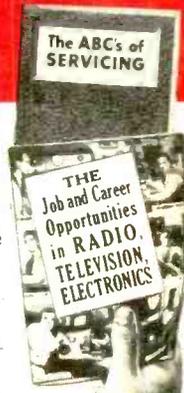
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**Bookshelf** (Continued from page 34)

of inverse feedback that are discussed. The text is written in straightforward, simple style, with math held down to a minimum. A number of schematic diagrams help the text.

*Recommended:* for students and technicians whose work and interests involve inverse feedback circuits.

**Free Literature Roundup**

Allied Radio's 1957 catalog contains over 350 pages describing the many items stocked by this distributor. To obtain a copy, write to Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Books and manuals covering various phases of radio and TV servicing are listed in a catalog available from Harry G. Cisin, Amagansett, N. Y. The list includes publications for beginners as well as for experienced technicians.

Designed primarily for young people, but appealing to readers of all ages, is an attractive book entitled "The Adventures of Grandpa Champ." Printed and illustrated in color, this 32-page book dramatizes the dangers of poor electrical wiring in the home. Recommendations for insuring safety by using A-MP (Aircraft-Marine Products Inc.) electrical terminals are included. The text is engaging and the cartoons riotous. For your copy, write to M. Russell Berger, Inc., 1700 Walnut St., Philadelphia 3, Pa.

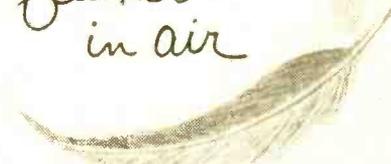
The 1957 edition of World Radio Laboratories' Catalog is now available. Included in it are 200 pages listing ham radio equipment. For your copy, write to World Radio Laboratories, 3415 W. Broadway, Council Bluffs, Iowa.

Microphones, phono pickups, recording heads, and related accessories are described in a new catalog available on request from Shure Brothers, Inc., 222 Hartley Ave., Evanston, Ill.

Thousands of radio-television service aids are described in a colorful, 80-page catalog available from General Cement Mfg. Co., Div. of Textron Inc., 919 Taylor Ave., Rockford, Ill.

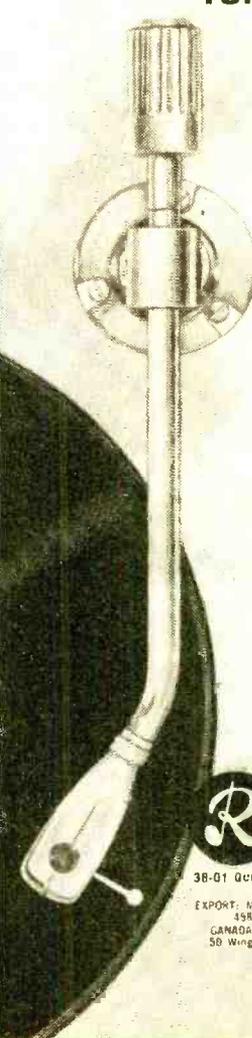
A folder describing General Cement's line of self-spray paints, with many electronic applications, may be obtained by writing to this organization at 400 S. Wyman St., Rockford, Ill.

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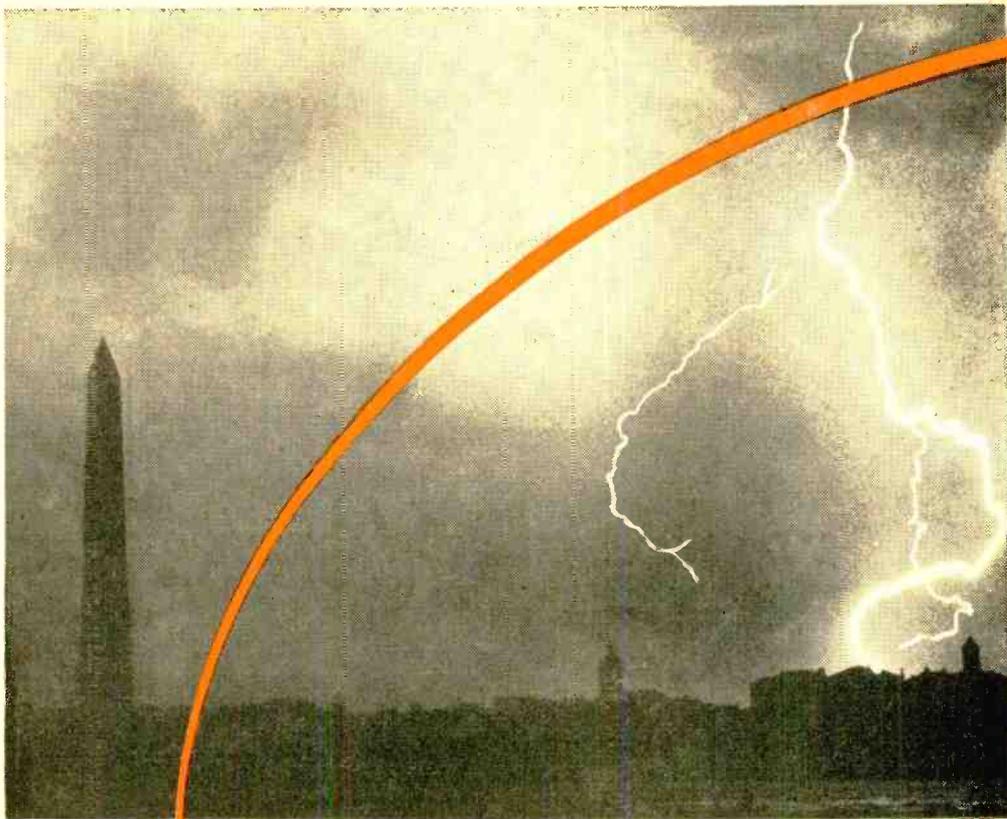
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## Thunderbolts and Whistlers

By **DON GLEASON**

**The why and wherefore of eerie-sounding radio signals generated by certain types of lightning**

**B**ONK!! . . . SHEEEEEEOOOOoooo . . .  
B . . . BONK! . . . SHEEEEEEOOOOoooo . . .  
. . . BONK! . . . SHEEEEOOOOOoooo . . .

These odd sounds were emitted over and over by a loudspeaker in The Naval Research Laboratory, Washington, D. C., during a stormy afternoon last summer. For hours the popping, crackling sounds of "sferics," the usual very-low-frequency radio static, had been monotonously pouring out. Then, about midday, a thunderstorm with strong lightning strokes had combined with the proper condition of the atmosphere. "Whistlers"—strange, drawn out, eerie-sounding radio signals—were being

generated by lightning stroke after stroke in great profusion.

What, you might ask, could be sillier than a bunch of people listening to static instead of turning the radio off during the storm? But it's not ordinary static they are listening to. The "Bonk!" of the lightning crash is followed a second or two later by a swooping whistle; a weird, downsliding tone like a sigh from the ether. The mysterious cause of these "whistlers" is what our scientists want to fathom.

According to theory, the sighing whistle means that part of the radio wave generated by the lightning flash has zoomed thousands of miles through the upper reaches of the atmosphere and out into space, turning downward again to the Southern Hemisphere. Way down near the Straits of Magellan, it bounces back off the earth and dogs its own track back to its point of origin. With uncanny precision, this errant radio wave seeks out the small storm area where it was "born" from all the immensity of the earth and sky. No homing pigeon could be more faithful than this

The theoretical path taken by a whistler is demonstrated by Harold E. Dinger with a loop of wire. Because it follows the earth's magnetic lines of force, the path extends into intersolar space.



mysterious, short-lived, v.l.f. radio wave.

For years, scientists at The Naval Research Laboratory have been studying these curious radio waves. From a long, low building on the Laboratory grounds, a coaxial cable runs up to the roof and connects to a long-wire antenna. This is 200 feet long and ends at the top of a 120' radio tower. Radio signals from thousands of sources fall on this receiving antenna. Local broadcast stations "plaster" it, and on 16 kc., the dahdahdit-dahditditdit-ditdahdit of GBR, Rugby, England, can be heard.

To Harold E. Dinger, the NRL expert on v.l.f. radio waves, these man-made signals are simply interference, requiring careful filtering for their elimination. "Whistling atmospherics" presently hold Mr. Dinger's concentrated attention, and he and his asso-

ciates have surrounded themselves with special electronic apparatus for their study. The long omnidirectional antenna feeds an audio amplifier which covers the frequency range from 800 to 14,000 cycles per second, and can amplify signal voltages by a factor of one million. A high-fidelity tape unit is fed by the amplifier and automatically records whistler activity.

Since a whistler tone is never completely pure and often very ragged, a careful analysis of the taped spectrograms is necessary to determine the dominant frequency. Mr. Dinger and his staff have studied thousands of whistlers, corroborating previous results by other workers, and have discovered new evidence which as yet is not completely explained.

*(Continued on page 115)*

**Pen-and-ink spectrograms** are analyzed to determine how the sound changes in frequency as time elapses. The whistler below is represented by the dark band running from left to right.



# How to Hear Whistlers

**W**ANT TO TRY YOUR HAND at detecting whistlers? If you have a hi-fi phono system with a reluctance pickup head and separate preamplifier, you need only a coil antenna and a hum-suppression filter, both of which can be assembled quickly.

To make the antenna, get 300 to 600 feet of any small-diameter insulated copper wire, either solid or stranded. Wind it into a large coil of 20 to 50 or more closely spaced turns, using the outline of an opened door as a temporary coil form. Bind the turns together with string or insulating tape at short intervals along the coil to make a single, closely packed winding. Remove the coil from the door and open it up into an approximately square shape. Using strings, suspend it in a vertical plane from the ceiling with the coil ends dangling over—and close to the arm of—the record player. Leave enough slack in the wires so that the coil may be rotated to the position of least hum pickup before it is permanently tied in place.

To make the hum-suppression filter, you will need one 0.02- $\mu$ fd. capacitor, one 0.002- $\mu$ fd. capacitor, and two half-watt, 22,000-ohm resistors. Connect the capacitors in series. Then twist the resistor pigtailed together (or connect them with a piece of wire) at one end and connect the free ends across the 0.002- $\mu$ fd. capacitor (as shown in diagram).

The filter should be inserted in the audio line between the preamplifier and the main amplifier chassis (see photo above, right). The junction of the two resistors and the shield of the cable from the preamplifier should all be grounded to the main amplifier chassis. You can test the filtering action by playing a record through the system. With the filter in place, the music should be clear but the low frequencies will be strongly suppressed.

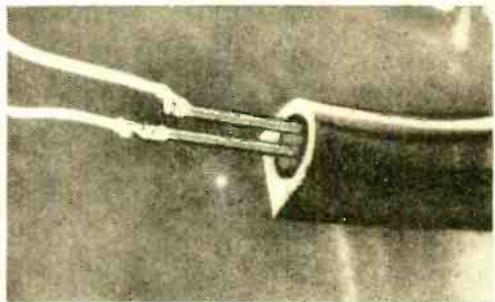
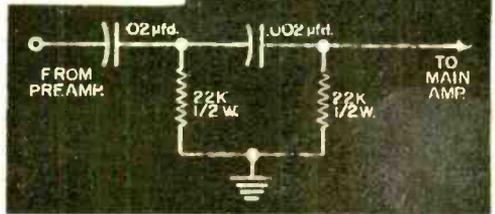
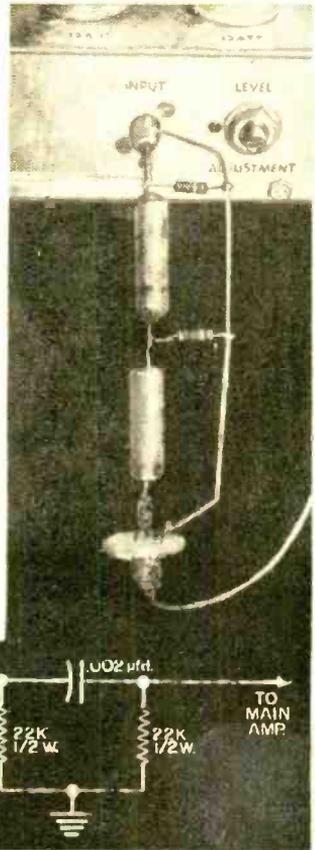


Next, disconnect the reluctance pickup head, and connect the coil leads to the input terminals on the arm. (See photo above.)

With the coil antenna connected and the filter in place, turn on the amplifier and turn up the gain. The residual hum and man-made interference you will hear comes from the magnetic fields produced by nearby 60-cycle power lines. The coil antenna may be rotated until the point of minimum hum is found. It should then be tied in place.

With this setup, you can hear "sferics," i.e., "clicks," "chinks," "tweaks," and if it is early morning, possibly the "dawn chorus," a still-unexplained phenomenon consisting of chirping noises. And, if conditions are favorable, you should hear—WHISTLERS! The best days will be when big thunderstorms occur within 600 miles. Conditions vary with latitude but it is believed that whistlers are generated wherever lightning strikes in the United States.

During the forthcoming International Geophysical Year, scientists all over the world will cooperate in gathering data on whistlers which may open up new horizons for communications.—Don Gleason





## A Head For Radio!

**A** MAN with a "head for radio" is Paul Johnson (left) of Jacksonville, Fla. Working in his garden out of earshot of his living room console, Johnson tunes in his one-tube receiver. The radio—complete with loop antenna, battery power supply, and earphones—fits neatly over Johnson's head. Two dry cells power the set which took an hour and a half to build and brings in local stations. It's certainly not hi-fi, but it sure beats the chugging of a lawn mower, or—in this case—the snip-snip of hedge clippers. (Wide World Photo)

## Talking Traffic Lights?

**T**RAFFIC LIGHTS that literally talk to pedestrians and motorists may occupy our street corners if the suggestion of General Electric engineer Elmer W. Hassel is followed. According to Hassel, voice messages could be given via traffic light equipment by using amplifiers mounted in the same cabinets containing intersection radio tone control units. Hassel says the projected "talking traffic lights" could be set up readily in cities already using G.E. radio tone control systems. Such cities include Los Angeles, Calif., Chicago, Ill., and Evansville, Ind.

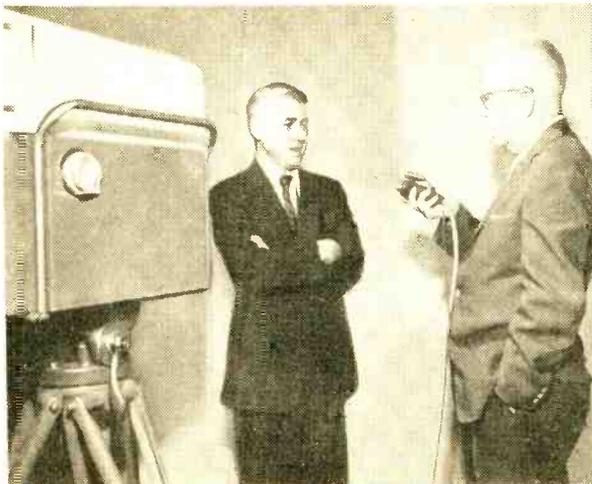
## Compact Computer Control

**C**IRCUITS for controlling large computers are printed on compact "cards" which may be stacked as shown to form a



complete control unit. Cards are fitted into their holder in building block fashion. Known as "Transac," the device can add two numbers in 1.5 microseconds; it multiplies in 15 microseconds. This unit contains nearly 1000 tiny transistors, 300 resistors, and 12 capacitors permanently dip-soldered. It was developed by the Philco Corp., Philadelphia, Pa.

resistors, and 12 capacitors permanently dip-soldered. It was developed by the Philco Corp., Philadelphia, Pa.



## Smallest TV Camera

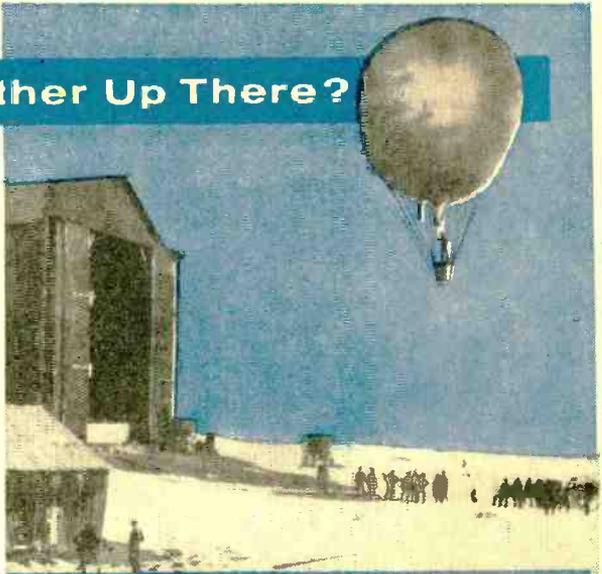
**D**ON GODDARD, TV news commentator, televises network executive Bob Whitehouse with a subminiature TV camera developed by Grundig-Majestic, a German electronics firm. Only 4" long and 2" in diameter, the tiny TV "eye" was used at the national political conventions in Chicago and San Francisco. With it, cameramen were able to pick up dramatic action in cramped quarters where standard TV cameras could not be moved into position. The unit is distributed by the Majestic International Corp., 743 N. LaSalle St., Chicago, Ill.

## What's The Weather Up There?

**F**OR OVER 100 years, the Army Signal Corps has been talking about the weather—and doing something about it. This meteorological preoccupation stems less from a need to fill conversational gaps than the knowledge that the weather is an active participant in battle.

With the advent of war in the air, and radio communications, the upper layers of the troposphere also became part of tactical planning. As shown on this page, electronics has joined the older means of exploring winds and weather at high altitudes.

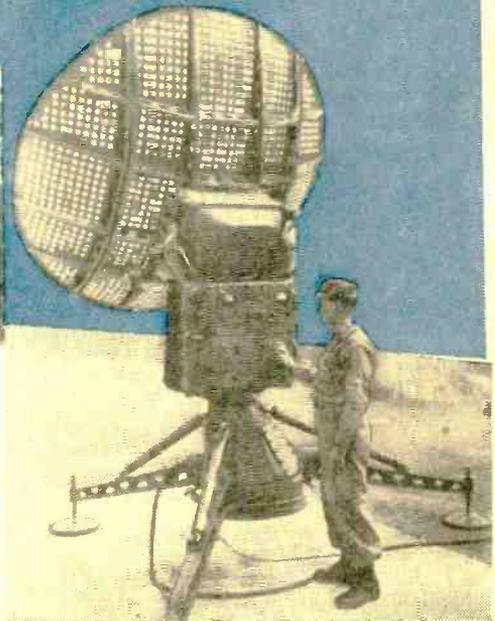
-30-



Pioneer research at the upper weather-forming layers of the atmosphere (top) had a personal touch: you had to go up there yourself to see if any storms were brewing. Weathermen rode in balloon baskets.



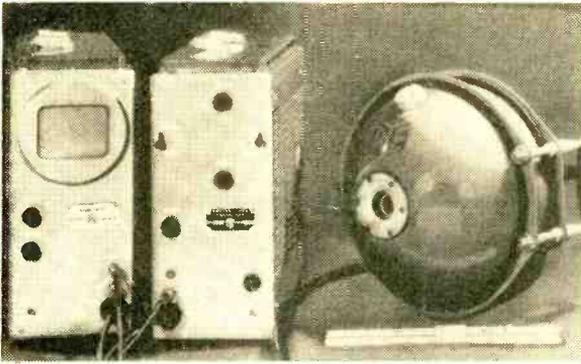
Sparing themselves uncertain journeys to nowhere, weathermen later developed ways of charting balloon flights from the ground. Above, an optical instrument—called a theodolite—tracks the balloon after it is released by the soldier holding it, thus recording speed and direction of upper winds.



Sharply directional antenna above is the electronic equivalent of a theodolite. It tracks a small balloon which sends out radio signals in flight, making survey independent of visibility and time of day.



Storm tracking by radar is the latest all-electronic addition to the weatherman's arsenal. With equipment at left, the Signal Corps maps cloud movements within a 200-mile distance from transmitter.

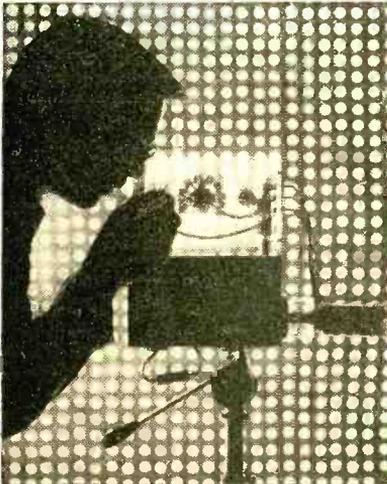
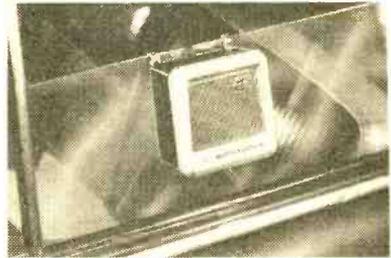


## TV for Skin-Divers

**N**OT EVERYONE can become a skin-diver, but all can "see" what the underwater swimmer sees with the aid of the special equipment shown at left. Made by Pye Ltd., Cambridge, England, it is claimed to be the smallest and lowest-priced underwater TV camera available. A high-definition picture on a 14-inch screen is obtained from the 38-pound unit, which is controlled remotely from above water.

## Transistors Run Mobile Speaker

**A** MOBILE-COMMUNICATIONS-type speaker with built-in transistor amplifier has been announced by Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill. Known as "Power Voice," the new speaker is small and light enough to fit onto a rolled-down car window, as in the photo at right; yet it provides up to ten times the audio output of standard "passive" speakers in mobile two-way radio installations. Response is 300 to 3000 cps.



## New Camera Eye Sees in Dark

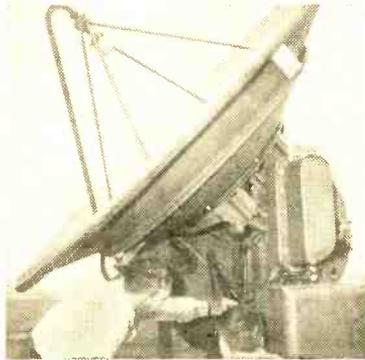
**D**RAMATICALLY posed against a television test pattern background is Westinghouse's new "Ebicon"—a TV camera tube that promises to be 100 times more sensitive than standard tubes used today. Deriving its name from the phrase "electron bombardment induced conductivity," the device can virtually "see in the dark." Its use is foreseen in special television pickup applications, including color TV and closed-circuit industrial TV.

## Counseling Service for Schools

**C**OUNSELING on how to set up electrical or electronic shop instruction in any size school is now available from the Crow Electri-Craft Corp. This organization will supply detailed recommendations for a complete shop, including test equipment. There is no charge for this service. Crow is

## Tracking the Storms

**R**ADAR PULSES from antennas similar to the one shown at right will help detect and track hurricanes and tornadoes for earlier and more reliable Weather Bureau storm warnings. Raytheon Mfg. Co., Waltham, Mass., will produce 39 new-type weather-radars for the U. S. Dept. of Commerce—tailor-made for forecasting work. These radars will form nation-wide network for spotting storms.

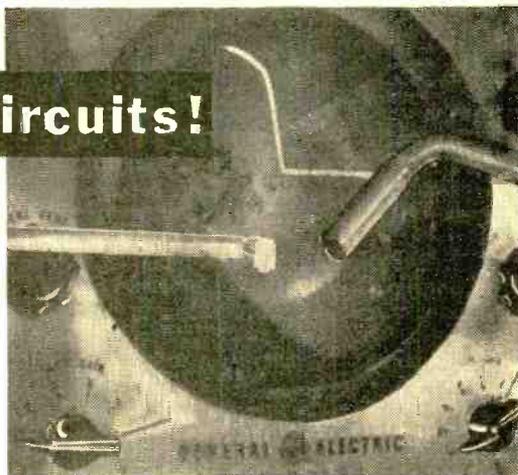


well known as the manufacturer of the "Electri-Craft" line of kits. Educators may avail themselves of the counseling service by writing for the School Counseling Service Questionnaire, Dept. 356R, Crow Electri-Craft Corp., 1102 Shelby Street, Vincennes, Ind.

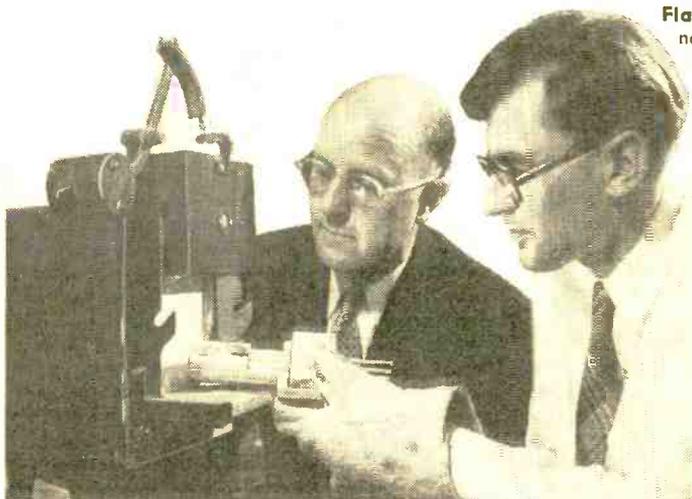
# Talk About Hot Circuits!

**R**ADICALLY new electronic devices which do not deteriorate at red-hot temperatures were shown recently by General Electric. This penetration of the "thermal barrier" in circuit building is claimed to be a major step in developing advanced electronic gear and controls for use in supersonic aircraft and guided missiles. An additional advantage is the eliminating of bulky, power-consuming cooling equipment from airborne installations.

-30-



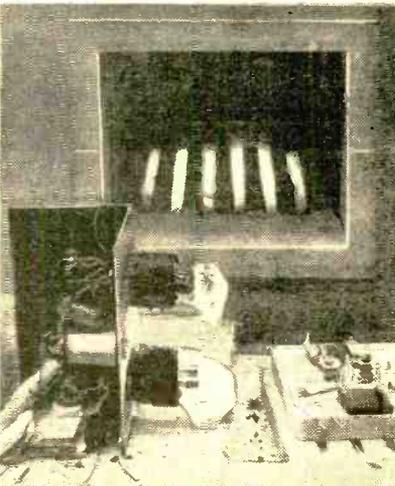
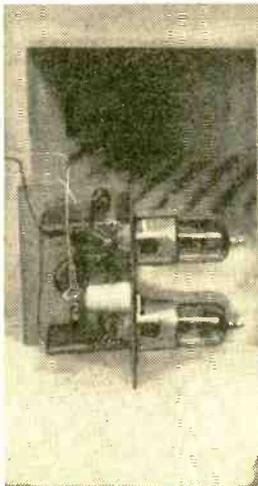
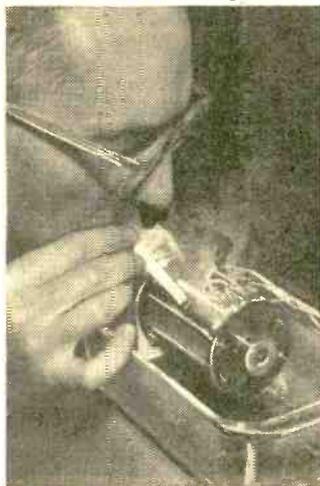
**Flame** from blow-torch is applied to new G.E. vacuum tube, laboratory model of the 6BY4 microminiature ceramic tube. Tube operated normally—even when red-hot in flame—as indicated by oscilloscope pattern in background. Nation's satellite program is expected to reap benefits of these new heat-resistant tubes and other circuit parts.

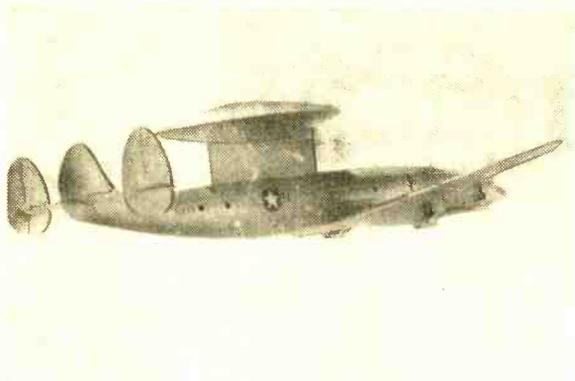


**High-temperature** multivibrator circuit (including vacuum tubes, resistors, capacitors, and printed wiring board) is placed in electric furnace at left as test gets under way. For results of heat test, see below.

**Unique** motor, below, got so hot during test that cigarette was lit by touching it. Motor ran 50 hours at 500 degrees C.

**Ordinary** circuit (below, left) before being placed inside furnace. At its right is same circuit after exposure to heat. Note melted tubes and damaged parts. At extreme right is new G.E. circuit after exposure to 1500 degrees C—still in top condition.





## Flying Saucer?

**F**IRST FLIGHT photo of one of the strangest shapes in the sky is this shot of a Lockheed Super Constellation carrying a large circular radome. Inside the plane's bulging bonnet is the largest and farthest-seeing airborne radar ever flown. Measuring more than 30 feet across, the radome has negligible effect on the aircraft's stability and controllability. The U. S. Navy expects added efficiency in its patrol missions with the radome and the equipment in it.

## Taking Stock with Tape

**T**HANKS to a battery of Presto SR-27 tape recorders recently installed in the American Stock Exchange, New York City, visitors to the financial center can now learn about its operations in any of six different languages. By simply picking up one of the 60 telephone handsets located in the gallery above the main trading floor, the visitor can hear a tape-recorded account of what's going on. The English language talk was recorded by John Daly, noted TV commentator.



## Radar Simulator Spurs Training

**T**HE CONSOLE shown in the above photo was designed as a ground-based training aid for teaching fledgling navigators how to use airborne radar. In this "SRI" radar recording system, a 70-pound airborne recording unit uses the video output of a radar receiver to regulate the brightness of a small spot of light imaged onto continuously moving 35-mm. photo film. The playback unit then shows the film as a realistic radar display. The playback signal can be fed into any number of standard radar display devices to create the familiar map-like presentation. Operating controls of each display device are manipulated by the student. Fifty minutes of radar presentation can be stored on 100 feet of film.

## Airport Monitor

**L**ISTENING in on the real-life conversations between airplane pilots and the airport control tower is a new visitor's pastime at La Guardia Field, N. Y. By depositing a dime in the box shown below, you can monitor these talks or hear a lecture on "airport facts." A toggle switch selects the talk to be heard.



## 4

CHILD'S RADIO

TIDDLY-WINKS

ROULETTE

HARMONICA

## ELECTRONIC TOY PROJECTS

**T**RADITIONALLY, different holidays and seasons of the year have close associations . . . like "firecrackers and the Fourth of July," "turkey and Thanksgiving." Over the years, Christmas, always a deeply significant religious holiday, has, in the American tradition, become associated with gifts of toys to children.

To the dyed-in-the-wool electronics hobbyist, tacking an "electronic" label to a strictly mechanical toy smacks slightly of sacrilege. But there are four electronic toys for which you need offer no apologies . . . all are "electronic" in operation as well as in name. And all are easy to build, sharing the common features of simplicity and economy. For convenience in discussion, each toy is described as an independent project. This is the same format used in our earlier article. Note that the toys have been carefully designed to have broad appeal to all children and special appeal to those in particular age groups.

Designed to have maximum appeal to children in the age-bracket from pre-school through the first or second grade, the "Child's Radio" (Project 1) emphasizes simple operation. But as the children grow older, they acquire greater dexterity and

Just one year ago POP'tronics published a feature article entitled "Electronic Toys For Christmas." Reader response to this article was most gratifying . . . so much so, in fact, that we've decided to make "Electronic Toys" a regular yearly feature. So here is another "installment" . . . written by the same author, E. G. Louis, incidentally, has five children of his own—more than enough to qualify him as an authority on toys!

The Editors

love to "do things" with their hands. A modern version of an old game, "Electronic Tiddly-Winks" (Project 2), can help satisfy this urge. While not beyond the capabilities of youngsters, this game requires sufficient skill to offer a challenge to children through the sub-teens. "Electronic Roulette" (Project 3) is a true electronic game of chance and, as such, will appeal to children in age-groups from Grade School through Junior High. What's more, by modifying the "rules of play" slightly, this toy can provide fun for older children and adults. Finally, the "Electronic Harmonica" (Project 4) will appeal to young men and women who want to develop their musical talents with a truly different instrument.

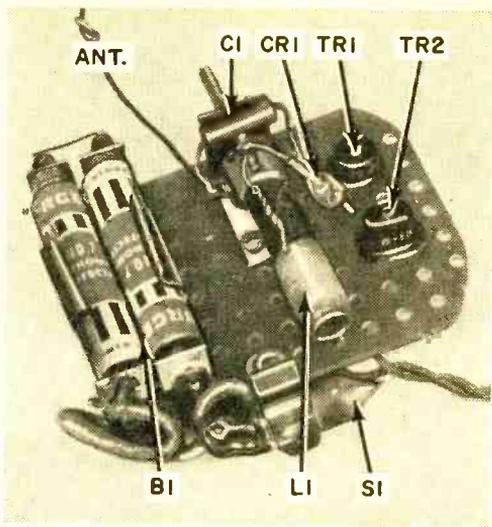
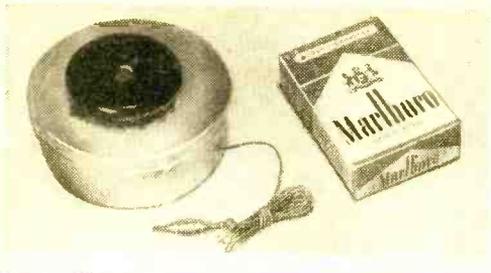
## PROJECT 1

## Transistorized "Child's Radio"

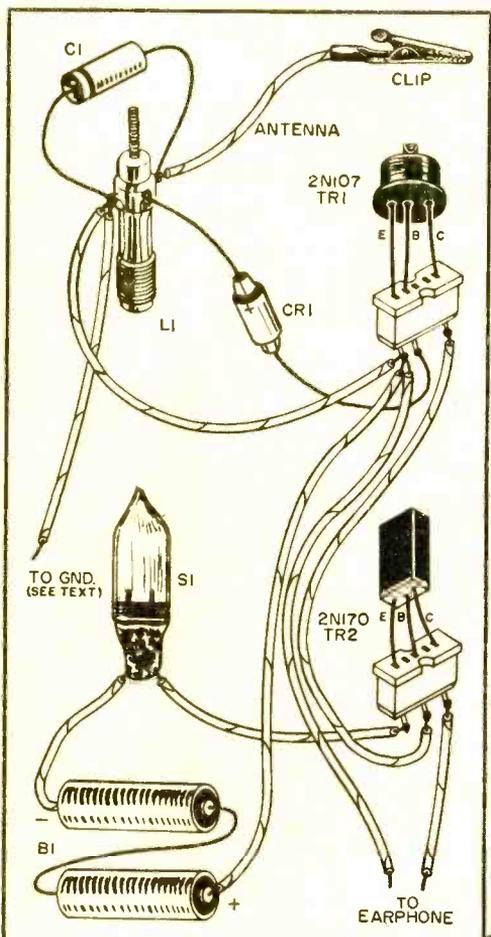
Simplicity is the real keynote of this radio receiver. Requiring few components, the circuit is simple and the receiver is an excellent assembly project for an older boy or girl, who could wire the set for the "baby" of the family. The radio almost operates itself, turning itself *ON* when used, and *OFF* when put away. This feature insures long battery life—the child *can't* forget to turn the set *OFF*.

A mercury switch controls the battery power. When the radio is lifted to the ear in normal "listening" position, the power is turned *ON*; when the set is laid down,





Top view of transistorized radio chassis is shown above. Above, left, is the complete radio.



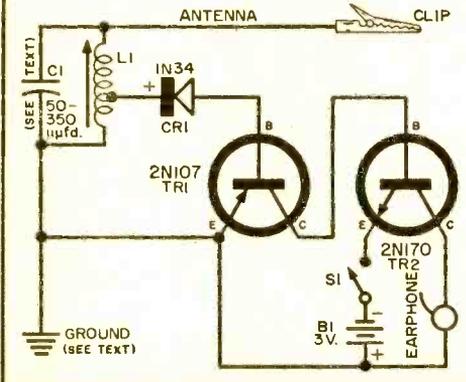
after use, the power is automatically switched OFF. Fixed tuning is employed, with the radio preset to the strongest local station. There is no need for a volume control.

*Construction Hints:* The author's model was assembled in a round plastic box—salvaged from the kitchen, where it originally held six wedges of cheese. Because circuit layout is not critical, you can assemble your model in a wooden box, plastic cigarette case, or any similar container.

The single magnetic earphone should be cemented in place in the case's lid, while the receiver proper is mounted on a perforated Bakelite "sub-chassis." If you are economy-minded, you can eliminate the transistor sockets, soldering the transistors permanently into the circuit. If you do this, use care to avoid overheating the transistor leads.

Mercury switch *SI* is held in place by a small fuse clip. Adjust its position so that

Diagrams and parts list for the "Child's Radio."



- B1—Two penlite cells (Burgess No. 7)
- CI—25-350- $\mu$ fd. fixed capacitor (see text)
- CRI—1N34A diode
- LI—Transistor "Loopstick" (Miller No. 2002 or Lafayette No. MS-299)
- SI—S.p.s.t. mercury switch
- V1—2N107 p-n-p transistor (General Electric)
- V2—2N170 n-p-n transistor (General Electric)
- 1—High-impedance magnetic earphone (1000 ohms or more)
- 2—Transistor sockets
- 1—2-cell battery box (Austincraft No. 141)
- 1—Antenna clip (Mueller No. 88)
- 1—Bakelite mounting plate (Lafayette No. MS-262)
- Misc.—Plastic box, coil mounting bracket, machine screws, wire, solder, etc.

the switch is *ON* (mercury touching *both* contacts) only when the receiver is held upright. A fixed capacitor (*C1*) and an adjustable coil (*L1*) select the desired station. Choose a value of *C1* to tune in the strongest AM broadcast station in your area. If the station is near 1500 kc., *C1* may have a value of from 25 to 50  $\mu\text{fd.}$ ; if it is near 1200 kc., a value of from 75 to 150  $\mu\text{fd.}$ ; if around 850 kc., a value of 180 to 220  $\mu\text{fd.}$ ; and, finally, if near 550 kc., *C1* may be from 250 to 350  $\mu\text{fd.}$  The exact value is not critical, since the tuned circuit is set to final frequency by adjusting the core of *L1*.

You'll have to experiment to determine the best antenna-ground arrangement in your area. If you have a strong station close by, you may find that a short antenna (about two or three feet long) with no ground connection is satisfactory. With weaker stations, you will need a longer antenna lead (say six to eight feet) equipped, at the end, with a small clip to permit attaching it to a window screen or other object which can serve as an antenna. For very weak stations, you may need both a ground and a good antenna.

Tune *L1* to the desired station *after* connecting the antenna and ground (if used) leads. When the receiver operates, install it in the plastic case and cement the lid in place. Apply cement *only* to the edges of the lid, so that you can break the cement bond when the batteries need replacement.

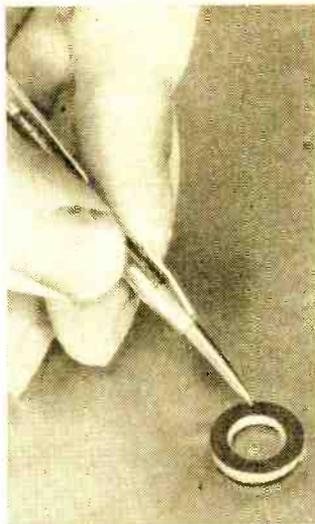
In use, the entire receiver is simply held to the ear in an upright position so that the mercury switch closes. When the child tires of listening, he simply lays the radio down and the mercury switch cuts off the power automatically!

## PROJECT 2

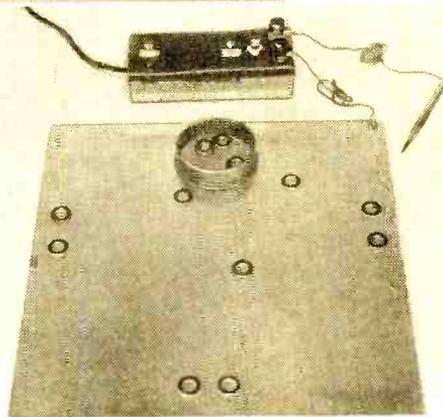
### "Electronic Tiddly-Winks"

The classical game of "Tiddly-Winks" is played with a cup and a number of small discs or buttons. The cup is placed in the center of the playing area and, using one disc to apply edge pressure, each player tries to *snap* all his remaining discs into the cup. The game can be made more difficult by using different-sized cups and varying the size of the playing area.

In "Electronic Tiddly-Winks," the goal of the game remains unchanged, but a number of refinements have been added. A special pointer or scribe is used to "flip" the playing pieces and—to make the game slightly more difficult—the pointer is *not allowed to touch the playing board*. A special control box serves as an electronic "monitor," watching over the game and giving an instant indication if this rule is broken.



To play "Electronic Tiddly-Winks," you flip the washer as shown at left with a home-made scribe. Below is the complete playing board with monitor unit in the background.



**Construction Hints:** You'll need to assemble the following items . . . the playing board, the goal cup, the playing pieces or "winks," the pointer or scribe, and the control box monitor. A large sheet of aluminum will make an excellent playing board. Mount a small soldering lug in one corner of the sheet and attach a flexible lead.

The playing pieces, or "winks," are small washers, which may be either fiber or plastic—metal washers *cannot* be used. These should be about  $\frac{1}{8}$ " thick and may be cut from thick fiber or plastic tubing. Provide at least four "winks" for each player, coloring them in "sets" for identification.

To make the scribe, solder a flexible lead to a sharpened nail and cement the nail in a plastic tube. The tube serves as an insulating handle. The metal point should be narrow, tapering and slightly rounded to prevent marring the "winks."

The control box monitors the game and indicates when the "no touch" rule has been violated. All parts are mounted on the lid of a small transparent plastic box. Windows for the neon bulb indicator lamps

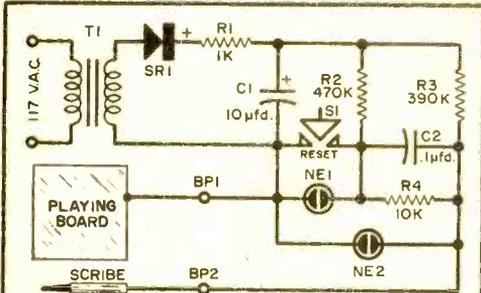
are provided by covering these areas with small bits of masking tape and spraying the back of the lid with colored Acrylic plastic. The masking tape is then peeled away, leaving a clear (transparent) area. Neon bulbs are held in place with small cable clamps, while smaller components (resistors and capacitors) are mounted on a seven-position terminal strip and connected to the reset switch, *S1*.

During proper operation, only the neon bulb *NE2* should glow first . . . and should remain glowing until the scribe is touched to the playing board. The instant the connection is made, *NE2* should go dark; when the connection is broken, the other bulb, *NE1*, should light. Depressing the reset switch *S1* should restore the original condition. The inexpensive neon bulbs used in this circuit are manufactured to rather broad electrical tolerances. Because of this, you may have to interchange the bulbs or adjust parts values experimentally to obtain optimum operation.\*

It is suggested that you use an a.c.-operated supply with an isolation transformer. As a substitute power supply arrangement, you can connect two 67½-volt batteries in series to provide 135 volts. The line cord and plug, *T1*, *SR1*, *R1* and *C1* are left out and the positive side of the battery connected to one side of a new s.p.s.t. switch (used as an OFF-ON control), with the other side of the switch connected to the junction of *C1*, *R2*, and *R3*. The negative side of the battery connects to the other side of *C1*.

We do not recommend use of the common selenium and capacitor a.c. rectifier taken directly from the power lines. Such a power supply can place the wrong side of the line above ground, and thus constitutes a severe a.c. shock hazard.

\* If readjustment of parts values is necessary, you'll find that *R2* should be larger than *R3*. Try values of from 390,000 to 560,000 ohms for *R2*, values from 220,000 to 390,000 ohms for *R3*. Capacitor *C2* may have values from .1 to 0.5 µfd., and *R1* values from 8200 to 18,000 ohms. Resistor *R1* and capacitor *C1* are part of the power supply circuit and may be left fixed in value.



**Schematic** and pictorial diagrams for "Electronic Tiddly-Winks" together with parts list.

*BP1*, *BP2*—Binding posts

*C1*—10-µfd., 150-volt electrolytic capacitor

*C2*—0.1-µfd., 200-volt tubular capacitor

*NE1*, *NE2*—Neon bulb

*R1*—1000-ohm, ½-watt carbon resistor

*R2*—470,000-ohm, ½-watt carbon resistor

*R3*—390,000-ohm, ½-watt carbon resistor

*R4*—10,000-ohm, ½-watt carbon resistor

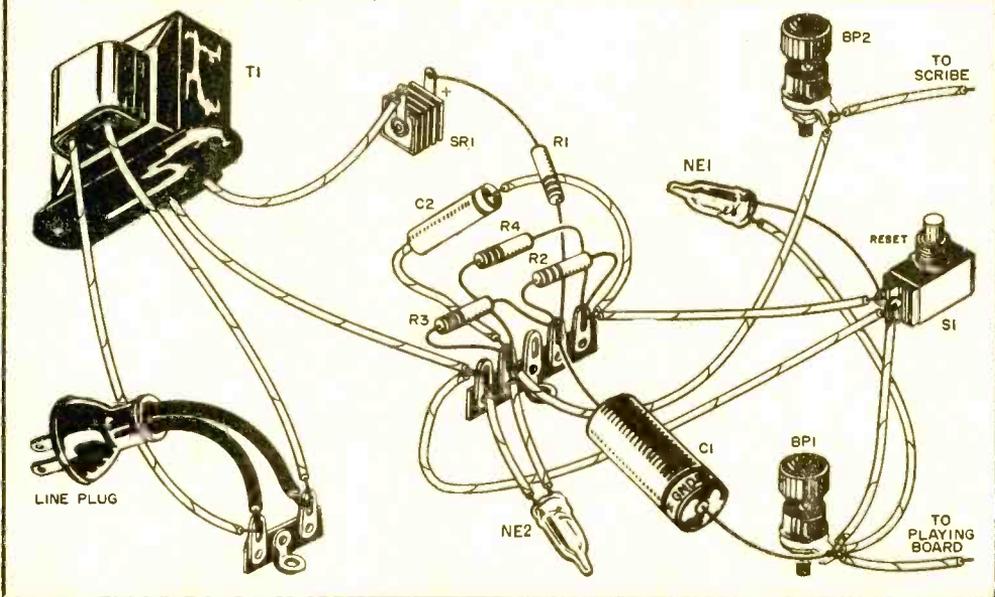
*S1*—S.p.s.t. push-button switch

*SR1*—20-ma. selenium rectifier (Radio Receptor 8Y1)

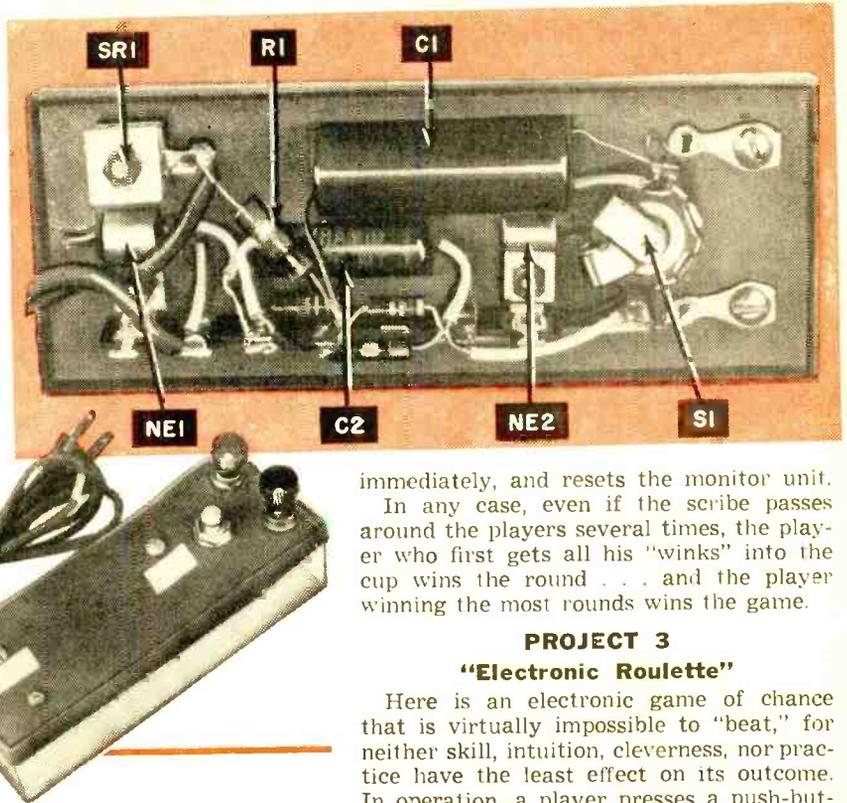
*T1*—115-volt isolation transformer (Lafayette No. TR-91)—see text

Misc.—Line cord and plug (see text), plastic box, terminal strip, cable clamps, machine screws, nuts, wire, solder, ground lugs, etc.

Accessories—Playing board (aluminum sheet, about 18" x 18"), plastic cup, thick fiber or plastic washers, scribe (see text)



Wiring of the control box for "Electronic Tiddly-Winks" is shown at the right; below is the complete monitor unit with line cord and plug.



immediately, and resets the monitor unit.

In any case, even if the scribe passes around the players several times, the player who first gets all his "winks" into the cup wins the round . . . and the player winning the most rounds wins the game.

### PROJECT 3

#### "Electronic Roulette"

Here is an electronic game of chance that is virtually impossible to "beat," for neither skill, intuition, cleverness, nor practice have the least effect on its outcome. In operation, a player presses a push-button switch. A meter pointer may—or may not—swing upscale to a peak reading, then fall back. The peak reading may have any value from zero to full scale, and *there is no way of determining, in advance, just how far upscale the pointer will swing before it drops back.* The number of times he depresses it has no effect. A whole series of readings may be "0" at one time—or full scale at another time—or may alternate from "0" to full scale and any value in between.

*Construction Hints:* Wired according to the schematic diagram, this toy may be assembled in a wooden, plastic, or metal cabinet. The author's model is mounted in a sloping front meter case.

If you use a power supply arrangement different from that specified in the wiring diagram, it may be necessary to make small changes in the component values. These changes can be made experimentally to insure proper operation.

Seal the monitor box against inquisitive fingers and to avoid possible shock. Since there are no batteries to be replaced, the plastic box may be cemented shut.

*Playing the Game:* Connect the playing board to *BP1*, the scribe to *BP2*. Place the goal cup in the center of the board and distribute the new "winks" to the players. Each player lines up his "winks" in a row near the edge of his side of the board. The control box is turned *ON*. One player, chosen by lot, has "first" turn.

The first player takes the scribe and tries to "snap" or "flip" one of his "winks" into the goal cup, without touching the playing board with his scribe. If the first player gets his "wink" into the cup, but touches the board, as indicated by the monitor, the "wink" remains in the cup but he passes the scribe to the next player and at the same time resets the monitor. And if he fails to get the "wink" into the cup on one try but doesn't touch the board, he gets a second try. But if he both touches the board and fails to get the "wink" in the cup, he passes on the scribe

Neither parts layout nor lead arrangement is critical. Most of the electrical components are wired on a small aluminum sub-chassis. The meter and the switch (*SI*) are mounted on the case proper. Any standard d.c. meter may be used if it has a full-scale reading of from 1.0 to 2.0 ma. If you use a 1.0-ma. meter, *R3* should have a value of 2.2 megohms. *R6* a value of 3000 ohms. If you employ a 2.0-ma. meter, *R3* should be dropped to 1.2 megohms. *R6* to 1500 ohms. All other parts values remain unchanged.

Note that the selenium rectifier is connected *in reverse to the usual arrangement*



Playing "Electronic Roulette." At right is a close-up of the indicator and control.

which is employed in a d.c. power supply. Although the unit is "floating" and should therefore be isolated, do not ground any part of the circuit to the chassis or case.

With the wiring completed and *S1* in its "normal" position, there should be no up-scale movement of the meter's needle. If there is a small up-scale movement, re-adjust to "0" using the meter's zero adjustment screw.\*

**How It Works:** Basically, the "Electronic Roulette" toy is a high-impedance transistorized d.c. meter used to measure the instantaneous charge on a large capacitor which, in turn, is driven from a source of pulsating d.c. When *S1* is depressed, the charge on *C1* at that particular instant is applied through *R3* to the transistor, connected as a common-emitter direct-coupled amplifier, with a d.c. meter as its collector "load."

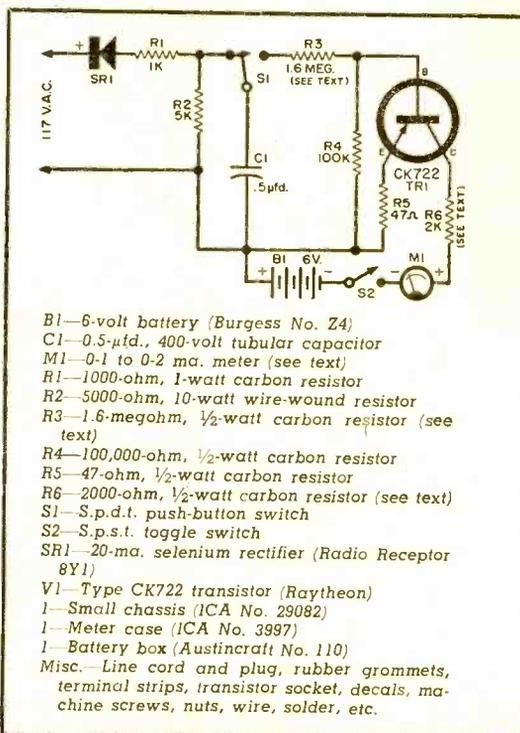
The resulting current flow is amplified by the transistor and indicated by the meter. Since the player has no way of knowing the charge on *C1* when he depresses the switch, and since this charge may be such as to give any indication from zero to full-scale and is varying over this range sixty times per second, the peak meter reading will depend almost completely on chance.

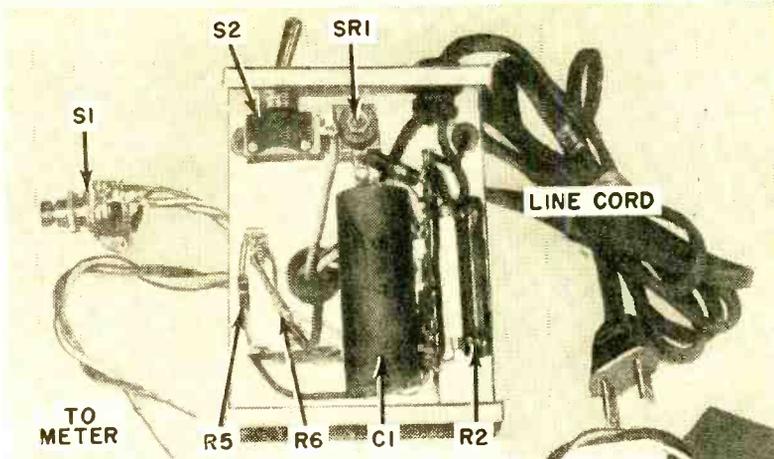
"Electronic Roulette" is suitable for a group of children. The score is kept on a piece of paper, with the game played in rounds . . . ten rounds constitute one game.

\* If an appreciable up-scale movement is obtained, it indicates that the transistor's leakage current may be a little on the high side (the transistor may still be "good," however). But in this case, you'll need another transistor.

To play a round, each child in the group, in turn, depresses *S1* with all watching to see how far the meter needle deflects. The child getting the maximum deflection, regardless of the exact reading, receives one point. If two, or more, are "tied," both receive a point.

After 10 rounds, point scores are totaled and the player with the most points





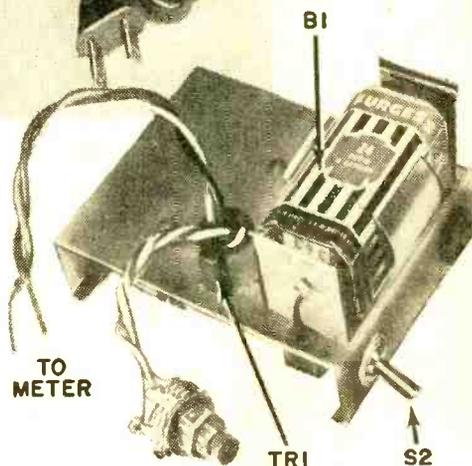
Parts layout under the "Electronic Roulette" chassis is shown at the left. Top view of wired chassis appears below. The chassis slips into a sloping front meter case.

wins the game. Since each game depends upon chance, with skill or ability having no effect on the outcome, this is a good game for children of mixed age groups.

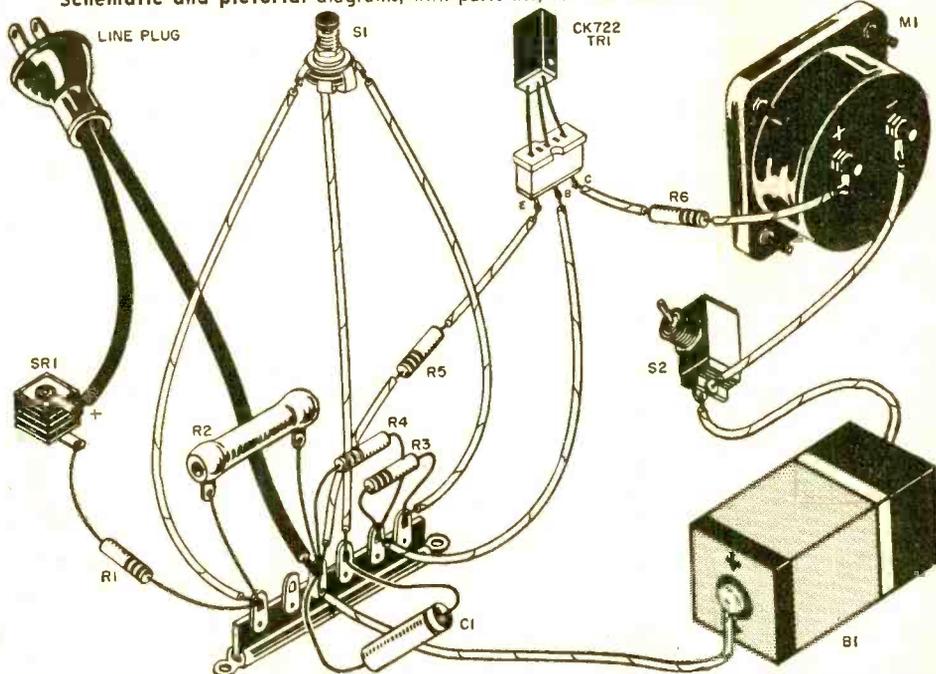
#### PROJECT 4

#### "Electronic Harmonica"

Of all the various arts, music has a truly "universal" appeal. There are few individuals, regardless of their age or background, who are completely cold to all phases of this art, whether it be creating music, operating an instrument, singing, or "just listening." It is only natural, then,



Schematic and pictorial diagrams, with parts list, for the "Electronic Roulette" game.

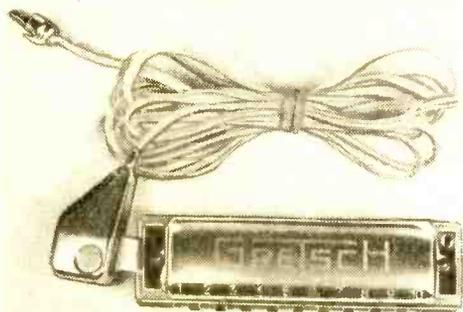


that we combine our favorite hobby, electronics, with the universal appeal of musical instruments in designing a "toy" which will interest all age groups. Of course, there are many types of electronic musical instruments, but here is an "off-beat" one—an "Electronic Harmonica."

This instrument consists of three basic parts . . . a standard harmonica, an especially designed vibration microphone, and a portable, self-contained audio amplifier. When used, the amplifier does much more than just amplify the sound of the harmonica. It provides a *stereo* effect.

*Construction Hints:* The first step in as-

**To use the "Electronic Harmonica,"** simply play it in the usual manner and adjust the audio output until there is no feedback to be heard. Place the amplifier to one side to make a stereophonic effect in room.



**The pickup** is attached to the harmonica by backing out one of the screws under the metal frame. Slip in pickup arm and tighten screw into place.

sembling the instrument is to mount the vibration microphone on a standard harmonica. The microphone has a small extension "lip" which is fastened directly to the frame of the harmonica, using one of the screws at either end of the frame.

If you have a good general-purpose audio amplifier available—or a hi-fi system which is provided with a "mike" input—you need go no further. Simply connect the assembled harmonica-microphone to your amplifier and you're all set to go and "ready for business."

If you prefer to have a special amplifier to be used only with the electronic harmonica, you can assemble a suitable unit by following the schematic diagram. This particular amplifier has been designed as a low-cost, easy-to-build (it uses *only two* tubes), and easy-to-operate instrument. It is assembled on a small aluminum chassis which, in turn, is mounted in a commercially available speaker case housing the loudspeaker.

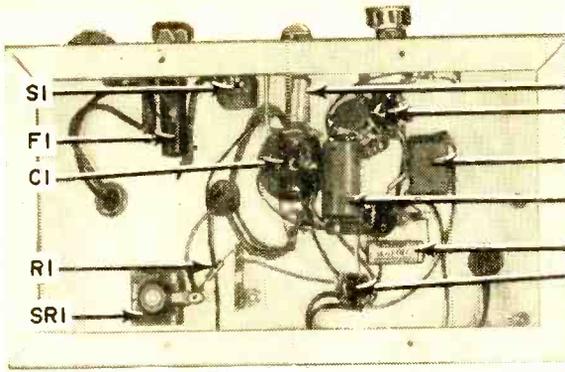
The rules of good wiring practice should be followed. All a.c. leads should be kept away from audio signal leads. The "input" and "output" circuits should be kept well separated, and all leads should be short.



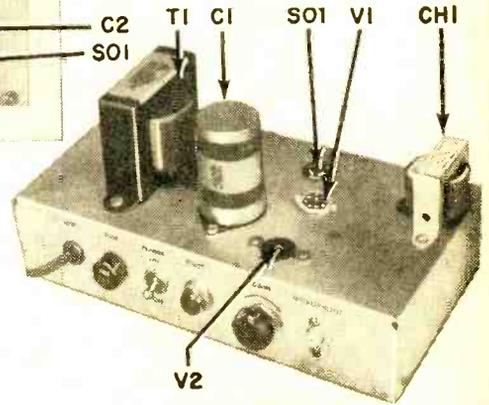
**Rear view** of amplifier case shows placement of the speaker and amplifier chassis. The gain control and jack for harmonica pickup are on the panel.

A printed-circuit plate simplifies wiring.

Be sure to give the amplifier an operational test before installing it in the cabinet. You can do this by plugging the line plug into a wall receptacle, turning the unit *ON*, turning up the *GAIN* control *R1* and touching your finger to the ungrounded



Bottom and top views of the "Electronic Harmonica" amplifier chassis are shown at the left and below. This easily built amplifier can be employed for public address if it is fed from a high-level crystal microphone.



**Schematic and parts for the "Harmonica."**

C1a/C1b/C1c—Triple-section electrolytic capacitor, 40/80/20  $\mu$ d., 150 volts (Mallory Type FP-311.7)

C2—0.001- $\mu$ d., 400-volt tubular capacitor

C3—0.01- $\mu$ d. disc ceramic capacitor

C4—25- $\mu$ d., 25-volt electrolytic capacitor

C5—0.005- $\mu$ d. disc ceramic capacitor

CH1—7-henry, 50-ma. filter choke (Stancor No. C-1707)

F1—2-ampere fuse, extractor-type fuse post

J1—Phono jack

P1—4-prong speaker plug to match SO1

PC1—Printed-circuit plate (Erie No. 1404-02)

PL1—Pilot lamp bracket and jewel with 6-volt bulb

R1—33-ohm,  $\frac{1}{2}$ -watt carbon resistor

R2—220-ohm, 1-watt carbon resistor

R3—1-megohm,  $\frac{1}{2}$ -watt carbon resistor

R4—8200-ohm,  $\frac{1}{2}$ -watt carbon resistor

R5—10-megohm,  $\frac{1}{2}$ -watt carbon resistor

R6—220,000-ohm,  $\frac{1}{2}$ -watt carbon resistor

R7—2-megohm potentiometer, audio taper

S1—S.p.s.t. toggle switch

SO1—4-prong speaker socket

SRI—65-ma. selenium rectifier

T1—Power transformer, 117 volts @ 50 ma., 6.3 volts @ 2 amp. (Merit No. P-3045)

T2—Audio output transformer (Merit No. A-3026)

V1—6AS5 tube

V2—12AT7 tube

Sp'k'r—6" PM loudspeaker

1—5" x 9 $\frac{1}{2}$ " x 2" aluminum chassis (ICA No. 29033)

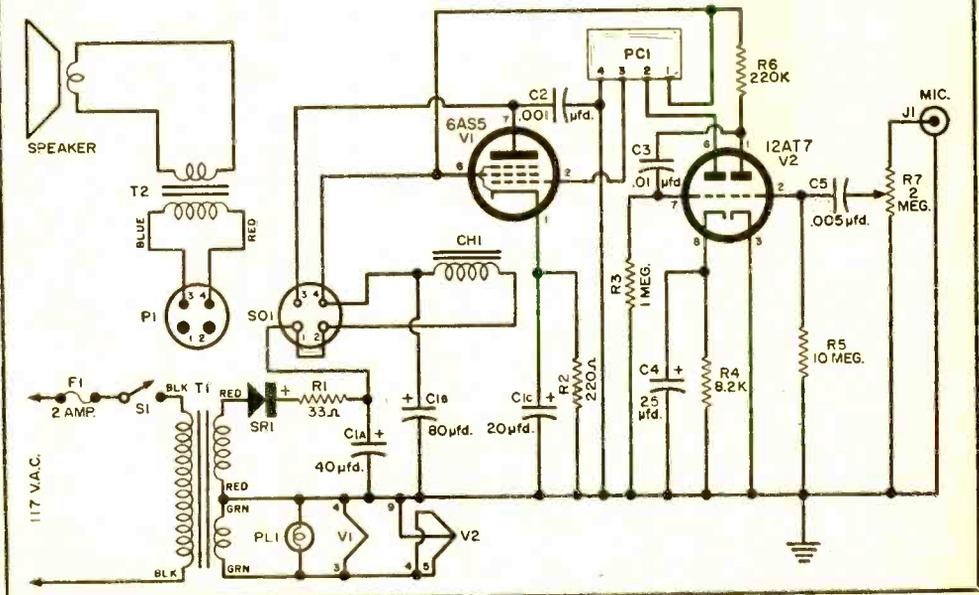
I—Speaker cabinet (ICA No. 3935)

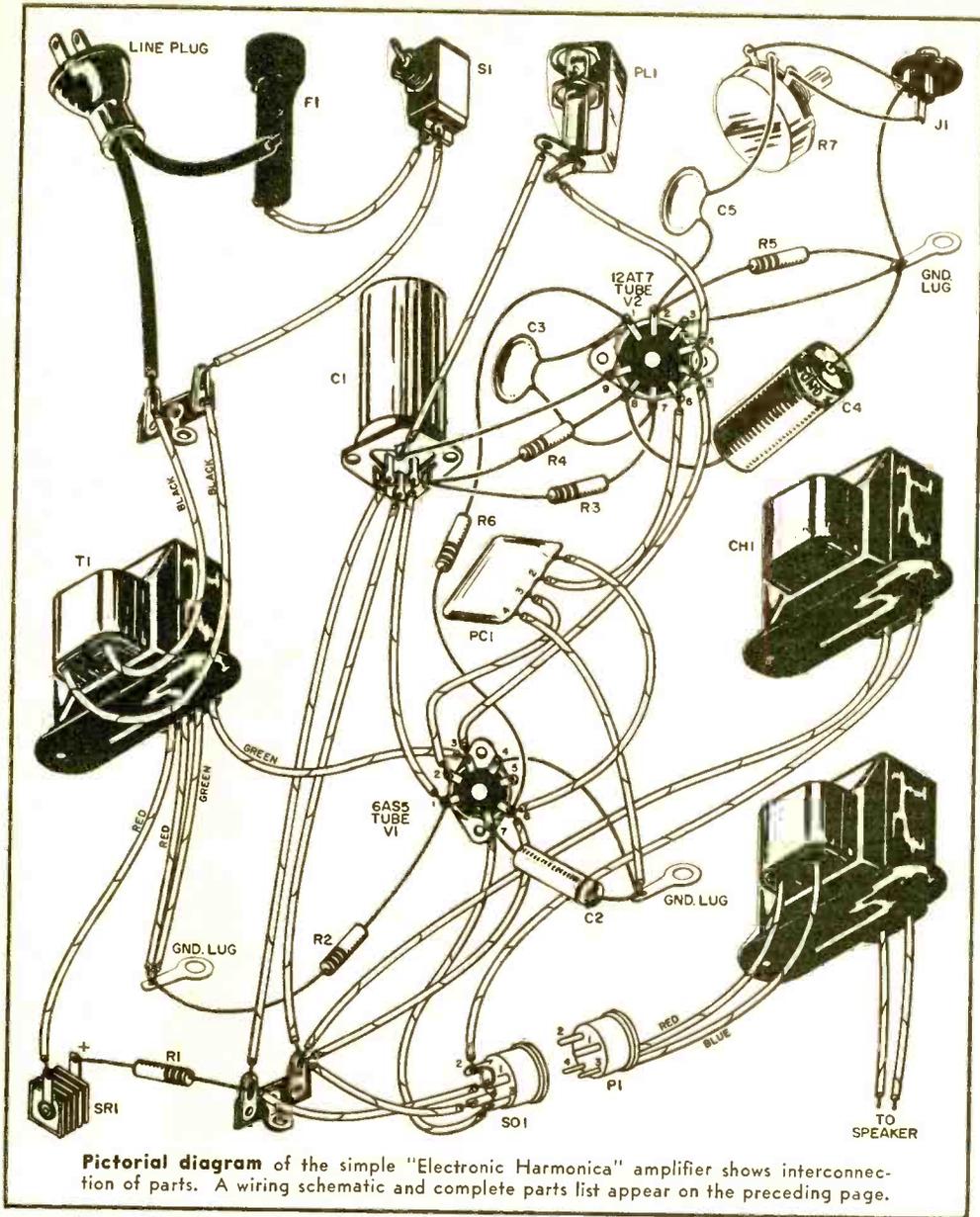
1—7-pin miniature tube socket

1—9-pin miniature tube socket

Misc.—Line cord and plug, phono plug attached to "Mic." cable, control knob, decals, rubber grommets, terminal strips, ground lugs, machine screws, nuts, wire, solder, etc.

Accessories—Standard harmonica, harmonica microphone (Argonne AR-18)





**Pictorial diagram** of the simple "Electronic Harmonica" amplifier shows interconnection of parts. A wiring schematic and complete parts list appear on the preceding page.

terminal of the microphone jack *J1*. You should hear a loud hum in the loudspeaker.

*Using the Harmonica:* Both the musician and the loudspeaker should face the audience. And the gain control should be set for the desired level.

The harmonica is played in usual fashion, although you may have to shift your hold on the instrument because of the extra bulk of the microphone. For best results, and a true "stereophonic" effect, the musician should be to one side and slightly behind the amplifier-loudspeaker.

Although the vibration microphone and

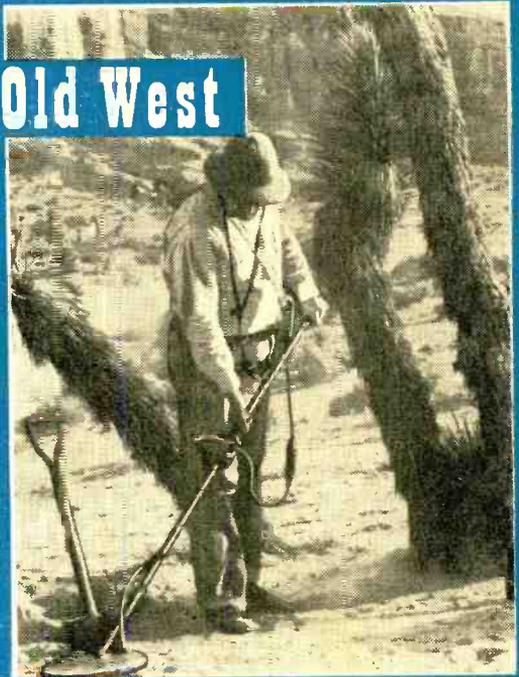
the amplifier are designed specifically for use in an electronic harmonica, you needn't feel limited to this arrangement. The microphone may be attached to many types of musical instruments. For example, you could attach it to the sounding board of a piano, a toy banjo, trumpet, or other instrument to convert any of these into "electronic" instruments. The amplifier itself makes an excellent general-purpose unit. If equipped with an r.f. detector probe, it can be used as a signal tracer or, if equipped with a standard microphone, as a compact p.a. system.

## Electronics Finds

# Treasures of Old West

**B**URIED wealth, treasure maps, adventure, mystery . . . most men have dreamed of such things, but to Frank L. Fish they are a fascinating reality. Every Friday, he loads a metal detector and other gear into a jeep and roars off onto the adventure trail.

The electronic metal detector is the heart of Fish's exciting adventures, and he owns several. A favorite is one which Fish converted from a World War II mine detector. Using this detector in California ghost towns, Fish has found valuable pieces of jewelry. One of these, a ring containing a small



**Metal detector** locates buried objects for explorer Frank L. Fish (above). At left is a collection of gold nuggets, jewelry, coins, etc. uncovered by Fish. Below are some of his many relics of the Old West; the skull contains a bullet hole and was found at the same time as one of the revolvers in the foreground.

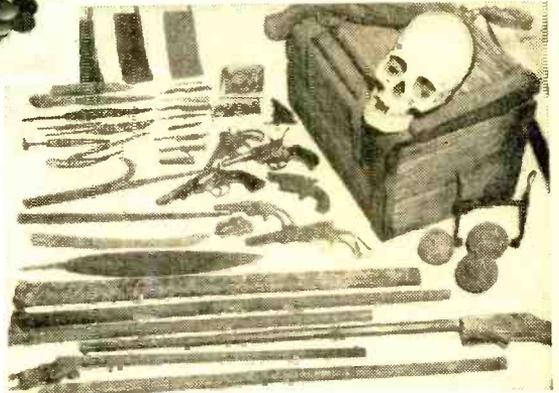


emerald, was appraised by experts at a value of \$1400.

Finds of such objects are, of course, comparatively rare, but that doesn't worry Fish, who has also uncovered small caches of silver bars and coins in addition to many historically valuable relics of the Old West.

Several of these finds hint at some rather lurid history. For instance, Fish was once exploring an apparently "dead" area when the detector suddenly went "be-e-ep." He dug down and uncovered an old, badly rusted revolver—still *fully loaded*. Further digging revealed a human skull with a bullet hole through the back of the head! Thus Fish may well have stumbled across mute testimony to a possible murder committed about 100 years ago.

Fish's method of operating is methodical. Before taking off on each weekly adventure, he prepares a map of the sites he is to explore. Then he draws, in color, pos-



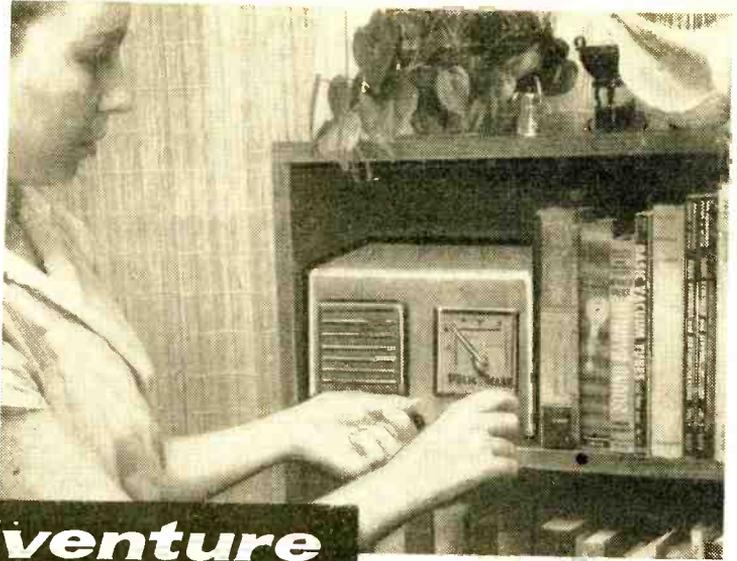
sible jeep routes between the sites. Fish gleans information from old letters and maps and from his own knowledge of old trails and town layouts. His maps are dotted with crosses indicating where important finds may be buried, and a glance at one of these colorful charts would make anyone eager to hit the treasure trail.

One of his finds which really thrilled  
(Continued on page 122)

**Police, Fire, Forestry  
are a few of the many  
stations you can hear  
every hour on v.h.f.**

By **ROBERT COBB**

Wives of policemen and firemen can use v.h.f. receivers to monitor their husbands' activities. Receiver shown here in a typical home bookcase is a Monitoradio PR-9.



## **High Adventure**

### **in V.H.F. Reception**

**E**XCITEMENT rides on the megacycles of the very-high-frequency public service communication bands for the listener who owns—or wants to build or buy—a special FM receiver. This set will enable him to tune police, fire, ambulance, state patrol, aircraft or mobile radio telephone frequencies.

A listener, for instance, twirling the tuning knob on his new v.h.f. receiver, might hear the blasting of a fire siren in the background as an excited voice shouts: "13 to 1, in service to a hotel fire at Broadway and Willamette." The same listener can also hear an ambulance driver call his central station, relaying instructions to the hospital. On the police frequencies, he will hear patrolmen at disaster scenes or even chasing the bandit whose bold robbery will be tomorrow's news.

From that point on, the listener, if he is a newsman, amateur fire watcher, or photographer, can spring into action by getting his own trade tools, and going to the scene himself. If he is a stay-at-home armchair explorer, he might turn on his television receiver and witness the entire event on his home screen—and at the same time hear officials and crewmen of all public agencies swing into action.

#### **RECEIVERS FOR LISTENING**

In the early days of radio communications, one of the greatest thrills was lis-

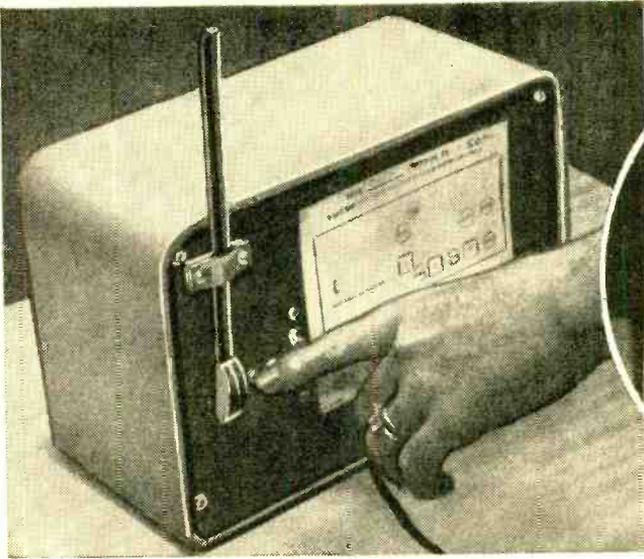
tening to the police stations. In the mid-thirties this was very easy, since many of the state police agencies used frequencies in the lower portion of the standard AM broadcast band. Local police forces used frequencies in the 2.0-megacycle band. Both of these bands could be publicly tuned with simple one- and two-tube AM receivers.

Shortly after World War II, the transition from these "public" bands was completed, and almost all the police stations now operate in either the lower (30 to 50 mc.) or upper (152 to 174 mc.) v.h.f. bands using FM signals. At these frequencies, there have been few receivers built that would intercept police signals.

This bottleneck has been broken with the introduction of the Gonset, Hallicrafters, and Monitoradio v.h.f. receivers. All of these companies are manufacturing receivers that will tune in the multitude of stations (including police, fire, taxicab, etc.) in the upper and lower v.h.f. bands.\*

The POP'tronics editorial staff has found that these receivers live up to the claims made for them. Since it is not the purpose of this article to discuss the merits of one manufacturer over another, we earnestly suggest your writing to these companies

\*Contrary to popular belief, it is not illegal to receive police calls. It is illegal (under federal laws) to use such information to your personal advantage by divulging it to a third party. A third party, in this instance, refers to anyone to whom the original information was not directed.



The v.h.f. receiver at left is a Gonset model showing the flexible steel tape that is permanently attached to the receiver as an antenna; the length of the tape is adjusted for best reception. Above is a photo of news reporter Jack Craig, Station KREG, who uses a v.h.f. monitor receiver, scoring a major news beat. After hearing a fire announcement, Jack rushed to the blaze with his tape recorder and obtained some first-hand impressions from the disaster victims.

for full information on their police receivers. If you use the code phrase "POP"-tronic's Police," you will receive this information as soon as possible.\*

On the v.h.f. bands, interference is reduced, and the range of stations is generally only 20 to 30 miles. With good outdoor antennas at a reasonable height, you may expect to receive signals from stations as far away as 80 or 90 miles. On rare occasions, lower band v.h.f. stations may be heard between 400 and 1200 miles in a fashion similar to TV DX transmissions.

Police station frequencies are now scattered between 30-50 and 152-156 mc. Because of the number of stations and communities involved, it is impossible to indicate in this short article where your local police stations might be operating. Many of the larger cities have stations operating in both bands. (New York City, for example, uses ten frequencies with stations around 39.9 and 155.8 mc.)

### STATIONS THAT CAN BE HEARD

Frequencies, call letters and locations of all the stations mentioned in this article may be found in the "Registries" published by the Communication Engineering Book Co., Radio Hill, Monterey, Mass. These "Registries" are the only concise public source of this information. The "registry"

\*Gonset Co., 801A South Main St., Burbank, Calif., produces four receivers to cover both AM and FM services in the v.h.f. band; these units have a noise limiter (for AM) and built-in squelch. . . . The Hallicrafters Co., Chicago 24, Ill., also produces four receivers, some with provisions for crystal-controlling the received frequency. . . . Monitoradio (Division of I.D.E.A., Inc.), 7900 Pendleton Pike, Indianapolis 26, Ind., has a wide selection, ranging from low-cost models for home use to special receivers that may be mounted in your car.

of the Police Radio Systems is priced at \$2.00, the Industrial Registry at \$3.00, and the Transportation Systems registry at \$3.00.

Since there are more than just police stations in the upper and lower v.h.f. bands, listed below are a few of the other radio services which can be heard frequently with these special receivers.

**Auto Emergency.** As the name implies, this group of stations specializes in towing and wrecker service. At this writing, 38 states have stations operating in this service. Most of these stations are on 35.70 or 35.98 mc.

**Forest Products.** Communication links between loggers have become quite common within the past few years. The majority of these stations operate between 49.22 and 49.58 mc. Some newer stations are operating around 153.25 mc.

**Highway Trucks.** This classification of "trucks" is slightly different than that of the "Motor Carrier" grouping listed below. These stations are mostly licensed by gas, oil and propane delivery trucks. Some 43 states have such stations in operation with most of them operating between 35.78 and 35.94 mc.

**Motor Carrier.** Over 2000 trailer trucks and heavy delivery vans have been

*(Continued on page 116)*

## World's First Underwater Broadcast Was All Wet



Underwater broadcast (above) as viewed through studio window by diver. Bubbles are seen rising at the side. Appreciative fish make a quiet studio audience.



Brave broadcasters (above) literally plunge into their work. Liquid surroundings didn't damp their enthusiasm.



Coming up for air after being on the air under there, Kirk calls on WMOP for WMOP-up operation.

**N**OT TO BE OUTDONE by fountain pens that write under water, Station WMOP at Ocala, Fla., set up a studio at the bottom of Florida's Silver Springs. From there, Jim Kirk, the station's manager, managed to get through a whole day of submarine broadcasting, complete with interviews of local notables who arrived via aqualung. Divers delivered the news bulletins at regular intervals, and even though the announcer was up to his waist in seepage water,

he and his equipment got through the day with nary a gurgle.

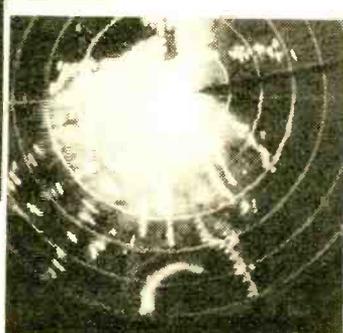
Fifteen feet below the surface, the air-locked studio was rather cramped but contained all the necessary equipment for a diversified broadcast: a record player, a record library, two microphones and a telephone. This equipment remained dry and fully intact. Only the announcer suffered damage in the form of a headache and cold.

Nobody is quite certain what all this proves, except that broadcast equipment is every bit as good as a ball-point pen and AM radio is not yet sunk. The fish liked it, too.

## Navy Hurricane Hunters Use Airborne Radar



Navy pilot (above) races life-saving hurricane warning as he surveys the storm area pictured before him on his radar scope (right) during flight.



**A**S A VITAL PART of the Joint Hurricane Warning Service, the U. S. Navy is performing low-level hurricane reconnaissance in the Atlantic, Gulf of Mexico, and Caribbean since 1946. The special squadrons based at Jacksonville, Florida, are assigned this mission during the hurricane season.

The "Hurricane Hunters" provide both low-level penetrations and radar reconnaissance. They track the movement of the storm center to give early warning. Up-to-the-minute data on threatening storms are thus reported.

Before this service started, about 400 people lost their lives for every 10 million dollars worth of property damage by storms. This figure has been reduced to about 2-4 lives lost for the same amount of property damage, thanks to the Navy.

# Santa Goes Electronic



**T**HOUGH SANTA stubbornly sticks to reindeer as his prime motive power, he seems quite attuned to technical progress in other respects. For instance, he recently revamped North Pole Industries, Inc., his renowned workshop, to start production on a new line of strictly up-to-date electronic items.

P.E. bundled its reporter in a parka for a preview of Santa's electronics department. Our pictures show Santa's test crew hard at work okaying new production models for southward shipment in December. Santa has also licensed a number of earthly establishments to help fill the de-

Transistor radio complete with mike for adding home-made announcements to broadcasts is made by Remco Industries, Newark, N. J.

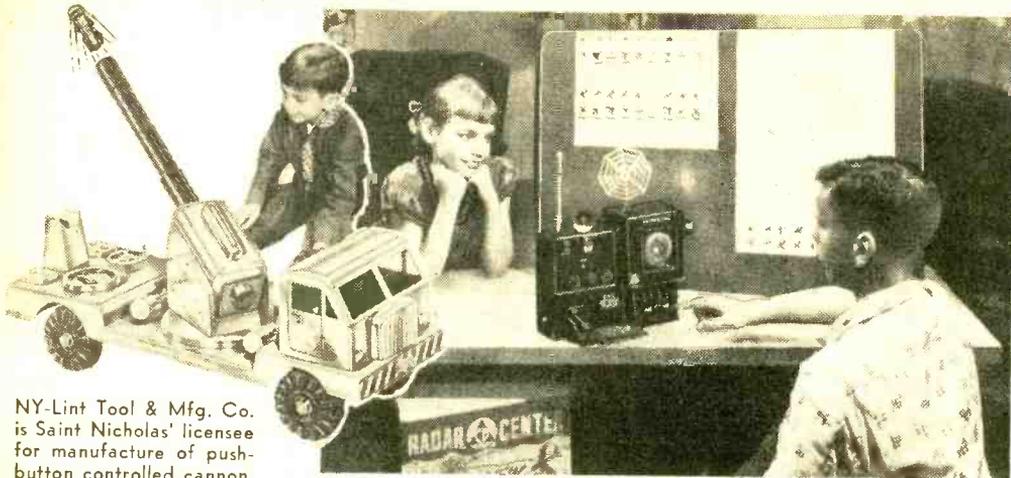
This Ford "Victoria" starts, stops and turns by remote control from portable transmitter, makes driving safer.



Preset "The Brain" of this robot to execute intricate maneuvers, such as figure eights, loops, triangles, fire rockets, etc. It is made by Vintage Products Company of Saint Louis, Missouri.

Junior ham sends messages over distance up to one mile by voice or code with this Bell Products two-way transceiver equipment.





NY-Lint Tool & Mfg. Co. is Saint Nicholas' licensee for manufacture of push-button controlled cannon.

With the help of the Product Miniature Company of Milwaukee, Wis., Santa Claus provides youngsters with a Radar Civil Defense Center, which simulates actual aircraft outlines on a lighted "radar" screen.

mand for his electronic innovations. These items range from toy phonographs and R/C vehicles to complete radio transmitting and receiving sets. Remote control cars and buses make indoor "driving" safe, as vehicles are steered electronically around such obstacles as chair and table legs; while the presence of rocket-shooting robots, "electronic" cannon and

such-like lend contemporary overtones to the Season of Peace.

Neither has modern Santa neglected his public relations. The Toy Information Bureau and the Toy Guidance Council, Inc., serve as Santa's principal information centers for this corner of the Earth. —30—

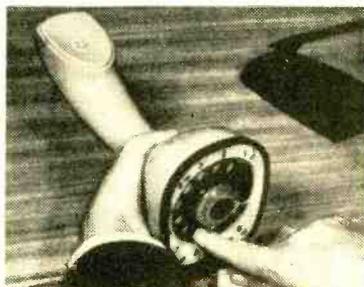
## Atoms Keep Time in Oscillator Circuit



**A**TOMIC MOVEMENT is used as the world's most accurate time standard in the new "Atomichron" clock, shown at left with its creators, Dr. Daly of the National Co., Malden, Mass., and Dr. Zacharias of M.I.T. Far more accurate than the pendulum of crystal-controlled timing devices, the "Atomichron" varies by no more than one second in 3000 years. Here, atoms control the frequency of an oscillator circuit.

## New One-Piece Phone Has Bottom Dial

**I**N CASE you're tired of picking up your telephone receiver and would rather pick up the whole phone, the North Electric Co. of Galion, Ohio, has just the thing for you. This phone sits on its dial and has a pointed receiver to fit practically everybody's ears. It is said to be very "functional." Without any separate headpiece wires, you're safe from "entanglements."



# Transistor Topics

By LOU GARNER

CERTAINLY this is the season of the year when the tune of *Jingle Bells* is heard over and over on radio and television. But there's another "jingle" that may be on the way out . . . the familiar jingle of the telephone bell! Experiments are being conducted with a *transistorized* tone generator as a replacement for the older bell. Advantages? More pleasing sound, greater variety of sounds, compactness, and, most important of all, lower power consumption. The bell, an electromechanical device, requires considerably more power for operation than a transistorized audio oscillator.

Looking to the future, we may see many other electromechanical sound producing instruments replaced by transistorized devices . . . the doorbell may be replaced by a tone generator connected with a two-way intercom, sirens and whistles may be replaced by portable transistorized alarms, and the day may come when we'll see entire orchestras composed of electronic instruments.

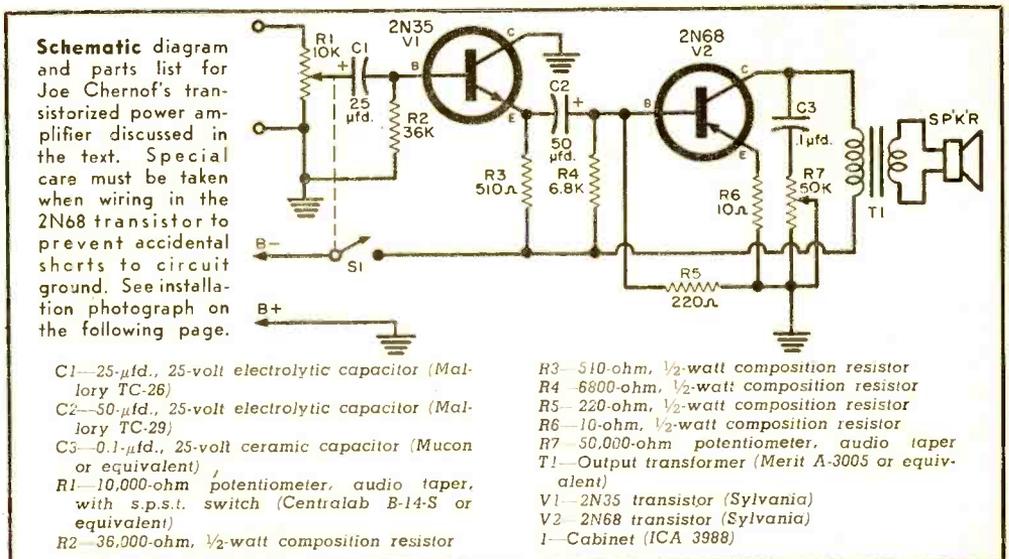
**Names and Names.** Among the letters and notes suggesting names for transistor enthusiasts is an interesting letter from Carl Altman of Madison, Wisconsin. Carl suggests rotating the standard transistor

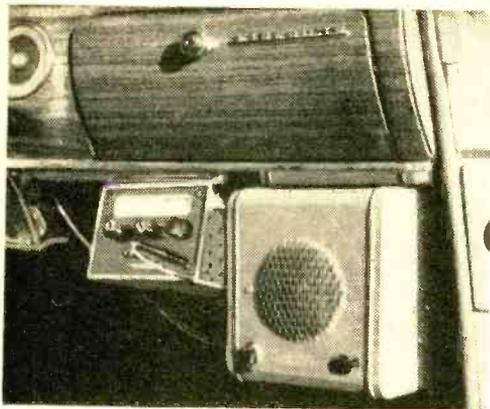
symbol, so that the base electrode lead points down, and removing the arrowhead from the emitter electrode. The resulting symbol is suggestive of a monogram for the letters V-O-T . . . which may be pronounced *Votee*. So Carl suggests 'VOTee as a good name, not only because it is symbolic of the transistor symbol "monogram," but as a contraction of *Devotee*—someone who is "devoted." The capitalization of the first three letters and the use of an apostrophe is to distinguish the name from *votee*, which is connected with voting.

Good thinking, Carl!

Well, fellows, how would you like to be called 'VOTees? Send a post card . . . simply say "For 'VOTee" or "Against 'VOTee," and include your name and address. We'll let you know the results.

**Reader's Circuit.** Many of the circuits described in this column come from readers . . . fellows who may never have written to a magazine before, and who may never have seen their names in print. But every now and then a professional author will "take pen in hand" and send your columnist one of his pet circuits. This month's contribution is from reader/author Joe Chernof—a fellow you should all recognize. Joe's





Mounted in Joe Chernof's automobile, his transistorized power amplifier (shown at the right with the speaker grille) has a very neat appearance.

"by-line" has appeared numerous times in both POP'tronics and other magazines.

Basically a self-contained audio power amplifier for mobile applications, Joe's gadget provides loudspeaker output when used with receivers (or other instruments) designed for headphone operation only. Chernof mounted his model in his auto and uses it with a low frequency Air-Radio receiver.

Referring to the schematic (page 63), a type 2N35 *n-p-n* transistor, connected as a grounded-collector amplifier, is resistance-capacity coupled to a 2N68 *p-n-p* power transistor which, in turn, drives a PM loudspeaker. The common-emitter circuit configuration is used in the output stage. Power is supplied by the 12-volt auto battery . . . but may also be obtained from a pair of Burgess No. F4P batteries connected in series. Operation on six volts is possible, but at a considerable reduction in output power.

In operation, the 2N35 grounded-collector stage maintains a moderately high input impedance while providing a reasonably good match to the 2N68 power transistor (which has a low input impedance). A portion of the audio signal applied across gain control *R1*, depending on the setting of this control, is coupled through *C1* to the base electrode of the first stage. Bias for this stage is supplied through base resistor *R2*.

The audio signal appearing across emitter load resistor *R3* is coupled through *C2* to the base of the power output stage. Bias for the power stage is supplied by voltage divider *R4-R5* and un-bypassed emitter resistor *R6*. This bias arrangement insures Class A operation and good d.c. stabilization. Control *R7*, in conjunction with capacitor *C3*, forms a simple TONE control, and may be used to reduce high frequency "hash" or other noise. The output trans-

former, *T1*, serves to match the transistor's output impedance to the loudspeaker's voice coil.

According to Joe's measurements, when the amplifier is driven with a 1-volt (rms) audio signal, a power output of 200 milliwatts (nearly a ¼ of a watt!) is obtained, with a 12-volt power supply. He indicates that the distortion level is less than 5%. Greater audio output is obtained with a higher voltage supply (up to 28 volts), less with a lower voltage supply (down to 6 volts).

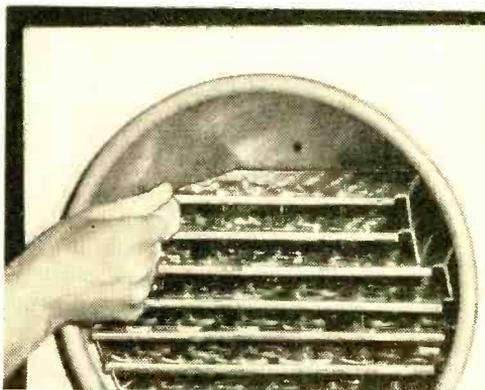
The construction of a model duplicating Joe's amplifier should present no problems to the average POP'tronics reader. Neither parts layout nor wiring arrangement should be especially critical. A standard loudspeaker cabinet (such as an ICA type 3988) makes an excellent housing for both amplifier and speaker. *One important point*—the collector electrode of the 2N68 power transistor is connected to its outer shell . . . use care when installing this unit to avoid accidental shorts to circuit ground.

**Tickler File.** Again, we remind you of interesting items mentioned in previous columns:

(1) Last month we mentioned CBS-Hytron's new low-cost high power transistors. Now you can get a booklet of circuits showing typical uses for these units . . . contact your regular distributor, or write to CBS-Hytron, Dept. of Public Relations, Danvers, Massachusetts, and ask for booklet PA-16. One circuit from this booklet (a *code practice oscillator*) is shown on page 126.

(2) *Subminiature resistors* are available from Wholesale Radio Parts Co., Inc., 311 W. Baltimore Street, Baltimore 1, Maryland.

(3) For the largest selection of transistor construction kits and transistor com-  
(Continued on page 125)



Power transistors for automobile radios are placed in a vacuum bake oven at the Hillsboro, N. H., electronics plant of Sylvania Electric Products Inc. for heat-treating prior to capping and sealing.

# Transtopic Experiment No.

## Light Beam Receiver

**T**HIS is another experiment in the series that started in the March, 1956, issue. The last experiment, No. 12, appeared on page 59 of the November issue.

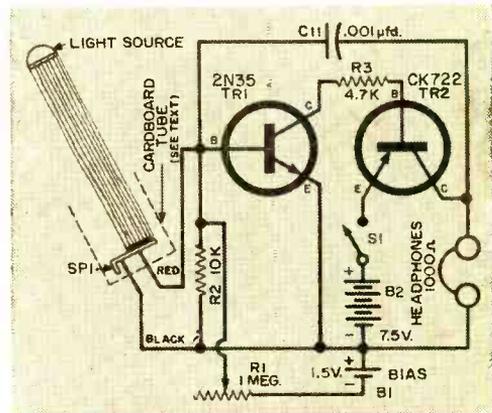
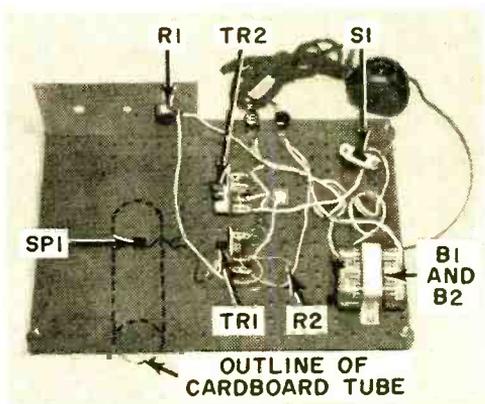
You can transmit code over a beam of light if you assemble this circuit. It converts light into an audio tone which can be heard in the "HEADPHONES." If the "LIGHT SOURCE" focused on photocell *SP1* is coded in "dots" and "dashes," the audio tone varies in the same way.

Mount a cardboard tube over *SP1* to exclude extraneous light; the tube may be from 3" to 12" long, closed at one end and painted black inside. Use a bright, sharply focused "LIGHT SOURCE." A small flashlight generally will work at distances of 8-15 feet; a 6-volt Burgess "Radar-Lite" will work at distances of 25-100 feet, or more, depending on whether a lens is used with the photocell and on the care taken in aiming the beam. Most small flashlights have a momentary contact push button which is adequate for sending code.

To use the light beam receiver, set up the "LIGHT SOURCE" so that the beam falls squarely on photocell *SP1*. Use about half of your expected maximum range. If you hear an audio tone, hold your hand in front of the photocell to cut off the light. If the tone stops . . . you're in business! But if the tone continues, with changed pitch, or if you fail to obtain a tone when you turn the unit "on," try readjusting *R1*. With proper adjustment, you'll get an audio note only when light strikes the photocell. Next, move the "LIGHT SOURCE" back to determine maximum range with your particular setup, readjusting *R1* if necessary.

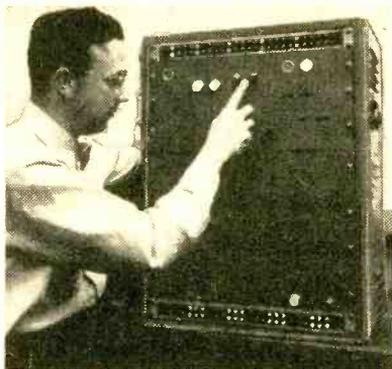
In operation, transistors *TR1* and *TR2* form a direct-coupled audio amplifier, with *R3* provided to limit d.c. flow between stages to a safe value. The "HEADPHONES" serve both as the collector load impedance of *TR2* and as the output device. Capacitor *C11* provides in-phase feedback between the output and input of the amplifier, converting it into an oscillator. Oscillation is prevented, however, by a current applied to the base-emitter circuit of *TR1* through voltage divider *R1-R2*, with the value of this "bias" depending on the setting of *R1*.

When light falls on the self-generating photocell *SP1*, a small voltage is developed, with a polarity which tends to cancel the bias applied by *R1-R2*, thus permitting oscillation to take place. —Louis E. Garner, Jr.



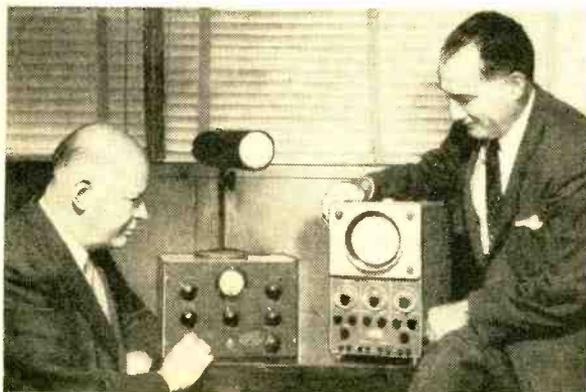
## Gambling Robot Beats Humans

**O**NE OF THE BIG BUGABOOS of science fiction—a machine that outsmarts men—may well be a reality what with a cagey gambling robot developed at the Bell Telephone Laboratories, Murray Hill, N. J. (right). Nicknamed “SEER” (from its full technical name, “Sequence Extrapolating Robot”), the machine has beaten a majority of lab assistants and visitors at the old penny-matching game. According to SEER’s engineer, D. W. Hagelbarger, the robot matches its less than 100 relays against some 10 billion neurons in a man. Aside from its “gambling instinct,” SEER is heralded as a forerunner of self-adjusting computers.



## Progress in 'Scopes

**A**DVANCES made in the design and application of oscilloscopes are represented by the two instruments viewed by Dr. Allen B. Du Mont (at left) and David T. Schultz. The instrument on the left is one of the first commercially produced cathode-ray oscillographs, developed by Du Mont 25 years ago. This firm’s latest contribution is the first of their “400” series, the Type 401 shown at the right of the photo which is a general-purpose service ‘scope.



## “Space Command” Tuner

**S**ENDING SILENT messages to your TV set, a new remote tuner permits you to control the receiver from your chair, or—as the man in the photo at the right—from another room. The device, made by Zenith Radio Corp., 6001 W. Dickens, Chicago 39, Ill., uses supersonic sound in the range of 40 kc. to do its job. Nicknamed the “Space Command” tuner, it requires no tubes, batteries, or wire connections. It consists of four tuning forks which are actuated by keys pressed by the user. The energy radiated by the forks can turn the TV set on or off, control its volume, and change channels. A TV set, in order to respond to the supersonic control, must be equipped with special apparatus which includes a microphone, high gain 39.5-kc. amplifier, integrator circuits, control relays, and a 117-volt a.c. induction motor. The remote unit weighs 8 ounces.



## Lightning-Fast Printer

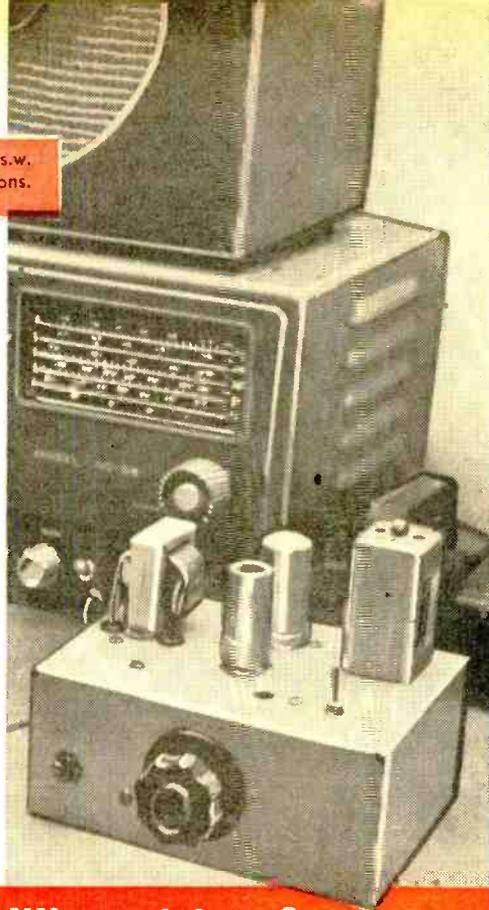
**A**N ELECTRONIC PRINTER that translates coded signals, composes the translation in a desired pattern, and reproduces the information on appropriate business stationery and forms which it prints simultaneously, has been developed experimentally by the Radio Corporation of America. Named “Bizmac,” this device will produce in one minute 40 complete and different letter-size business documents.



Using this converter with a standard s.w. receiver, you can get 100 to 500 kc. stations.

WE'VE ALL HEARD of the broadcast band, FM band, and short-wave band ... but how many electronics experimenters know what's on the "long-wave band?" This is the band whose radio wavelengths are longer than those of the broadcast band. They are *above* the broadcast band—not below it like the short waves. Articles have recently appeared in POP'tronics on long-wave DX and a simple receiver.\* If you want good long-wave reception at a minimum investment in radio parts, then the single-tube converter to be described here is for you.

This converter transforms the frequencies of the long-wave DX stations to something that can be handled by the cheapest SWL or Novice ham receiver. Power to operate it comes from a built-in power supply. To use the converter, disconnect the antenna from your receiver and connect the output of the converter in its place. Set your receiver at about 1500 kilocycles, and from then on, tune in the 100 to 500



## Better Your Long-Wave DX'ing with a Converter

kc. long-wave stations by rotating the dial on the converter. A 20' length of wire is a sufficient antenna; with it, the converter can be used with good results even in a city apartment.

**Construction.** Since very few parts are used in this circuit, the converter and its power supply can be assembled quite conveniently on a 5" x 7" x 3" aluminum chassis. Tuning capacitor *C5* is centered on the front panel of the chassis first, then trimmer *C6* is mounted below deck just to the right of it. Output transformer *T2* occupies the right rear corner of the chassis, with filter capacitor *C8* between it and the little power transformer, *T1*. This allows the socket for the tube to be mounted centrally on the chassis. At the same time, the two front corners of the chassis are left conveniently uncluttered for mounting the bandpass filter components on the left and the oscillator coils at the right.

A foot or so of fine insulated wire will be found wrapped loosely around the lower part of the Vari-Loopstick coil form. Since this piece of wire will not be used in the

By FRANK H. TOOKER

*Insure good reception by feeding your receiver with this simple one-tube unit*

present application of the Vari-Loopstick, it should be removed. Mark the terminal to which it is connected with red fingernail polish, for this terminal is the one which should be wired to the stator of variable capacitor *C5*.

Coil *L1* is the winding already on the Vari-Loopstick. Tickler *L2* is wound on the form in the space available immediately below *L1*; it consists of six close-spaced turns of No. 28 enameled wire wound in the same direction as *L1*. Wrap a layer of plastic insulating tape around the lower part of the coil form, put on the turns for the tickler, and then wrap a second layer of the plastic tape over the tickler to hold the turns firmly in place. The lead at the lower end of the tickler coil should be

\*"The Comeback Trail for Long-Wave DX," by Tommy Kneitel, October, 1956, page 51; "Long-Wave DX'er—A Single-Tube Receiver," by Frank H. Tooker, November, 1956, page 66.



Under-chassis component immediately to adjust in contact with ground lug

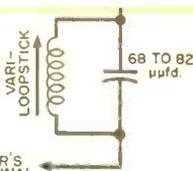
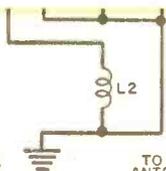
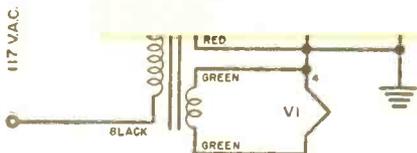
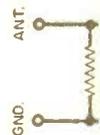
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# POPULAR ELECTRONICS

366 MADISON AVENUE  
NEW YORK 17, NEW YORK



Schematic diagram and parts list for the converter.

- C1, C3—300- $\mu$ fd. silver-mica capacitor
- C2—47- $\mu$ fd. silver-mica capacitor
- C4—100- $\mu$ fd. mica capacitor
- C5—50- $\mu$ fd. variable capacitor (Hammarlund Type HF-50 or equal)
- C6—3-30  $\mu$ fd. mica trimmer capacitor
- C7—0.05- $\mu$ fd., 400-volt paper capacitor
- C8a, C8b—30/30  $\mu$ fd., 150-volt dual electrolytic capacitor
- L1—Vari-Loopstick
- L2—Tickler coil, 6 turns of No. 28 enameled wire (see text for winding details)
- R1, R2—12,000-ohm,  $\frac{1}{2}$ -watt composition resistor

- R3—22,000-ohm,  $\frac{1}{2}$ -watt composition resistor
- R4—4700-ohm, 1-watt composition resistor
- RFC1, RFC2—Ferrite-core, 5-millihenry r.f. chokes (Suprex Type F-50 or equal)
- S1—S.p.s.t. toggle switch
- SRI—65-ma., 130-volt selenium rectifier
- T1—Miniature power transformer, 125 volts at 15 ma., 6.3 volts at 0.6 amp. (Stancor Type PS-8415 or equal)
- T2—1500-kc. converter output transformer (Miller Type 512-WT or equal)
- V1—Type 6BE6 tube
- 1—5" x 7" x 3" aluminum chassis

Using this converter with a standard s.w. receiver, you can get 100 to 500 kc. stations.

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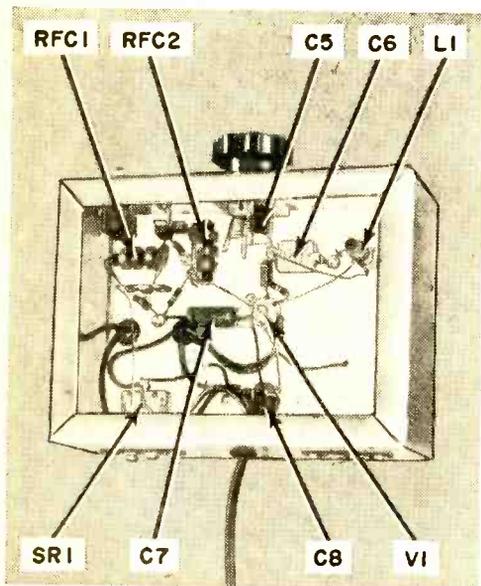
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*Insure good reception by feeding your receiver with this simple one-tube unit*

present application of the Vari-Loopstick, it should be removed. Mark the terminal to which it is connected with red fingernail polish, for this terminal is the one which should be wired to the stator of variable capacitor *C5*.

Coil *L1* is the winding already on the Vari-Loopstick. Tickler *L2* is wound on the form in the space available immediately below *L1*; it consists of six close-spaced turns of No. 28 enameled wire *wound in the same direction as L1*. Wrap a layer of plastic insulating tape around the lower part of the coil form, put on the turns for the tickler, and then wrap a second layer of the plastic tape over the tickler to hold the turns firmly in place. The lead at the lower end of the tickler coil should be

\* "The Comeback Trail for Long-Wave DX," by Tommy Kneitel, October, 1956, page 51; "Long Wave DX'er—a Single-Tube Receiver," by Frank H. Tooker, November, 1956, page 66.

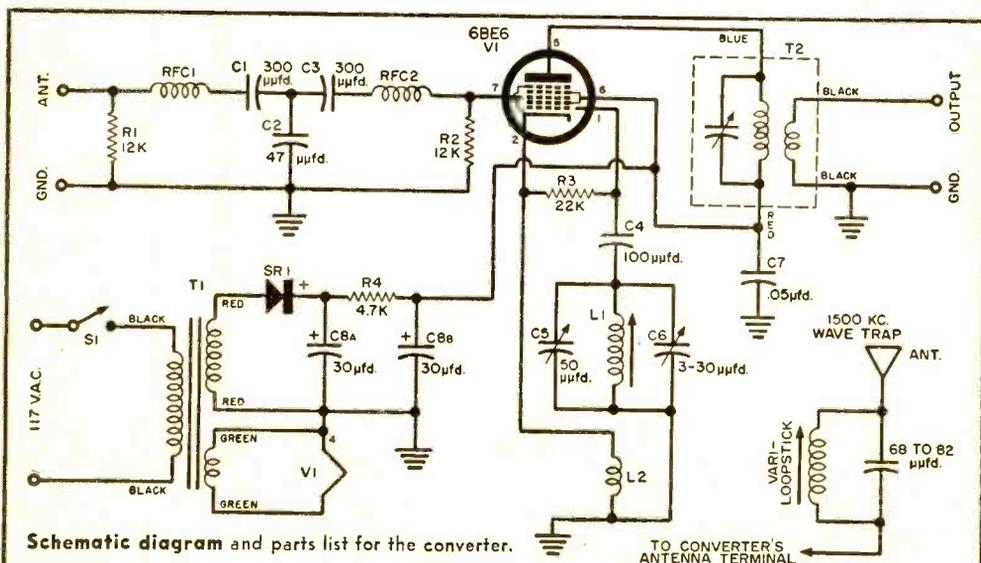


**Under-chassis view** shows placement of major components. A  $\frac{3}{8}$ "-diameter hole in the chassis immediately above trimmer C6 provides access to adjusting screw. The trimmer lug which makes contact with the adjusting screw is soldered to a ground lug which is bolted to the chassis deck.

soldered to the unmarked terminal on the Vari-Loopstick. This terminal also should be connected to a ground lug when the coil is mounted on the chassis. Make the lead at the upper end of the tickler long enough to reach over to the cathode (pin 2) connection of V1.

The Vari-Loopstick used as the oscillator coil and the two ferrite-core r.f. chokes (RFC1 and RFC2) make up the heart of this converter. While the mounting of these components cannot be considered as critical, a certain amount of care must be exercised in their placement. Keep the Vari-Loopstick at least one inch away from the metal front and side panels of the chassis, and mount RFC1 and RFC2 at right angles—with the end of one pointing toward the center of the other—as shown in the underchassis photo. Locate RFC1 and RFC2 on tie points, and keep them spaced at least a half inch away from the chassis deck. The capacitors, C1, C2, and C3, must be silver-mica units.

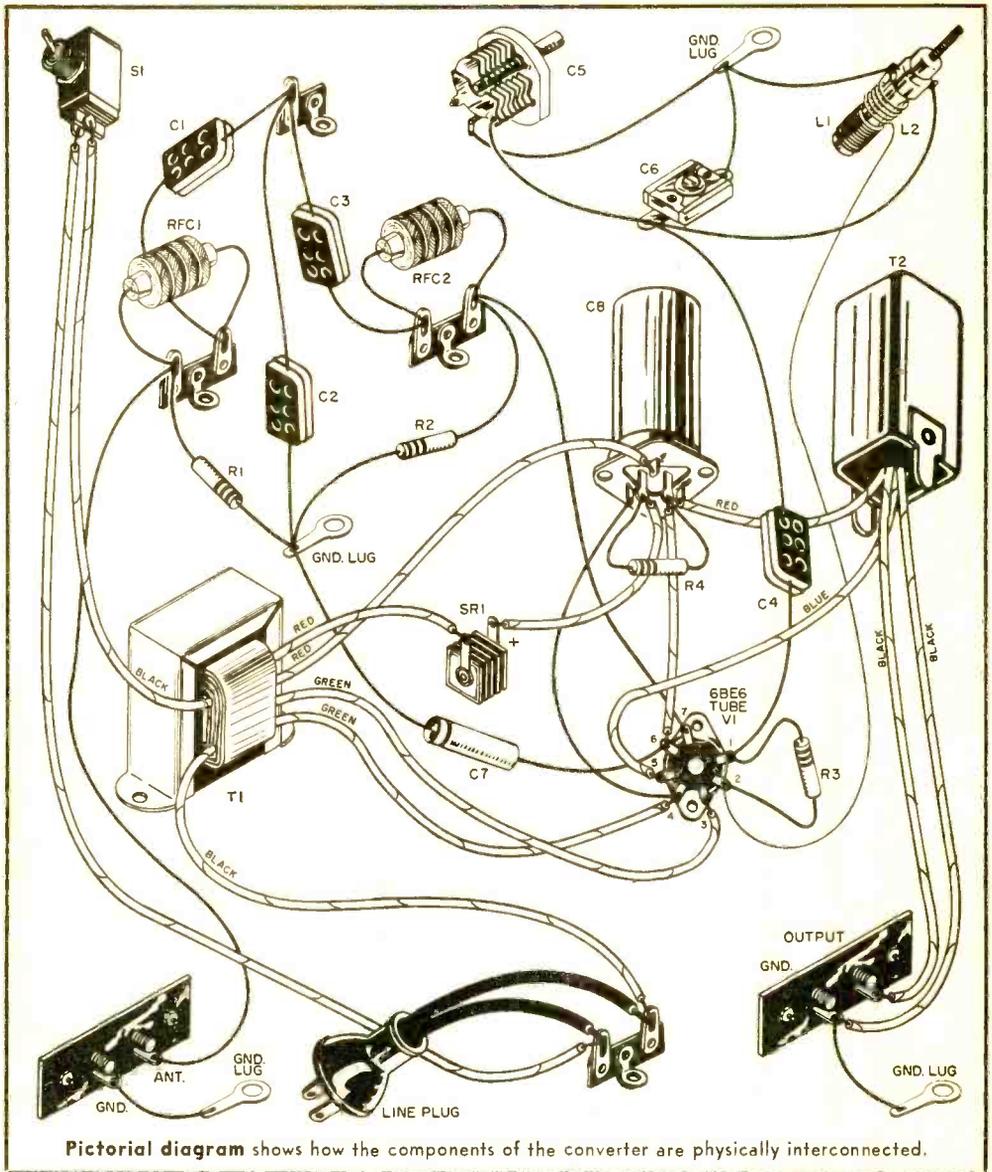
**Adjusting the Converter.** After you have assembled the converter, check first to make sure that the tube filament is lit. If you have a VTVM, you might check the voltage between the chassis and the solder lug on filter capacitor C8b. It should meas-



**Schematic diagram and parts list for the converter.**

- C1, C3—300- $\mu$ fd. silver-mica capacitor
- C2—47- $\mu$ fd. silver-mica capacitor
- C4—100- $\mu$ fd. mica capacitor
- C5—50- $\mu$ fd. variable capacitor (Hammarlund Type HF-50 or equal)
- C6—3-30  $\mu$ fd. mica trimmer capacitor
- C7—0.05- $\mu$ d., 400-volt paper capacitor
- C8a, C8b—30/30  $\mu$ d., 150-volt dual electrolytic capacitor
- L1—Vari-Loopstick
- L2—Tickler coil, 6 turns of No. 28 enameled wire (see text for winding details)
- R1, R2—12,000-ohm,  $\frac{1}{2}$ -watt composition resistor

- R3—22,000-ohm,  $\frac{1}{2}$ -watt composition resistor
- R4—4700-ohm, 1-watt composition resistor
- RFC1, RFC2—Ferrite-core, 5-millihenry r.f. chokes (Superex Type F-50 or equal)
- S1—S.p.s.t. toggle switch
- SR1—65-ma., 130-volt selenium rectifier
- T1—Miniature power transformer, 125 volts at 15 ma., 6.3 volts at 0.6 amp. (Stancor Type PS-8415 or equal)
- T2—1500-kc. converter output transformer (Miller Type 512-WT or equal)
- V1—Type 6BE6 tube
- 1—5" x 7" x 3" aluminum chassis



**Pictorial diagram** shows how the components of the converter are physically interconnected.

ure between 90 and 100 volts, and the solder lug on C8b should be positive (+) with respect to the chassis. A check with a VOM will give a lower reading.

Disconnect the antenna from your communications receiver and, in its place, connect one end of a foot or so of insulated wire. Place the other end of this wire close to the oscillator components in the converter. Do not make an actual connection to the converter. Set the range switch and the tuning dial of the receiver to 1600 kc. (1.6 mc.), and its r.f. gain control to maximum. Turn the dial of the converter to where the plates of the variable tuning capacitor, C5, are nearly meshed. Then turn

the adjusting screw on the trimmer, C6, full in (maximum capacitance). Rotate the threaded brass rod extending from the Vari-Loopstick *counterclockwise* while watching the receiver's S-meter for an upswing, indicating that the oscillator in the converter is tuned to 1600 kc.

Next, set the receiver's tuning dial to 2000 kc., and rotate the tuning knob on the converter while again watching the receiver's S-meter for an indication. One should occur when the plates of the converter's tuning capacitor are about 10° away from being fully unmeshed. If this is the case, no further adjustment of the oscillator is required. In any event, only a very slight

## HOW IT WORKS

Chokes *RFC1* and *RFC2*, capacitors *C1*, *C2*, and *C3*, and resistors *R1* and *R2* form a bandpass filter network which passes all signals over the band from 100 to 500 kc. and opposes the passage of signals at all other frequencies. This portion of the circuit selects the signals that appear at the signal grid of *V1*.

The oscillator portion of the converter consists of Vari-Loopstick *L1*, tickler coil *L2*, variable tuning capacitor *C5*, trimmer *C6*, coupling capacitor *C4*, and grid bias resistor *R3*. The oscillator tunes over the frequency range from 1600 to 2000 kc. Converter output transformer *T2* is fixed-tuned by means of its built-in trimmer to 1500 kc. The signal frequency to which the converter is tuned at any time is equal to the oscillator frequency minus the output frequency. Thus, the low end of the range is at 1600 kc. minus 1500 kc.—or 100 kc. The high end is at 2000 kc. minus 1500 kc.—or 500 kc.

This converter is complete with its own power supply. If desired, the built-in supply may be deleted when the converter is to be used with a receiver having the necessary voltages brought out to a socket on the rear of the chassis. Converter requirements are 6.3 volts a.c. at 0.3 amp. and approximately 100 volts d.c. at 12 ma. When such an external power source is used, the value of bypass capacitor *C7* should be increased to about 0.25  $\mu$ f. A series isolation resistor of at least 1000 ohms in the B+ lead may also be desirable in some cases. A B+ potential higher than 100 volts should not be employed unless the proper voltage-dropping resistor and bypass capacitor are included in the screen-grid circuit of the converter. If you are in doubt about any of these conditions, you will be best off using the built-in supply.

readjustment of the trimmer should be necessary to set the oscillator's frequency at this end of the range.

When the oscillator in the converter has been adjusted to cover the range of 100 to 2000 kc., remove the lead you placed near the oscillator components to assist in the adjustment. Connect the free end of this lead to the converter's output terminal. (The other end should remain connected to the receiver's antenna terminal.) Run a second lead from the receiver's ground terminal to the output ground terminal on the converter, and connect a 20' length of wire to the converter's antenna terminal. The input ground terminal should be connected to a cold water pipe to assure good grounding for the converter.

Set the receiver's tuning dial to 1500 kc. Then turn up the audio gain control, and adjust the trimmer screw at the top of the converter output transformer for maximum "rush" or static from the speaker.

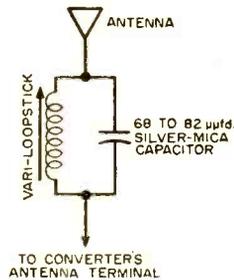
**Interference.** If you experience interference from a nearby broadcast station, disconnect the lead to the receiver's antenna terminal (at the receiver's antenna terminal). Leave the ground connections intact. If the AM station still comes through, the interference is leaking directly into the receiver itself, and only better shielding in the receiver will cure the difficulty.

Another possible source of trouble is the lead between the converter and the receiver's antenna terminal. Unwanted broadcast stations sometimes tend to be picked up on this lead. Less interference will be obtained by replacing the lead with a length of coaxial cable. Any lead used here should always be as short as possible.

If you have a strong broadcast station near you which operates on 1500 kc., it will be wise to operate the converter output transformer and the receiver a little higher in frequency — on 1600 kc., for

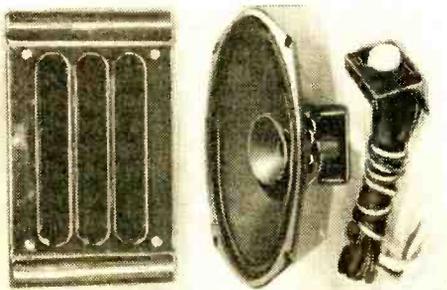
instance, if this channel is clear. In this case, set the converter's oscillator to cover 1700 to 2100 kc.

Light interference on 1500 kc. caused by a broadcast signal leaking through the converter can often be cured by connecting a wave trap in the antenna lead to the converter. Locate the trap as closely as possible to the converter's antenna terminal. A suitable circuit is shown in the diagram above. Adjust the slug in the coil for minimum interference.



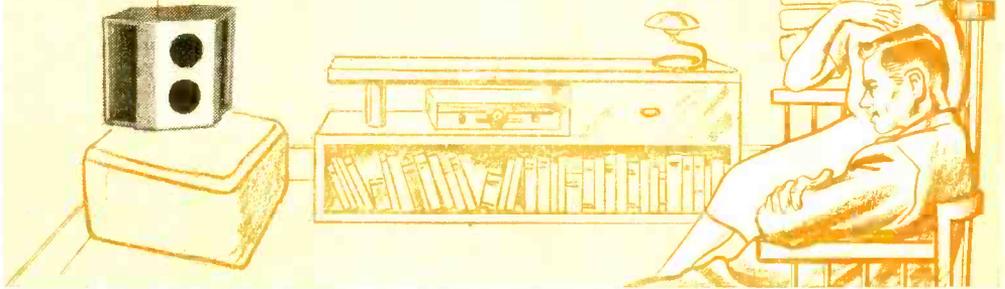
**A wave trap**, such as this one, will prevent interference from nearby broadcast stations.

## Rear Seat Speaker Improves Car Radio



**A** MOTORIST with an ear for music can improve the sound of his car radio by adding an extension speaker. Shown at left is a kit containing such a speaker, as well as connecting leads, selector switch, and protective grille. Instructions for mounting the parts are included. The switch permits you to select either speaker or both at once. Prices vary with the size of the speaker. For detailed information, write to the manufacturer, Cletron, Inc., 1974 E. 61 St., Cleveland 3, Ohio.

## BUILDING THE "MINI-HORN"



By Walter H. Niehoff

**Easy to make, this tiny hi-fi enclosure produces big sound using only two small speakers**

ONE OF THE TRICKIEST turns on the road to high-fidelity tries to get around a tough and persistent problem: how to obtain the most bass out of the smallest space. Here the road splits up into as many paths toward a possible solution of the problem as there are different opinions and designs. One of these approaches leads to the "Mini-Horn."

As a rear-horn-loaded enclosure designed to house two 5" speakers, it occupies little more than one square foot of floor space, and costs about three dollars to build. What's more, its diminutive size (13" high) makes it light enough in weight to be considered a truly portable enclosure.

**Construction Hints.** All of the wood used in construction was cut from one 2½' x 2½' piece of half-inch plywood. The panel layout drawing shows how to cut the panels. Whether you cut the wood yourself or have it done at the lumber yard, watch the angles on the pieces—they are critical to correct fitting. The dimensions shown in the drawing take into account the cutting waste made by a one-eighth-inch saw blade. A complete list of materials is given on page 72.

Start work on the interior panels by cutting the long edges of the 3½" x 12" panels, one at an angle of 46° and the other at an angle of 21°. Be sure that they are cut as shown in the layout drawing.

Cut the long edges of the 2¾" x 12" panels, one at an angle of 88° and the other

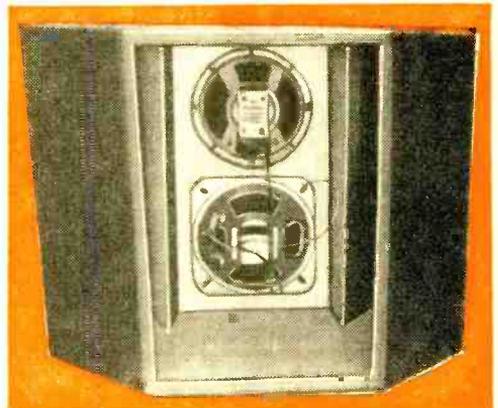
at an angle of 21°—exactly as in the diagram. Form the two interior panels as shown, one of each of the two types of panels just cut with one of the two 2" x 13" panels. The 13" panels must overlap the other two by a half-inch on each end.

Glue and nail the two formed panels to the bottom of the enclosure, making certain that they are joined to the 6¾" sides. Then, cut the 13" edges of the front panel to a 51° angle, being sure that the inner surface is six inches wide. This finished, cut the circular speaker holes in the panel 4½" in diameter, centering them as shown on the construction layout diagram.

Now glue and nail the front to the bottom of the enclosure and the previously installed panels. There will be a little bit of overhang due to the differently cut angles. However, this may be rounded off later with a file and sandpaper.

Join the 5¾" x 13" panels to the bottom with glue and wire brads. Then cut the 13" edges of the back panel to a 45° angle,

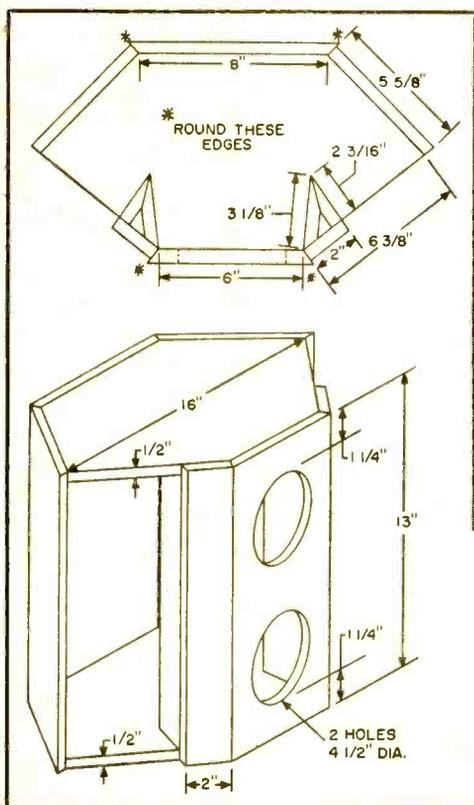
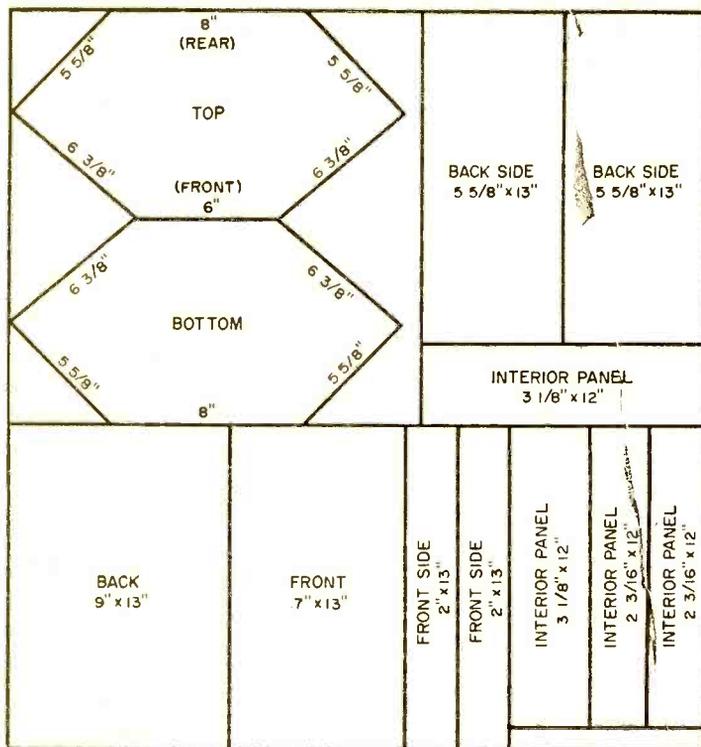
**Rear view** of the Mini-Horn, with back panel removed. Angled ducts on either side of speaker panel provide horn-loading for improved bass response.



making sure that the surface pointing inward is eight inches wide. The back panel is screwed on, rather than glued and nailed, so that the speakers may be installed and serviced. Carefully fit the top onto the enclosure, and glue and nail it into its permanent position. The actual construction of the Mini-Horn is now completed.

You may finish the Mini-Horn to suit your own taste. One easy way would be to cover the entire enclosure with grille cloth. Even covering the horn openings, this cloth will not impair the sound.

**Speakers.** Install two 5" speakers in the unit. These may be chosen at your own discretion. If two 4-



ohm speakers are used, they may be wired in series for total impedance of 8 ohms. They must be phased correctly—both speaker cones should move in the same direction when a signal is applied to their voice coils. Run the speaker wires through a hole drilled in the back panel. After the rear panel is screwed in place, the Mini-Horn will be ready to “sound off.”

For best results, place the system in a corner. Good sound can be also obtained by placing it against a flat wall. Either way, you'll be pleasantly surprised at how the Mini-Horn responds—from the lowest notes of the tympani to the highest of the piccolo. “Boominess” is nil because the enclosure is non-resonant.

Add it up—cost, portability, ease of construction, time used, and operation—the Mini-Horn is truly a hi-fi bargain. —30—

### BILL OF MATERIALS

- 1—2 1/2' x 2 1/2' piece of 1/2" plywood
- 1—small box 1" wire brads
- 1—small bag upholstery tacks
- 4—1" wood screws, No. 6
- Wood glue
- Paint, or finishing material, as desired
- Grille cloth, as desired

Use layout drawing at top of page as guide for cutting Mini-Horn panels. Dimensional drawing at left shows how pieces fit together.

## Do You Need a TV Ghost Eliminator?

**M**ANY TV VIEWERS have found that one way additional signal strength can be gained is by using high-gain non-directional antennas. But with these, a viewer may have to put up with ghosts (double images) or seek a new antenna mounting location, or—worse yet—replace the antenna with expensive narrow-beam units.

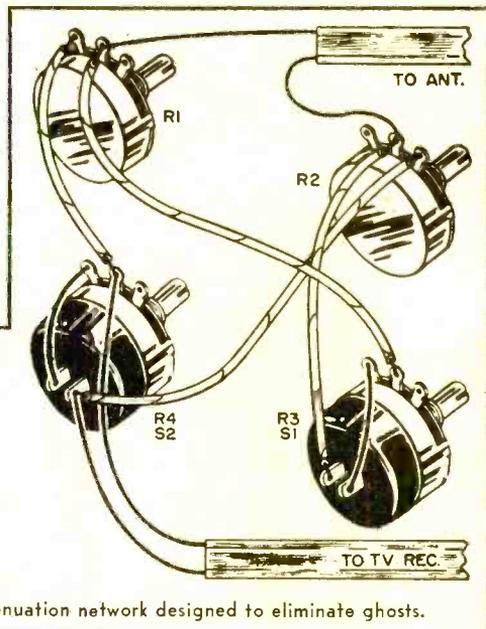
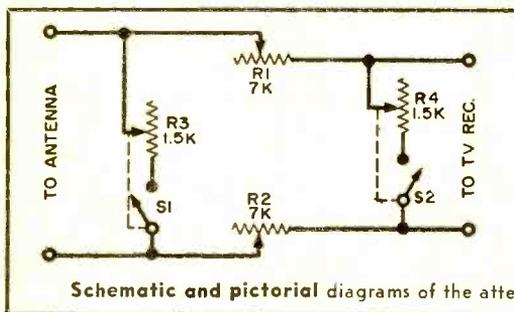
The antenna attenuation network described here was designed to overcome this difficulty. It inserts losses into the antenna lead-in to eliminate secondary signals, commonly called ghosts. In primary signal areas, the original signal is always stronger than the secondary or ghost signal (if the antenna is correctly oriented). Since there is an overabundance of signal in primary areas, attenuation of the signal not only eliminates the ghosts, but often greatly improves the over-all picture quality!

Construction of the ghost eliminator is simple and involves little time or work. Four potentiometers are mounted on a 4" x 4" x 1/8" piece of plastic or hardwood

and wired in a conventional attenuation network. A metal angle bracket can be used to mount the device on the rear edge of the TV receiver.

To align the completed eliminator, adjust potentiometers *R3* and *R4* to their "off" position and adjust *R1* and *R2* until the ghosts are eliminated or minimized as much as possible. Then turn the line-balancing potentiometers *R3* and *R4* "on," and adjust them until you obtain the clearest picture.

—Warren J. Smith



Schematic and pictorial diagrams of the attenuation network designed to eliminate ghosts.

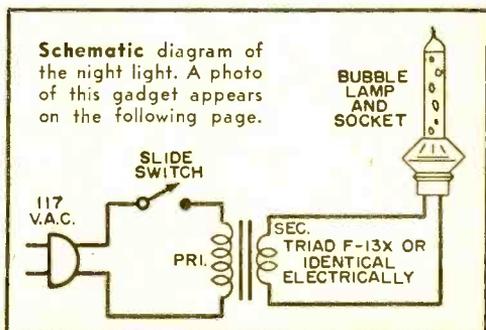
## Children's Night Light Is a Child's Delight

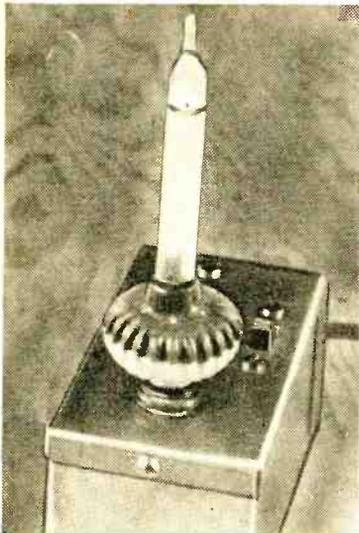
**H**ERE'S A GADGET to delight the small fry—and it's a boon to mamas and papas, too! Not only does it provide a small light in the nursery, but most children are fascinated by the bubbles rising in the glass tube. Before they know it, they're fast asleep.

You can easily assemble this night light in an hour. Since it operates at reduced current, it will probably work for a couple of years before the bulb burns out. As may be seen from the schematic diagram and the photo, the unit is nothing more than a Christmas-tree bubble lamp and socket, a small filament transformer, and a little slide switch. It is constructed on a 2 1/4" x 2 1/4" x 4" aluminum box. You can paint the box or decorate the front and sides with children's decals.

The filament transformer should be 6.3

volts, rated at less than one ampere. Although Christmas-tree bulbs are rated at 15 volts, most of them will work with such under-size filament transformers. If a particular lamp doesn't start to bubble after warming up for two or three full minutes,





check to make sure the bubble tube is pushed down firmly against the lamp in the base. These units operate on the heat thrown off by the lamp, so a snug contact between bubble tube and lamp is necessary. Two out of three of the author's lights started and operated perfectly with this arrangement.

You can use a bulb socket from an old string of series-wired Christmas-tree lights. Drill a hole in the cover of the box just slightly smaller than the lower part of the socket, and force-fit the socket in the hole. Then run a generous fillet of household cement between the socket and the box. Solder the two *secondary* leads of the transformer to the two leads of the socket. Each soldered connection should be insulated separately with plastic tape.

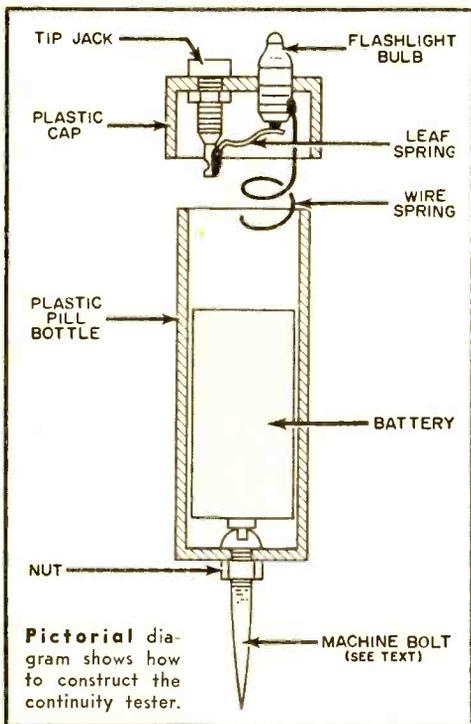
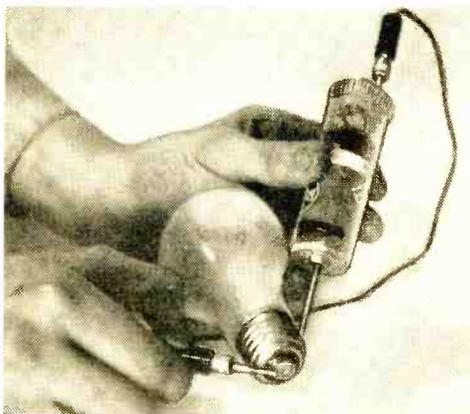
Insert the power cord through a grommeted hole. Solder one lead of the transformer *primary* to one terminal of the switch, and solder the other terminal of the switch to one wire of the power cord. Then solder other wire of power cord to remaining *primary* lead of transformer. Insulate this joint with plastic tape—and the wiring is finished. —Frank H. Tooker

## Simple Shockless Continuity Tester

**F**OR TESTING LAMP BULBS, circuits, fuses and home electrical appliances, this pill-bottle tester is easily made and requires little room in your pocket or toolbox. All you need is a single cell battery that fits a plastic pill bottle, a short lead wire with prods at both ends, pin jack, 1 1/4" round-head machine screw, and a 1 1/2-volt flashlight bulb.

Grind or file most of the threads off the

brass machine screw and form it into a point. Drill a hole in the bottom of the plastic bottle, insert the screw and fasten



with a nut. Push the dry cell down in the bottle until it makes firm contact with the head of the brass screw. The screw's pointed end serves as one of the test points.

Drill a snug-fitting hole in the bottle cap to hold the bulb. Alongside the bulb, drill another hole and insert the pin jack. Solder the end of a short brass strip to the pin jack and bend the other end of the strip so that it makes contact with bottom of bulb. Then wrap a few turns of bare copper wire around the threads of the bulb so that a spiral-like spring will make contact with the bottom of the dry cell when the plastic cap is put back on.

When using the tester, plug one end of the flexible-wire lead into the pin jack. Employ its other end and the brass-pointed screw for the test. —Stanley Clark

# BUILD The "ECONOMY" Audio Oscillator



**It's inexpensive, uses only one tube, and will cover range from 22 to 12,000 cycles**

By RICHARD GRAHAM

**T**HERE IS LITTLE NEED to talk about the virtues of an audio frequency generator—particularly to the audio experimenter. In this field, it is as basic as a voltmeter. But although you may realize the need for such an instrument, what can you do if your financial resources are limited? Take heart, for if you really want an audio generator, the unit described in this article may be just what you're looking for. It was designed with your pocket-book clearly in mind.

This generator covers the entire audio frequency range from 22 cycles to 12,000 cycles; such coverage effects quite a sav-

ing in the cost of switches and other components usually found in most audio frequency generators. The frequency control is an inexpensive potentiometer rather than an expensive multigang variable capacitor or multigang potentiometer. And, best of all, only one tube is used.

**Construction.** The oscillator is housed in an aluminum 6" x 6" x 6" box known as LMB Type 666. One-half of this box is an L-shaped piece which makes it convenient to use as the panel and base. No separate chassis is necessary since the unit is so simple that the parts can be easily mounted, wired and serviced right on the bottom of the cabinet.

Mount the tube socket on metal stand-offs or spacers to clear the socket pins from the metal cabinet. It is advisable to

## HOW IT WORKS

In this circuit, the pentode section of the 6L8 functions as a high-gain audio amplifier. The triode section is directly coupled to the pentode stage with the output connected as a cathode follower. Positive feedback which is independent of frequency is achieved through the two 3-watt bulbs, *PL1* and *PL2*, connecting the two cathodes together. The bulbs have a nonlinear resistance vs. current characteristic. As the feedback increases, the lamp resistance also increases, thus aiding in regulating the output voltage. If they were replaced with a linear resistor, i.e., a standard carbon resistor, the output voltage would vary and the waveform would be seriously distorted.

A negative feedback path is routed through the

network connecting the grid of the pentode section to the cathode of the triode section. This network is frequency-selective. The frequency at which the positive feedback cancels out the negative feedback is the frequency at which the circuit will oscillate. Amount of negative feedback varies with frequency and is adjustable by the potentiometer *R5* which functions as the frequency control. The output is a fairly constant 3 volts into a high impedance over the frequency range except at the very low frequencies where the output rises to almost 4 volts.

For those interested in vectorial development of this type of network, an excellent reference appeared in *Electronics*, January, 1952, page 95, which can be obtained at many of the larger public libraries.

wire as many capacitors, resistors, etc., as you can to the socket before mounting.

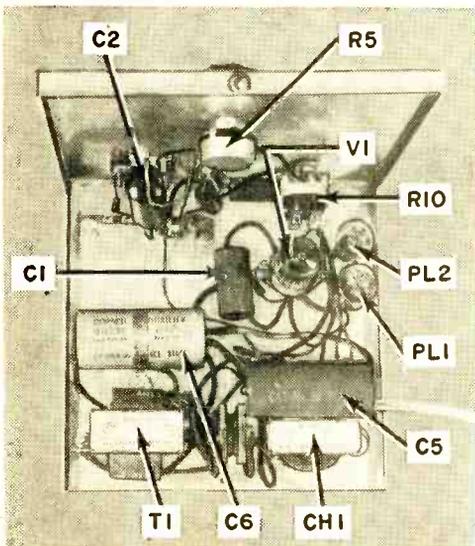
The two 3-watt bulbs (PL1 and PL2) are mounted by soldering the screw sides of the base to a terminal strip. Then solder the connecting wires directly to the lamp

base. No lamp sockets are needed since the lamps are used at only a very small fraction of their rating and should last as long as any other component. Incidentally, don't expect to see any visible glow from these lamps when the oscillator is operating.

After the unit is constructed, there are no adjustments necessary to put it into operation other than calibrating the main frequency control. This could pose a small problem for some, since another piece of test equipment is required which you may or may not have.

**Calibration.** Two possible methods of calibration are shown on page 131; it is assumed that you can borrow or obtain the use of the necessary equipment long enough to calibrate the "Economy" audio signal generator. The method shown in (A) is the simplest. You just feed the audio generator into an audio frequency meter which will read the signal output frequency directly.

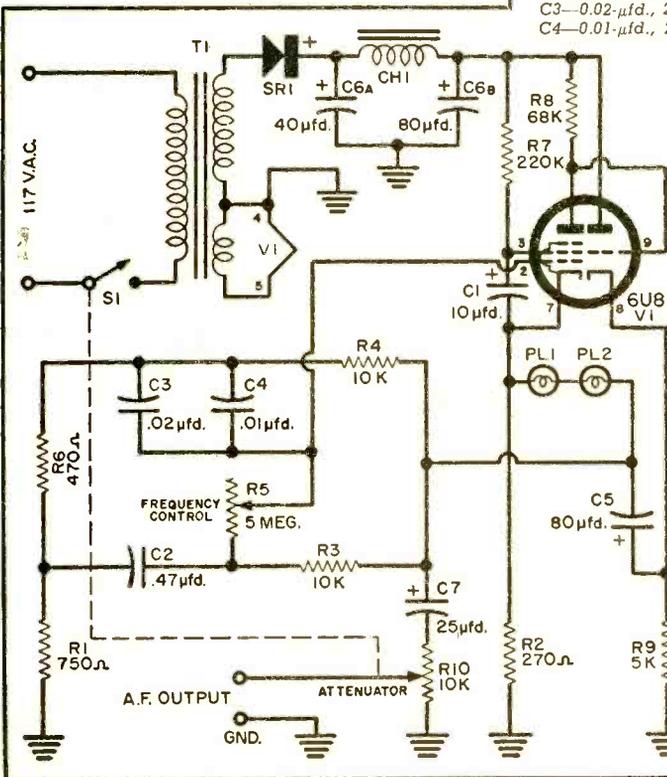
The method shown in (B) is based on comparing the frequency out of the "Economy" generator with that of another calibrated audio generator known to be rea-



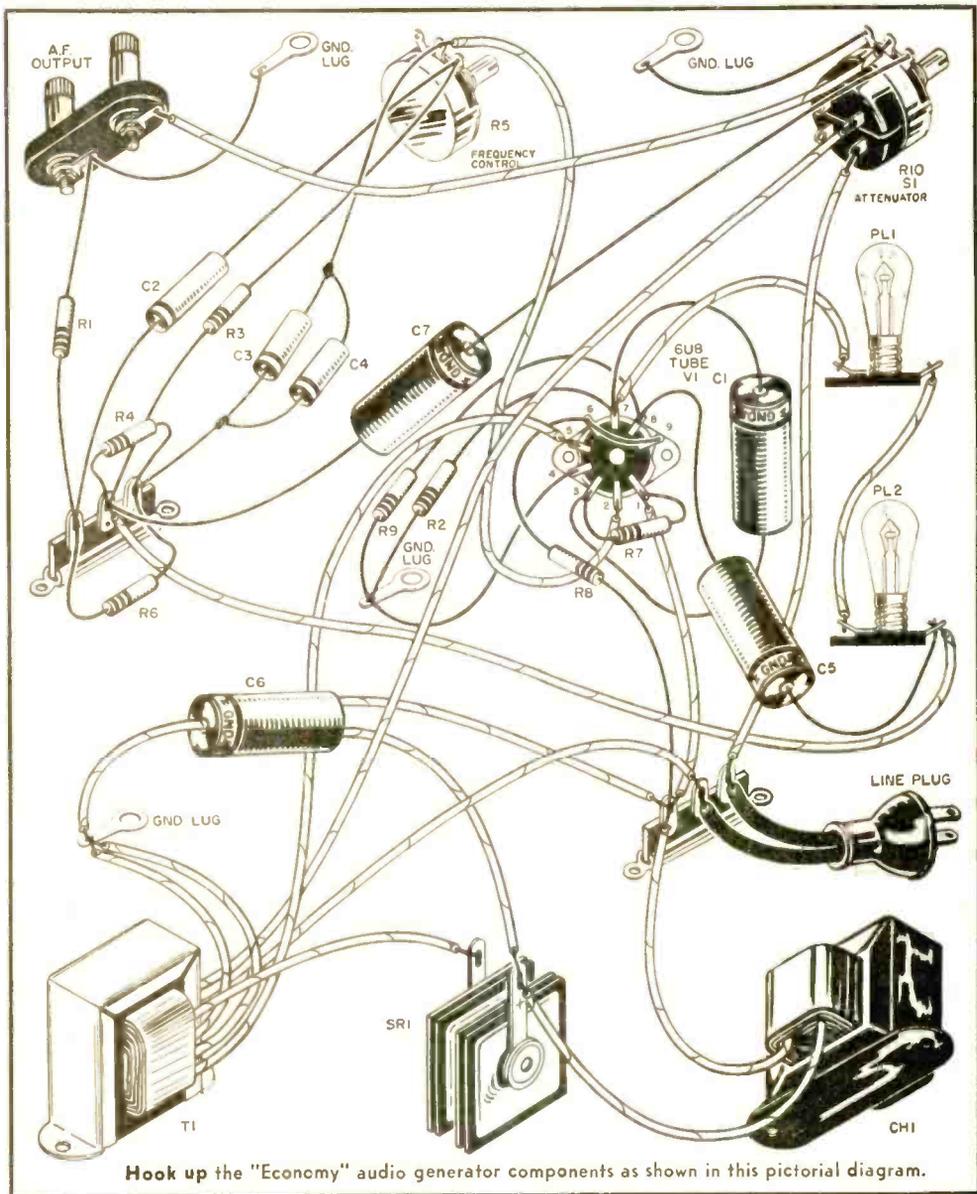
Looking down at the audio generator, note placement of major parts. The unit is housed in an aluminum box; no separate chassis is needed.

### PARTS LIST

- C1—10- $\mu$ f., 150-volt electrolytic capacitor
- C2—0.47- $\mu$ f., 200-volt paper capacitor
- C3—0.02- $\mu$ f., 200-volt paper capacitor
- C4—0.01- $\mu$ f., 200-volt paper capacitor
- C5—80- $\mu$ f., 150-volt electrolytic capacitor
- C6a/C6b—40/80  $\mu$ f., 150-volt electrolytic capacitor
- C7—25- $\mu$ f., 25-volt electrolytic capacitor
- CH1—7-henry, 50-ma. choke (Stancor C1707)
- PL1, PL2—3-watt, 115-volt lamp
- R1—750-ohm,  $\frac{1}{2}$ -watt fixed resistor
- R2—270-ohm,  $\frac{1}{2}$ -watt fixed resistor
- R3, R4—10,000-ohm,  $\frac{1}{2}$ -watt fixed resistor
- R5—5-megohm potentiometer with reverse logarithmic taper
- R6—470-ohm,  $\frac{1}{2}$ -watt fixed resistor
- R7—220,000-ohm,  $\frac{1}{2}$ -watt fixed resistor
- R8—68,000-ohm,  $\frac{1}{2}$ -watt fixed resistor
- R9—5000-ohm resistor
- R10—10,000-ohm potentiometer, linear taper
- S1—S.p.s.t. switch on R10
- SRI—65-ma. selenium rectifier
- T1—Power transformer, 125 volt at 15 ma., 6.3 volt at 0.6 amp. secondary (Stancor PS8415)
- VI—6U8 tube
- 1—6" x 6" x 6" aluminum box (LMB Type 666)



Complete wiring details for the oscillator are at left.



sonably accurate. One generator is fed into the horizontal input of an oscilloscope. Feed the other generator into the vertical input of the oscilloscope. The calibrated generator is set on a frequency point to be calibrated. Adjust the uncalibrated generator until a circle, straight line or ellipse is obtained on the 'scope face. The two generators are then at the same frequency. This procedure should be repeated for all the points to be calibrated.

If you want to maintain the output absolutely constant over the entire frequency range, fixed resistor  $R1$  can be replaced with a 100-ohm potentiometer. By ad-

justment of  $R1$ , the output voltage can be regulated. However, readjustment of  $R1$  may produce an unfavorable effect on the output voltage. Therefore, it is recommended that  $R2$  simultaneously be changed to a 1000-ohm potentiometer. Thus,  $R1$  and  $R2$  can be adjusted for an output voltage of approximately 3 volts. The fixed value resistors  $R1$  and  $R2$  constitute a happy compromise between economics and performance.

**Operation.** In use, it is only necessary to remember that the generator will work into impedances over approximately 1000

(Continued on page 131)

# AFTER CLASS



Special Information on Radio, TV,

Radar and Nucleonics

## USING TIME DELAY RELAYS

**T**IME DELAY in oil burners, in transmitter power supplies, in power failure alarms! Time delay in arc-welding, spot welding, resistance welding! Time delay in x-ray exposure, photo-finishing, transoceanic radio, and offset photography! Hardly a moment passes that some electronic device in industry, communication, or entertainment isn't making use of time delay action in one form or another.

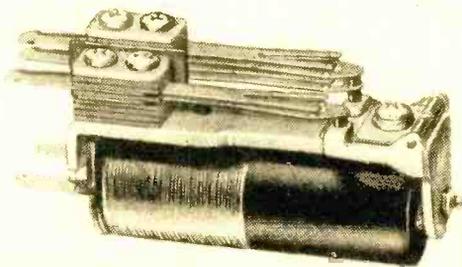
Although time delay as a fundamental electrical principle enters into these devices in numerous ways, we will only discuss relay action in timing circuits.

**What Is Time Delay?** Let's first be clear about what time delay means and about the terms we must use in describing various actions.

In taking an x-ray, your dentist presses a button momentarily; the x-ray machine then comes alive for an accurately timed interval, after which it goes off automatically to prevent dangerously prolonged exposure. The "on" interval is the time delay period, so that the action might be described as: *momentary make* (button pressed)—*fast pull-in* (x-ray machine goes on instantly)—*slow drop-out* (x-ray machine goes off after timed interval).

Or take another example: a radio operator throws a toggle switch on and the filaments of his mercury vapor rectifiers light instantly; fifteen seconds later, the plate voltage is automatically applied to the tubes. Then, when the transmission is complete, the switch is turned off and both

filaments and plate voltage go off *simultaneously*. In this case, the time delay interval is fifteen seconds and the sequence is: *held-make—slow pull-in—fast drop-out*. The individual response of a given relay and the length of the time delay interval

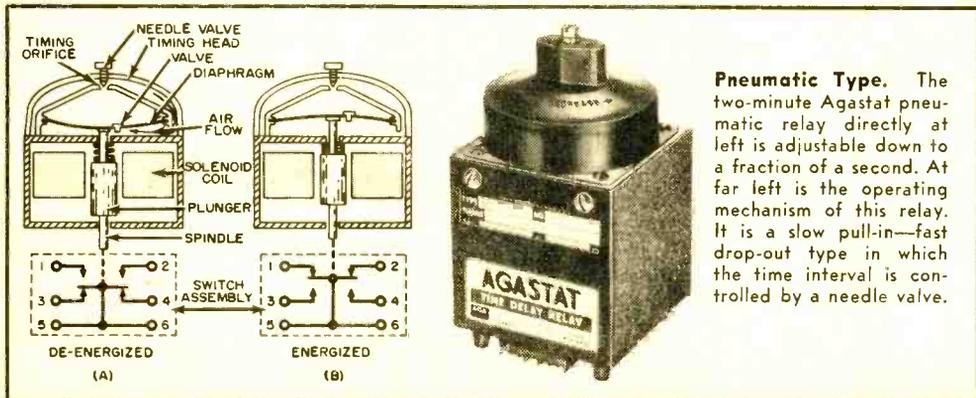


**Reluctance Type.** Note the metal sleeve that encircles about half the electromagnet coil in this reluctance type of time delay relay which is manufactured by Potter and Brumfield.

are of course governed by the needs of the particular piece of equipment in which the relay is used.

**Basic Principles.** Time delay relays utilize many different principles. Among the most popular are: (a) magnetic reluctance action, (b) pneumatic or hydraulic chambers, (c) thermo-mechanical action, and (d) resistance-capacitance (*RC*) charge or discharge time in connection with electron tubes.

**Magnetic Reluctance Relays.** These are useful for relatively short time delays—a



**Pneumatic Type.** The two-minute Agastat pneumatic relay directly at left is adjustable down to a fraction of a second. At far left is the operating mechanism of this relay. It is a slow pull-in—fast drop-out type in which the time interval is controlled by a needle valve.

few seconds as a rule. Generally, a copper sleeve encircles a part of the relay coil. The eddy currents induced in the sleeve as the magnetic field builds up set up an opposition action which prevents the electromagnet from reaching full strength instantly, thus delaying the pull-in. Relays of this type are not particularly flexible and are not suitable for wide-range adjustments.

**Pneumatic or Hydraulic Relays.** Such relays are easily controlled to provide timing intervals from a fraction of a second to many minutes. Time delay is obtained by having a magnetically actuated plunger work its way through a gas (pneumatic) or a liquid-filled (hydraulic) chamber much like door-slam stoppers.

**Thermo-mechanical Relays.** These depend upon the heating time of a bi-metallic strip for their delay action. Actuating current flows through a heater adjacent to the compound bar; the heat radiated to the bar causes it to bend as a result of the unequal coefficients of expansion of the two metals comprising the bi-metallic strip. Thus, contact between two points may be made or broken by the bending action. Thermo-mechanical relays are quite inexpensive but have limited application for two reasons: (1) they are seldom adjustable and must therefore be purchased with a specific delay rating for a specific job;

### Hydraulic Type.

This is an oil-filled dashpot relay of the hydraulic variety, adjustable over a wide range of timing intervals. Such relays see years of uninterrupted service with your telephone company.

(2) they recycle slowly so that they provide *slow pull-in* — *slow drop-out action*, being incapable of fast, momentary contact response.

**RC Time Delay Relays**—By far the most popular and most suitable basic principle for experimenters with limited budgets involves the charge or discharge time of a capacitor in connection with a resistor. RC time delay relays that provide virtually any sequence of delay action can be built up from scrap parts and tubes. For those who enjoy experimentation, the circuit of Fig. 2 offers hours of fun and profitable experience since it can be made to perform several time delay tricks. Before describing its use, let's review some fundamental ideas that will help to clarify the circuit action.

**RC Relay Circuits.** A resistor  $R$ , a capacitor  $C$ , two keys, and a 100-volt source are connected as illustrated in Fig. 1. When key 1 is closed, a current starts to flow into the capacitor, causing it to build up a charge. The time required for the capacitor to reach a voltage which is 63% of the charging potential, or in this case, 63 volts, is called the "time constant" of the RC combination. The following simple equation may be used to find time constant (time constant is in seconds,  $R$  in megohms, and  $C$  in microfarads):

$$\text{Time constant} = R \times C$$

For example, if the resistor is 3 megohms and the capacitor 2 microfarads, a time interval of 6 seconds is required to allow the capacitor (and hence the available output voltage at the terminals) to reach 63 volts. As the equation shows, this interval may be changed at will by altering the value of either  $R$  or  $C$ , or both at the same time. It is interesting to note

(Continued on page 124)

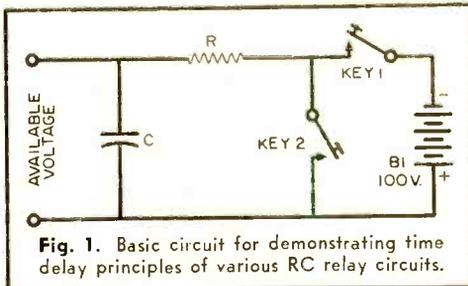


Fig. 1. Basic circuit for demonstrating time delay principles of various RC relay circuits.

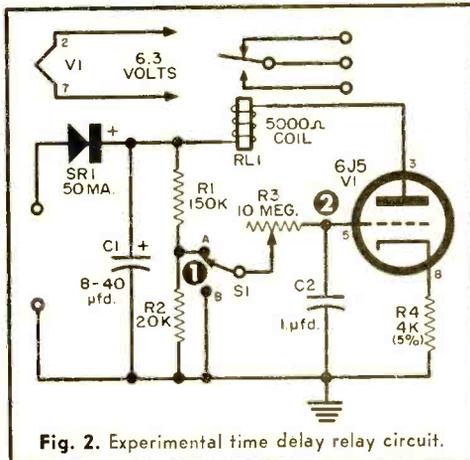
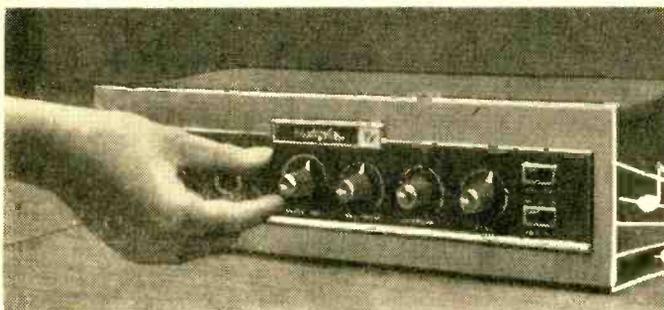
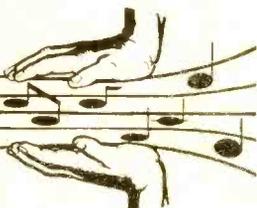


Fig. 2. Experimental time delay relay circuit.



By  
**LEONARD FELDMAN**



Reach for the Loudness Control if you want

## PEACE WITH THE NEIGHBORS

"HI-FI IS SWELL, but why do you have to play it so loud?"

This used to be a common—and fairly legitimate—complaint regarding the listening level of most hi-fi enthusiasts. Playing the system "wide open" was necessary to hear the entire frequency spectrum. It is a fact that our hearing falls off at the high and low ends of the audio band. In other words, it is actually harder for us to hear lows and highs than it is for us to hear the mid-range, assuming the same sound intensity throughout the frequency range.

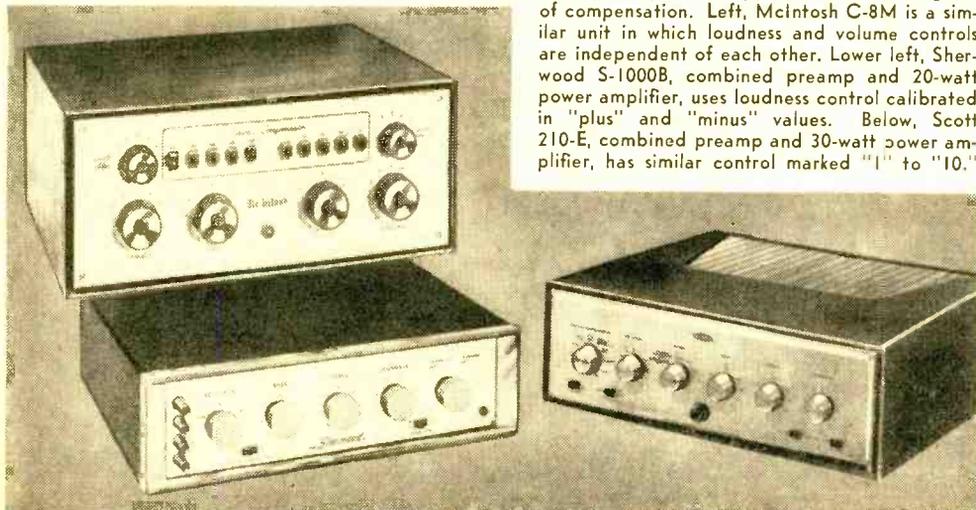
A simple way of illustrating this fact is to ask a hi-fi owner to demonstrate the response of his system. Out comes an audio oscillator, test record, and scope or meter. Then follows a series of tonal grunts and squeals which, you are told, comprise the entire audible spectrum from "practically" zero cycles all the way to supersonic "dog" frequencies. All the while, the indicating device hooked across the loudspeaker ter-

minals remains motionless, indicating that the response of the electronic part of the system is, indeed, flat within the prescribed limits of a high-quality sound-reproducing system.

It is quite obvious during such a test that not all the tones *sound* equally loud to you, the listener. The low notes may sound faint; the very high tones seem somewhat less intense than the middle frequencies.

These audibility effects were investigated in detail by Harvey Fletcher and W. A. Munson in 1933—some time before high-quality sound invaded the living room. The curves in Fig. 2 summarize their intensive research and are now popularly referred to as the Fletcher-Munson curves. They point out what you have suspected all along—that human hearing response is anything but "flat." In fact, if you saw curves such

**Lowering** volume while keeping full tonal balance is job of loudness control. Above, Electro-Voice PC-1 preamp uses stepped control for degrees of compensation. Left, McIntosh C-8M is a similar unit in which loudness and volume controls are independent of each other. Lower left, Sherwood S-1000B, combined preamp and 20-watt power amplifier, uses loudness control calibrated in "plus" and "minus" values. Below, Scott 210-E, combined preamp and 30-watt power amplifier, has similar control marked "1" to "10."



as these on a commercial amplifier, you wouldn't even bother to give it a listening test.

At this point you're probably ready to pounce upon the author with the following questions: "So what, if we don't hear all tones equally loud? After all, that's how we're used to hearing sounds, that's how we hear live sounds in the first place. It wouldn't be right to 'doctor up' our hi-fi systems by introducing 'unnatural' tone compensation gimmicks, would it?" Therein lies the whole argument for and against "loudness controls."

If we listened to *all* recorded music at exactly the same level at which it was recorded (or, in other words, placed ourselves in the same hearing position that the microphone occupied during recording), the argument would cease to exist. Unfortunately (or fortunately for our neighbors in the next apartment), it is rarely possible to play a recording of a full symphony orchestra at such a level. First, the room in which you listen at home is considerably smaller than a symphony concert hall. Secondly, there are times when you may want the music as background to other activities, in which case extremely low level is desirable.

**Why a Loudness Control?** Let's take a detailed look at Fig. 3. Suppose the average level of a symphony orchestra corresponded to 80 decibels as heard from a good center-orchestra seat. The frequency response of your hearing mechanism is as shown in Fig. 3. Notice that at 50 cycles your "mental amplifier" is down about six decibels (only one-quarter of the original power but 74/80ths of original sound level as far as your hearing is concerned). Of course, while you are sitting at

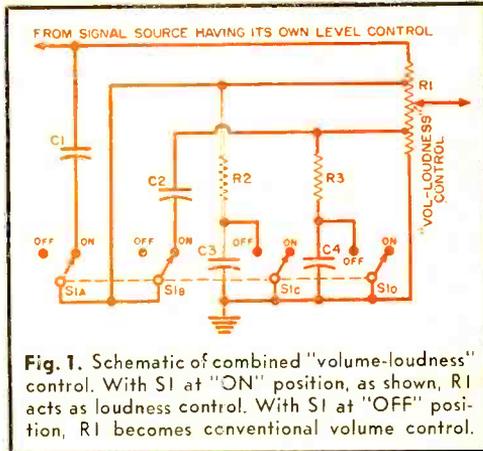


Fig. 1. Schematic of combined "volume-loudness" control. With S1 at "ON" position, as shown, R1 acts as loudness control. With S1 at "OFF" position, R1 becomes conventional volume control.

the concert, this fact makes no difference at all because that's the way music has *always* sounded at this particular level.

Suppose you enjoy a particular selection and rush right out to the record shop after the concert to purchase the piece. You place it on the record changer, adjust the volume control and settle down for a repeat performance—with one major exception. That volume control was adjusted to play back the selection at an average level of only 50 db, because it is now late in the evening and everyone else but you is asleep. At this level, your hearing has a response characteristic like that shown dotted in Fig. 3. You will note that the response at 50 cycles is now down some 25 db (only 1/300th of original power), or about 50 db lower than during the actual performance (three-eighths as loud to your ear).

Other low and high notes are similarly displaced in relation to their original "live" intensity. You can check the amount of

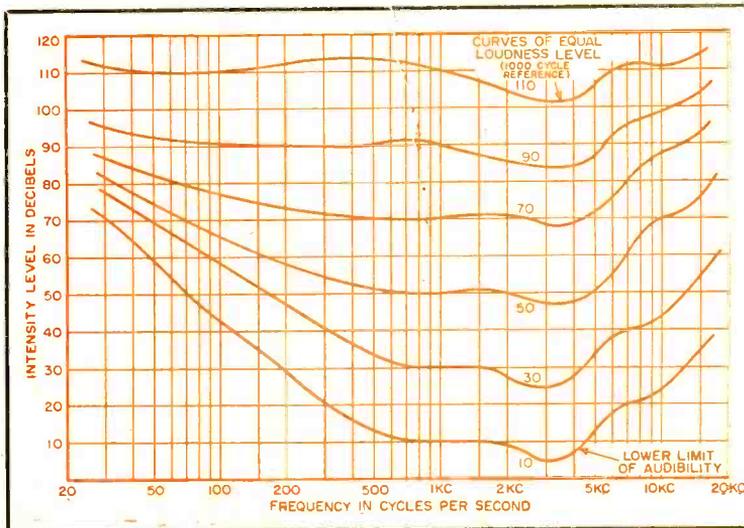
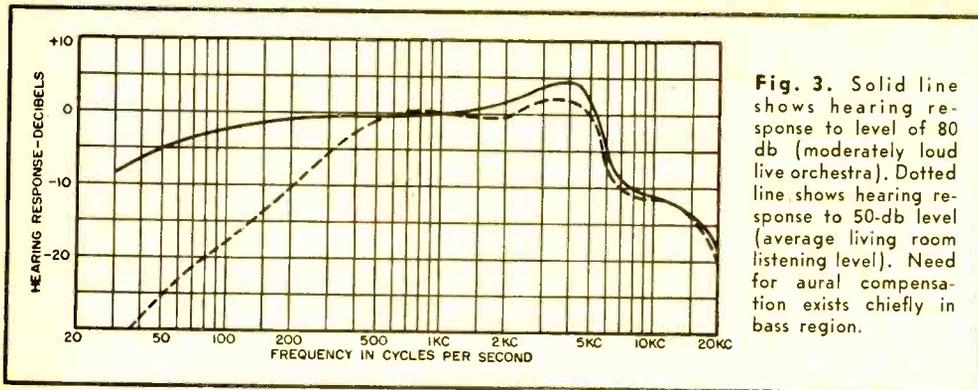


Fig. 2. Graph showing how hearing varies with level and frequency of sound. Note that it requires a level of about 50 db at 100 cycles to sound as loud as a level of only 20 db at 1000 cycles. These curves represent "equal loudness" points at various audio frequencies. Action of loudness control is to get amplifier to respond in line with the loudness curves.



**Fig. 3.** Solid line shows hearing response to level of 80 db (moderately loud live orchestra). Dotted line shows hearing response to 50-db level (average living room listening level). Need for aural compensation exists chiefly in bass region.

“shift” at any particular frequency by the curves shown in Fig. 3. This effect is pretty apparent even to the inexperienced listener. All you have to do is vary your volume control from fairly loud level to quiet “background level” and notice what seems to happen to the bass tones. They all but disappear.

There are two good reasons why ordinary tone controls aren’t adequate to compensate for these effects. In the first place, you can never be sure *how much* to compensate or boost the controls unless you have some absolute reference. Secondly, the amount of required correction at the “low frequency” end is often very great. If you were to boost the bass by the required amount—using your bass tone control—you wouldn’t have much “bass boost” left with which to compensate for *other* deficiencies in the system, such as acoustics of the room, speaker, enclosure, etc. However, the loudness control takes care of these needs conveniently and simply—and you don’t have to be a mathematician to use it properly.

**How It Works.** All commercially designed loudness controls are basically the same as tone control circuits, except that the amount of boost of both treble and bass tones is automatically adjusted as the volume control is varied. From the explanation of our hearing process given above, it follows that *the louder the music you’re listening to, the less correction you need.*

And that’s exactly how one popular form of loudness control works. If the control is at maximum (highest volume), the response of the circuit remains flat. As the control is rotated to decrease the volume level, more and more compensation is introduced. A partial schematic of a typical loudness control is shown in Fig. 1.

Some controls apply correction at both low and high frequencies, while others only compensate for the more serious bass region deficiency. In either case, there is one more requirement for setting up the control to work properly. Somewhere else in

the system there should be another common level or volume control. It may be on the same amplifier, at the input jack to the amplifier, on the tuner chassis (if it contains the preamplifier and selector switch of the system), or on a separate preamplifier-circuit unit.

**Using the Control.** In setting up a loudness control to work properly, one point should be emphasized. Not all people have exactly the same hearing response. In fact, the Fletcher-Munson curves are actually *average* results of hearing tests given to hundreds of people. Therefore, the instructions to follow are, at best, an approximation. Slight variations in preference are to be expected in individual cases.

Start by rotating the loudness control to maximum. The volume control in the system should then be increased gradually from minimum, causing the music to sound louder and louder until, in your judgment, it is as loud as it would be if you were sitting in a choice orchestra seat at a concert. (This is a lot louder than you would at first believe. Think back on the last concert you attended—or better, still, attend another one with these thoughts in mind!) Now, reduce the volume to a comfortable “living-room listening level” by means of the loudness control, leaving the original volume control permanently set.

Regardless of how high or how low you set the loudness control, the correct amount of tonal compensation will take place automatically, lending realism never before possible at all listening levels. It would be ideal if that’s all there was to it, but not all recordings are made with the same average amplitude. Thus, it may be necessary to repeat this process for different types of music and for particular recordings.

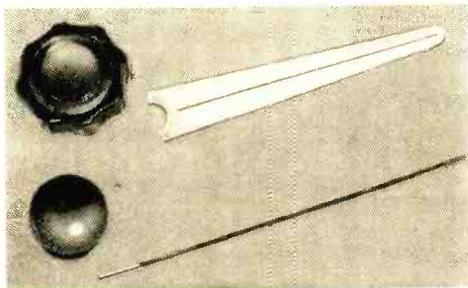
For example, a piano recording may often be heard as loudly as it was played during the original performance. In such a case, no compensation would be necessary. That would mean that the loudness control

(Continued on page 123)

## Make Your Own Long Pointer Knobs

**M**ANY TYPES of home-built electronic equipment require long pointer knobs which are used as indicators for large calibrated dials. Two types are popular—a transparent plastic pointer with a fine central hairline, and the solid hairline pointer. Unfortunately, long pointer knobs are not commonly available as “across-the-counter” items. But you can make your own—here's how to do it:

*Transparent Pointer.* Basic ingredients are a round knob with a smooth, flat under-surface, a piece of clear plastic (such as Lucite, Polystyrene, or Plexiglass) and a good “universal” cement (such as Duco or General Cement No. 45-2). Cut the plastic to the shape and size pointer needed. Now, scratch a fine line on the back



of the plastic to serve as a “hairline.” Use a *sharp* scribe or similar tool for this job. If you wish, you can “fill” the hairline with color by rubbing a crayon across its surface.

Next, use fine sandpaper to roughen both the under-surface of the knob and the lower part of the plastic wire—to insure good bonding by the cement. Apply the cement liberally to both surfaces. Then clamp the knob and pointer together, taking special care to insure proper alignment, and allow to set for 24 hours.

*Solid Hairline Pointer.* For this, you'll need a small, round knob, cement, and a piece of stiff, straight wire. Either 14- or 16-gauge copper wire may be used, but a smaller gauge of steel or iron wire is preferable. After straightening the wire, cut off a piece that is slightly longer than the desired pointer. You can color it if you wish, using a quick drying lacquer—fingernail polish is excellent.

Drill a *slightly* under-sized hole in the side of the knob. Final assembly is simple. Coat the end of the pointer wire with cement and *force* it into the hole in the knob. Allow sufficient time for the cement to set.

Both types of home-made pointer knobs are shown in the photo. —E. G. Lewis

## How to Regulate Your Line Voltage Booster

**O**NE of the principal uses of the author's line voltage booster, which was described in the June, 1956, issue of POPULAR ELECTRONICS (“Build Your Own Line Voltage Booster”), is to keep the line voltage at the input to a TV receiver at a more or less constant level. It can be made considerably more useful in this respect by adding a television voltage regulator. The unit shown in the photo, a Clarostat Type TV-A, is especially easy to use for this purpose since it plugs into the outlet of the booster. In turn, the power cord of the TV set plugs into the regulator.

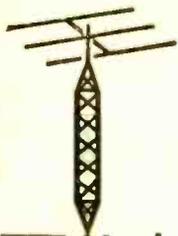
Voltage regulators of this type are intended to be operated within definite power limits. The Clarostat Type TV-A regulator, for instance, will operate at its best when the device plugged into it draws between 200 and 300 watts. A similar unit, the Type TV-B, will handle from 300 to 375 watts.

As an example of typical TV applications, the author plugs the regulator into his de luxe booster, as shown in the photo, to regulate the input to a Sylvania TV receiver which draws 200 watts. These units operate very well together. In normal use, the booster is set to give a reading of

120 to 125 volts on its meter. The regulator then takes over and loses the few volts necessary to maintain voltage regulation at the input to the TV set.

This same general type of setup can be used to advantage to regulate the line voltage at an amateur transmitter or any other device, provided that the booster and the regulator are chosen to work best at the power level consumed by the particular device. —B. W. Blachford





# THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

**E**FFECTIVE January 1, 1957, FCC regulations require that all amateur stations must be equipped with means to insure suspension of radio transmissions during a CONELRAD Radio Alert. (CONELRAD = System for CONTROL of ELECTRO-magnetic RADIations.) Such an alert will be announced in the event of an enemy attack on the United States and will be the signal for most radio stations to leave the air, so that the enemy cannot use our signals to operate radio navigation equipment.

A CONELRAD Radio Alert will be announced via AM broadcast, FM, and television stations. They will interrupt their regular programs to broadcast the alert announcement and will then leave the air. In a few minutes, however, certain broadcast stations will return to the air on 640 kc. or 1240 kc., to broadcast civilian defense information. They will use low power and will operate in clusters. Each station in a cluster will transmit for only seconds at a time in a random pattern.

Test alerts are held from time to time and amateurs who do not suspend operations during a test or actual alert will be in serious trouble.

**Complying with Regulations.** The simplest way to comply with the CONELRAD regulations is to check the broadcast band before going on the air and to keep a receiver tuned to a broadcast station while

you are on the air. If it leaves the air unexpectedly, suspend operations until you determine if other broadcast stations are operating normally. If they are, resume operations, but if the only stations you hear are those on 640 kc. and 1240 kc. broadcasting civilian defense information, stay off the air until they broadcast the "all clear."

A disadvantage to using a standard receiver as a CONELRAD monitor is that you must keep it operating all the time. It would be better if an alert would immediately flash a warning light, ring a bell, or automatically shut off your transmitter. Adding a device to do these things to a standard receiver is not much of a problem, as shown by W2EEJ in CQ (see diagram at left).

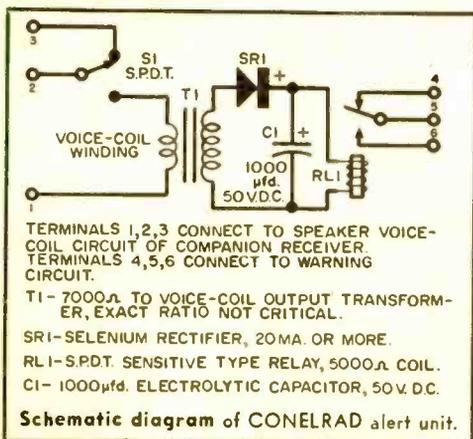
The output signal from the receiver is fed into the unit via transformer *T1* and rectifier *SR1*. The rectifier converts the signal to direct current, which operates a sensitive relay, the contacts of which operate the warning light, or bell, or shut off the transmitter.

Of course, the output signal from the receiver is constantly varying in accordance with the program being broadcast.

If it were not for the capacitor *C1* across its coil, the relay would operate erratically. When the output of the rectifier is high, the capacitor stores up energy, and when the output is low, it discharges the stored energy through the relay coil to keep its contacts closed, despite signal variations.

**Building Alert Unit.** The alert unit may be built in any convenient box. No particular parts arrangement is required. To connect the CONELRAD unit, a slight modification must be made in the AM receiver. Disconnect one of the two leads between the output transformer of the receiver and the loudspeaker voice coil. Reconnect this transformer lead to the center terminal of toggle switch *S1*, and the speaker lead to the terminal at one end of the switch. Next, connect a wire to the other speaker voice-coil terminal and another wire to the remaining switch terminal. These wires go to the input winding of *T1* in the control unit.

(Continued on page 112)



## HELP US OBTAIN OUR HAM LICENSES

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

### K1/W1 CALL AREA

Morton Krantz, 61 Litchfield St., Hartford, Conn.

Walter Terlik, 14 Palmer, Chicopee Falls, Mass.

Jimmy Monahan, 60 Cosey Beach Ave., E. Haven 12, Conn.

Henry J. Maresi, TD3, FAETU Det. #3, NAS, Quonset Point, R.I. (Code and theory)

Michael Friend, 56 Catharine St., Worcester 5, Mass.

Ted L. Gibson, Dewey St., Bernardston, Mass. (Code)

### K2/W2 CALL AREA

John W. Noe (11), 226 Naples Terrace, New York 63, N. Y.

David Howson, 126 Union St., Westfield, N. J. (Theory)

Mike Vinocur (14), 1776 E. 13 St., Brooklyn 29, N. Y.

Peter Gordon (14), Cedar Knolls School, Hawthorne, N. Y. (Code and theory)

Robert Niglorino, 489 E. 22 St., Paterson 4, N. J. (Theory)

Ronald G. Seeley, 33 Maple Ave., Keansburg, N. J. (Code)

Jeffrey Elliot, Half Mile Road, Armonk, N. Y. (Code and theory)

Mal Wisch, 3935 Bedford Ave., Brooklyn 29, N. Y. Phone: DE 9-4880. (Code and theory)

David Cassata, 303 North Park Ave., Buffalo 16, N. Y. (Code and theory)

Walter Ludewig, Box 431, Church St., Carmel, N. Y. Phone: CA 5-2300. (Code and theory)

Robert Kern, 2 Stuyvesant Oval, New York 9, N. Y.

Steve Smith (14), 20 New St., Binghamton, N. Y. (Code and theory)

Peter Becker, 41 Eagle Rock Ave., Roseland, N. J. (Code and theory)

Paul Reinhart, Box 81, Pavillon, N. Y.

Steve Denys (14), 48-36 Oceania St., Bayside, L. I., N. Y. (Code and theory)

### K3/W3 CALL AREA

Tom Farmerie, 634 Malibrán Drive, Pittsburgh 37, Pa. (Theory)

Philip L. Lynch, 4620 Greene Pl. N. W., Washington 7, D. C. (Code)

Philip Graitcer, 157 E. Plumstead Ave., Lansdowne, Pa. (General code and theory)

Donald H. Bennett, Jr., 1855 Irving St., N. W., Washington 10, D. C.

Robert Himler (15), 11 W. Madison St., Latrobe, Pa.

### K4/W4 CALL AREA

Gordon Lewis, Jr., 2391-A Lindmont Circle N. E., Atlanta 5, Ga. (Code and theory)

Jerry G. Webb, 120 S. Fairground St., Savannah, Tenn.

Donald Ludlow (14), 314 South Monterey St., Mobile, Ala. (Code and theory)

### K5/W5 CALL AREA

Jimmy Roughley, 1500 North 37th St., Ft. Smith, Ark. (Code)

Arthur Minke, Jr., 823 N. 17th, Waco, Texas.

Fred P. Martin, Jr., 3025 Groves Ave., Groves, Tex. (Code and theory)

Q. T. Dickerson, P. O. Box 541, Pascagoula, Miss. (Code and theory)

### K6/W6 CALL AREA

Michael Kandarian, 120 El Monte, Los Altos, Calif.

Chris Clemens, 316 S. Barranca, Covina, Calif. (Code)

Robert L. Cloke (12), 506 S. 8th St., San Jose, Calif. (Code and theory)

Bob Coomler, 6047 Comey Ave., Los Angeles 34, Calif.

Dick Schmidt, 3909 Cresta Way, Sacramento 25, Calif. (Code and theory)

George Breazeale, 12462 San Pablo Ave., Apt. C, Richmond, Calif. (Code and theory)

Dan Duffin, 141 Covina Ave., Long Beach, Calif.

Wayne Overbeck, 1511 Ruhland Ave., Manhattan Beach, Calif. (Code)

David Shallenberger, Boys Republic, Chino, Calif.

### K7/W7 CALL AREA

Richard Sires, 1900 S. Fairfield, Las Vegas, Nevada.

Bob Fornworth, 151 Fuller Way, Pocatello, Idaho. (Code)

John Thomas, Box 238, Mt. Angel, Oregon. (Code)

James Weiss, 495 Division St., Salem, Ore. (Code and theory)

Peter Kirk Skarbo, Castle Rock, Wash.

### K8/W8 CALL AREA

Rick Davis (15), 981 Sandusky St., Conneaut, Ohio. (Code)

Jim Fishbeck, 3505 Harold St., Lansing 10, Mich.

John Newman, 2518 Outlook St., Kalamazoo, Mich. (Code and theory)

Earl E. Tiley (51), 405 E. Main St., Blanche, Chester, Ohio.

Myron L. Braun, 202 Howard St., Bellevue, Ohio. (Code and theory)

### K9/W9 CALL AREA

Jerry Heiman, 2409 E. 97th St., Chicago 17, Ill. (Code and theory)

Pearley Roy Cunningham, 312 Queen St., Muncie, Ind. (Code)

Tom Kidd, 846 North St., Huntington, Ind.

Patrick Long (13), 1942 Lake, Wilmette, Ill. (Code and theory)

Dennis Herr, 232 So. 73 St., Milwaukee 14, Wis.

### K0/W0 CALL AREA

James R. Lamm, 6016 10th Ave., Minneapolis 17, Minn.

Stephen Vaughan, 163 Van Ness, Ottumwa, Iowa. (Code and theory)

Ray Cunningham, 3313 Mellier, Kansas City, Kans. (Code)

John Fife, 2732 North 41 St., Kansas City, Kans. (Code and theory)

### VE AND OTHERS

Thomas R. Hill (45), R. R. 3, Ft. William, Ont., Canada. (Code, theory and regulations)

Gordon Cummer (14), 88 Sunset Blvd., St. Vital, Man., Canada. (Code and theory)

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 33 1/3 rpm) and a Novice Theory Course for \$10.00, post-paid. The complete course or more information on it is available from RETMA, Suite 800, Wyatt Bldg., 777 Fourteenth St., N. W., Washington 5, D. C.

# Tuning the Short-Wave Bands

with Hank Bennett

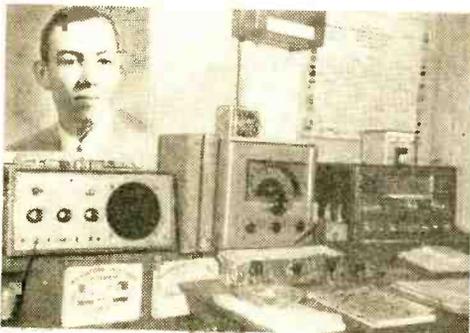
**O**UR FEATURED DX'ER this month is William F. Flynn of 964, The Alameda, Berkeley 7, Calif. Single and a student, Bill is 25 years old. He does his DX'ing on a National NC-125 receiver, with a Zenith T/O (5H40) as a standby.

Bill's listening post is well equipped with a DB-22A preselector, an FCC-90A frequency standard, Bell RT-65B 3-speed tape recorder, Drake Q-multiplier, and a home-built antenna tuner. Antenna-wise, he employs both 60' and 100' long wires, and a 12' vertical whip.

The logbook at the Flynn listening post is impressive—Bill has 228 verifications from 99 countries. He finds it hard to decide which veries he prizes the most but rates QSL's from *Radio Puckapunyal*, Australia (75 watts) and Forces Broadcast Station, Benghazi, Libya (4935 kc.) among the best.

Unlike many DX'ers, Bill chooses the 3-mc. "Tropical Band" as his favorite DX band. He prefers the programs of *Radio Australia* because of the excellent and consistent reception, and the Swiss Broadcasting Corporation because of its informative and reliable DX programs. Bill's best DX includes: ZOY, Accra, Gold Coast, on 4915 kc. (1952); Belgrade, Yugoslavia, on 9505 kc.; ZNB, Mafeking, Bechuanaland (1948); and dozens of low-powered Chinese Nationalist stations (1947).

It was in 1947 that Bill began listening



Bill Flynn and his listening post. The equipment is described in text above; unit on table in the foreground is his "home-brew" antenna tuner.

to short-wave broadcasting on an impulse. He spends most of his DX'ing time now on the s.w. broadcast bands, although he does like to tune the Aero channels from time to time.

In addition to being a valuable contributor to the POP'tronics s.w. column, Bill is



Warren Fisher, Miami, Florida, uses three receivers: at left is a Hallicrafters SX28 with a Scott 215 on top of it; at right, a Collins 51J4.

a member of the Newark News Radio Club, the Universal Radio DX Club, the International Shortwave Club (England), the New Zealand DX Radio Association, the Heureka DX Club (Norway). He is a contributor to the *Deutsche Welle DX Bulletin* (Germany) and the *World Radio Handbook* (Denmark). Fishing, geography, swapping SWL cards, and tape recording are some of his other hobbies.

Bill likes our present column setup of one feature per month plus tips arranged by country. He thinks that detailed schedules which are generally available from other sources should be kept to a minimum in favor of "best bets" and lesser known information. Bill also likes our system of reporting by post card,\* feeling that it is really convenient to jot down the information and pass it along without having to write a complete letter—a chore that would discourage many.

(Continued on page 117)

\* In addition to having reporting cards available for our POP'tronics reporters, we also have letter-size report sheets now. Either or both may be had on request.

**I**T MAY SOON be possible for anyone to "play" every imaginable musical instrument, and several unimaginable ones besides. This impending revolution in music is heralded by RCA's Electronic Music Synthesizer, on which you can set up electrical waveforms to duplicate the sound of any musical instrument, or, if you like, you can "invent" new ones by making and mixing your own blend of tone patterns on this machine. Any similarity to previously known instruments would then be purely coincidental, for the variety of sounds obtainable in this way is practically infinite.

Did you ever wish you could sing a song in a certain way—the way you felt it ought to be sung—thinking to yourself: "If I only had a good voice"? Or have you ever struggled with an obstinate piano (or trumpet or clarinet) trying to make the music sound just as you heard it in your mind? Here the RCA Synthesizer ends your frustration. It gives you any voice you want—soprano, bass, or anything between and beyond—with precisely the inflection, coloring and phrasing you want. The same machine will "play" piano or any other instrument for you with any degree of virtuosity, leaving all the shades of interpretation entirely to you.

Best of all, you can set the machine to play different instruments, then put them all together, and you have an orchestra which you can play all by yourself and which responds to you completely.

**Tatters and Totals.** To design electronic circuits that make music, we must first figure out what musical sound is. Sound can be broken down into four basic "building blocks": (1) frequency (=the

**Electronic Music Synthesizer** is operated here by its designer, Dr. Harry Olson, who punches the keyboard at rear; his associate, Herbert Belar, adjusts filter and amplifier settings. The device can create unlimited varieties of sound, including the imitation of known musical instruments. It can also generate all sorts of rhythm patterns. Turntable in back of Dr. Olson records the output.

pitch of a note); (2) timbre (=particular mixture of overtones or harmonics that lends a characteristic color to the sound); (3) loudness; (4) duration. The last two form the "envelope" of the wave, which determines the way the sound begins, grows and dies away between its start and finish.

Instead of tearing musical sound into

# Music by Proxy

By H. H. FANTEL

Associate Editor





**Dr. Olson translates** musical score into punched code on "typewriter" keyboard of the Synthesizer (above). The machine converts code to sound recorded by cutter on lower disc (below). Upper disc combines tracks in simultaneous playback.



these separate tatters, the RCA Synthesizer reverses the process and builds up the sound by generating these "building blocks" and adding them up into a tonal total.

This is quite similar to what synthetic chemists have been doing for years: they analyze a substance into its component molecules; then they make a synthetic duplicate of the same molecule pattern to create an artificial version of the real thing. The RCA machine does the same for music.

Yet, to say that music is "nothing but" these basic elements is akin to saying that a cathedral is just a pile of stones. The essence of the end product lies in the way the "building blocks" are put together. It

is this element of over-all design that makes any structure, whether stone or tone, meaningful and vital. That's why there can be no machine substitute for architects or musicians, or for anything else requiring the creative spark of life.

Like all robots, the Synthesizer can do no more than follow instructions from its human master. It has no musical sense of its own. It can only reflect the feeling and expression of the man at the controls.

**The Innards.** If the Music Synthesizer were "to sing its heart out," it would spew forth a roomful of intricate circuitry. Square-wave oscillators provide the basic frequencies. Multipliers and sawtooth converters add harmonics, and cascaded filters and resonator circuits shape the precise overtone pattern for every tone. Gain controls govern the swelling and subsiding of sound. To tie one note to the next in the gradual swoop musicians call "portamento," a special glide oscillator provides the necessary frequency change for six different kinds of glide. Besides, there are circuits for producing the incidental sounds of music, such as bow-scraping, valve tapping, and other random effects typical of "live" performance.

After passing through this electronic gauntlet, the finished tone finally arrives at a disc recorder and is engraved on acetate. All this happens in total silence. Only later, in playback, does the synthesized sound become audible for the first time through a loudspeaker.

To play the Synthesizer, you punch out the music on something that looks like a typewriter. This "typewriter" turns out a perforated tape similar to old-fashioned player-piano rolls. From this, the Synthesizer "reads" the necessary data for every tone, all broken down into the basic "building blocks." Only one melody, voice or instrument line is punched at a time and recorded on a separate track. By combining the various tracks in simultaneous playback, they are made to sound together as an orchestra.

**Adventure for the Ear.** Nobody intends the Music Synthesizer to replace musicians. Mr. Petrillo can rest assured. But it may definitely affect the music you hear in the future in the form of special effects added to the usual orchestra. With the Synthesizer, composers can go beyond all known sounds and make up entirely new experiences for the ear. Fast, tricky rhythm might be used which no human player could manage. The sound-equivalent of a whole orchestra could be made to throb in such stirring tattoo.

Add to this the sound of instruments never built, their voices made up with

*(Continued on page 122)*

# HEATHKITS . . . are fun to build, and you save by dealing directly with the manufacturer!



It's easy to follow simple step-by-step directions with large pictorial diagrams as your guide. You save labor costs and get more real quality for less money. Your greatest dollar value in fine kit-form equipment.

## BUDGET YOUR PURCHASE . . .

We invite you to take advantage of the HEATH TIME PAYMENT PLAN on any order amounting to \$90 or more. Just 10% down, and the balance in twelve easy monthly payments. Write for complete details.



MODEL V-7A

**\$24.50**

Shpg. Wt. 7 lbs.

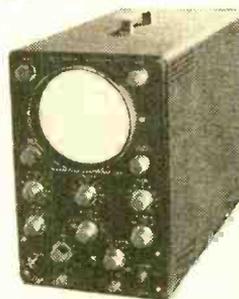
\$2.45 DWN.,  
\$2.06 MO.

*Largest selling VTVM  
in the world!*

*. . . etched circuit board*

### HEATHKIT VACUUM TUBE VOLTMETER KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit boards. AC (RMS) and DC voltage ranges are 0-1.5, 5, 15, 50, 150, 500 and 1500. Peak-to-peak AC ranges are 0-4, 14, 40, 140, 400, 1400 and 4000 volts. Ohm-meter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K and X1 megohm.



*New  
improved . . .  
full 5" size  
. . . etched  
circuit  
for only*

**\$42.50**

Shpg. Wt. 21 lbs.

\$4.25 DWN.,  
\$3.97 MO.

MODEL OM-2

### HEATHKIT 5" PUSH-PULL OSCILLOSCOPE KIT

This new and improved oscilloscope sells for less than the previous model. You can have a full 5" oscilloscope at the remarkably low price of only \$42.50. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 MC, and down only 6 DB at 1.5 MC. The sweep generator functions from 20 CPS to over 150 KC. Amplifiers are push pull, and modern etched circuits are employed in critical parts of the circuit. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, three-position step attenuated input, adjustable spot shape control, and many other "extras."



MODEL M-1

**\$14.50**

Shpg. Wt. 3 lbs.

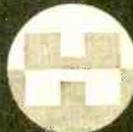
\$1.45 DWN.,  
\$1.22 MO.

*Compact, portable . . .  
a favorite in the home  
and in the service shop*

### HEATHKIT HANDITESTER KIT

Measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10MA and 0-100MA. Ohm-meter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

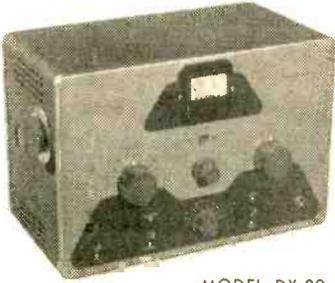
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*A Subsidiary of Daystrom, Incorporated*



BRAND NEW MODEL

**HEATHKIT**

**CW TRANSMITTER KIT**



\$3.60 DWN.,  
\$3.02 MO.

MODEL DX-20

**\$35<sup>95</sup>**

Shpg. Wt. 18 lbs.

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



MODEL SG-8

**\$19<sup>50</sup>**

\$1.95 DWN.,  
\$1.64 MO.

Shpg. Wt. 8 lbs.

POPULAR WITH SERVICEMEN

**HEATHKIT**

**RF SIGNAL GENERATOR KIT**

Produces RF signals from 160 KC to 110 MC on fundamentals on 5 bands, and covers 110 MC to 220 MC on calibrated harmonics. Output may be pure RF, RF modulated at 400 CPS, or audio at 400 CPS. Preadjusted coils eliminate the need for calibration after completion.



MODEL AR-3

**\$30<sup>75</sup>**

**HAM BANDS  
CLEARLY MARKED**

incl. Fed. Excise Tax  
(less cabinet)  
Shpg. Wt. 12 lbs.

\$3.08 DWN.,  
\$2.58 MO.

**HEATHKIT COMMUNICATIONS-TYPE**

**ALL BAND RECEIVER KIT**

This receiver covers 550 KC to 30 MC in 4 bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer-type power supply — electrical bandspread — antenna trimmer — separate RF and AF gain controls — noise limiter — headphone jack — and automatic gain control. Built in BFO for CW reception.

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



MODEL GD-1B

**\$19<sup>95</sup>**

\$2.00 DWN.,  
\$1.68 MO.

Shpg. Wt. 4 lbs.

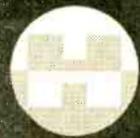
FULL SET OF COILS  
INCLUDED WITH KIT

**HEATHKIT GRID DIP  
METER KIT**

An instrument of many uses for the ham, experimenter, or serviceman. Useful in locating parasites, neutralizing, determining resonant frequencies, etc. Covers 2 MC to 250 MC with prewound coils. Use to beat against unknown frequency, or as absorption-type wave-meter.

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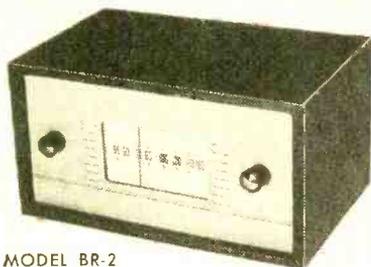
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**EASY TO BUILD**  
**... A "LEARN-BY-DOING" EXPERIENCE**  
**HEATHKIT BROADCAST BAND**  
**RECEIVER KIT**

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

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



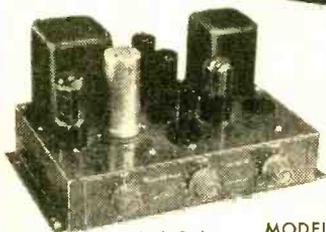
MODEL BR-2

**\$192.5**

incl. Fed.  
Excise Tax  
(less cabinet)

\$1.93 DWN.,  
\$1.62 MO.

Shpg. Wt. 10 lbs.



incl. Fed.  
Excise Tax  
\$1.87 DWN.,  
\$1.57 MO.

MODEL A-7D

**\$186.5**

Shpg. Wt. 10 lbs.

**REAL HI-FI PERFORMANCE**  
**AT MINIMUM COST**  
**HEATHKIT 7-WATT**  
**AMPLIFIER KIT**

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

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

MODEL CR-1

**\$87.5**

incl. Fed.  
Excise Tax  
Shpg. Wt. 3 lbs.

\$ .88 DWN.,  
\$.73 MO.



**... INTERESTING PROJECT FOR ALL AGES**

**HEATHKIT**  
**CRYSTAL RECEIVER KIT**

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

**FOR AMATEUR OR PROFESSIONAL**  
**PHOTOGRAPHERS**

**HEATHKIT**  
**ENLARGER**  
**TIMER KIT**



MODEL ET-1

**\$11.50**

Shpg. Wt. 3 lbs.

\$1.15 DWN.,  
\$.97 MO.

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

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**NEW EDGE-LIGHTED  
TUNING DIAL FOR  
IMPROVED READABILITY**

**HEATHKIT HIGH FIDELITY  
FM TUNER KIT**

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

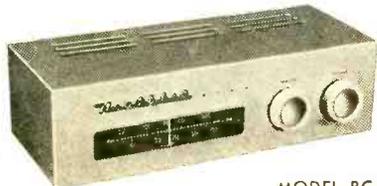


MODEL FM-3A

**\$26<sup>95</sup>**

incl. Fed. Excise Tax (with cabinet)  
Shpg. Wt. 7 lbs.

\$2.70 DWN.,  
\$2.26 MO.



MODEL BC-1

**\$26<sup>95</sup>**

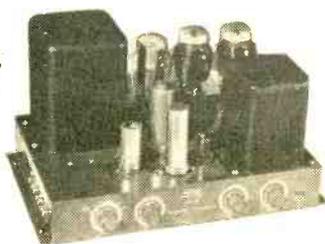
incl. Fed. Excise Tax (with cabinet)  
Shpg. Wt. 8 lbs.

\$2.70 DWN.,  
\$2.26 MO.

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

**HEATHKIT BROADBAND  
AM TUNER KIT**

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



MODEL A-9B

**\$35<sup>50</sup>**

Shpg. Wt. 23 lbs.

\$3.55 DWN.,  
\$2.98 MO.

**FULL 20 WATTS FOR PA  
OR HOME APPLICATIONS**

**HEATHKIT 20-WATT  
AMPLIFIER KIT**

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

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FEATURES GOOD LOOKS

AND HIGH PERFORMANCE

**HEATHKIT HIGH FIDELITY  
SPEAKER SYSTEM KIT**

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



MODEL SS-1

**\$39<sup>95</sup>**

\$4.00 DWN.,

\$3.36 MO.

Shpg. Wt. 30 lbs.

ATTRACTIVE STYLING  
MATCHES MODEL SS-1

**HEATHKIT HIGH FIDELITY  
RANGE EXTENDING  
SPEAKER SYSTEM KIT**

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



MODEL SS-1B

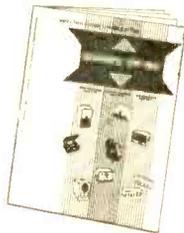
**\$99<sup>95</sup>**

\$10.00 DWN.,  
\$8.40 MO.

Shpg. Wt. 80 lbs.

**Free 1957 CATALOG**

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



**HOW TO ORDER**

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

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Quantity	Item	Model No.	Price

Enclosed find  check  money order for \$\_\_\_\_\_. Please ship C.O.D.  postage enclosed for \_\_\_\_\_ lbs. On express orders do not include transportation charges — they will be collected by the express

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

POSTAGE  
TOTAL

# Radar Scores SAC Bombing Test

AIRMEN cried "Bombs away!" but instead of devastating blasts the only visible evidence of the crew's ability to destroy a target was cryptic electronic signals observed by technicians at work inside a special radar station.

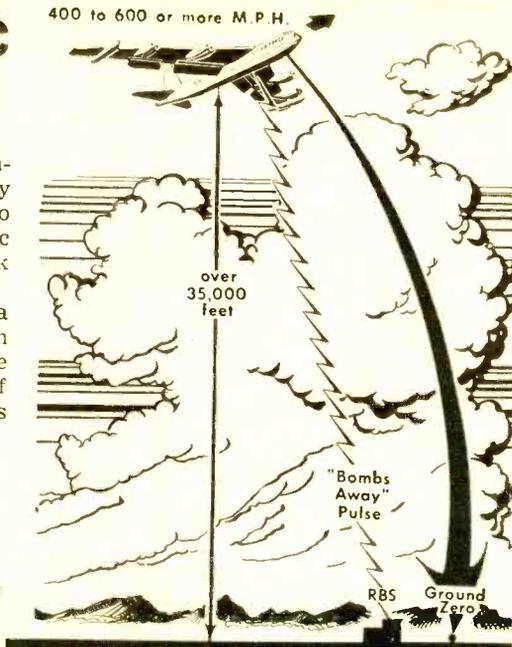
This was the general picture during a recent bombing and navigation competition between the huge bombing planes of the Strategic Air Command (SAC). Some of the nation's top bombardiers and crews



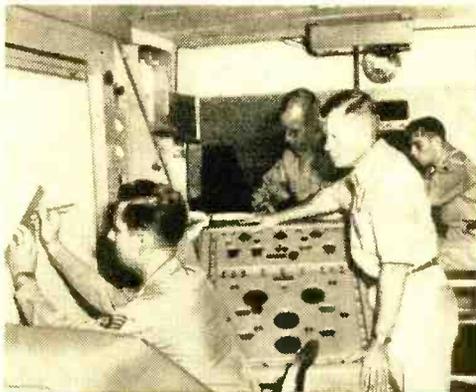
were rated with unflinching accuracy, yet they never released one real bomb. It was all done by radar and computers, linked together to form an ingenious tracking and scoring system that has also been used as a valuable training aid for fledgling airmen.

Here's what happens: when the airplane signals "Bombs away!" a radar pulse is sent from the bomber to the ground station, known as a Radar Bomb Scoring (RBS) unit. The station is built inside a mobile van. A Mobile Radar Control System (MSQ) in the van uses the received pulses to track the course of the bomber, while computers determine the accuracy of "hits." Blips across a radarscope represent the flight path of the plane. The results of the scoring computer are shown as a thin red line traced by an electronic "pen" on a sheet of blank paper. With this data, the RBS group working in the van knows just where the "bomb" hits.

Variable factors such as wind drift are taken into account by the computers. Pinpoint accuracy enables the RBS personnel to judge the amount of error in the bom-



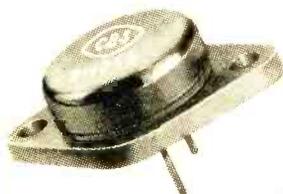
At "Bombs away!" signal, radar pulse sent from plane is received at Radar Bomb Scoring (RBS) station. Computers then graph hit or miss. Left, Col. Harold A. Strack, RBS Group Commander, watches sky from atop van housing Mobile Radar Control System (MSQ). Pulses received by antenna at his left are translated into data and plotted by technicians shown below at work inside RBS control station.



bardier's salvo. Similarly, the scores can estimate the amount of damage that would ensue with a hit.

As a training aid, the RBS system provides crews with a sense of realism previously missing from mock bombing runs. The MSQ radar and computing equipment was manufactured for SAC by the Reeves Instrument Corp., a subsidiary of Dynamics Corp. of America, 25 West 43 St., New York 36, N. Y.

**NOW**  
**... LOW-COST**  
**POWER**  
**TRANSISTORS!**



**2N255 ... \$2.95**



**2N256 ... \$3.45**

*Reliable products  
 through Advanced-Engineering*

CBS, leading manufacturer of power transistors for automobile radios and industrial equipment, offers you new low-cost power transistors delivering up to 10 watts output in Class B! Now you can build a variety of economical transistorized amplifiers capable of real power output.

The 2N255 and 2N256 PNP alloy-junction germanium transistors are designed for six- and twelve-volt battery operation respectively ... ideal for mobile use. They feature high power coupled with high current amplification and their construction permits high heat dissipation.

Check the typical operating data. Order the 2N255 and 2N256 from your CBS Tube distributor ... they are available now!

**TYPICAL OPERATING DATA**

	2N255	2N256	
<b>Battery voltage</b>	6	12	<b>volts</b>
<b>Class B push-pull output</b>	5	10	<b>watts</b>
<b>Class A output</b>	1	2	<b>watts</b>
<b>Distortion at max. output</b>	Less than 10		<b>per cent</b>
<b>Power gain, Class A</b>	24	27	<b>db</b>
<b>Total max. dissipation*</b>	6.25	6.25	<b>watts</b>
<b>Alpha cutoff frequency</b>	200	200	<b>kc</b>

\*With chassis as heat radiator.

Free ... "CBS Power Transistor Applications"

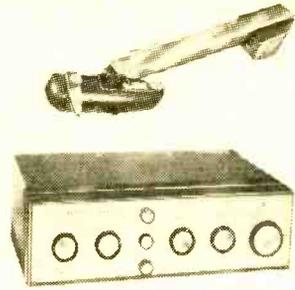
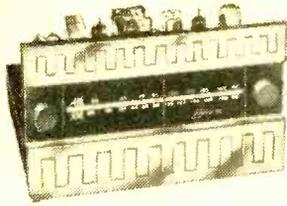
This easy-to-read booklet gives data and operating notes for the CBS 2N255 and 2N256 in addition to six simplified power transistor circuits: Regulated power supply ... code practice oscillator ... d-voltage multiplier ... relay control ... portable phonograph ... and mobile public address system. It's free ... from your CBS Tube distributor. Or write direct. Ask for CBS Power Transistor Applications, PA-16.



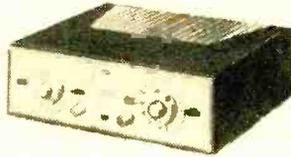
**semiconductors**

**CBS-HYTRON**

Semiconductor Operations, Lowell, Mass.  
 A Division of  
 Columbia Broadcasting System, Inc.



## what's new in hi-fi



Shown here and discussed in text: top row, left to right, Lafayette FM-AM tuner kit KT-100, Ercona's Dekamix Record changer, Metzner's new "Starlight" tone arm; directly above, Brociner Mark 20 "all-in-one" amplifier; extreme left, Librascope bulk tape eraser; directly left, Scott FM-AM stereo tuner.

**C**OMPONENTS . . . components . . . components. To help see the trees through the forest, your editors will use this column to present an interesting variety of components each month—both finished and in kit form.

Using an Armstrong circuit for FM, and a superhet for AM, Lafayette's new tuner kit will please any cost-conscious hi-fi'er handy with a soldering gun. Response on FM is claimed to be 20 to 20,000 cps. A.f.c. is used. Price, \$34.95. (*Lafayette Radio*, 100 Sixth Ave., New York, N. Y.)

More on the low-cost front: a new model of the Dekamix record changer, featuring intermix action and a 4-pole motor, is being sold for \$29.95. The turntable is weighted and balanced. A rubber mat on its surface protects discs and reduces noise pickup. (*Ercona Corp.*, 551 Fifth Ave., New York 17, N. Y.)

Looking for a moderately priced all-in-one amplifier? Check the Brociner Mark 20. This unit features complete audio controls, tape take-off jack, plus audio power up to 20 watts for driving your speaker. Use of printed circuits has reduced chassis dimensions to "pancake" style proportions. Baxandall tone control circuits are used. Price is \$99.75. (*Brociner Electronics Corp.*, 344 E. 32 St., New York, N. Y.)

A "Starlight" transcription arm has been announced by Metzner, the maker of the

turntable of the same trade name. The arm is counter-balanced and has convenient weight adjustment from 4 to 14 grams. It nets for \$25.00. (*Metzner Engineering Corp.*, Dept. 14, 1041 N. Sycamore Ave., Hollywood 38, Calif.)

To meet the demand for stereophonic or "binaural" broadcasts, as well as provide top-quality single-channel FM and AM reception, Scott has designed a tuner with completely separate FM and AM sections. Either or both sections may be played simultaneously. What's more, the FM section can receive multiplex signals (a type of super hi-fi FM broadcasting that may be used in the near future). The tuner nets for \$199.95. (*H. H. Scott, Inc.*, 385 Putnam Ave., Cambridge 39, Mass.)

Tape fans, attention! A new bulk tape eraser known as "N-HF NOISERASER" can remove unwanted signals from an entire tape reel in a matter of seconds. It operates from any 117-volt a.c. outlet. (*Librascope, Inc.*, Burbank Div., 133 E. Santa Anita St., Burbank, Calif.)

-30-



**Cutting your own records?** Presto's K-11 disc recorder, at right, is a portable, 3-speed device for making records up to 13½" in diameter. Twin-speaker system for playback is housed in K-11's lid (not shown) which fits over turntable. Details are available from Presto Recording Corp., Paramus, N. J.

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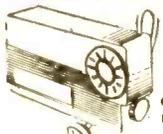
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Your choice of ANY \$1 KIT FREE!

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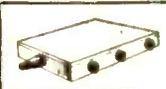
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⑥ By top US mike maker! Plastic case for hand or table use. Sensitive, crisp, 100-8,000 cps. Shielded cable. In orig. mfrs. cartons.

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- 2 175-FT. HOOKUP WIRE IN 25-ft. rolls. Ass'td. colors, stranding, insulation. 18 to 24. Wt. 2 lbs. Reg. \$3.75. **\$1**
- 3 20 AC/DC LINE CORDS for clocks, motors, etc. Molded plugs. 2 cond. Wt. 1 lb. **\$1** Reg. \$5.
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# Sound



# Impressions

**“WE’RE RUNNING** out of piano concertos! The hi-fi crowd just can’t get enough of them.” This outcry of mixed triumph and despair by the repertory director of one of the largest record companies points up another curious relation between music and hi-fi. What accounts for the unusual popularity of piano concertos among hi-fi record buyers?

First of all, let’s define a “concerto.” It is a large piece of music, usually in three separate movements, in which a solo instrument is set off against an orchestra. This invariably means plenty of tonal contrast through the interplay of the agile standout voice of the solo instrument and the massive body of sound created by the orchestra. Such tonal contrast is real “meat” for hi-fi.

A concerto may involve any kind of solo instrument—violin, cello, trumpet, saxophone, oboe, etc. But piano concertos give your hi-fi system a special workout as the percussive piano beats against the solidly sustained tone masses of the orchestra.

For the past 150 years, since the invention of the modern hammer piano, composers themselves have been fascinated by the exciting sound patterns of keyboard cascades rippling against reedy woodwinds or softly humming strings. A moment later, the piano’s sweet tinkle may change to stormy crashes of full chords, hammered with shattering force against the bellow of orchestral horns. Such sonic contrast flings a hard challenge at the electronic designer

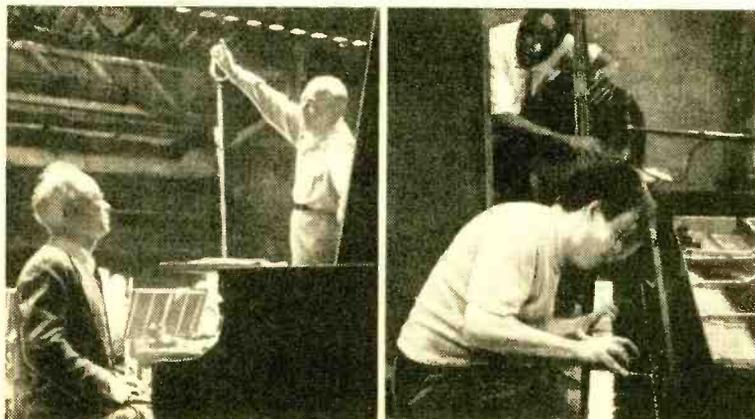
to create equipment able to withstand the steep transient wavefronts without budging into distortion.

The hard, percussive phase of a piano tone when the hammer first hits the string has up to 100 times the force of the sustained sound that follows. Moreover, the impact carries with it intense transients in the uppermost range, which must be reproduced cleanly to convey an impression of the pianist’s touch. The rise of these high amplitudes is almost as sudden as that of a square wave.

And while following these peaks, the sound system must, at the same time, do justice to the delicate coloring of soft strings or woodwinds that may be playing along with the piano. This is admittedly a tough task for any phonograph, because intermodulation at these peaks grates this multi-textured sound pattern into shapeless tonal hash. But when the equipment and the recording are equal to the technical demands, they offer the listener one of the greatest thrills in the combined realms of music and high fidelity.

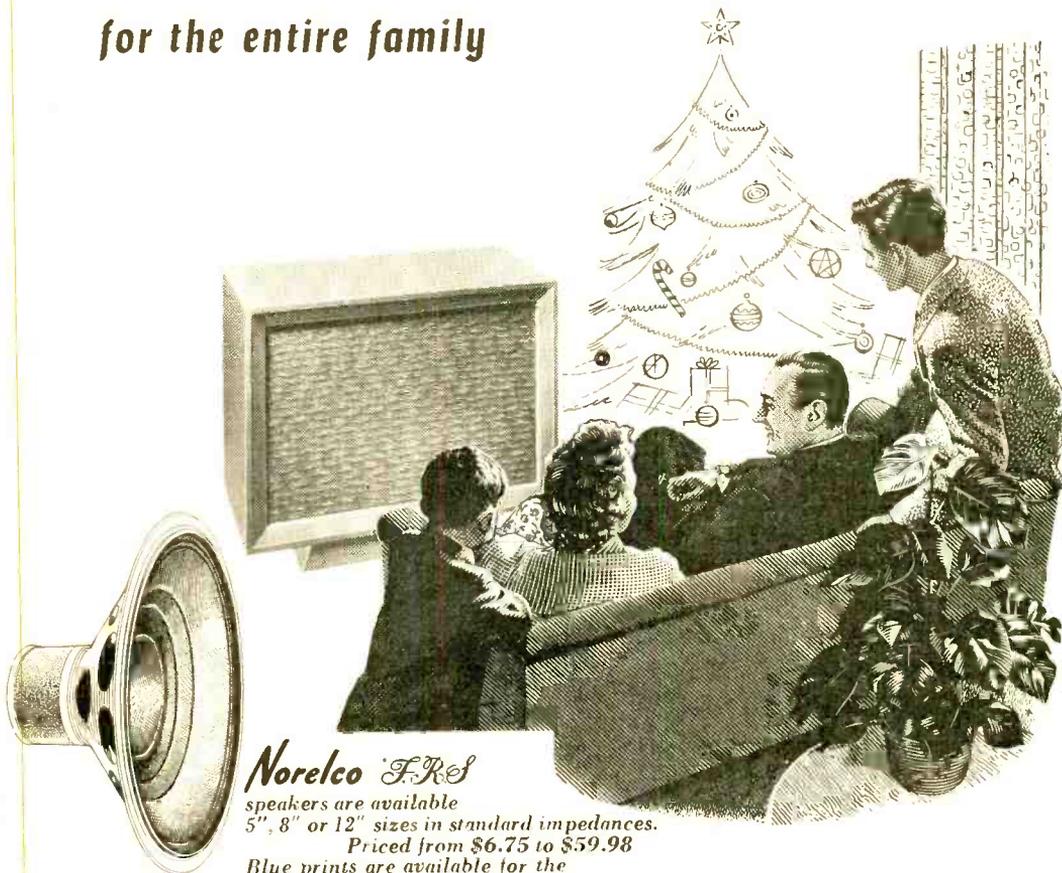
**Adventures in Sonority.** The piano concertos discussed here are representative of piano and orchestra combinations over the past seventy-five years, more or less from the time composers began using large orchestras capable of the tonal variety so dear to hi-fi fans.

An excellent point of departure is Brahms’ *Concerto No. 2 for Piano and Or-*  
*(Continued on page 110)*



**Classical** and jazz pianists differ in mood but are alike in their absorption in the music. Rudolf Serkin (left) gets a cue from conductor Ormandy for a “take” of the Brahms concerto. At right, maverick jazzman Villegas pours rhythmic rapture into the mike.

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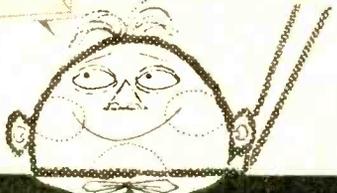
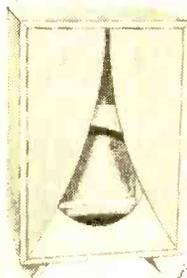
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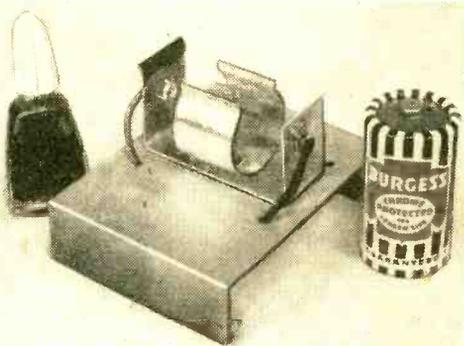
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# TIPS and TECHNIQUES

## POLARIZED BATTERY CLIP

Most of the spring battery clips or "battery boxes," so popular in R/C gear, transistorized units, and portable battery-operated equipment, suffer from a common disadvantage—they are not "polarized." A



battery may be inserted in either of two ways, and there is no convenient way of telling how a battery is to be installed unless you are familiar with the equipment, or take time to trace out the wiring. With some types of equipment, installing a battery with reversed polarity may result in damage to components.

Here's a little trick you'll find helpful for "polarizing" battery boxes. Simply paint the positive side of the clip with one or two coats of red finger-nail polish . . . your wife will never miss the small amount you'll use. But don't cover the contact terminal . . . or you'll insulate it! —G. R.

## BREADBOARD SOCKET MOUNTING

If you are building breadboard models of circuits, and you don't have any small brackets or spacers normally used for mounting octal and miniature tube sockets, try using ordinary screws. For the octal socket, solder the mounting flange to No. 8 one-inch flat-head wood screws. For the miniature sockets, use No. 8 round-head screws. Both types are shown in the drawings on page 103.

For ease of soldering, with miniature sockets, try this procedure. First, drive the round-head screw into the wooden bread-

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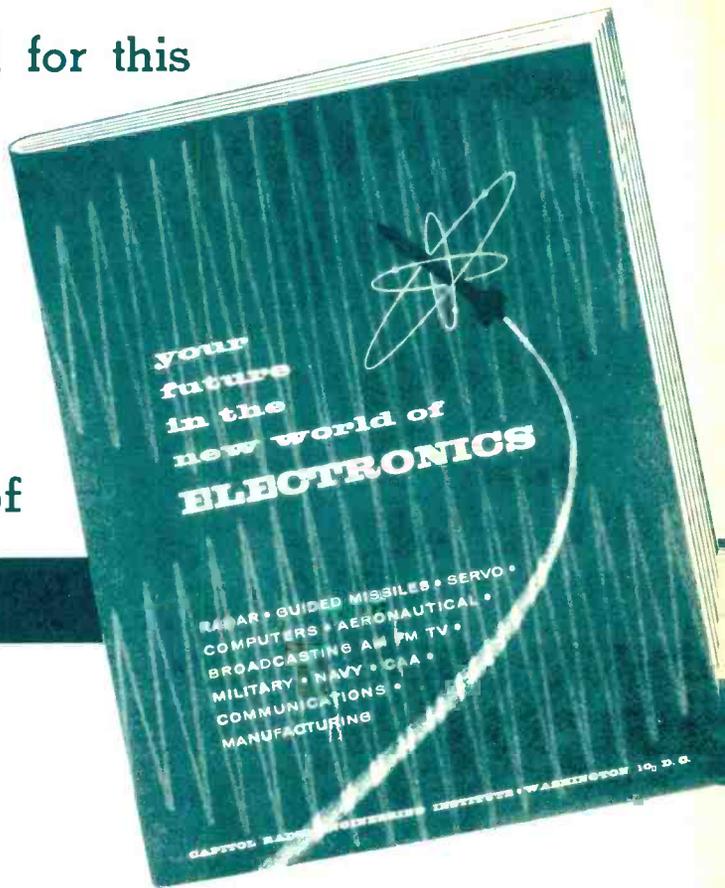
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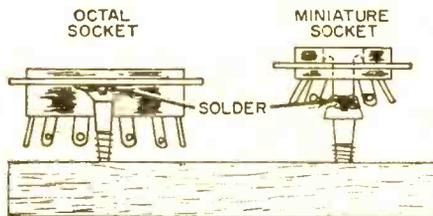
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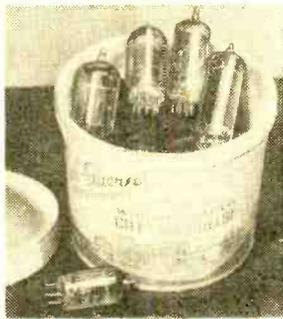
board. Then, remove the screw and solder the top of the screw to the bottom of the collar in the center of the socket which is used for ground connections, junctions, etc. Next, replace the screw in its original hole.



The mounting of the miniature socket will not be as sturdy as that of the octal, but it will serve well as long as no undue pressure is placed on it. —B.E.

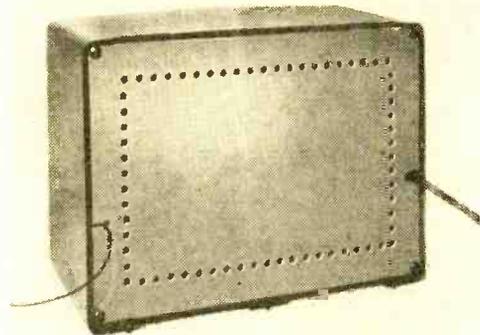
### HANDY TUBE CONTAINER

A cheap and convenient way of storing and carrying a set of tubes, or quantity of small parts, is in an empty cheese or butter container. As shown in the photo, a 16-ounce size container will hold the tubes from an average receiver. The carton itself is quite sturdy and water-resistant. And don't forget the lid—it can provide protection for the parts. —H. L.



### NEW BACKS FOR OLD SETS

Table radios and other small equipment may be missing their protective back panels. Others may have backs that are badly bent or broken. It's a good idea to keep the back of a set in good shape. It



helps prevent dust, rust, and the danger of shock to the prying fingers of small children.

The photo shows an old a.c.-d.c. table

December, 1956

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radio with a new, homemade back panel. This panel was made from 9-ply brown sign-painter's cardboard. A sheet measuring 28" by 44" is available at most stationery or art supply stores for about 45 cents. Often, sign-painters have scraps around that they will let you have for a little or nothing.

Lay out the size and shape for the panel, and then cut with a razor blade. The corner mounting holes, as well as the rows of ventilating holes, can be made easily with a dime-store paper punch. Slots for antenna wire and power cord are cut out with a razor blade.

—A.T.

### MIKE DOUBLES AS EARPHONE

In an emergency, the crystal microphone often furnished with home tape recorders can be used as a monitoring or playback earphone. This is possible because action of the crystal element is usually reversible.

When used as a microphone, the pressure applied to the crystal by the sound waves of the voice distorts the crystal in varying degrees as the voice varies, producing a correspondingly varying voltage fed into the recorder. Conversely, when the recorder output voltage is applied to the crystal during playback, the resulting deformation of the crystal vibrates the air in step with the output voltage variations, thereby producing the sound of the program. Prolonged

use as an earphone may damage the mike, however.

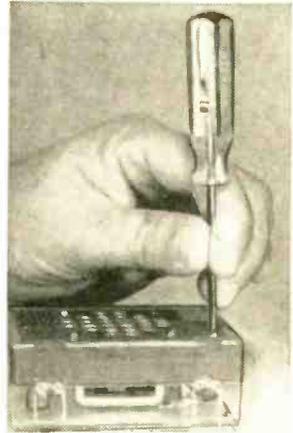
—E.F.C.

### SCREWDRIVER "DODGE"

Jewelers' screwdrivers are so designed that it is difficult to apply excessive torque with them, which might damage the threads of fine screws. If you have to work with small screws, but don't have a set of jewelers' screwdrivers, here's an easy-to-use "dodge."

Use your smallest regular screwdriver, but instead of holding it by the handle, grasp its shaft between your thumb and forefinger. You'll find that you can control it quite easily, with a truly "delicate touch." You can spin it back and forth rapidly, but it is almost impossible to apply enough torque to damage miniature screws.

—E. G. L.



**NEW! Audax** compass-pivoted **TONE-ARM**  
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The new KT models exactly duplicate the Audax "Compass-Pivoted" transcription arm long recognized as top "blue chip." These new arms are the crowning achievement of a quarter-century of constant refinement and re-engineering of the very first commercial electronic pickup arm (Audax 1928) . . . to the fewest possible parts. It is this very *nth* degree engineered simplicity that makes the new KT arms possible.

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1LD5	.57	6AJ5	.70	6J5	.39	7E5	.45	25Z6	.37
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1LH4	.64	6AQ5	.46	6J8Q	.85	7F7	.59	35B5	.50
1LN5	.47	6AR5	.46	6K6GT	.37	7F8	.70	35C5	.50
1NSGT	.50	6AS5	.48	6K7	.39	7G7	.75	35L6GT	.47
1R5	.50	6AS6	1.70	6K8	.65	7H7	.50	38W4	.34
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1T4	.50	6AT6	.39	6L7	.42	7K7	.75	35Z3	.39
1U4	.47	6AU4GT	.65	6N7	.60	7L7	.75	35Z5GT	.34
1U5	.42	6AU5GT	.59	6Q7	.40	7N7	.50	37	.29
1V2	.65	6AU6	.42	6S4	.40	12AT6	.37	50A5	.46
1X2	.61	6AV5GT	.65	6S4T	.45	12AT7	.66	50B5	.50
2A3	.55	6AV6	.39	6S7	.48	12AZ7	.63	50C5	.50
2A5	.57	6AX4GT	.60	6S7T	.41	12A6	.41	80L6GT	.43
2A7	.55	6AX5GT	.57	6S7H	.43	12AU7	.53	75	.42
3A4	.51	6B4G	.52	6S7J	.43	12AV6	.35	76	.42
3A5	.50	6B8	.69	6SK7	.45	12AV7	.67	77	.38
3A5	.50	6BA6	.47	6SL7GT	.55	12AX4GT	.65	78	.38
3A5	.45	6BA7	.58	6SN7GT	.55	12AX7	.58	80	.34
3A6	.46	6B5	.47	6S7	.39	12B4	.68	84/6Z4	.44
3B3C	.54	6B5T	.60	6SR7	.42	12B8A	.46	117L7GT	1.09
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3Q4	.46	6BF6	.50	6T8	.68	12BH7	.60	117Q7GT	1.09
3Q5GT	.57	6BG6G	1.15	6U8	.75	12BY7	.63	117R7GT	1.09
3S4	.47	6BH6	.50	6V3	.80	12BZ7	.61	117S7GT	1.09
3V4	.47	6B8	.47	6V6GT	.46	12C6	.95	117T7GT	1.09
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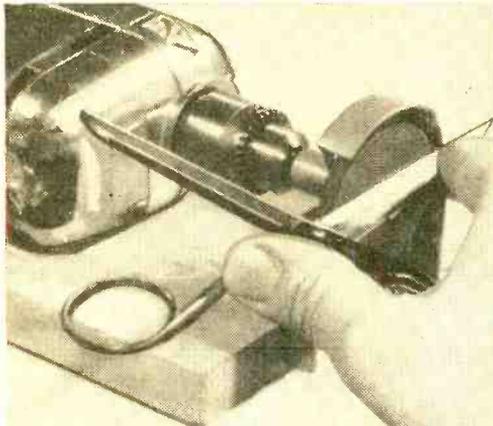


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G2 is priced at \$2.95. A larger, professional model, for drills up to 1/2" size, is also available; it is priced at \$5.95 when supplied with a hard, general-purpose grinding wheel, and \$6.95 with a soft "green grit" wheel for masonry drills and carbide-tipped tools. (Popular Mfg. Co., 4115 Glencrest Rd., Minneapolis 16, Minn.)

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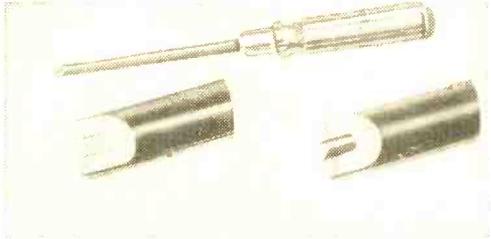


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ments are checked by using test leads on pin 4 and on pins 5 and 9; older radio and TV tube filaments may be checked by using the test leads on the large pins. Price, \$4.95. (Nutronics, Inc., 1446 N. Clark St., Chicago 10, Ill.)

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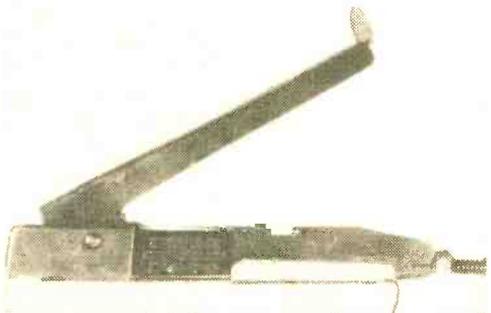
The "Magic-Tip" screwdriver not only gives a tight grip even in worn slots, but also enables the screwdriver to hold screws without being magnetized. Fashioned from



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-30-

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1U5	6BK7	6X4	19T8
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5U4G	6BZ7	7E7	25Z6GT
5V4G	6C4	7F7	35A7
5Y3	6CB6	7F8	35C5
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6AC7	6F6	12A15	35W4
6AG5	6H6GT	12A17	35Y4
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6AK5	6J5GT	12AV6	50B5
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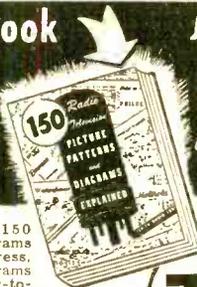
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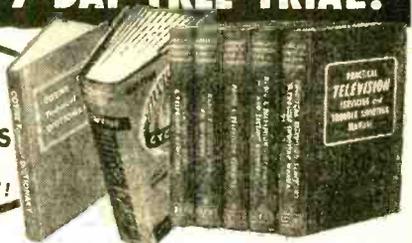
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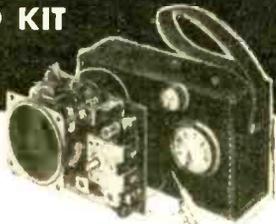
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Patent Attorney & Advisor  
U. S. NAVY DEPT. 1930-1947  
PATENT LAWYER

## Sound Impressions

(Continued from page 98)

chestra in a new version by the Philadelphia Orchestra, with Eugene Ormandy conducting and Rudolf Serkin as soloist (Columbia ML 5117). Here hi-fi recording reveals the complex interweaving of themes and harmonies, and the dramatic interplay between piano and orchestra which accounts for this work's popularity still growing nearly 80 years after its composition. The concerto is a sober but songful and often reflective work, ranging from moods of gentle fragility to thundering heights of robust vigor. This performance is splendid, matching musicianship and technical skill to the emotional demands of the score. Sonically, the pressing is one of Columbia's finest—with wide dynamic range, full concert-hall sound, and very clean surfaces.

Many composers tried to break away from the strict concerto form. Thus we find the French composer Vincent d'Indy writing what he called a *Symphony on a French Mountain Air*. Essentially a piano concerto, this work spins a simple folk tune into a major score. Thus, in addition to the piano-orchestra aspect, this composition is also fascinating in its build-up of a humble melody through a series of variations to its full-blown symphonic climax.

In a recent Angel recording (35104), conductor André Cluytens and pianist Aldo Ciccolini show full appreciation of this two-fold interest. Both the orchestra and the soloist approach the piece modestly, but with a sense of increasing intensity and assertiveness, until the final movement sweeps the listener to a rousing conclusion.

Unflagging interest in the concerto form continues, with modern composers being stimulated by its possibilities, and in turn fascinating audiences with their handling of it. Serge Prokofieff has written five, of which *Piano Concerto No. 3* is the most popular as well as the most typical of this composer's unique style. It also happens to be one of the most fiendishly difficult pieces to play. Its intricate rhythms, unusual harmonies, and fantastic sonic effects challenge the musicianship, technical skill and ability to get together and stay together on the part of soloist, conductor, and orchestra. Because of its difficulty, performances of this work are not too frequent and really good performances are very rare.

Westminster's new release of this masterpiece (*XWN 18178*) leaves an unforgettable impression on the listener. The performance is by pianist Emil Gilels, assisted by the State Radio Orchestra of the USSR,

which is conducted by Kiril Kondrashin.

A recent *Concerto for Piano & Orchestra* by Andre Jolivet is a challenging experiment. Jolivet, a young Frenchman, makes his first appearance on records in this London International release (DTL 93014). A strong and vital musical imagination speaks to us from these grooves in a highly personal idiom far removed from the traditionally melodic bend of French music. It may take a while to become accustomed to it, but if you like modernism in the style of Stravinsky, this disc is your dish. The piano often joins the percussion group in strange tonal effects contrasted against the expertly handled orchestra. The high point of the concerto is undoubtedly the middle movement; here the relentless and almost brutal rhythms give way to a dreamy, magical "night piece" of bell-like chords, gliding flute tones, and hushed tappings.

**Anti-Gravity Matter.** If any music can be guaranteed to lift you straight up into a high holiday mood, it is the waltzes of Johann Strauss. Regardless of your musical tastes, the lilting three-quarter time sweeps you along with the soaring and capering flight of melody. Favorites like *Tales from the Vienna Woods*, the *Emperor Waltz* and *The Bat* never seem to run out of the kind of upward propulsion

that takes you clear out of this world. But between the fast whirls you can float lazily for a while in sweet and slow nostalgia. So, all along the trip, you're never sure whether you are riding a rocket or a fiacre.

Bruno Walter, who leads the expedition on Columbia *ML 5113*, knows the secret of such a hybrid timetable. Mixing the rhythmic zest with easy relaxation of the melody line, sprinkled with offbeat accents, he brews intoxicating fuel for your joyride. The engineers in the booth have collected a rich sonic fare for extra-smooth going.

**Adeste Hi-Fideles.** The cream of the Christmas crop of hi-fi caroling can be skimmed off *Yuletide Songs of Many Lands* sung on Decca (*DL 9689, DL 9553*) by the Trapp Family with a wonderful mixture of piety and joyfulness. The beautifully balanced recording brings out the clarity of these beautifully blended voices.

The caroling of the Randolph Singers on Westminster (*WP 6022-3*) benefits from their profound skill in the madrigal style and makes this record a choice item for any season.

Though these carols are sure to warm his heart, the confirmed hi-fi addict needs no "special" music for his holidays. To him, all good music, well recorded, is a feast. The giving and receiving of records is bound to make his Christmas merry. —30—

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**The Transmitting Tower**

(Continued from page 84)

The switch may be mounted either in the receiver or in the control unit. With it in one position, the receiver will operate normally. In the other position, the loud-speaker will be silenced, and the relay will close when a signal is tuned in.

To test the unit, snap the switch so that the speaker is in the circuit and tune in a signal on the receiver. Snap the switch to the other position, and the relay should close. Return the switch to the first position, and the relay should open again, after a short delay as *C1* discharges. Of course, with the switch back in this position, the speaker operates again.

The amount of delay before the relay opens after the switch is snapped will depend upon the capacity of *C1*, the resistance of the relay winding, and the setting of the receiver volume control. At the higher values, the delay is longer. The values shown for *C1* and the relay are about optimum.

Adjusting the receiver volume control to the proper point is not difficult. If it is set too low, the relay may not close at all, or it will flop open during momentary pauses in the incoming signal. On the other hand, advancing it too far may permit noise to keep the relay closed even in the absence of a received signal. Check this possibility by leaving the switch in the "Control" position and tuning the receiver dial to a point where no signal is received, and notice if the relay opens as it should. If it does not, retard the volume control until it does.

**Using the Device.** This merits a little thought. If a light bulb or warning buzzer and a power source are connected to the normally closed contacts of the relay, a warning will be given as soon as the incoming signal is lost or the relay becomes de-energized for any reason—as long as nothing happens to the light, buzzer, or power source.

For automatic protection, connect the normally open relay contacts in series with the control circuit of your transmitter. Then, as long as everything is o.k., the contacts will remain closed, and your transmitter will operate normally. But, if anything goes wrong, the relay contacts will open and automatically take the transmitter off the air. In a c.w. transmitter, the obvious place to connect the relay contacts is in series with one of the key leads.

Any receiver capable of receiving nearby broadcast stations while your transmitter is on the air will be satisfactory to operate the CONELRAD control unit. Tune it to any strong station, except one operating on 640 kc. or 1240 kc., and connect its 117-volt

line cord, so that it is turned on along with your transmitter.

Remember, whether you build a unit such as described above or depend on other methods, it is your responsibility to be prepared to comply with these new regulations.

### News and Views

**Tony, ZS6CJ**, thinks that hams who make all their radio contacts "hello-goodby" affairs are missing out on much of the friendship possible through amateur radio. He and **Gregg, W2OBX**, for example, have been working each other regularly since 1934. In that time, they have both married and now have families who share their radio joys . . . **Les, WN1LDK**, has made 143 contacts in 20 states in three months on the air. He runs 25 watts of power on 80 and 40 meters into a 100' antenna, and his receiver is an S-38D.

**Pete, KN9DRR**, added a BFO to an old RCA "all-wave" receiver so he could receive code signals. He uses the Eldico TR-75 transmitter and a Windom long-wire antenna. Working 40 meters only, he has 15 states confirmed. Pete's pet peeves are hams who will not QSL or who will not ragchew a bit . . . **Dave Bergdahl (N.Y.)**, while waiting for his Novice license to arrive, summed up the results of 15 months as an SWL. His percentage of replies to cards sent was 94% from s.w. broadcast stations and just over 50% from hams. Realizing that most hams consider answering

an SWL card as doing a favor to the listener, he always included a stamped reply envelope with his reports.

In three weeks on the air with a DX-35 and SX-43, **Bill, KNØHAN**, has garnered 28 contacts in nine states. He has a center-fed, 133' antenna on 80 and 40 meters and QSL's 100% . . . **Jim, WN3EHN**, sticks to 3733 kc. Running 35 watts to a home-brew 807 transmitter, feeding a 135' wire, and using an S-38B receiver, he has marked down 22 states and Canada. Best DX is California. His General Class license is in the mail—he hopes.

Speaking of waiting for licenses, lately they have been taking around three months to come through. By the first of the year, the FCC should have nibbled down the tremendous pile of General Class renewal applications, and this long waiting period should be greatly reduced. Along this line, *Short Wave Magazine* (London) and the *R.S.G.B. Bulletin* report that, in past years, it has taken up to six months for the results of English amateur exams to be announced, but this year the results of the May examination were announced in two months. Of the 518 who sat for this particular examination, 458 passed, but these still had to pass a 12-wpm code test before receiving their licenses.

**Ron, KN4GNW**, uses an AT-1 transmitter and an S-38D receiver, and he operates on 80, 40, and 15 meters with a Windom antenna. For 15 meters, he also has a "Quad" type rotary beam, which he built for \$7.00, including

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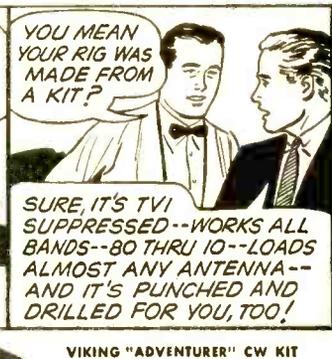
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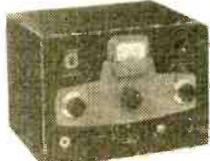
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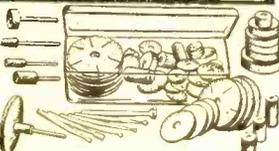
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the cost of a surplus motor to rotate it. He has worked 42 states, two Canadian provinces, and Puerto Rico in 180 contacts. Helping his sending is a code monitor he built for less than 50¢ . . . Loren, WN7EOJ, just got his ticket a month ago and has already made 250 contacts in six states—who needs sleep? He uses the dual-band Novice antenna described in March POPULAR ELECTRONICS, and he also has a "beer-can" vertical for 40 meters. A 50-watt Knight transmitter excites his antennas, and an SX-43 receiver excites his headphones.

Bob Culter, Oregon SWL, recommends a steel tape measure as a convenient temporary antenna. It certainly shouldn't be difficult to adjust it to the desired length. But it won't help KN2UBC and others with his problem. They live in places where even outside TV antennas are forbidden; therefore, putting up any sort of an amateur antenna, let alone an efficient one, presents quite a challenge. Do you have any suggestions? Marty, KN2UBC, tries to work 40 meters with a 20-watt rig and BC-455 receiver, but the antenna restrictions have cut his number of contacts down to zero. About all that can be said in favor of this record is that answering QSL cards is no problem. Let's hope, though, that it soon becomes one for him.

Steve, K2RDP, reports building a 90-watt rig he "designed" himself; so he is now on the air with a 5-watt rig that works. He is interested in hearing from other low-power enthusiasts . . . LaVerne, KNØEFB, claims the Conditional/General class examination isn't so hard. After three days of continuous study, he took and passed the examination. In five months as a Novice he has worked 31 states with his 807 running 50 watts. He receives with an S-38C . . . Skip, W2ESQ, has been helping the newcomers in his neighborhood convert "surplus" "Command" receivers (BC-454, 455, and 453) into good low-priced amateur receivers. Then, he started listening to his own propaganda. As a result, he now uses converted 454's on 20 and 40 meters feeding into a 453 in a dual-conversion superhet set-up, and finds they work as well as he said they did.

Earl, KN8CFJ, thinks he has gotten a little late start in ham radio at 51, but he is start-



KN4JBJ, Griffin, Ga., has worked 30 states from coast to coast in three months of operation.

ing at the bottom and working his way up. So far, he has constructed a 6AG7 transmitter and a three-tube receiver and has his sights set on a DX-35. A ruptured neck disc slowed him down for a while, but that is healed now; so watch him go. See his name and address in the "help" list . . . Another one who has learned that amateur radio fascinates adults as much as youngsters is **Dr. Paul Gudgel** of Danville, Ky. After 20 years of playing with radio, the bug finally bit. His AT-1 and S-77 receiver are ready to go, as soon as his Novice license arrives. This will be any day now—he hopes—because he passed the test a month before writing to the *Transmitting Tower*.

**Help Offered:** **K2IBQ, Stephen Maybar**, 379 Rockaway Parkway, Brooklyn 12, N.Y., will help Novices seriously interested in learning radio to get their General Class licenses.

**Addresses of Contributors:** **ZS6CJ, A. M. Holtzhausen**, Junette Farm, P.O. Box 72, Brits, Transvaal, Union of South Africa; **WN1LDK, L. Franklin**, 54 Alabama St., Mattapan 26, Mass.; **KN9DRR, P. Gilster**, 310 Buena Vista, Chester, Ill.; **Dave Berghadi**, 113 Elmwood St., Valley Stream, L.I., N.Y.; **KNØHAN, W. Hemme**, Terril, Iowa; **WN3EHN, J. L. Fish**, RD 5, P.O. Box 129, Irwin, Pa.; **KN4GNW, R. Collins**, Route 2, Harrisburg, Va.; **WN7EOJ, L. Gebhard**, Rt. 2, Box 640, Central Point, Oregon; **Bobby Culter**, 1317 Horseshoe Curve, Oswego, Oregon; **KN2UBC, M. Davidoff**, 2045 Rockaway Pkwy, Brooklyn 36, N.Y.; **K2RDP, 777 St. Marks Ave., Brooklyn 13, N.Y.**; **KNØEFB, LaVerne Killion**, Box 347, Gothenwood, Nebr.; **W2ESQ, M. F. Nelson**, 21 Knollwood Ave., Madison, N.J.; **Dr. Paul Gudgel**, 326 W. Main St., Danville, Ky.

That uses up all our space again. Why don't you write that letter to the *Transmitting Tower* that you have been planning to write for so long? 73 and Merry Christmas to everyone,

Herb, W9EGQ

## Thunderbolts and Whistlers

(Continued from page 40)

What is the precise mechanism of propagation of these waves? Any attempt to explain even the common types of whistlers must show how the single sharp "Bonk!" of electromagnetic energy from a thunderbolt is changed into a delayed echo many seconds long. Where did the energy go during the one or two seconds between lightning flash and whistler? The delay strongly suggests an echo or reflection from a remote point.

The German scientist, Heinrich Barkhausen, is generally credited with discovering whistlers while intercepting Allied land-line telephone conversations in World War I. Later, both Barkhausen and the English scientist T. L. Eckersley offered the theory that the pulse from the lightning flash traveled through the ionosphere. Eckersley further proposed that the earth's magnetic field would cause the energy from a flash

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1C5GT	.43	6BD5GT	.53	7C5	.42
1D5GP	.41	6BF5	.46	7C6	.43
1E7GT	.41	6BF5	.40	7C7	.45
1G6GT	.47	6BG6G	1.18	7E5	.45
1H5GT	.57	6C4	.51	7E8	.30
1LA4	.47	6B16	.47	7E7	.49
1LA6	.47	6B16	.47	7F7	.59
1L8A	.59	6BK5	.68	7F7	.70
1LC5	.49	6BK7A	.76	7F8	.70
1LM5	.47	6BL7GT	.75	7G7	.75
1N5GT	.50	6BN6	.58	7H7	.75
1R4	.86	6BD6GT	.80	7J7	.50
1R5	.51	6BQ7A	.80	7K7	.75
1S4	.59	6BY5G	.58	7L7	.58
1S5	.51	6BZ7	.57	7M7	.59
1T4	.51	6C5	.37	7Q7	.45
1T5GT	.58	6CSGT	.35	7Z4	.35
1U4	.47	6CF6	.80	7Z4	.40
1U5	.50	6C5	.47	12AT6	.66
1U6	.53	6CB6	.51	12AT7	.66
1X2A	.68	6CL6	.71	12AU6	.69
2A3	.50	6CQ6G	1.18	12BH7	.59
3A4	.51	6C9	.51	12AV6	.42
3AL5	.57	6D6	.48	12AV7	.67
3A8	.57	6E5	.37	12K6	.49
3A9B	.57	6E5	.37	12Y7	.48
3BA6	.60	6H6GT	.38	12BA6	.46
3RE6	.60	6J5	.49	12B7	.60
3Q5GT	.57	6J6	.49	12B4	.68
3B4	.47	6J7	.43	12BE6	.46
3V4	.58	6J7GT	.80	12B7	.64
5A05	.60	6J9G	.40	12J5GT	.40
5AT8	.80	6K9GT	.67	12K6	.49
5J6	.60	6G6GT	.39	12SA7	.48
5T4	.69	6K4	.39	12SA7GT	.48
5U8	.80	6K7GT	.63	12S17	.55
5U4G	.49	6K8G	.65	12S17GT	.47
5V4G	.58	6K8GT	.63	12S7	.45
5Y3G	.39	6S4	.4J	12SK7	.48
5Y3GT	.39	6S4T	.4J	12SK7GT	.50
5Y4G	.43	6S7	.48	12SL7GT	.60
5Z3	.45	6S7GT	.47	12SN7GT	.37
5Z4	.54	6S7	.41	12S7GT	.60
6A7	.57	6S7GT	.43	14A7	.47
6B4	.45	6S7	.43	10B6G	1.18
6B87	.59	6S7	.50	10T6	.48
6AC5GT	.59	6S7GT	.57	25B06GT	.85
6AC7	.67	6SN7GT	.57	25L6GT	.47
6AF4	.79	6SQ7	.41	25Z6GT	.37
6AG5	.50	6SR7	.42	3B45	.46
6AG7	.69	6SS7	.41	35B5	.48
6AH4	.80	6T7G	.63	35C5	.48
6AH6	.70	6T8	.68	35L6GT	.47
6AK5	.54	6U8	.80	35W4	.39
6AL3	.42	6V6GT	.46	35Y4	.40
6AL7GT	.70	6W4GT	.40	35Z3	.41
6AQ8	.46	6X4	.39	35Z3GT	.39
6AQ7GT	.42	6X4	.53	4675GT	.40
6AMB	.80	6X5GT	.39	50A5	.48
6AN8	.80	6B8	.75	50B5	.48
6AS5	.48	7A4-XXL	.47	50C5	.48
6AT8	.39	7A5	.43	50L6GT	.45
6AU4	.65	7A6	.45	70L7GT	.60
6AUSGT	.60	7A7	.45	11Z3	.37
6AUS	.43	7A8	.35	11Z3GT	.62

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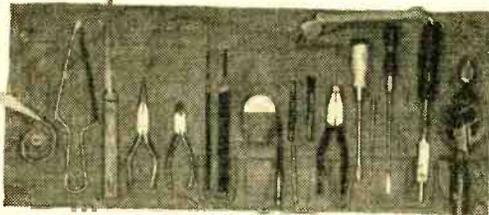
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to be split and was responsible for the generation of a whistler.

In 1950, in the famous Cavendish Laboratory, University of Cambridge, England, L.R.O. Storey took up the study of whistlers. By 1953 he had calculated that the path length of whistlers was a minimum of fifteen thousand miles. With the help of data obtained from British thunderstorm locating stations, he deduced that the waves were focused into a huge curved beam, closely following a line of force of the earth's magnetic field out into space and down into the Southern Hemisphere, and that they returned after reflection to an area around the initial flash. He proposed that the whistlers sometimes heard without a preceding "Bonk!" or "click" had originated in the Southern Hemisphere during thunderstorms there.

It seems virtually certain that whistlers will provide a valuable tool to assist in determining the nature of the "outer" ionosphere. These studies may also throw new light on partially unexplained geophysical phenomena such as "radio blackouts," magnetic storms, and the aurora.

—30—

## V.H.F. Reception

(Continued from page 59)

equipped with two-way radio sets. Most stations are in the 44.10 to 44.42 mc. frequency band. Some of the largest users are: Akers Motor Lines, Central Truck Lines, East Texas Motor Freight, Campbell 66 Express, St. Johnsburgy Trucking Co., Trans-american Lines, etc.

**Power Utility.** Maintenance of electric power lines has been greatly expedited with the introduction of two-way radio. In this category, the number of licensed transmitters is well above 20,000. In the lower v.h.f. band, they may be heard between 37.50 and 37.86 mc., or 47.70 and 48.54 mc. In the upper v.h.f. band, they are between 153.41 and 153.71 mc.

**Railroads.** It may seem strange, but a vast number of stations in the v.h.f. bands have been licensed by railroads. The Southern Pacific Railroad, for example, has approximately 1200 transmitters in operation. Other famous-name railroads have similar numbers of stations. Most transmitters are licensed for the channels between 159.63 and 161.79 mc.

**Taxicabs.** Practically every reader of POP'ronics has ridden in a taxicab with a two-way radio set. The number of such stations can only be counted in the thousands. Washington, D.C., taxicabs account for about 2000 transmitters. Base taxicab stations operate between 152.27 and 152.45 mc., and the taxicab mobile transmitters

operate between 157.53 and 157.71 mc. **Urban Transit.** This category is reserved for fixed and mobile stations that service trolley, bus and subway lines. Although many stations are spotted around 44.50 mc., the greatest number of mobile units appears between 30.66 and 31.14 mc. In this small band, the Philadelphia Transportation Co. and the United Transportation Co. (Providence, R.I.) have nearly 325 stations licensed and in operation.

Not included in the listing above are stations in the Relay Press, Motion Picture, V.H.F. Maritime, Special Industrial, Petroleum & Gas Pipeline, Citizens Service, Highway Maintenance, and Special Emergency Services.

The possibilities in this crowded v.h.f. communications monitoring field are about as varied as the imagination. The biographer of a recent book on the life of Walter Winchell tells how Winchell and the late Damon Runyon used to "ride" police and fire calls during the early morning hours for adventure and relaxation. This hobby is not restricted to newsmen—hundreds can daily sit in their armchairs, riding herd on the "megacycles" for the high adventure that lies at their fingertips on these v.h.f. bands. Such a hobby can also be a rewarding one to the free-lance writer or photographer who wants to be on the scene while tomorrow's news is "in the making."

-50-

## Tuning the Short-Wave Bands

(Continued from page 86)

The following is a resume of the current reports. All times shown are EST, 24-hour system. These reports were correct at the time of writing. Stations often make changes in frequency or schedule with little advance notice; hence, certain items may appear to be incorrect.

We are now using numbers to credit items. These numbers pertain to those reporters that have received their Monitor Identification Cards. Other reports will continue to be credited by initials.

**Australia**—The rarely noted 2-kw. outlet on 6090 kc., *VL16*, Sydney, has been heard around 0800-0817 with news. (31)

**British Guiana**—*ZFY*, *Radio Demerara*, QSL's this information: now on 5981 kc. (2 kw.), 3255 kc. (2 kw.), and 1230 kc. (500 watts). Schedule is Sundays and weekdays 0345-0915. Address: The British Guiana United Broadcasting Co., Ltd., Georgetown, British Guiana. (PB)

**Bulgaria**—*Radio Sofia* has two English xmsns nightly to N.A. from 1930-2000 and 2300-2330. The frequency is 9700 kc. (*WS, GL*)

**Canada**—English from Canada can be heard three times daily as follows: at 1955-2045 to the U.S. on 15,190 and 9630 kc.; to Australasia at 0325-0415 and to Europe at

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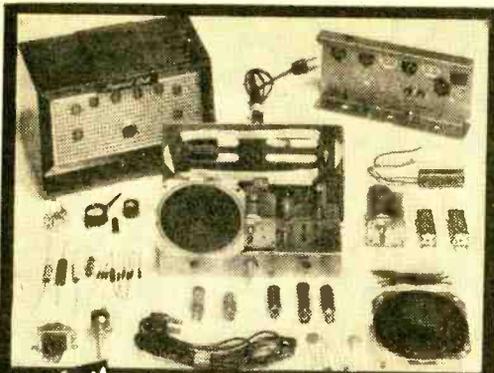
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**Ceylon**—Colombo is now on 15,265 kc. (replacing 15,120 kc.) at 1230-1600 with VOA programs. "Music USA" is broadcast at 1400-1600. This xmsn is beamed to Africa. (RL)

**Radio Ceylon**, 9520 kc., can be heard faintly around 0800 in English in a Commercial Service beam to India. (37)

**Chile**—A rare 2.5-kw. station is **CE1185**, **Radio La Aurora**, Santiago, on 11,850 kc. It is noted from 0815-0830 in Spanish. Schedule is 0700-2300. (WG)

**Colombia**—**Emisora Nuevo Mundo**, Bogota, is heard evenings on 4787 kc., replacing the inactive 6000-kc. channel. **HJFW**, Manizales, moved from 5020 kc. to 5027 kc. to provide more separation from **HJCA**, **Radio Nacional de Colombia**, on 5014 kc. (RL)

**HJBW** can be heard a few hours daily on 5055 and 9080 kc. They are running tests. (40)

**Costa Rica**—In addition to their regular English schedule on 1330-1430 and 2300-0000. **TIFC**, San Jose, **The Lighthouse on the Caribbean**, on 6037 and 9645 kc., has an extra hour of English from 2200-2300, Sundays only. New programs are "Sunday At Nine" and "The Whole Bible Series" from Dallas. (54, CM, WG, TH)

**Dominican Republic**—**HI3K**, **Ondas del Yaque**, Santiago de los Caballeros, is again being heard evenings. (RL)

**HI3C**, **La Voz del Papagayo**, La Romana, has drifted from 2440 kc. to 2420 kc. (91)

**Ecuador**—**HCJB** is heard at 1700-1730 with a religious program, at 1730-1800 with a program in Russian on 17,889 kc., and at 1800 with "Off The Record" on 9745 kc. This lat-

**Special Offer.** A copy of the "Electromagnetic Spectrum and 1955 FCC Frequency Allocations" chart can be had upon request from P. R. Mallory & Co., Distributor Division, Indianapolis, Indiana. This chart shows the usage of all frequencies from 10 kc. to 100,000 mc. It also gives other information about the bands therein.

ter program consists of messages from missionaries to friends in America. (93)

**El Salvador**—According to Mr. Ron Moyer, Guatemala City, the following stations are still operating: **YSO**, **La Voz de la Democracia**, San Salvador, on 9515 kc.; **YSDR**, **Radio Tropical**, Santa Ana, 4800 kc.; **YSI**, **Radio Imperador**, San Salvador, 6130 kc.; and **YSR**, **La Voz de El Salvador**, San Salvador, 6050 kc. Exact schedules are requested by the **World Radio Handbook**.

**France**—**Radiodiffusion Francaise**, Paris, has an English xmsn to Great Britain at 1500-1600 on 15,400 and 9625 kc. The outlet on 11,845 kc. was noted at 1850-1940 with music and news in French; s/off at 2000. (11, WF)

**French Cameroons**—A new station is **Radio Garoua**, operating on 9900 kc. from 1300-1400 with news at 1300-1310. Report to **Radiodiffusion du Cameroun**, Yaounde. (40)

**Greece**—The latest schedule of **Radio Athens** is: 0200-0315 to Cyprus on 9607 and 11,927 kc., 0400-0500 to Egypt on 11,927 kc., 0530-0830 to Cyprus on 9607 kc., 0900-1015 to the Balkans on 17,300 kc., 1030-1045 to Russia

on 17,745 kc., 1100-1200 to Cyprus on 9607 and 11,718 kc., 1215-1245 to Europe on 15,345 and 17,745 kc. (in English and French), and at 1315-1345 to Cyprus on 9607 kc. and on 11,718 kc. (40)

**Guatemala**—*Transmitiendo Gratas Nuevas Alagres* operates *TGNA*, 5952.5 kc., *TGNB*, 9668 kc., and *TGNC*, 11,850 kc. Stations on 15,100 and 17,870 kc. are inactive. Power is 5 kw. on each frequency and the schedule is 0730-0900 and 1730-2200 in Spanish, and 2200-2345 in English. (33)

*TGLA, La Voz de Centro America*, Guatemala City, 6295 kc., can be heard around 2130-

### SHORT-WAVE ABBREVIATIONS

A—Approximate frequency  
 BBC—British Broadcasting Corporation  
 c.w. QRM—Interference from code station  
 1D—Identification  
 kc.—Kilocycle  
 kw.—Kilowatt  
 mc.—Megacycle  
 N.A.—North America  
 s/off—Sign-off of station  
 SSB—Single sideband  
 s.w.—Short-wave  
 xmsn—Transmission from station  
 xmtr—Transmitter used by station  
 V—Frequency varies  
 VOA—Voice of America

2145 with music and Spanish announcements. Power is 1 kw. (SD)

**Honduras**—*HRA, La Voz de Lempira*, listed on 5920 kc., is being reported on 5890A kc. at 2230-2358 s/off with news in Spanish at 2335-2345. (31)

**HRN, La Voz de Honduras**, Tegucigalpa, was noted at 2230 with 1 kw. on 5875 kc. The schedule is 0800-2300. This is not too easy to hear. (70)

**Iceland**—*TFJ, Reykjavik*, 12,175 kc., is another hard one to log. This station operates **ONLY** on Sunday at 1115-1130 in the Icelandic language. C.w. QRM. (JB)

**India**—*All India Radio*, New Delhi, is heard on a new channel of 15,160 kc., dual to 17,720 kc., with English news at 1930-1940 and 2133-2145. Another English program is noted at 1445-1545 on 15,415 and 11,705 kc. to Great Britain. Address is P. O. Box 500, New Delhi. (4, 11, 87)

**Indonesia**—*Radio Indonesia* carries English to N.A. at 0600-0700, 0930-1030, and 1400-1500 on 9710 kc. (YDF6), 9865 kc. (YDF8), and 11,770 kc. (YDE). (11)

**Kashmir**—*Radio Srinigar* is on the air daily from 0230-0330, 0730-1430, and 2100-2300 on 7270, 6110, and 4860 kc. Reception reports to: The Director, Indian Home Service, All India Radio, New Delhi. The reports are forwarded from New Delhi to Srinigar. (38)

**Kenya**—*Radio Mombasa*, Box 2200, Sauti Ya Mvita, is operating on 4985 kc. with 1 kw. at 1030-1115 and 1205-1300 in Swahili, and at 1115-1205 in Arabic. (WRH)

**Mauritius**—*V3USE, Forest Side*, 15,037V kc., is noted at 1905-2030 with music, news, and talks, in French. Signal strength is only fair. This station is often heard to 2300A. (52)

**Mexico**—*XEBR, El Heraldo de Sonora*, Sonora, Hermosillo, 11,820 kc., has a steady signal from 1115-1130 with Latin-American music and commercial ads in Spanish. Fre-

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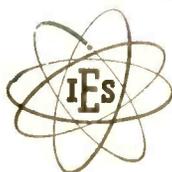
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quent identifications for **XEBR** and **XEBH** make this one a rather easy one to log. (61)

**Mozambique**—**CR7BD**, Lourenco Marques, 15,080 kc., is heard 1315-1515 s/off with music and Portuguese language. (52, 76)

**Netherlands**—Hilversum, 9590 kc., can be tuned at 2130 on Sat. with world news following the sign-on and on Sun. at 0730 with "The Happy Station Program." These xmsns are in dual with 15,365 kc. The N.A. xmsn is on the air daily at 2130-2210. The 17,725-kc. outlet carries English to 1725 s/off. (76, MA, JM, SD)

**New Zealand**—**ZL14**, 17,820 kc., Wellington, is heard quite well from 2005-0000 with mu-

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Chuck Maxant (11) Baldwin, N. Y.  
George Quay (21) Allentown, Pa.  
Peter Risse (23) Atlanta, Ga.  
Floyd Backus (26) Richmond, Va.  
Gordon Nelson (33) Inglewood, Calif.  
William Currell (37) Toronto, Ont.  
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William G. Smith (WS) Louisville, Ky.  
Arthur Teal (AT) Chester, Conn.  
Joel Whitaker, II (JW) Indianapolis, Indiana  
World Radio Handbook (WRH)

sic, news, stories, classical music, and sports. **ZL10**, 15,220 kc., operates 1500-0115 to Australia, is heard well in Eastern N.A. (38, 51, 59, WF)

**Pakistan**—Karachi is operating on a new frequency of 15,260 kc. at 0845-1000 with English news at 0945-1000. (RL)

**Radio Pakistan** can be heard 1930-2015 s/off in English and Urdu to S.E. Asia, on 17,750 and 15,335 kc. They reopen at 2030 with Oriental music. (23, 38)

**Panama**—**Radio Hogar**, operating on 670 kc. (**HOLY**) and 5960 kc. (**HOL21**), is on the air daily at 0600-2200. An Italian program was noted at 1900-1930 followed by news in Spanish to 2000. Power is 500 watts on s.w. for **HOLY**. (WRH)

**HOLA**, Colon, 9505 kc., can be noted around 1615 with dance music. (26)

**Portugal**—Lisbon on 17,895 kc. can be heard with an English program, dual to 21,700 kc., from 1200-1245. News at 1215-1222V and the remainder is music and talks. (21, 59)

**Sierra Leone**—**The Sierra Leone Broadcasting Service**, Freetown, has begun regular

xmsns on 3316 kc. with 5 kw. Other channels which may be used are 5980 and 9630 kc. Present schedule is Mon. thru Fri. at 0145-0300, 0700-0900, 1100-1745; Sat. at 0145-0300, 0700-1745; Sun. at 0100-0300, 0530-0900, and 1100-1745. They use the English, Mende, and Temne languages. Many programs are relays of BBC. Reports should go to Sierra Leone Broadcasting Service, Public Relations Office, 26A. Westmoreland Street, Freetown. (40)

**Solomon Islands**—The present schedule for VQO2, Honiara, 5960 kc., is 0200-0300 on Mon. to Sat. and a special xmsn on Wed. at 0130. There is no broadcast on Sun. The power is 100 watts. (31)

**South Africa**—The station calling itself *The Freedom Station* on approximately 5200 and 4500 kc. is no longer operating according to a news dispatch from A. M. Holtzhausen, ZS6CJ, Brits, Transvaal, South Africa. The station had been operating as an illegal station.

**Spain**—*The Voice of Spain*, Madrid, has three English xmsns to N.A. on 9360 and 6135 kc. at 2215-2250, 2315-2350, and 0015-0050. (76, WS)

**Tangier**—Two new frequencies for VOA stations are 25,920 kc., scheduled 0700-0915 to Europe and Near East, and 0915-1130 to India and Pakistan, and 25,670 kc., scheduled 0700-1230 to Europe. (RL)

*Radio Tangier International* is testing on 9490 kc. at 10-minute periods in afternoons. It has been heard at 1905-1908 and 1958-2004. Reports should go to Victor B. Bemmer, Copen-

hagen, Denmark. They hope to open a Danish program very shortly. (10, 57)

**Thailand**—*Radio Thailand*, HSK9, 11,670 kc., is being heard 0845-0900 with Oriental music and Thai language. English ID was given at 0900 and the station either signed off or faded out. (61)

**Uruguay**—*Radio El Espectador*, CXA19, 11,835 kc., was noted at 1645 with music and Spanish language. (JW)

**United States**—*The Voice of Maritime Labor* is on the air Sundays only at 1140-1215 with a continuous newscast concerning maritime labor problems, shipping, etc. The station is sponsored by the AFL-CIO Maritime Committee. WFK95, 15,700 kc., is beamed to Europe and the Mediterranean Area; WFL65, 15,850 kc., to Western South America; and WFK39, 19,850 kc., to Eastern South America and Mexico. They are asking for reception reports to: The Voice of Maritime Labor, 346 West 17th Street, New York. (54)

**Utility Stations**—On the Aero channels, Wake Island, Tokio, Saigon, Bangkok, Hong Kong, Colombo, Manila, Rangoon, Singapore and Sydney have been heard on 8871 kc., Midway Island, Hickam AFB (Honolulu), and Guam on 6738 kc. On the telephone channels, Amsterdam (20,505 kc.), Port-of-Spain (17,800A kc.), Guam (15,400A kc.), Wellington (9890A kc.), and Paramaribo (9257A kc.) have been heard with SSB transmissions. (31)

Paramaribo (17,672.5 kc.) and Dominican Republic (15,055 kc.) have been heard in the telephone service. (WF)

-30-

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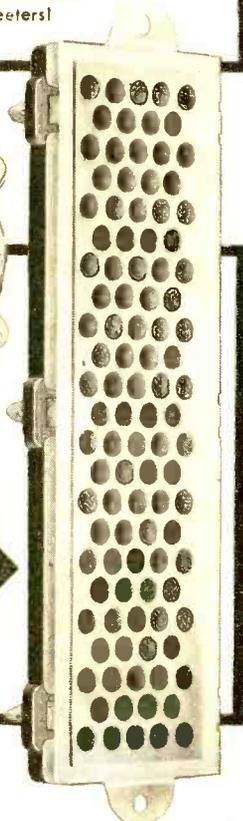
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## Electronics Finds Treasures

(Continued from page 57)

Fish was the discovery of the mountain hide-out of Joaquin Murietta. In the crag-surrounded cave which had evidently been used by the notorious outlaw of the mid-nineteenth century, the metal detector turned up rifles, knives, and other weapons. As for Murietta's reputed loot, this is as yet just one more cross on Fish's map.

As a by-product of his treasure-hunting activities, Fish has acquired an amazingly complete knowledge of California history. He has done "field" detective work for several missions and performed similar services for the State of California and historical societies.

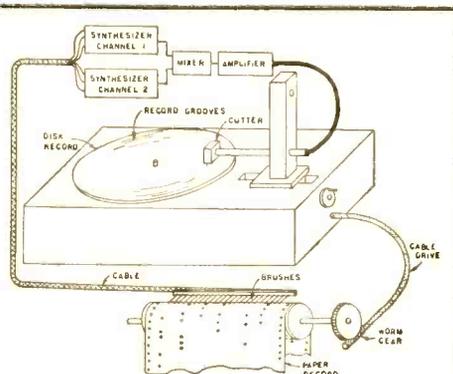
—Gordon S. Fay

## Music by Proxy

(Continued from page 88)

nothing more than the idea of what is wanted. If such instruments were actually constructed, chances are that human hands or lungs could not play them. But the Music Synthesizer spans any interval, has an infinity of "fingers," never gets out of breath, and can draw a "bow" as long as its endless arm.

What sort of music will these possibilities suggest to the minds of composers once they learn to utilize the Synthesizer? Since the human imagination is not predictable, there can be no answer to this question. But again we can compare the situation to modern chemistry. Not only has the chemist duplicated already existing substances (e.g., vitamins, silk, leather, etc.), but he has constructed new materials of his own imagination for which nature has no model, like plastics and steel. The RCA Synthesizer gives musicians a similar freedom to search for new sound "mate-

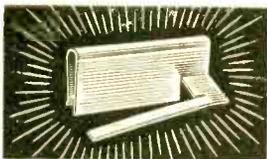


**Block diagram** of Music Synthesizer from punched tape to link-driven disc cutter.



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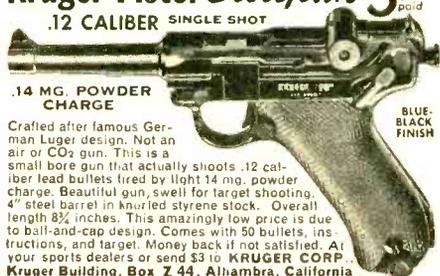
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amount of compensation indicated by the curves of Fig. 2. These refinements are handy, but not essential, because it's always possible by working back and forth between the loudness control and volume control to set up conditions that suit your ears precisely.

If your present hi-fi system does not have one, the installation of a loudness control can be a worthwhile project. It is fairly simple to do using a commercially available component for just that purpose. Details on such an installation will be given in a subsequent article.

-30-

**After Class**

(Continued from page 79)

that the charging curve of a capacitor shows it to be theoretically impossible for the capacitor ever to attain the same potential as the source, but most authorities agree that five time constant periods are enough to bring the capacitor up to *substantially* source voltage.

If the capacitor starts with a charge of 100 volts, closing key 2 permits the capacitor to discharge more or less slowly through the resistor. At the end of one time constant interval, the capacitor voltage will be 37 volts. From this, it is apparent that a capacitor follows the time constant equation on both charge and discharge, since it has *lost* 63 volts of the original 100 volts that it had on full charge.

In the experimental circuit of Fig. 2, the voltage across capacitor *C2* is applied between the grid and cathode of a tube such as a 6J5. This voltage then serves to neutralize the bias caused by the passage of plate current through resistor *R4*, so that the plate current of the tube may rise sufficiently to pull in the relay in the plate circuit. *R1* and *R2* form a voltage divider; with *S1* at point A, about 20 volts appear at the grid (with respect to ground), making the grid positive. When *S1* is moved to point B, the grid is placed at ground potential. Thus, in the first case pull-in plate current is established, and in the second case the current is too small to actuate the relay. *R3* and *C2* comprise the time delay network with the timing made variable over an appreciable range by *R3*, the 10-megohm potentiometer.

**Some Delay Sequences.** A circuit like the one in Fig. 2 makes several different sequences easily possible.

(1) *Momentary contact—fast pull-in—slow drop-out.* Move *S1* to position B. The grid thus stabilizes at ground potential and the relay remains open, the plate current being held down by the bias established by

the voltage drop across  $R_4$ . Now short-circuit point 2 to point 1. The relay will instantaneously pull in and will remain closed for a period determined by the adjustment of potentiometer  $R_3$ . Typical uses for this sequence are: photographic enlarging and contact printing timing, x-ray dosimeter timing, cutting starting resistances into motor circuits.

(2) *Momentary contact—fast drop-out—slow pull-in.* Move switch to position A. Apply power and allow warm-up time. The relay will close and remain closed. Now short-circuit point 2 to ground. The relay will drop out instantly and then pull-in again after the preset time delay period. A typical use for an arrangement like this is to de-energize a photoelectric alarm circuit for authorized passage. It then resets automatically, eliminating the possibility that someone may forget to turn it on again.

(3) *Held contact—slow drop-out—slow pull-in.* With switch  $S_1$  on position A, the relay is pulled in. Now flick the switch to position B. After the desired time delay, the relay will drop out. Moving the switch back to position A will provide approximately the same time delay interval before the relay again pulls in. The order of this sequence may be reversed, if desired, by inverting the order of the steps. That

is, start with an open relay by having  $S_1$  on position B and then go from B to A and back as described above.

If a time delay unit is to be built for actual application using the circuit of Fig. 2 as a base,  $S_1$  may, of course, be omitted and permanent connection of the wiper of  $R_3$  may be made to either point 1 or ground depending upon the sequence desired. It should also be mentioned that the "ground" of the experimental circuit is one leg of the a.c. line and that a shock hazard exists for the careless user. It cannot be over-emphasized that all electronic equipment in home use should be isolated from the a.c. lines via an inexpensive isolation transformer for protection against electrical shock and the danger of inadvertent short circuits.

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## Transistor Topics

(Continued from page 64)

ponents offered *anywhere*, get a copy of Catalog No. 300, issued by Lafayette Radio, 165-08 Liberty Avenue, Jamaica 33, N. Y. It's *free* for the asking.

**Tech Talk.** One question which comes up pretty regularly concerns transistor *life* . . . that is, how long a transistor can be expected to last in normal work. This ques-

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2D21	6A7GT	6S4	12A6	35W4
2D22	6AS5	6S7G	12AH7GT	35Y4
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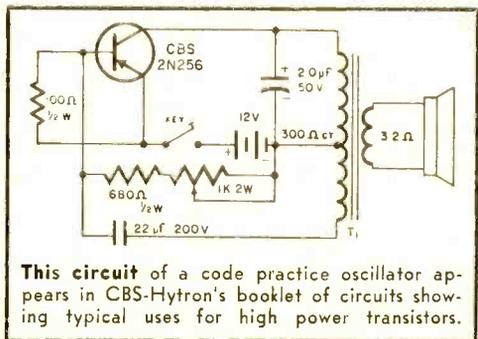
tion has many possible answers, depending on the answerer's viewpoint.

Theoretically, a perfectly made transistor, operating under "ideal" conditions, should have almost infinite life . . . there are no parts to wear out, no filaments to burn open, no cathode which can be exhausted. In fact, one scientist, writing in a professional journal, indicated that there was only one part in a piece of transistorized equipment which would have a service life as long as the transistors used—the metal chassis on which the equipment was built!

In the early days of transistor manufacturing, before production techniques were fully refined, and before hermetic sealing had become standard practice, it was not too unusual for a transistor to be "poisoned" during assembly—that is, some impurity would get into the transistor accidentally. This impurity would adversely affect the semiconductor material on which the transistor depended for its operation. Over a period of time, the transistor would go "bad," generally developing a high internal leakage. And this would sometimes happen *even if the transistor were not in use* . . . if, in fact, it were simply in storage. As a result, some transistor engineers would jokingly remark that "a transistor has infinite operational life, but limited shelf life."

Heat will also affect a transistor's life. This is especially true of germanium units, and most manufacturers will specify a "maximum storage temperature" for their products. Along with heat, electrical overload will seriously reduce a transistor's useful life. But excessive heat and electrical overloads are unusual conditions and should not occur in properly designed and operated equipment.

According to a recent report from General Electric, the replacement of transistors in portable radios and other electronic equipment may never be necessary if the units are used within limits set by the manufacturer. The report stated that life tests



This circuit of a code practice oscillator appears in CBS-Hytron's booklet of circuits showing typical uses for high power transistors.

started in 1954 on transistors picked at random from regular manufacturing lots showed no failures after 18,000 working hours at full power . . . equivalent to a maximum load of eight hours a day every day for six years. And, even after these extensive tests, the transistors acted like new units!

In contrast, especially made "premium" vacuum tubes have a survival record of only 50% after less than half this time at full power. And standard vacuum tubes, as used in home radio and TV sets, have an even shorter life.

In addition to a long operational life, transistors are extremely rugged mechanically. In experimental tests, standard transistors have withstood the shock of being fired from a mortar.

**Product News.** From RCA comes news of two new transistor types. Intended for audio work, the type 2N206 is designed primarily for military applications. The type 2N247 is a new high frequency transistor. Check your local distributor for information on availability.

*Audiophiles take notice!* Lafayette Radio (165-08 Liberty Avenue, Jamaica 33, N. Y.) is the first supplier to announce the availability of true high fidelity transistor transformers. Type numbers are AR-500 and

AR-501; their response is 20 cps to 20 kc.

Herman Fialkov, president of General Transistor Corp. (Richmond Hill, N. Y.), has announced several additions to their line. The newest unit is the type GT-109, a p-n-p transistor designed primarily for use in audio push-pull output stages. Used as a Class B amplifier, the GT-109 offers high efficiency and low battery drain.

The Lansdale Tube Company, a division of Philco, has announced a trio of medium power audio transistors . . . type numbers 2N223, 2N226 and 2N224. In driver and Class B push-pull operation, these new p-n-p transistors provide up to 300 milliwatts audio output at battery supply voltages of 3 to 12 volts.

Sylvania has announced a new power transistor, designed especially for the audio output stages of automobile radio receivers. Designated as type 2N242, the new transistor is hermetically sealed and will provide 2½ watts audio power with less than 5% distortion, when operated Class A from a 12-volt power source.

That's it for now, fellows. Hope you have a Merry Christmas and find loads of transistors and components in your stockings . . . and don't forget to save a little Egg Nog for Santa. . . .

Lou

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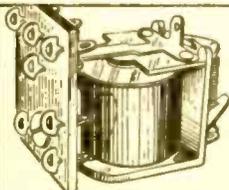
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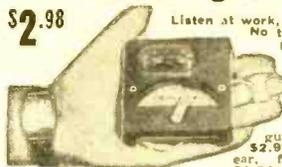
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**24 PAGE Handbook "Crystal Set Construction"** including Experimenters' catalog-30¢. Laboratories, 328-L Fuller, Redwood City, California.

**TRANSISTOR Kits.** Free Information. Transit Electronics, Box 15-P5, Alden Manor, N. Y.

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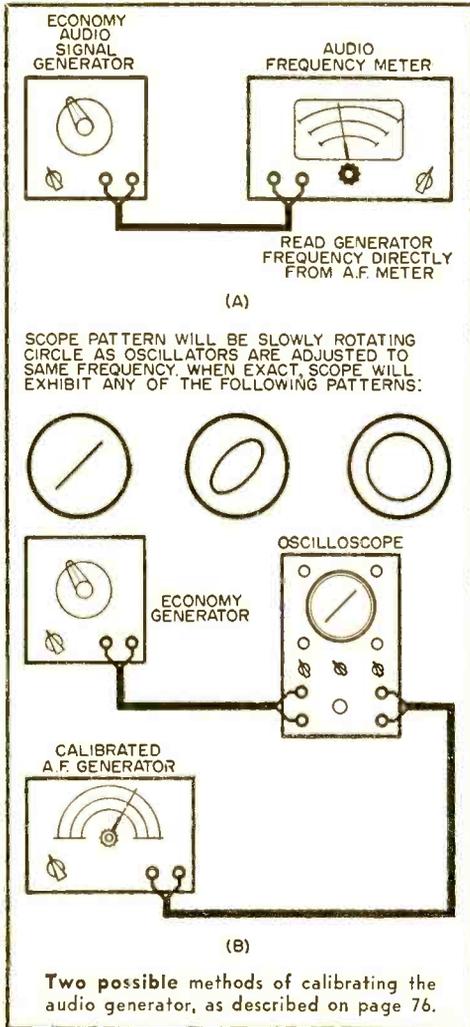
## "Economy" Audio Oscillator

(Continued from page 77)

ohms with the attenuator control completely open, i.e., maximum output. The unit will work into lower impedances if the attenuator control is backed off slightly to introduce some resistance in series with the external load. Of course, this will also reduce the output.

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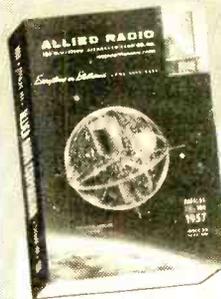
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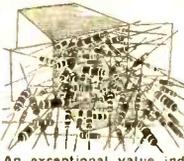
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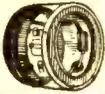
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WRITE US—GET ON OUR MAILING LIST!

Please Be Sure to Mention  
**POPULAR ELECTRONICS**  
When Answering Advertisements

**WRITE FOR NEW BONUS CATALOG**  
1000's of Un-Advertised Specials



**INFRARED SNOOPERSCOPE**  
See in Dark Tube

SELECTED, GTD & TESTED for resolution. 1st class image converter viewing tube. Hi-sensitivity simplified design 2" dia. Willemite screen—Hi-Resolution. Tube & Data.

**"TAB" SPECIAL** @ \$4.75; 2 for \$9  
MODEL PS2003, Snooperscope Doubler Power Supply, Less Chassis \$13.95

**NEW "TABLITE" ELECTRONIC FLASH KITS**  
AC & Battery Operation Inbuilt  
All in One Camera Case

MODEL 400B, 60 Watt Sec'd; color 75+; B&W 225+. Recycles 2 Sec'd. \$25.95  
Two (2) 240 VOLT BATTERIES @ \$10



Write for Details & Specifications

**TUBES** "TAB" **Guaranteed**  
TESTED OUR 12TH YEAR IN BUSINESS

0A2 .70	6AQ5 .45	6S4 .45	12AX4 .70
0Z4 .42	6AS5 .75	6SA7 .45	12AX7 .55
1B3 .60	6AT6 .35	6SH7 .40	12BH7 .65
1L4 .40	6AU4 .75	6SJ7 .45	
1R5 .49	6AU6 .40	6SK7 .45	CK1028 3.25
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1S5 .40	6BA6 .43	6SN7 .55	12BY7 .70
1T4 .49	6BC5 .45	6SQ7 .39	12SA7 .65
1U4 .45	6BS5 .45	6T4 1.00	12SK7 .43
1U5 .40	6BF5 .50		12SW7 .55
1X2A .60	6BG6 1.12	1N21 .25	12SQ7 .45
2V2 .75	6BK5 .75		14A7 .55
3A4 .48	6BL7 .80	6T8 .75	19B5 1.25
3A5 .75	6BN6 .65	6U8 .75	25BQ6 .90
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6AR4 .40	2D21 .75	7C5 .55	35Z5 .45
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6AR4 .75	6CD6 1.12	7N7 .95	50C5 .45
	6CK6 .45	7Q7 .75	50L6 .40
	6J5 .38	12AT6 .40	75 .45
	6J6 .45	12AT7 .60	76 .45
6AH6 .85	6K7 .35	12AU7 .39	77 .40
6AK5 .52	6K7 .35	12AV6 .35	117L7/N7 1.75
6AL5 .38	6L6 .65	12AV7 .75	

**"TAB" CHRISTMAS BARGAINS**  
MICROWITCH TRANSMITTING

#B-1, SPNG  
30 Amp. C'SD  
includes  
MAG/ARC  
SUPPRESSOR  
Reg. \$9.00



MICA  
CONDENSER  
.006 MFD  
2500V VDC  
Reg. \$6.50



**20c EACH; LOTS OF FIVE**  
May Be Assorted

**KITS! KITS!**

Each "TAB" Kit Contains the Finest Selection of Top Quality Components in the Most Popular Values & Sizes

**EXTRA!** Free Kit with Each \$10 Kit Order

- 25 Precision Resistors
- 10 Switches
- 25 Knobs
- 75 Carbon Resistors\*
- 36 Panel Lamps
- 10 Electrolytic Cond's
- 15 Volume Controls
- 25 Tube Sockets
- 50 Tubular Condensers
- 500 Lugs & Eyelets\*
- 10 Bathtub Oil Cond's
- 5 lbs. Surprise Package
- 10 Transmit Mica Pack
- 40 Insulators

- 25 Power Resistors
- 65 Mica Condensers
- 5 Crystal Diodes
- 250 ft. Hook Up Wire, Ass'd\*
- 100 Fuses
- 35 Ceramic Condensers
- 10 Rotary Switches
- 6 Crystals
- 60 Inductors & Coils
- 5 Microswitches
- 10 Wheat Lamps
- \* In Plastic Box

**1,000's OF SATISFIED CUSTOMERS** EACH KIT ONLY... **99c**  
Every Kit Sold on "TAB" Money Back Guarantee

**"TAB" FINEST HI-FI RECORDING TAPE**

7" Reel—1200 Ft. Per Reel **\$1.45** Lots Sold on Money Back Guarantee **\$1.45** of 12  
Highest quality HI-FI Precision Coated & Silt.  
FERRO-SHEEN processed, quality controlled, constant output. Noise FREE, Splice FREE Plastic Tape, Freq. 7 1/2 IPS, 40-15K Oxide Wind In. "TAB" @ \$1.59 ea. 3/\$3.50 ea.



NEW 1st quality "MYLAR" 2400 Ft.—7" REEL FERRO-SHEEN processed Double Play RECORDING TAPE @ "TAB" SPECIAL \$4.49 Ea.; 3 for \$12; 12 for \$45.

Guaranteed Replacement Needles—All Cartridges  
Single Diamond \$8.98; Dual Dia \$16.98; Dia-Sapphire \$10.98.  
Please Send Cartridge Name & Number

**"TAB"**

TERMS: Money Back Gtd. (cost of mds. only), \$5 min. order F.O.B. N.Y.C. Add shpg. charges or for C.O.D. 25% Dep. Tubes Gtd. via R-Exp. only. Prices shown are subject to change.

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Superior's New Model 770-A

# The FIRST Pocket-Sized VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER

**71% MORE SCALE AREA!!**

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2 1/2 Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

**FEATURES**

- ★ Compact—measures 3 1/8" x 5 7/8" x 2 1/4"
- ★ Uses Full View™ 2% accurate, 850 Microampere D'Arsonval type meter
- ★ Housed in round-cornered, molded case
- ★ Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use

**Specifications**

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

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

**\$15<sup>85</sup>**



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 to 10 Megohms

- CAPACITY: .001 to 1Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
- 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

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

**\$28<sup>40</sup>**



**ADDED FEATURE:**

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

## 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 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.

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Dept. D-300, 3849 Tenth Avenue, New York 34, N.Y.

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- Model TV-11... Total Price \$47.50 \$11.50 within 10 days. Balance \$6.00 monthly for 6 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 770-A... Total Price \$15.85 \$3.85 within 10 days. Balance \$4.00 monthly for 3 months

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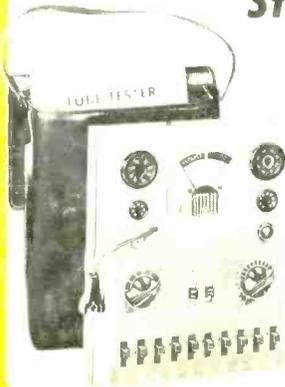
CUT OUT AND MAIL TODAY! ▶

All prices net, F.O.B., N.Y.C.

Superior's New Model TC-55

Streamlined

# TUBE TESTER



## FOR

The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester. The Professional Serviceman, who needs an extra Tube Tester for outside calls. The busy TV Service Organization, which needs extra Tube Testers for its field men.

- You can't insert a tube in wrong socket. Separate sockets are used, one for each type of tube base.
- "Free-point" element switching system Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap".
- Checks for shorts and leakages between all elements. Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated.
- Elemental switches are numbered in strict accordance with R.M.A. specification. The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Speedy, yet efficient operation is accomplished by: Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

Model TC-55 comes complete with operating instructions and charts and streamlined carrying case.

**\$26<sup>95</sup>**

Superior's new Model TV-11

Standard Professional

# TUBE TESTER



- ★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyatron Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- ★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
- ★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

Free-moving built-in roll chart provides complete data for all tubes.

Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relax-

ation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

**\$47<sup>50</sup>**

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FIRST CLASS

Permit No. 61430

New York, N. Y.

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**NO INTEREST  
OR FINANCE  
CHARGES ADDED!**

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

## SEE OTHER SIDE

CUT OUT AND MAIL TODAY!