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
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CONTENTS

FEATURE Articles and Electronic Developments

Thunderbolts and Whistlers .................................................. Don Gleason 39
What’s the Weather Up There? ................................................. 43
Talk About Hot Circuits ......................................................... 45
Electronics Finds Treasures of Old West ................................. Gordon S. Fay 57
High Adventure in V.H.F. Reception ........................................ Robert Cobb 58
Santa Goes Electronic ............................................................ 61
Radar Scores SAC Bombing Test .............................................. 94
Index to Volume 5 (July-Dec., 1956) ...................................... 132

ELECTRONIC Build-It-Yourself Projects

How to Hear Whistlers .......................................................... Don Gleason 41
Four Electronic Toy Projects .................................................. E. G. Louis 47
Transop tic Experiment No. 13—Light Beam Receiver ................. Louis E. Garner, Jr. 65
Better Your Long-Wave DX’ing with a Converter, Frank H. Tooker 67
Build the “Economy” Audio Oscillator ...................................... Richard Graham 75
Do You Need a TV Ghost Eliminator? ....................................... Warren J. Smith 73
Children’s Night Light Is a Child’s Delight ................................ Frank H. Tooker 73
Simple Shockless Continuity Tester ......................................... Stanley Clark 74
Make Your Own Long Pointer Knobs ....................................... E. G. Louis 83
How to Regulate Your Line Voltage Booster .............................. B. W. Blachford 83

AUDIO and Hi-Fi Features

Building the “Mini-Horn” ...................................................... Walter H. Niehoff 71
Peace with the Neighbors ...................................................... Leonard Feldman 80
Music by Proxy ................................................................. H. H. Fantel 87
What’s New in Hi-Fi? ............................................................ 96

Miscellaneous Electronic News

A Head for Radiol .............................................................. 42
Compact Computer Control ................................................... 42
Smallest TV Camera ................................................................ 42
Talking Traffic Lights ............................................................ 42
Counseling Service for Schools .............................................. 44
New Camera Eye Sees in Dark ................................................. 44
Tracking the Storms .............................................................. 44
Transistors Run Mobile Speaker ............................................. 44
TV for Skin-Divers ............................................................... 44
Airport Monitor ................................................................. 46
Flying Saucer? ................................................................. 46
Radar Simulator Spurs Training ............................................. 46
Taking Stock with Tape ....................................................... 46
Navy Hurricane Hunters Use Airborne Radar ......................... 60
World’s First Underwater Broadcast Was All Wet .................... 60
Atoms Keep Time in Oscillator Circuit ..................................... 62
New Oge-Piece Phone Has Bottom Dial .................................. 62
Gambling Robot Beats Humans ............................................. 62
Lightning-Fast Printer .......................................................... 66
Progress in ‘Scopes ............................................................ 66
“Space Command” Toner ..................................................... 66
Rear Seat Speaker Improves Car Radio .................................... 70

(Also see page 6 for DEPARTMENTS)

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DEPARTMENTS
Carl & Jerry .................. John T. Frye  10
Letters from Our Readers .................. 26
McWatts .................. Carl Kohler  30
POP'tronics Bookshelf .................. 32
Transistor Topics .................. Lou Garner  63
After Class .................. 78
The Transmitting Tower .................. Herb S. Brier  84
Tuning the Short-Wave Bands .................. Hank Bennett  86
Sound Impressions .................. 98
Tips and Techniques .................. 100
Tools and Gadgets .................. 107

COMING NEXT MONTH (JANUARY)

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
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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!”

“You’ll never make it,” Jerry warned. “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 earphone with the diaphragm taped right

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December, 1955
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 'skin-phone.' 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 flinched and began to giggle. "Hey, that tickles!" he announced. "but I can make (Continued on page 16)

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December, 1956
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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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 is only you can hear; by plugging into the KT-96 kit listed below, it is instantly converted to a full 4-transistor home radio, complete with speaker for the entire family to enjoy. The set is completely subminiaturized and utilizes the new, radically different Argenne “Poly-Var-Cou” ultra miniature 2-gang variable condenser, you will be delighted with the truly subminiature parts, from the variable which measures only 3/16" square x 7/32" deep, to the tiny I.F.'s and electrolytics. The chassis measures only 4" x 3-3/16" W x 1 1/8" 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 antenna. The result is a sensitive, stable and selective set covering the entire broadcast band. Requires an 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.

KT-96 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?"

HANDS 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.

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December, 1956
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."

Jerry 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-
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VETERANS: Give Date of Discharge

December, 1956

23
Carl & Jerry (Continued from page 22)

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

"Go right ahead," Carl said in return.

AFTER 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.

THE 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 laddling out the hot tar right now!"
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Found: Parabolic Dishes
- In answer to the letter in your November issue, I think that Electronica, Inc., Bronsvillie S, 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 Seventies 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
Elie, 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 330 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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Address: __________________________ Age: ___
City: ____________________________ Zone: ___ State: ___

December, 1956
Letters (Continued from page 26)
more material on computers and automation with details of circuitry.

John N. Landon, ET1
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 Ebb
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, W0CJT
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.

R. Kinningham
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?
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Recommended: to all tape hobbyists.


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.


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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Bookshelf

(Continued from page 32)

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

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


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.


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.


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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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.

December, 1956
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Always say you saw it in — POPULAR ELECTRONICS
Thunderbolts and Whistlers

By DON GLEASON

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

BONK!! . . . SHEEEEOOOOOooooo . . . BONK! . . . SHEEEEOOOOooooo . . . BONK! . . . SHEEEEOOOOOooooo

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 atmospheres" presently hold Mr. Dinger's concentrated attention, and he and his associates 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

WANT 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-μfd. capacitor, one 0.002-μfd. capacitor, and two half-watt, 22,000-ohm resistors. Connect the capacitors in series. Then twist the resistor pigtails together (or connect them with a piece of wire) at one end and connect the free ends across the 0.002-μfd. capacitor (as shown in diagram).

The filter should be inserted in the audio line between the preamplifier and the main amplifier, close to 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
Talking Traffic Lights?

Traffic 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.

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)

Compact Computer Control

Circuits 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.

Smallest TV Camera

Don 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.
FOR 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.

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.

December, 1956
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.

TV for Skin-Divers

NOT 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.

New Camera Eye Sees in Dark

DRAMATICALLY 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

COUNSELING 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 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.

Tracking the Storms

RADAR 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-radas for the U.S. Dept. of Commerce—tailor-made for forecasting work. These radars will form nation-wide network for spotting storms.
Talk About Hot Circuits!

RADICALLY 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.

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.

December, 1956
Taking Stock with Tape

THANKS 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.

Flying Saucer?

FIRST 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.

Airport Monitor

LISTENING 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.

Radar Simulator Spurs Training

THE 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.
TRADITIONALLY, 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 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,
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 S1 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)
C1—25-350-mµfd. fixed capacitor (see text)
CR1—1N34A diode
L1—Transistor “Loopstick” [Miller No. 2002 or Lafayette No. MS-299]
S1—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.

Top view of transistorized radio chassis is shown above. Above, left, is the complete radio.
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 µfd.; if it is near 1200 kc., a value of from 75 to 150 µfd.; if around 850 kc., a value of 180 to 220 µfd.; and, finally, if near 550 kc., C1 may be from 250 to 350 µfd. 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 scriber 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 homemade scriber. 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 scriber, 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 ½" 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 scriber, 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

December, 1956
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 390,000 to 560,000 ohms for R3. Capacitor C2 may have values from 0.1 to 0.5μF, and R4 values from 8200 to 18,000 ohms. Resistor R7 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.

BPI, BP2—Binding posts
C1—10μfd, 150-volt electrolytic capacitor
C2—0.1μfd, 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.

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 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.

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 (S1) 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.
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 upscale movement of the meter's needle. If there is a small up-scale movement, readjust 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.

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...
Part 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,
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 "offbeat" 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 assembling 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.

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.

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.

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 μfd., 150 volts (Mallory Type FP-311.7)
C2—0.001-μfd., 400-volt tubular capacitor
C3—0.01-μfd. disc ceramic capacitor
C4—25-μfd., 25-volt electrolytic capacitor
C5—0.005-μfd. disc ceramic capacitor
CH1—7- henry, 50-ma. filter choke (Stancor No. C-1707)
F1—2-ampere fuse, extractor-type fuse post
P1—4-prong speaker plug to match SO1
PCI—Printed-circuit plate (Erie No. 1404-02)
FL1—Pilot lamp bracket and jewel with 6-volt bulb
R1—33-ohm, 1/2-watt carbon resistor
R2—220-ohm, 1-watt carbon resistor
R3—1-megohm, 1/2-watt carbon resistor
R4—9200-ohm, 1/2-watt carbon resistor
R5—10-megohm, 1/2-watt carbon resistor
R6—220,000-ohm, 1/2-watt carbon resistor
R7—2-megohm potentiometer, audio taper
S1—S.p.s.t. toggle switch
SO1—4-prong speaker socket
SR1—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’kr—6” PM loudspeaker
1—5" x 9 1/2" x 2" aluminum chassis (ICA No. 29053)
1—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)
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

Buried 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 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, possible 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

EXCITEMENT 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 listening 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 law) 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.
for full information on their police receivers. If you use the code phrase "POPtronics 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"

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*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 21, 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.

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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.

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

NOT 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 aqua lung. 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

AS 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.
THOUGH 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 examining new production models for southward shipment in December. Santa has also licensed a number of earthly establishments to help fill the de-
NY-Lint Tool & Mfg. Co. is Saint Nicholas' licensee for manufacture of push-button controlled cannon.

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.

Atoms Keep Time in Oscillator Circuit

ATOMIC 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

IN 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."

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.
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...fellow 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
"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 transformer, 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 1/4 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)
Transtopic

Experiment No.

Light Beam Receiver

This 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 SPI is coded in "dots" and "dashes," the audio tone varies in the same way.

Mount a cardboard tube over SPI 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 SPI. 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 SPI, 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

One 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

Advances 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

Sending 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

An 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.
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 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 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


December, 1956
Schematic diagram and parts list for the converter.

C1, C2—300-µfd. silver-mica capacitor
C2—47-µfd. silver-mica capacitor
C4—100-µfd. mica capacitor
C5—50-µfd. variable capacitor (Hammarlund Type HF-50 or equal)
C6—3-30 µfd. mica trimmer capacitor
C7—0.05-µfd., 400-volt paper capacitor
C8a, C8b—30/30 µfd., 150-volt dual electrolytic capacitor
L1—Vari-Loopstick
L2—Tickler coil, 8 turns of No. 28 enameled wire (see text for winding details)
R1, R2—12,000-ohm, 1/2-watt composition resistor
R2—22,000-ohm, 1/2-watt composition resistor
R4—4700-ohm, 1-watt composition resistor
RFC1, RFC2—Ferrite-core, 5-milli henry r.f. chokes (Superex 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 S12-WT or equal)
V1—Type 6BE6 tube
1—5" x 7" x 3" aluminum chassis

4 cents postage will be paid by

POPULAR ELECTRONICS
366 MADISON AVENUE
NEW YORK 17, NEW YORK

www.americanradiohistory.com
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.

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**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 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

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Better Your Long-Wave DX’ing with a Converter

By FRANK H. TOOKER

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

December, 1956
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-

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**Under-chassis view** shows placement of major components. A 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.

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

C1, C2—300-µfd, silver-mica capacitor  
C3—47-µfd, silver-mica capacitor  
C4—100-µfd, mica capacitor  
C5—50-µfd, variable capacitor (Hammarlund Type HF-50 or equal)  
C6—3-30 µfd, mica trimmer capacitor  
C7—0.05-µfd, 400-volt paper capacitor  
C8a, C8b—30/30 µfd, 150-volt dual electrolytic capacitor  
R1—Vari-Loopstick  
R2—Tickler coil, 6 turns of No. 28 enameled wire (see text for winding details)  
R3—22,000-ohm, 1/2-watt composition resistor  
R4—4700-ohm, 1-watt composition resistor  
RFC1, RFC2—Ferrite-core, 5-milli henry r.f. chokes (Superex Type F-50 or equal)  
S1—5-p.s.t. toggle switch  
SR1—85-ma., 120-volt selenium rectifier  
T1—Miniature power transformer, 125 volts at 15 ma., 6.3 volts at 0.6 amp. (Stancor Type FS-5415 or equal)  
T2—1500-kc. converter output transformer (Miller Type S12-WT or equal)  
V1—Type 6BE6 tube  
1—5" x 7" x 3" aluminum chassis
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 at 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

December, 1956
HOW IT WORKS

Choices 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 crosses 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 Varistor L1, tickler coil L2, variable tuning capacitor C5, trimmer C6, coupling capacitor C7, 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 jack 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 mfd. 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.

Adjustment 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.

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.

POPULAR ELECTRONICS
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 2 1/2' x 2 1/2' 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 3 1/8" 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 2 3/16" x 12" panels, one at an angle of 88° and the other at an angle of 51°. This finishes, cut the circular speaker holes in the panel 4 1/2" in diameter, centering them as shown on the construction layout diagram.

Now glue and nail the two formed panels to the bottom of the enclosure, making certain that they are joined to the 6 5/8" sides. Then, cut the 13" edges of the front panel to a 51° angle, being sure that the inner surface is six inches wide. Finally, cut the circular speaker holes in the panel 4 1/2" in diameter, centering them as shown on the construction layout diagram.

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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.

**BILL OF MATERIALS**

1—2⅜' x 2⅜' piece of ⅛" 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?

Many 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

Children's Night Light Is a Child's Delight

Here'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 bulb 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

For 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 1/2" round-head machine screw, and a 1 1/2-volt flashlight bulb.

Grind or file most of the threads off the brass machine bolt 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
It's inexpensive, uses only one tube, and will cover range from 22 to 12,000 cycles

By RICHARD GRAHAM

THERE 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 pocketbook clearly in mind.

This generator covers the entire audio frequency range from 22 cycles to 12,000 cycles; such coverage effects quite a saving 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 6L6 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, P11 and P12 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 Electrons, January, 1954, page 25, which can be obtained at many of the larger public libraries.

December, 1956
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-

### PARTS LIST

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>10-µfd., 150-volt electrolytic capacitor</td>
</tr>
<tr>
<td>C2</td>
<td>0.02-µfd., 200-volt paper capacitor</td>
</tr>
<tr>
<td>C3</td>
<td>47-µfd.</td>
</tr>
<tr>
<td>C4</td>
<td>0.02-µfd.</td>
</tr>
<tr>
<td>C5</td>
<td>80-µfd.</td>
</tr>
<tr>
<td>C6a</td>
<td>40/80 µfd., 150-volt electrolytic capacitor</td>
</tr>
<tr>
<td>C6b</td>
<td>25-µfd., 25-volt electrolytic capacitor</td>
</tr>
<tr>
<td>C7</td>
<td>780 henry, 50-ma. choke (Stancor C1709)</td>
</tr>
<tr>
<td>P1</td>
<td>PL1—2-watt, 115-volt lamp</td>
</tr>
<tr>
<td>P2</td>
<td>R1—750-ohm, ½-watt fixed resistor</td>
</tr>
<tr>
<td>P3</td>
<td>R2—270-ohm, ½-watt fixed resistor</td>
</tr>
<tr>
<td>P4</td>
<td>R3—R4—10,000-ohm, ½-watt fixed resistor</td>
</tr>
<tr>
<td>P5</td>
<td>R5—5-megohm potentiometer with reverse logarithmic taper</td>
</tr>
<tr>
<td>P6</td>
<td>R6—470-ohm, ½-watt fixed resistor</td>
</tr>
<tr>
<td>P7</td>
<td>R7—220,000-ohm, ½-watt fixed resistor</td>
</tr>
<tr>
<td>P8</td>
<td>R8—68,000-ohm, ½-watt fixed resistor</td>
</tr>
<tr>
<td>P9</td>
<td>R9—5000-ohm resistor</td>
</tr>
<tr>
<td>P10</td>
<td>10,000-ohm potentiometer, linear taper</td>
</tr>
<tr>
<td>S1</td>
<td>S.p.s.t. switch on R10</td>
</tr>
<tr>
<td>S1R</td>
<td>65-ma. selenium rectifier</td>
</tr>
<tr>
<td>T1</td>
<td>Power transformer, 125 volt at 15 ma. 0.5 volt at 0.6 amp. secondary (Stancor P88415)</td>
</tr>
<tr>
<td>V1</td>
<td>V1—6U8 tube</td>
</tr>
<tr>
<td>LMB</td>
<td>1-6&quot; x 6&quot; x 6&quot; aluminum box (LMB Type 666)</td>
</tr>
</tbody>
</table>

Complete wiring details for the oscillator are at left.
Hook up the "Economy" audio generator components as shown in this pictorial diagram.

reasonably 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 1000-ohm potentiometer. By adjusting 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)
TIME 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, trans-oceanic 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 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
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 expensive 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;

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**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 recyle slowly so that they provide slow pull-in — slow dropout 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)
"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 terminals 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?" There-
in 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 re-
corded (or, in other words, placed ourselves
in the same hearing position that the micro-
phone occupied during recording), the argu-
ment 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 or-
chestra at such a level. First, the room in
which you listen at home is considerably
smaller than a symphony concert hall. Sec-
ondly, there are times when you may want
the music as background to other activities,
in which case extremely low level is de-
sirable.
Why a Loudness Control? Let's take
a detailed look at Fig. 3. Suppose the aver-
age level of a symphony orchestra corre-
sponded 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 con-
cerned. Of course, while you are sitting at
the concert, this fact makes no difference
at all because that's the way music has al-
tways 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 per-
formance—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 char-
acteristic like that shown dotted in Fig. 3.
You will note that the response at 50 cycles
is now down some 25 db (only 1/300ths 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

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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.

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.
"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

Many 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 line 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 pointer—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—finger-nail 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. Louis

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How to Regulate Your Line Voltage Booster

One 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. Blackford
THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

Effective 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 Electromagnetic 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 SRI. 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/WI CALL AREA
Morton Krantz, 61 Litchfield St., Hartford, Conn.
Walter Terlik, 14 Palmer, Chicopee Falls, Mass.
Henry J. Maresi, TDA, 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), 220 Naples Terrace, New York 3, 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 Niglirino, 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, Chichester, N.Y. (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 Engle Rock Ave., Roseland, N.J. (Code and theory)
Paul Reinhar, Box 81, Pavilion, N.Y. (Code and theory)
Steve Denys (14), 48-36 Oceania St., Bayside, L.I. N.Y. (Code and theory)

K3/W3 CALL AREA
Tom Farmerie, 634 Malabar Drive, Pittsburgh 37, Pa. (Theory)
Philip Graicier, 157 E. Plumstead Ave., Lansdowne, Pa. (General code and theory)
Donald H. Bennett, Jr., 1855 Irving St., N.W., Washington 10, D.C. (Code and theory)
Robert Himler (15), 11 W. Madison St., La
trobe, 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)

K3/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/WG CALL AREA
Michael Kandarian, 120 El Monte, Los Altos, Calif. (Code and theory)
Chris Clemens, 316 S. Barranca, Covina, Calif. (Code)
Robert L. Cloke (12), 506 S. 8th St., San Jose, Calif. (Code and theory)
Bob Coumer, 6047 Conew Ave., Los Angeles 34, Calif.
Dick Schmidt, 3909 Cresta Way, Sacramento 25, Calif. (Code and theory)
George Brezgesic, 1262 San Pablo Ave., Apt. C, Richmond, Calif. (Code and theory)
Dan Dutilin, 141 Covina Ave., Long Beach, Calif.
Wayne Overbeck, 1511 Ruiland Ave., Manhattan Beach, Calif. (Code)
David Shallenberger, Boys Republic, Chino, Calif.

K7/W7 CALL AREA
Richard Sires, 1900 S. Fairlair, 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 Skarlo, Castle Rock, Wash.

K8/W8 CALL AREA
Rick Davis (15), 381 Sandusky St., Conneaut, Ohio. (Code)
Jim Fishbeck, 3505 Harold St., Lansing 10, Mich.
John Newman, 2518 Outlook St., Kalamazoo, Mich. (Code and theory)
Carl E. Tiley (51), 405 E. Main St., Blanchester, Ohio.
Myron L. Braun, 202 Howard St., Bellevue, Ohio. (Code and theory)

K9/W9 CALL AREA
Jerry Heiman, 2406 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.

K9/WO 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-Televi
sion Manufacturers Association offers a set of code records (recorded at a speed of 33 1/2 rpm) and a Novice Theory Course for $10.00, post
paid. The complete course or more informa
tion 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

Our 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 (51H40) 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 Puckapung, 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, Acera, 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 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 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.

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.

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.

www.americanradiohistory.com
IT 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 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
Dr. Olson translates musical score into punched code or "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 synthetics 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-scratching, 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.

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. Ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K and X1 megohm.

MODEL V-7A
$24.50
Shpg. Wt. 7 lbs.
$2.45 DWN.,
$2.06 MO.

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

$42.50
Shpg. Wt. 21 lbs.
$4.25 DWN.,
$3.97 MO.

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 OM-2

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. Ohmmeter 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.

MODEL M-1
$14.50
Shpg. Wt. 3 lbs.
$1.45 DWN.,
$1.22 MO.

HEATH COMPANY • BENTON HARBOR 10, MICH.
A Subsidiary of Daystrom, Incorporated

December, 1956
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!

**HEATHKIT**

**CW TRANSMITTER KIT**

MODEL DX-20

$35.95

Model SG-8

**$19.50**

Model AR-3

**$30.75**

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. Prealigned coils eliminate the need for calibration after completion.

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 parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 MC to 250 MC with prewound coils. Use to beat against unknown frequency, or as absorption-type wavemeter.

HEATH COMPANY • BENTON HARBOR 10, MICH.

A Subsidiary of Daystrom, Incorporated
EASY TO BUILD
...A "LEARN-BY-DOING" EXPERIENCE
HEATHKIT BROADCAST BAND RECEPTOR 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 5 1/2" 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.


MODEL BR-2 $19.25
incl. Fed. Excise Tax (less cabinet)

MODEL CR-1 $8.75
incl. Fed. Excise Tax
Ship. Wt. 3 lbs.
$3.80 dwn.,
$3.73 mo.

...INTERESTING PROJECT FOR ALL AGES
HEATHKIT CRYSTAL RECEPTOR KIT
The crystal radio of dad's day is back again, but with big improvements! Sealed diode eliminated "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
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.

MODEL ET-1 $11.50
Ship. Wt. 3 lbs.
$1.15 dwn.,
$9.97 mo.

HEATH COMPANY • BENTON HARBOR 10, MICH.
A Subsidiary of Daystrom, Incorporated

December, 1956
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
$26.95
incl. Fed. Excise Tax (with cabinet)
Shpg. Wt. 7 lbs.

MODEL BC-1
$26.95
incl. Fed. Excise Tax (with cabinet)
Shpg. Wt. 8 lbs.

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 ± 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 ± 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**

$39.95

$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 4000 CPS. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 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**

$99.95

$10.00 DWN.,

$8.90 MO.

Shpg. Wt. 80 lbs.

**ORDER BLANK**

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Orders from Canada and APO's must include full remittance. NOTE: All prices subject to change without notice.

**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!
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 unfailing 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 bombardier'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!

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!

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<th>TYPICAL OPERATING DATA</th>
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<td>Battery voltage</td>
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<td>Class B push-pull output</td>
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<tr>
<td>Class A output</td>
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<td>Power gain, Class A</td>
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<tr>
<td>Total max. dissipation</td>
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<tr>
<td>Alpha cutoff frequency</td>
<td>200</td>
<td>200</td>
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*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-c 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.

Reliable products through Advanced-Engineering
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.)

Cutting your own records? Presto's K-11 disc recorder, at right, is a portable, 3-speed device for making records up to 13 1/2" 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.
UNTIL DEC. 31st ONLY... ANNUAL "SANTA CLAUS" SPECIAL!

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Your choice of ANY $1 KIT FREE!

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= ELEVEN DOLLARS WORTH OF PARTS FREE

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AS A "THANK YOU" TO OUR THOUSANDS OF CUSTOMERS—FREE XMAS GIFT WITH ANY SIZE ORDER!

SCOOP! PERSONALIZED SUPERHET PORTABLE

COMPLETELY WIRED, READY TO PLAY!

$12.99

LOWEST PRICE ANYWHERE!

Sold elsewhere from $20 to $27! Completely wired, ready to go! Plays anywhere, with no external connections. Handsome ivory styrene case (only 7 1/2" x 3 1/2" x 1 5/8") ships already equipped for antennas. Civil Defense, Defense, Coven-

brush battery—$20 to 1600 R. S. K. R. R. built by top

um, 6 miniature tubes, sensitivity & selectivity equal to biz-set performance... must be heard to be believed! BATTERIES 20¢ EXTRA!

2-TRANSISTOR RADIO KIT $7.78

Exclusive design saves impendence & direct coupled stages, capped ferri-filmix for superior selectivity. Mini-var, good tuning; 2 high-imp transistors. Pre-designed transi-\n
case, ALL PARTS MOUNTED! Step-by-step instructions, knowwire, posts, jack, ship, wt. 1 lb.

BATTLE LANTERN

$1.88

Only $1.88

Colored, heavy black, 3 5/8" x 3 5/8" x 6". Orig. price $2.98.

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12 40 SUBMINIATURE RESISTORS, 250 ohm each to 10 meg. 1/5 to 50 val.

$1

2 TRANSISTOR LOOP-

$1

STICK; tapped for hetero-selectivity. Quick tuning without knobs or crystals.

7 MINIATURE CAPACITORS, 372, 1000, 5000, 10,000, 33,000, 50,000
capacitors. Wt. 1.5 oz. Reg. $1

8 TRANSISTOR SOCKETS, 3000 watts. Isolated for direct tuning, shipper included. Wt. 3 oz. Reg. $1

6 MURPHY-STYLE 9-VOLT BATTERIES. Suitable for any 9 volt equipment. Wt. 1 lb. Reg. $1

2 6-G19 DIODES. Select,atest Govt. spec. better than commit. types. Wt. 1 lb. Reg. $.35

HOBBY MOTOR, 115 VAC. 2500 rpm, run, stop, start, run, stop, start, run, stop, start by switch for building of gadgets. Wt. 1 lb. Reg. $.35

3 TRANSISTORS: Sicom, Motorola, General. PLUG-INTYPE, for printed circuit use. Wt. 1 lb. Reg. $.35


10 VACUUM TUBE DRILL SET, 1/16 thru 1/4" by 64ths, with storage box and instructions. Wt. 4 lb. Reg. $.35

10 PHOTOFILM TIMERS, 0 to 60 minute. Panel type w/hcl. hands, w/ gently weighted arm. Wt. 2 lb. Reg. $.35

SOLDIERING IRON with solder included. Only $1

CRYSTAL MIKE

$2.98

By top 129 make market, Plastic case for hand or table use, Positive V-osc., high grade crystal. Wt. 8 oz. Reg. $2.98

MAGNETIC PICKUP

$1.49

High impedance unit by Pairthe Audio. All metal construction. No-rub case & arm. Cartridge included. Wt. 2 oz.

NEW! EXCLUSIVE!

TRANSISTOR RADIO KITS

by "KIT KING"

KIT #21, "SOLAR/CELL" Dual-powered, socket size. Buna

ontype. Mercury Cell for bits—outlasts regular batteries for a MINUTE TO COMPLETE-ALL PARTS MOUNTED! Pre-designed

batteries. Step-by-step instructions, mercury cell, transistor, 1000 ohm, 10 volt, size 9 battery. Wt. 3 oz.

$5.88

KIT #22, "SOLAR" Sun Battery powered. (Out of stock this battery.)

$4.98

KIT #23, "CELL" Mercury Cell powered.

$3.98

HI-IMPE. PHONES for above sets, only $1.99

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EXCLUSIVE WITH LEKTRON!

10 "POLY" BOXES. Assorted. Semi, clear, plastic, hugger boxes w/screw locks. Reg. $1.56

30 TERMINAL STRIPS & 30 clamps, 16 & 20 gauge, screw & solder plts. Wt. 1 lb. Reg. $2

100 VOLUME CONTROLS, 100 values, 150 ohm min. Wt. 1 lb. Reg. $4.95

10 RESISTORS, assorted, 1/2 watt, 1% ±. Wt. 1 lb. Reg. $1.50

60 TUBULAR CAPACITORS, assorted, for AC use. Min. .001 to 1000µF. Wt. 2 lbs. Reg. $7.50

3000000 ELECTROLYTICS. FP Form, flat top, 3000000 values, 1000 volts. Wt. 20 lbs. Reg. $100

3000000 PAPER & MKETCAPS. FP Form, flat top caps, 3000000 values, 1000 volts, various types. Wt. 150 lbs. Reg. $500

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1000000 WIRE, assorted, 16 & 20 gauge, 1000 ft. Reg. $50

7 STANDARD KNODS, assorted, various values, 56 ohms to 1 meg., 1 1/2" long. Wt. 1 lb. Reg. $1.50

175 FT. HOOKUP WIRE

25-ft. rolls. Assorted colors, stranded insulation. 22 to 14 gauge. Wt. 8 lbs. Reg. $3.95

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20 pc., 15" long, insulated w/0.05" insulation. Wt. 55 oz. Reg. $2.75

7000000 DIODES. 30 assorted. Wt. 8 lbs. Reg. $30

70 MICA CAPACITORS, 30 assorted, values 2000pf to 1000µF, assorted. Wt. 3 lbs. Reg. $30

7 DIODE WIRE, assorted, insulated. Various values. Wt. 1 lb. Reg. $1.95

SPECIALS

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Please order by number, including check or MO and freight postage, excess postage refunded, orders, 25% down. Nitet, net 90 days. Print name, address, amount money enclosed.

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December, 1956

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PE-12 28 GARDINER STREET

CHELSEA 50, MASS.

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"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)
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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 fingernail 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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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.

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.

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

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radio with a new, homemade back panel. This panel was made from 9-ply brown signpainter'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.

**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.

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December, 1956

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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 Prokofiev 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 (DL 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 like the madrigal style. 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. —00—

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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 loudspeaker 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 CI 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 CI, 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 CI 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.

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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 pheasants are hams who will not QSL or who will 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, KN0QHAN, 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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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 antennae, and an SX-43 receiver excites his headphones.

Bob Culver, 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 KNZUBC 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, KNZUBC, 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 80-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, KNOEFB, 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-
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 hit. 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 Maybor, 379 Rockaway Parkway, Brooklyn 12, N.Y., will help Novices seriously interested in learning radio to get their first 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., Mattapany, Mass.; KN9DRR, P. Gilster, 310 Buena Vista, Chester, Ill.; Dave Bergoldi, 113 Elmwood St., Valley Stream, L.I., N.Y.; KN0HAN, W. Hemme, Terri, Iowa; WN3EHJ, J. L. Fish, RD 5, P.O. Box 129, Irwin, Pa.; KN4GNW, R. Collins, Route 2, Harrisburg, Va.; WN7EOJ, L. Geibhart, Rt. 2, Box 640, Central Point, Oregon; Bobby Culter, 1317 Horseshoe Curve, Oswego, Oregon; K2ZUBC, M. Davidoff, 2045 Rockaway Pkwy, Brooklyn 36, N.Y.; K2ZDP, 777 St. Marks Ave, Brooklyn 13, N.Y.; KN0EBF, LaVerne Kisson, Box 347, Gothenburg, Nebraska; 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 landline 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...
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 light on partially unexplained geophysical phenomena such as "radio blackouts," magnetic storms, and the aurora.

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. Johnsbury Trucking Co., Transamerican 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'tronics 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."

### 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., VLI6, Sydney, has been heard around 0800-0817 with news. (37)

- **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 xmns 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 1555-2045 to the U.S. on 15,190 and 9630 kc.; to Australasia at 0325-0415 and to Europe at December, 1956
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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, 9620 kc., can be heard faintly around 0600 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 4797 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)

HJBB 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—H13K, Ondas del Yaque, Santiago de los Caballeros, is again being heard evenings. (RL)

H13C, La Voz del Papagayo, La Romana, has drifted from 2440 kc. to 2420 kc. (91)

Ecuador—HCEL 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 latter 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, 4900 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 11,643 kc. was noted at 1830-1940 with music and news in French; s/off at 2000. (II, WF)

French Camerouns—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., 0530-0630 to Cyprus on 9607 kc., 0900-1015 to the Balkans on 17,300 kc., 1030-1045 to Russia

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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 TGNU, 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 1330-2200 in Spanish, and 2200-2345 in English. (33)

TGLA, La Voz de Centro America, Guatemala City, 6295 kc., can be heard around 2130-

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 5880A kc. at 2230-2355 s/w 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. (WHF)

**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**—XEER, 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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**SHORT-WAVE ABBREVIATIONS**

A—Approximate frequency
BC—British Broadcasting Corporation
c.w.—QRM—Interference from code station
ID—Identification
kc.—Kilocycle
kw.—Kilowatt
mc.—Megacycle
N.A.—North America
s/off.—Sign-off of station
SSB—Single sideband
s.w.—Short-wave
trans.—Transmission from station
transmitter—Used by station
V.—Frequency varies
VOA—Voice of America

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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/o with music and Portuguese language. (52, 76)

Netherlands—Hilversum, 9580 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/o. (76, MA, JM, SD)

New Zealand—ZL14, 17,820 kc., Wellington, is heard quite well from 2005-0000 with music, news, stories, classical music, and sports. ZL10, 15,220 kc., operates 1500-0115 to Australasia, is heard well in Easter 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/o 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, 9805 kc., can be noted around 1615 with dance music. (26)

Portugal—Lisbon on 17,890 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

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Wellington, 17,820 kc.
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, 0700-0915, 1405-1530, 2145-0000. 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 VQZQ, 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 10 kwatts. (36)

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. Holtzhauzen, 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 8300 and 6135 kc. at 2215-2230, 2315-2350, and 0015-0050. (76, W/S)

Tangier—Two new frequencies for VOA stations, 25,920 kc., scheduled 0700-0915 to Europe and Near East. and 0915-1130 to India, Pakistan, and 25,970 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 1938-2004. Reports should go to Victor B. Bemer, 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, CXA9, 11,835 kc., was noted at 1645 with music and Spanish language. (IW)

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. WFK3, 15,700 kc., is beamed to Euro-

top 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 VOA and ABC radio 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 at 6738 kc. On the telephone channels, Amsterdam (20,505 kc.), Port-of-Spain (17,800 kc.), Guam (15,400 kc.), Wellington (8980 kc.), and Paramaribo (9257A kc.) have been heard with SSB transmissions. (31)

Paramaribo (17,572.5 kc.) and Dominican Republic (15,055 kc.) have been heard in the telephone service. (WF)—50

December, 1956
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 "mat-
rial" to mold into valid forms of artistic expression.

**Detour to Perfection.** In its present experimental state, the Music Synthesizer is far too clumsy and complex to serve any practical everyday purpose. This is no adverse reflection on its designer, Dr. Harry Olson, who conceived the present model merely as a research tool for purposes of further exploration. Its attainments and limitations are evident to anyone who has heard the sound created by this machine on RCA Victor record No. LM-1922, which is generally available in record stores. Yet the present shortcomings are merely the inevitable detours in the road of progress. There seems little doubt that further development will let the Synthesizer fulfill its inherent promise.

# Peace with the Neighbors

*(Continued from page 82)*

should be set at maximum, and any adjusting of room listening level would then be done with the volume control.

Some commercial loudness controls have a switch with which the compensation effects can be turned off at will. Still others go a step further and provide as many as six so-called "contour" positions on a switch, for those people who don't happen to have the same hearing as Mr. Fletcher and Mr. Munson's "listeners," or for taking care of recordings whose program content requires more or less than the "average"
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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 sub-stantially source voltage.

If the capacitor starts with a charge of 100 volts, closing key 2 permits the capac-itor 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 R1, 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

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—

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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 between 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.

Transistor Topics
(Continued from page 64)

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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.

* * *

Audioophiles 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 additional 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 2 1/2 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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(Continued from page 77)

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Another characteristic of the circuit, which is true of many RC oscillators, is that if the frequency control is changed suddenly, lamps PL1 and PL2 must adjust to new operating conditions. Since this oscillator has a range wider than most, it may take a second or two to overcome the thermal inertia of the lamps. This is quite normal in such an oscillator. Operation otherwise is straightforward and should present no problem.

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Converter, Long-Wave DX'ing with a (Tooker) 87 Dec.
Code Reception on “All-Wave” Receivers
(Blachford) .......................... 83 July
Long-Wave DX, Comeback Trail (Kneitel) 51 Oct.
Single-Tube Receiver, Long-Wave DX'er
(Tooker) ............................ 66 Nov.
Superheterodyne, Miniature, “Minidyne”
(Tooker) ............................ 75 Sept.
V.H.F. Reception, High Adventure in (Cobb) 58 Dec.

BOOK REVIEWS
Allied’s Electronics Data Handbook (Allied
Radio) .................................. 38 Oct.
Amplitude Modulation (Schure) ......... 36 Oct.
Audel’s Television Service Manual
(Anderson) ............................. 38 Oct.
Audio Amplifiers and Associated Equipment
(Howard W, Sams & Co.) ............ 22 Aug.
Automatic Factory—A Critical Examination
(June) ................................. 22 July
Basics of Phototubes and Photocontrols (Mark) .... 24 Sept.
Blocking Oscillators (Schure) ......... 24 Sept.
Building Your Record Library (Hoopes) .. 20 Aug.
Color TV Training Manual (Olliphant & Ray) .... 20 Aug.
Electronic Tubes, Circuits, and Devices
(Blevins) .............................. 32 Dec.
Hi-Fi Loudspeakers and Enclosures (Cohen) 18 July
Hi-Fi Speaker Systems (Jensen Mfg. Co.) ... 36 Oct.
How To Make Good Tape Recordings (LeBel) ... 32 Dec.
How To Select and Use Your Tape Recorder
(Mark) ................................. 20 July
Industrial Electronics (Bukstein) ....... 22 Sept.
Introduction to Color TV (Kaufman &
Thomas) .............................. 22 July
Inverse Feedback (Schure) ............ 34 Dec.
Logic Repairing, Putting Together (Trainor) .. 29 Nov.
Mighty Force of Research (Editors of Fortune) 18 July
Public Address (Crowhurst) ............ 22 Aug.
Quest for Quality (Crowhurst) ......... 20 July
Radio-Electronic Master, 21st Edition
(United Catalog Publishers) ... 34 Dec.
Radio Receiver Laboratory Manual (Levey) ... 20 Aug.
R.F Transmission Lines (Schure) ....... 22 Aug.
Ribbons of Sound (Barleben) .......... 34 Dec.
Simplified Radio Servicing by Comparison
Method (Beitman) .................... 36 Oct.
Superheterodyne Converters and I-F Ampli-
fiers (Schure) .......................... 32 Dec.
Tape Recorders and Tape Recording (Weiler) 22 July
TV Servicing Guide (Deane and Young) ... 34 Nov.
TV Trouble Tracer (Cain) .............. 24 Sept.

CONSTRUCTION PROJECTS
(see other categories also)
Alarm Clock, Illuminated (Pearce) ....... 46 July
Antenna, Simple FM Yagi (Stoner) ...... 58 July
Camera Synch, Check Your (Winklepleck) 100 Aug.
CD Observer Post, “Ears” for (Garnet) .. 47 Aug.
Clock Repairing, Putting Together (Trainor) .. 29 Nov.
Crystal Receiver, Progressive (Dunant) .. 73 Nov.
Direction Finders, Two-Penny (Robberson) .. 52 July
Dry Battery Rejuvenator (Harvey) ....... 47 Oct.
Electronic Lock, Fool Your Friends with
(Shields) ................................ 60 Sept.
Fire Alarm, D.C. Operated (Chapel) .... 83 Sept.
Hygrometer, All-Electronic (Pollack) ..... 85 Oct.
Intercom, Instant-Heating, “Tirade Termi-
nator” (Pollack) ..................... 47 Nov.
Magneteze for Fun and Utility (Samuels) .. 57 Aug.
Microphone-to-Stand Adapter (Trauffer) .. 59 Aug.
Night Light, Children’s (Tooker) ....... 73 Dec.
Neo Lamp, 90 Volt, Runs on 4½ Volt Battery
(Pearce) ............................. 53 Aug.
Radio, “See-Through” (McCafferty) ..... 76 Aug.
Relaxation Oscillator Makes Perpetual
Flasher (Frantz) ........................ 85 Sept.
Sun Battery Power, Magnifying (Trauffer) .. 90 Aug.
Time Switches, Custom-Design (Rasmussen) ..... 69 Sept.
Touch-o-Matic Control, The “Soft Touch”
(Pollack) ............................. 39 Sept.
Toy Projects, 4 Electronic (Louis) ...... 47 Dec.
Whistlers, How to Hear (Gleason) ...... 40 Dec.

DEPARTMENTS

FEATURE ARTICLES
“Brains” Taking Over? (Reid) ............ 41 July
Cathode Rays Are “On the Beam” (Fantel) 43 Nov.
Drive-In Church Attracts Motorist Congrega-
tion (Norman) ....................... 51 Nov.
Drive-In, Electronics Comes to (Clark) ... 92 Nov.
Electro-Motive Electronic (Reid) ....... 39 Nov.
Electronic Mind—How It Remembers (Fantel) 31 Aug.
Elevators, No Guesswork with These .... 48 July
Fishways, Electronics on (Magda) ....... 60 Nov.
Government by Automation (Makower) ... 48 Sept.
Hearing Aids, Miniaturization Shrinks ... 103 Aug.
Hot Circuits, Talk About ................ 45 Dec.
Movie Camera’s “Electric Eye” ........... 73 July
Phone from Your Boat (Robberson) ..... 91 Aug.
Pin Boy, Automatic ................... 34 Aug.
Piston Capacitors Require Watchmaker’s
Skull ................................. 37 July
Radar Chain Tracks Missiles 1500 Miles ... 68 Aug.
Radar Scores SAC Bombing Test ....... 94 Dec.
Radar Tames Wild Blue Yonder (Smith) ... 74 Nov.
Radio Stamps Make Rare Collection ... 62 July
Radio Wave Curvature, Army Studies .... 43 Sept.
Radio Waves Heard from Jupiter and Venus
(Ferrell) ............................... 35 Sept.
Robots Behind Your Phone (Fantel) ..... 95 July
SAGE — Whirlwind Defense Quarter-
back (Morgan) ....................... 43 Aug.
Santa Goes Electronic .................. 61 Dec.
SEE Who’s on the Phone .............. 51 Nov.
TECH Writing, What About (Norman) ... 73 Sept.
Testing Assures Survival at Supersonic
Speeds, Sure-Safe ................. 95 Aug.
Thin Air, My Foot (Kohler) ............ 51 July
Treasures of Old West, Electronics Finds
(Foy) ................................. 57 Dec.
Tube Tester Plug-In Accessories .. 88 Aug.
Voices in the Mail (Webster) ......... 39 Aug.
Weather, Dodging with Radar ....... 53 Aug.
Weather, What’s the .. 43 Dec.
Whistlers, Thunderbolts and (Gleason) .. 39 Dec.

HI-FI AND AUDIO
Bass Reflex, Jr. (Tooker) .............. 71 Aug.
Boost, Hi-Fi (Fields) .................. 53 Nov.
Demonstrate Hi-Fi, How to (Eisenberg) .. 41 Oct.
Enclosure with Burlap Finish (Rasmussen) ... 128 Aug.

POPULAR ELECTRONICS

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Equalize Hi-Fi, Why (Fields & Johnson) 96 Aug.
Hi-Fi, Do You Really Have (Eisenberg) 82 Sept.
Hum. Mum That (Cortiel) 72 Oct.
Kings of Swing Hi-Fi Receives (Hawthorne) 45 Sept.
Living Room, How "Hi-Fi," Is Your (Cortiel) 99 July
Loudspeaker Installation (Richardson) 46 July
"Mini-Horn" (Niehoi) 71 Dec.
Mixing It Up (Dubbe) 84 Nov.
Music by Proxy (Fanel) 87 Dec.
Peace with the Neighbors, Loudness Control (Feldman) 80 Dec.
Plate That Talks (Lanier) 89 Sept.
Phono Speed Changer (Cartier) 89 Aug.
Record Player, Amplifierless (Traufzer) 80 Nov.
Records, Life Insurance for (Smith) 85 July
Tape Recorders Take Time 71 July
Tone Compensator for Tape Recorder (Stone) 77 July
Tuner, AM, for Low-Cost Hi-Fi (Norman) 52 Aug.
Tuner, How to Buy (Reid) 58 Oct.
Turntable Upkeep 56 Aug.
Tweeter, Hi Tide in the (Kohler) 77 Oct.

RADIO CONTROL
Dual Proportional System (McIntyre) 63 Sept.
Slave Photoflash Tackles Football Parade (Edwards) 65 July
Three Controls on One Channel Triplex (McCullough) 86 Nov.

TELEVISION
Chester Cord and Outlet Assembly (Fred.) 77 July
Closed-Circuit TV (Norman) 67 July
Ghost Eliminator (Smith) 73 Dec.
Tall Timer, TV in (Gibbs) 45 Oct.
Traffic Snarls, TV Will Unravel 39 July
Troops, TV for 34 July

TRANSISTORS
Light Beam Receiver—Experiment No. 13 (Garner) 65 Dec.
Megaphone, Single Transistor (Garner) 31 July
Regenerative Receiver, High-Gain—Experiment No. 11 (Garner) 63 Oct.
Short-Wave Converter, First Transistorized 37 Sept.
Timer, Electronic—Experiment No. 12 (Garner) 59 Nov.
"Transistor Portable," More Sensitivity for (Duda) 50 July

WORKSHOP AND TEST EQUIPMENT
Audio Oscillator, "Economy" (Graham) 75 Dec.
Batteries in Your Portable (Cortiel) 51 Aug.
Capacitor Duo-Decades (Tooker) 56 Nov.
Components, Storing Small (Kuehn) 65 Nov.
Continuity Tester, Shockless (Clarke) 74 Dec.
Ferrite Rod, Loop, Antennas, Handy Connections for (Traufzer) 65 Nov.
Grid Dipper, How to Use (Sutphin) 49 Sept.
Impedance Checking Made Easy (Turner) 91 July
Line Voltage Booster, How to Regulate (Blachford) 83 Dec.
Long Pointer Knobs, Make Your Own (Louis) 83 Dec.
Meters, Testing Second Hand-Sensitive (Traufzer) 66 July
Parts Checker, Junkbox (Graham) 83 Aug.
Power Supply, Handy (Tooker) 74 July
Printed and Etched Circuits, Telling Apart (Louis) 58 July
Part 2 (Garner) 53 Sept.
Probe Adds Range to Your VOM (Middleton) 88 Nov.
R and C Stocks (Blachford) 124 Aug.
Rectifier, Oil Bath Increases Rating (Cartier) 67 Sept.
Selenium Rectifiers (Louis) 48 July
Signal Chaser, "Economy" (Graham) 63 Nov.
Tester Uses "Magic Eye" (Mareh) 79 Oct.
Third Hand You Have, Oil Blown (Adams) 90 Nov.
Transformers, Identifying Salvaged (Tooker) 88 Sept.

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