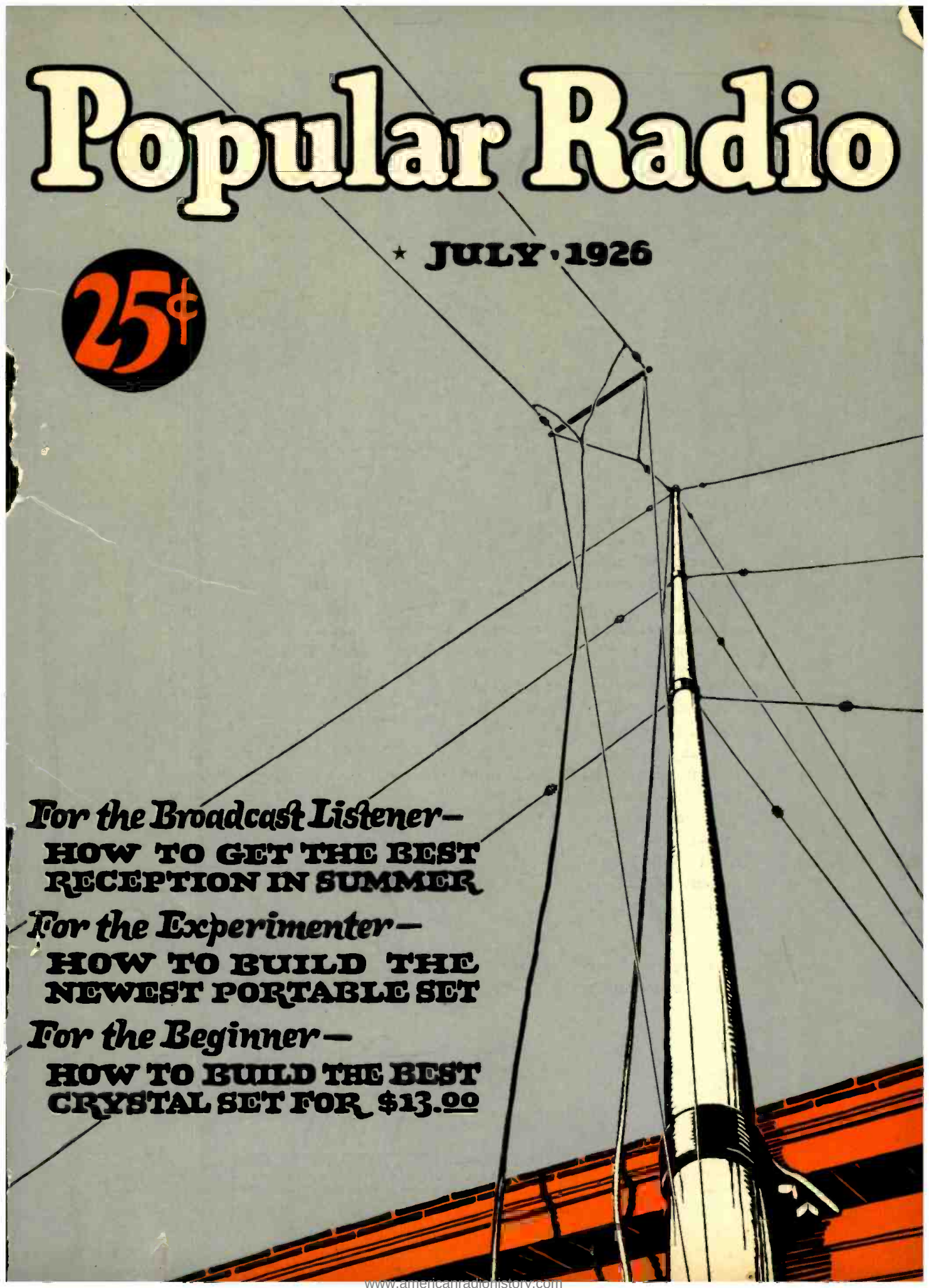
Popular Radio

★ JULY · 1926

25¢



For the Broadcast Listener—
HOW TO GET THE BEST RECEPTION IN SUMMER

For the Experimenter—
HOW TO BUILD THE NEWEST PORTABLE SET

For the Beginner—
HOW TO BUILD THE BEST CRYSTAL SET FOR $13.00

economical "B" power

from your lighting socket

Plug in the new Duo-Rectron and end "B" battery troubles. Instead of a limited store of current that forever needs renewing—call on the inexhaustible current of your house wires.

RCA Duo-Rectron, complete $65

Note first—the rectifier tube. A full-wave rectifier specially designed for exceedingly long life. It changes 60 cycle A.C. current into uni-directional B-plate current. You have one tube to do the whole job—and you don't need to buy two half-wave rectifiers to use the whole current.

A voltage regulator tube—new to battery eliminators—governs the output of the Duo-Rectron, which feeds to your radio set exactly the voltage it requires—for current drain all the way up to 50 milliamperes! Whether you have a one tube set, or a ten tube set, you get the current it needs—no more—no less.

The Duo-Rectron has taps for 22½, 45, 90 and even *135 volts,* and it delivers power enough for the new power Radiotrons UX-120 and UX-112.

It is silent—with no hum. It is steady. It is dependable and economical of operation.

RCA Duo-Rectron

MADE BY THE MAKERS OF THE RADIOLA

RCA

RADIO · CORPORATION · OF · AMERICA · NEW YORK · CHICAGO · SAN FRANCISCO

Brandes

—always pioneers in acoustics

IN hundreds of thousands of homes in America enjoying radio, tonight's audience owes its supreme contentment to Brandes.

To this public, Brandes is known as a radio pioneer—its staff of engineers has been developing the acoustics of reproduction for the public since 1908.

In the early days of radio, and even today, Brandes Superior Headsets are regarded as the standard.

Brandes was the first to announce a $10 loud speaker.

Appreciating the need for artistry in loud speaker design it produced the first attractively finished horn-type loud speaker. Soon after it announced the first quality cabinet speaker.

As the radio art advanced Brandes saw the need for attractive cone speakers. It immediately offered a fine cone in a beautiful clock-like design cabinet.

Progress is always its own reward. Brandes occupies a high position because of its constant achievements.

It is its desire to stand for all that is best today and for all that betokens progress.

Brandes will shortly announce its latest achievements—new contributions to the enjoyment of radio.

Acoustics by

Brandes

means the ultimate in reproduction

Popular Radio

EDITED *by* KENDALL BANNING

FOUNDED 1911

VOLUME X July, 1926 NUMBER III

CONTENTS

(Cover design by Frank B. Masters)

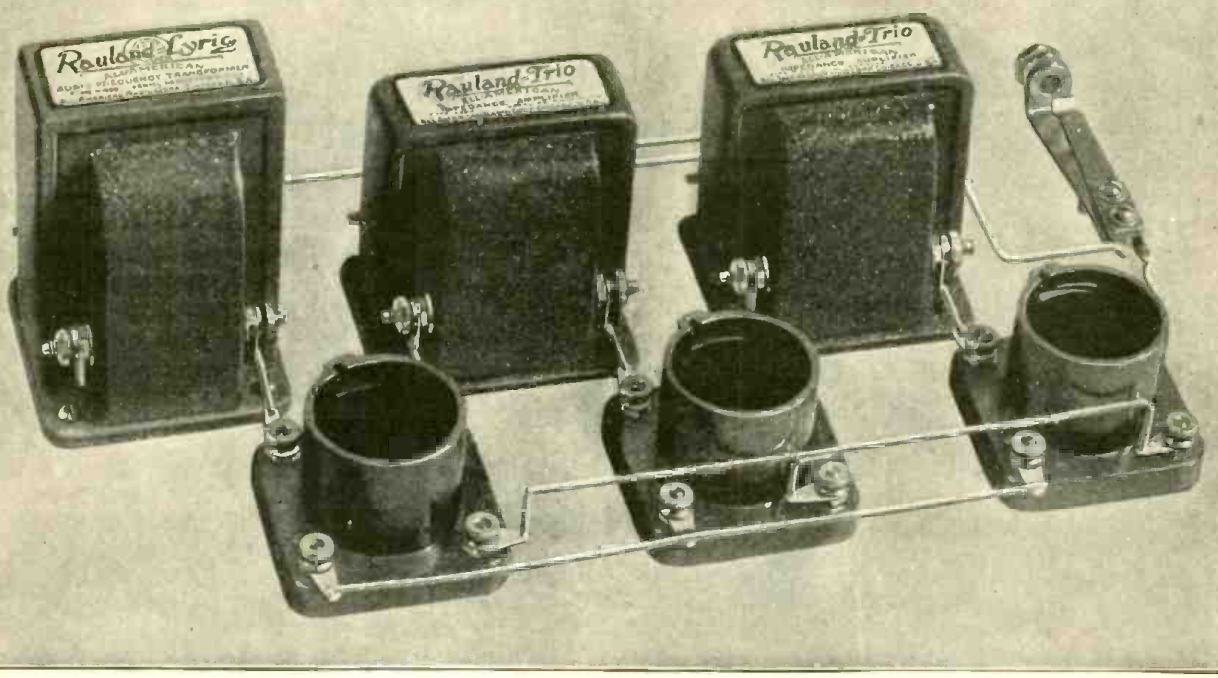
DEPARTMENTS

VOLUME X JULY, 1926 NUMBER 3

Published monthly by Popular Radio, Inc., 627 West 43rd St., New York, N. Y., telephone number, Chickering 1906; Douglas H. Cooke, President and Treasurer; Kendall Banning, Vice-President; Laurence M. Cockaday, Secretary; Joseph T. Cooney, Asst. Treasurer. Price 25 cents a copy; subscription $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second class matter April 7, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879. *For advertising rates address* E. R. Crowe & Company, Inc., 25 Vanderbilt Ave., N. Y., or 225 North Michigan Ave., Chicago. Printed in U. S. A.

E. E. FREE, Ph.D., *Contributing Editor* LAURENCE M. COCKADAY, *Technical Editor* JOHN V L. HOGAN, *Contributing Editor*

Rauland-Lyric-Trio



A remarkable improvement in audio amplification

New unit perfected by All-American Engineers gives you the full, pure, natural tone you have always sought

YOU have always wanted the ideal result in audio amplification—pure, natural tone with good volume. The laboratories of All-American Radio Corporation have developed a new method of audio amplification and now bring to you this long sought ideal result in the—

Rauland-Lyric-Trio

You know the Rauland-Lyric transformer. Its exceptional tone perfection has made it the largest selling quality transformer in the world. The Rauland-Lyric is now used in combination with the new Rauland-Trio (impedance units) to produce the Rauland-Lyric-Trio amplifier—the highest known perfection in three stage audio amplification.

It is well known that any system of amplification using instruments of similar characteristics has inherent disadvantages. Rauland-Lyric-Trio successfully combines the two leading systems—transformer and impedance coupling—coordinated to retain the advantages of both and to eliminate their weaknesses.

This new method consists of a Rauland-Lyric transformer for the first stage, a Rauland-Trio Type R-300 impedance for the second stage, and a Rauland-Trio Type R-310 impedance for the third stage.

Rauland-Trio

This is a triple feature instrument containing an inductance, a capacity and a resistance in one compact impedance unit. Through laboratory tests of utmost precision, absolutely correct balance is maintained between these important factors. You secure full advantage of impedance amplification and overcome the common variance of commercial types of condensers and resistances. Rauland-Lyric-Trio is the last word in audio amplification.

ALL-AMERICAN TRADE MARK

A free book, "Modern Audio Amplification," tells more about this interesting new development. Write for handbook B-90.

ALL-AMERICAN RADIO CORPORATION
4207 BELMONT AVE., CHICAGO, U. S. A.

Station WENR—266 *Meters—is owned and operated by the All-American Radio Corporation*

A Page With The Editor

From a photograph made for Popular Radio

How the "Town and Country" Portable Set Was Tested

To test the reception qualities of the portable receiver (described on page 224 of this number), the technical staff of Popular Radio *transported the laboratory set by automobile for hundreds of miles in and around New York City. Here is the staff in the "Shady Nook" Inn, near White Plains, N. Y., where dance music with enough volume to fill this large room was brought in in full daylight from all of the New York City stations and from others as far away as Philadelphia. The set was kept in almost constant and successful operation during these motor trips.*

On page 219 of this number of Popular Radio is published the announcement of the first awards of the Popular Radio Medal for Conspicuous Service.

* *

The exploit which won this recognition was remarkable not only because one of the amateurs who participated in it—notably George Reynolds, 4AG—was confronted with obstacles that would have discouraged any but the most persistent and experienced of fans, but also because his services led so directly to the saving of human life.

* *

Readers of Popular Radio are urged to report any cases that have come to their knowledge of non-professional operators or broadcast listeners who "directly or indirectly, through the medium of radio, have been instrumental in alleviating human suffering or saving human life."

* *

On page 280 the "Yes and No Man" makes his initial—and anonymous—bow to the readers of Popular Radio.

* *

Just who the "Yes and No Man" really is must remain a mystery—at the urgent request of the Man himself. "If the broadcast artists and announcers identify me," he explains, "I'll be in hot water all the time, as most critics are. So *please* let me remain among the Great Unknown."

In the meantime, if any reader has some bits of information about the better known broadcast artists and announcers—about their life histories, their personal peculiarities, their methods of work, their romances, or other items that are of interest to broadcast listeners generally—tell the "Yes and No Man" about them.

* *

"No. 1, Volume X, May 1926 has just come to hand," writes Hayden Brown of Meriden, Conn. "A hearty handshake in congratulation! You've done it again! Despite the fact the graphs and colors took my eye immediately I find my first impression justified. It truly looks and reads more like the ideal radio magazine every day. Peculiarly I feel a new interest in things radio, both with reference to broadcast listening and of a scientific nature. It comes as a refreshing breeze, with some new thoughts on an old subject."

* *

Ever since the popular interest in radio burst so spectacularly upon the American public, which dates back only to the establishment of the first broadcasting station in the latter part of 1921, the radio fans have been led to believe that in the near future—perhaps in six months or three months or possibly even within a month—some new and startling "innovation" in receivers that would revolutionize reception would be submitted to an expectant and waiting market.

And in anticipation of that momentous event, many prospective fans have deferred their purchase of radio apparatus . . . Indeed, many of them are still waiting.

* *

As a result of this hesitancy to buy (for which certain of the set manufacturers have themselves been in part responsible) countless thousands of people have been denied entrance into the magic realm of radio which they will eventually enter. The loss has not only been theirs; it has been the loss of the radio industry as well.

* *

True, the development of radio receiving apparatus has been going on apace. Improvements and refinements have marked the progress of the radio art. This progress will continue.

* *

Radio reception today is far, far better than it was four years ago. Engineers, scientists and experimenters have contributed greatly to the radio art—and will contribute for years to come. But the long-heralded "innovation" that was to throw all previously existing sets into the discard has not yet made its appearance—and never will.

* *

Next year's receiver—like next year's motor car or next year's typewriter—will offer improvements on and refinements of this year's model. But to deprive one's self of a receiver altogether in the meantime merely in order to take advantage of these changes is to forego an actual pleasure of today for an "innovation" of tomorrow that is as imaginary as—well, as the mongoose of ancient fable.

* *

"What animal are you carrying in that sack?" asked a curiosity-ridden man of a fellow traveller.

* *

"That," was the reply, "is a mongoose for catching the snakes that one sees when one has the *delirium tremens*."

"But those are only imaginary snakes" expostulated the questioner.

* *

"Well, this is an imaginary mongoose," was the grim reply.

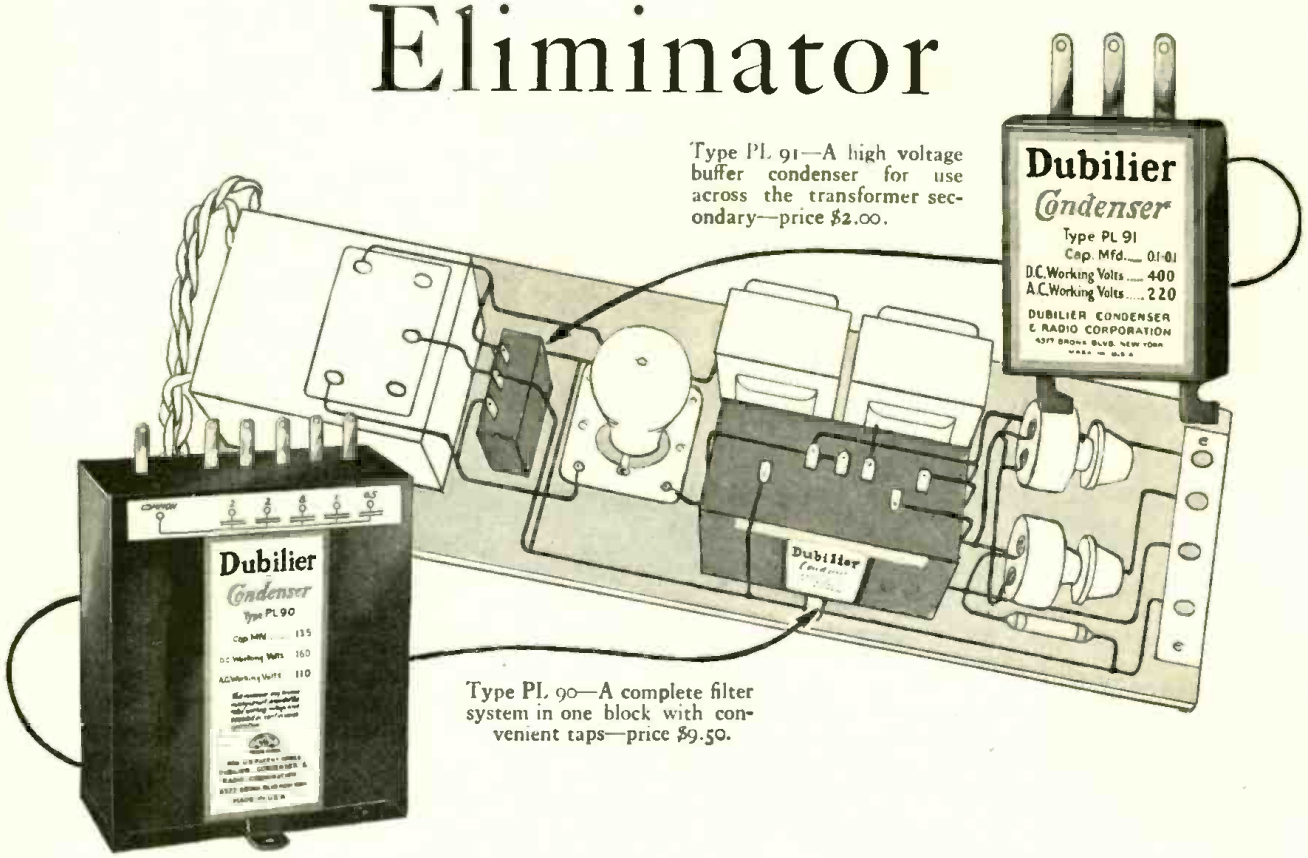
* *

The time to select your radio apparatus is *now*—when the summer static season is beginning to wane and when the broadcasting season is looming bigger and better than ever before.

Kendall Banning

Editor. Popular Radio

Use Dubilier Condensers *in your* Raytheon Eliminator



Type PL 91—A high voltage buffer condenser for use across the transformer secondary—price $2.00.

Type PL 90—A complete filter system in one block with convenient taps—price $9.50.

These new Dubilier condensers will make your Raytheon "B" battery eliminator better.

Type PL 91, is a .1—.1 buffer condenser to be used across the secondary of the 110 volt input transformer.

Type PL 90, contains all condensers needed in the filter circuit, and is tapped at 2, 2, 8, 1 and .5 mfds.

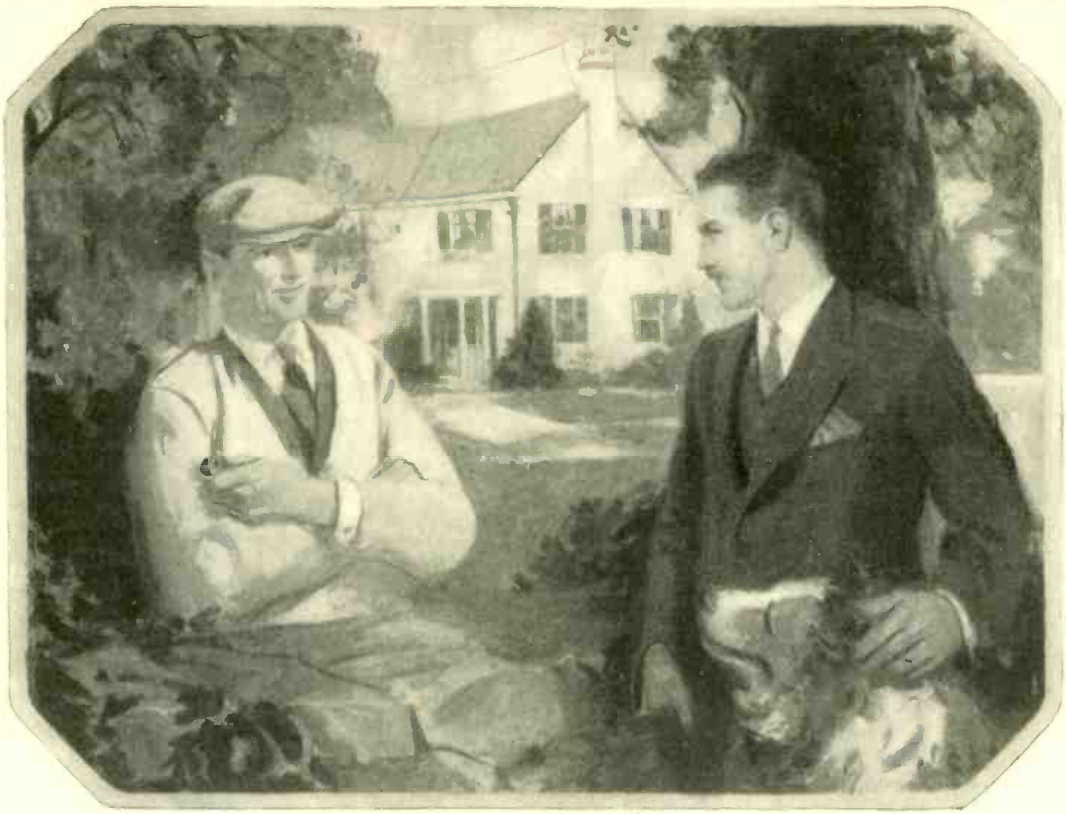
Dubilier condensers are specially designed and constructed to withstand the high voltages used in "B" battery eliminators. They are the finest condensers obtainable for this purpose.

Send 10c. for our booklet which shows fourteen ways in which you can improve your set by simple application of Dubilier condensers.

4377 Bronx Blvd., New York, N. Y.

Dubilier

CONDENSER AND RADIO CORPORATION



"We give our sets about the same amount of use, but your 'B' batteries always last longer than mine. What's your secret?"

"WHY, there's really no deep, dark secret about it. It's simply knowing what are the right size batteries to buy for your set."

"Yes, but what do you mean by *right* size?"

"The right size depends on the number of tubes in your set. The more tubes you have, the bigger the 'B' battery you need to give you long, economical service. Just follow the rules laid down by Eveready and you can't make a mistake." These are the rules and the results:

On all but single tube sets—connect a "C" battery. The length of service given below is based on its use.*

On 1 to 3 tubes—use Eveready No. 772. Listening in on the average of 2 hours daily, it will last a year or more.

On 4 or more tubes — use the Heavy-Duty "B" Batteries, either No. 770 or the even longer-lived Eveready Layerbilt No. 486. Used on the average of 2 hours daily, these will last 8 months or longer.

The above rules will give you the maximum of "B" battery life and economy. Of course, if you listen in more than 2 hours a day, which is the universal year-round average, your "B" batteries will not last quite so long, and if you listen less they will last longer. Eveready "B" Batteries give a pure, steady, noiseless current, the kind of current that is absolutely essential if you prize pure tone.

Send for booklet, "Choosing and Using the Right Radio Batteries," sent free on request. There is an Eveready dealer nearby.

Manufactured and guaranteed by

NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a "C" battery.

LEFT - No. 486, for 4, 5 or more tubes, $5.50.
RIGHT - Eveready Dry Cell Radio "A" Battery, 1½ volts.

EVEREADY
Radio Batteries
-they last longer

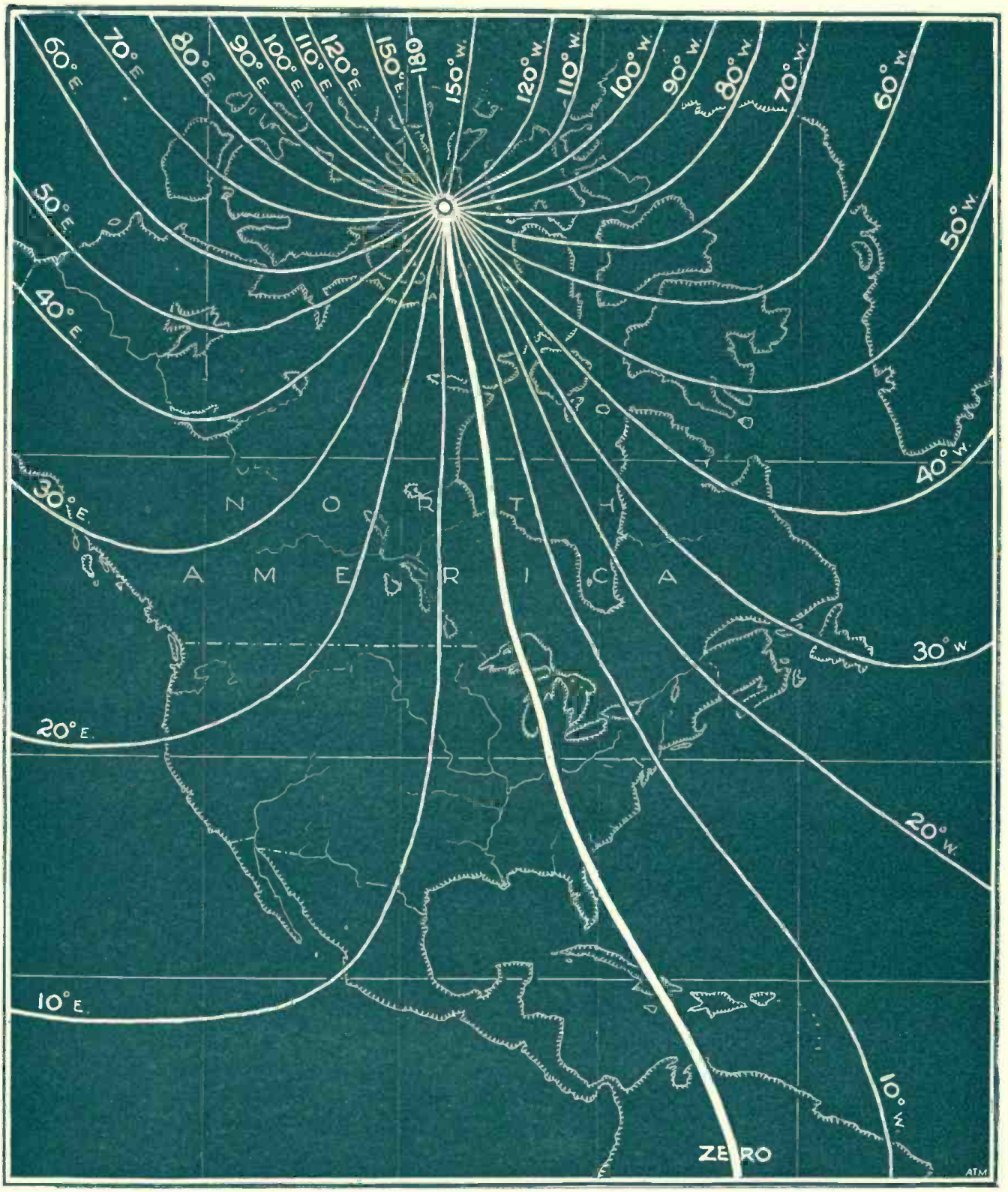
Tuesday night means Eveready Hour—8 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WTAG–*Worcester*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WTAM–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOC–*Davenport*
WCCO { *Minneapolis* / *St. Paul*
KSD–*St. Louis*

"Popular Radio Is Invaluable"

"I HAVE *been a regular reader of* POPULAR RADIO *for the past few years and have found it invaluable in keeping me posted in regard to radio development."*

Walter H. Wassie



A Map That Experimenters Can Use to Study Earth Magnetism in North America

The lines on this map indicate the present declinations of a compass needle away from true north. Along the heavy line at the center the compass needle has no declination; it points to true north. Along the first line to the east of this heavy one, the compass points ten degrees west of true north. The other lines are interpreted similarly. For places between the lines the compass declination is intermediate, and is proportional to the relative distances of the place from the two lines on either side. From this map an experimenter can find the compass declination which should exist at his observing point. Tests with a surveyor's compass will then disclose whether there are any local disturbances of the earth's magnetic field.

Popular Radio

VOLUME X July, 1926 NUMBER III

The GREAT MAGNET

that Rules Radio

That the magnetic and electric forces of the earth have profound effects on radio is now well known to experimenters. In an article in POPULAR RADIO *for June, Dr. Free discussed the chief facts of earth electricity. In this article, the second and last of the series, he outlines the important phenomena of earth magnetism. All radio theories must take these phenomena into account.*

By E. E. FREE, PH.D.

IF you hold a powerful magnet close to your radio receiver you cannot expect the receiver to do its best. More often than not it will stop operating altogether.

The lines of magnetic force from the poles of the magnet affect the paths of the electrons in the vacuum tubes, the movements of the currents in the coils, the shapes and intensities of the electromagnetic fields surrounding such parts as transformers and variometers and condensers. The magnet stretches its invisible fingers into every cranny of the receiver—almost as much so as would any stray electric currents which you allowed to leak into your circuits from some nearby dynamo or from a misplaced battery.

Nevertheless, we cannot keep magnetism out of our radio receivers, no matter how hard we try.

Every radio experiment, every instance of broadcast reception on a distant receiver, is necessarily conducted in the midst of powerful magnetic forces.

These forces are due to the magnetism of the earth.

They are not constant forces. On the contrary, they change from place to place, they ebb and flow from time to time. Radio engineers have just begun to realize how intimately and how importantly they effect the everyday problems of radio transmission and reception.*

The earth is not an inert ball of matter. It is a vast electric dynamo, continually charging itself, we do not know how, with a charge of negative electricity.

Equally it is a great magnet, its magnetic forces being in continual interplay with its electric ones.

Now that the importance of these terrestrial vagaries are appreciated by radio engineers, the radio experimenter or theorist must know the facts about them and must take these facts into account, no less than he must the properties of vacuum tubes or of static charges or of alternating currents.†

One example of such radio influences will suffice. Mr. Terrell has described in POPULAR RADIO the unusual amount of interference and disturbance which was encountered in most parts of the United States during the winter of 1925-1926.‡ These effects appeared to be closely accompanied by unusual displays of the Northern Lights or Aurora Borealis. They are believed to have been caused by disturbances in the sun, indicated by sun spots. The terestrial mechanism, however, operated through disturbances in the electric and magnetic fields of the earth. Such events will never be understood or kept from influencing our radio receivers until we shall have won a better knowledge of the electricity and the magnetism which characterize the spinning magnet on which we live and do our sending or receiving.

The total magnetic force of the earth is enormous. If all of it could be collected into one magnetic pole, like a pole of one of the familiar horseshoe magnets, that pole would be strong enough to lift a solid block of iron covering the entire State of New York and extending nearly fifty miles up into the air, much more iron than now exists as metal in the entire known world. Fortunately,

*See "How the Air Affects Radio," POPULAR RADIO for September, 1925, pages 199-206; "How Earth Magnetism Affects Radio Waves," by H. W. Nichols and J. W. Schelleng, POPULAR RADIO for October, 1925, pages 309-316, and "Alexanderson's Theory of Twisting Waves," POPULAR RADIO for November, 1925, pages 461-464.

†The main facts about earth electricity were described in the first article of this series, appearing in the June issue of POPULAR RADIO. The present article discusses the main facts of earth magnetism. For additional details about earth magnetism, with further references to the literature, the reader is referred to the following recent summaries. "The Earth's Magnetism," by Daniel L. Hazard, special publication number 117 of the United States Coast and Geodetic Survey, 52 pages, 1925, purchasable for 15 cents cash from the Superintendent of Documents, Washington, D. C.; "The Origin of the Earth's Electric and Magnetic Phenomena," by Professor W. F. G. Swann, *Journal of the Franklin Institute* (Philadelphia, Pa.), volume 201, pages 143-176 (February, 1926); "The Magnetic and Electric Survey of the Earth," by J. A. Fleming, *Journal of the Washington Academy of Sciences* (Baltimore, Md.), volume 16, pages 109-132 (March 4, 1926).

‡"Does the Aurora Borealis Affect Radio Reception"? by W. D. Terrell, POPULAR RADIO for May, 1926, pages 11-14 and 58-59.

the earth's magnetism is not concentrated in any such way. If it were the two magnetic poles of the earth, one located in the North Polar regions and the other on the Antarctic Continent, would exercise a virtually irresistible attraction for all iron objects, just as the fabled mountain of lodestone was supposed to do in the story of the Arabian Nights. Ships would be drawn inescapably to one or the other of these magnetic poles. Pocket knives would fly through the cloth of men's pockets to begin their journeys poleward. Even the steel wheels would be pulled out of watches and needles out of the tailor's fingers, to fly like arrows toward the center of so tremendous a magnetic attraction.

The real facts, of course, are very different. Both of the magnetic poles have been reached by explorers.

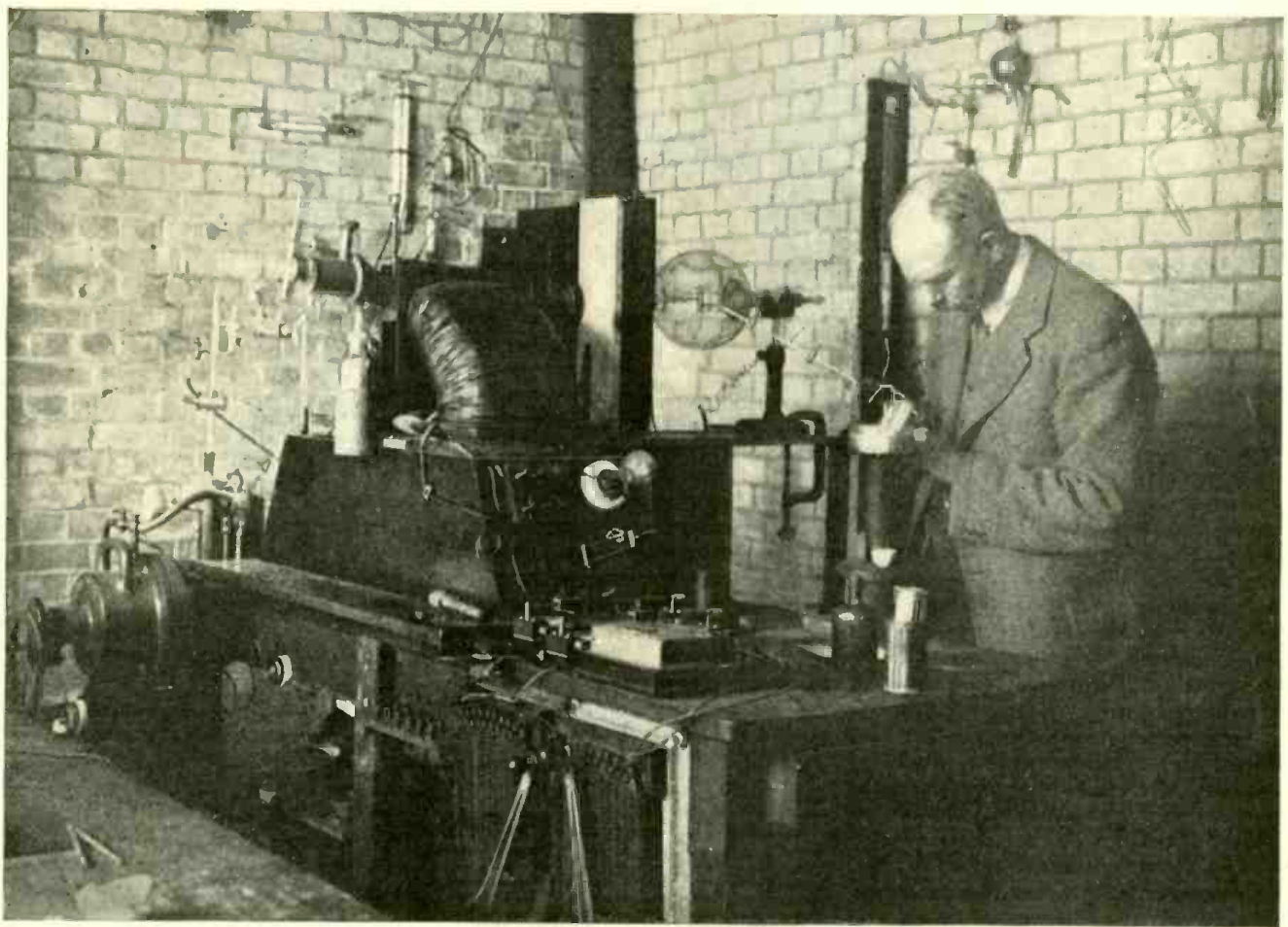
The northern magnetic pole lies in latitude 71 degrees north and longitude 96 degrees west, which is in the arctic islands north of Canada, just northwest of the uppermost corner of Hudson's Bay. The south magnetic pole is in latitude 73 degrees south and longitude 156 degrees east, which is on the edge of the Antarctic Continent, almost due south of New Zealand.

At neither pole is the magnetic force excessive at the surface of the ground. There exist, in fact, several places on the earth where the magnetic forces are still more intense than they are at the magnetic poles.

This means that there is no truth in the statement sometimes made in text books that the earth behaves as though it had inside it a great bar magnet, stuck through the globe from one magnetic pole to the other one. Were this true the force near the two poles would be intense. A better model of earth magnetism is a very short, thick bar magnet, placed close to the center of the earth.

Think of a bit of magnetized knitting needle about an eighth of an inch long. This tiny magnet will have two poles as all magnets do, one at each end of the tiny rod of metal. Insert this bit of metal at the center of an orange. The lines of force from the tiny magnet, well inside the sphere, will then come out on the surface of the orange much as the lines of force do come out and surround the earth.

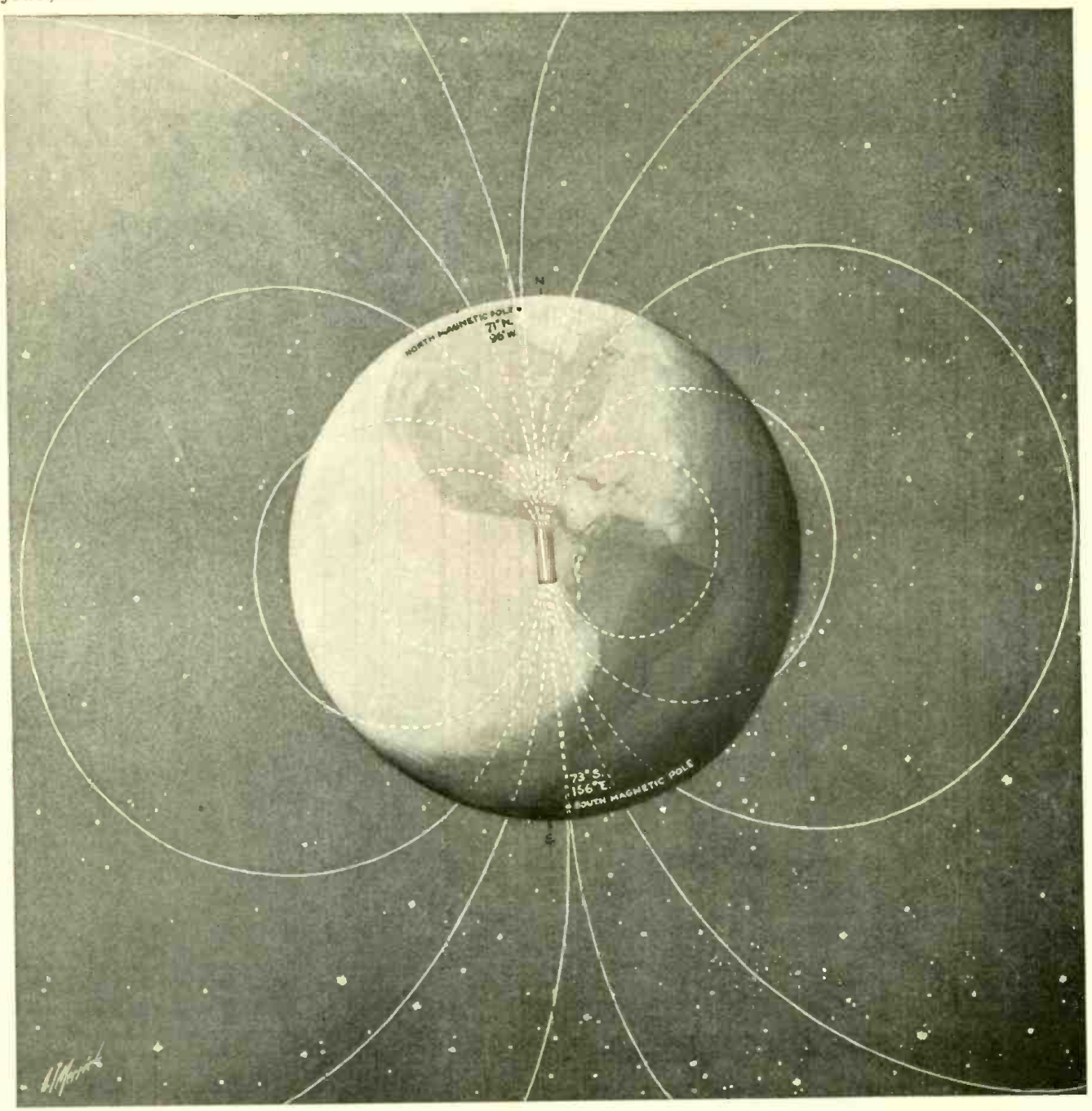
It is not intended, of course, to imply that the magnetism of the earth actually is due to any magnetized bar of iron, large or small, buried in its interior. Indeed, known facts about the earth's magnetism definitely disprove any such idea. The bit of knitting needle in the orange is merely a model. It helps us to visualize what the surface magnetic



From a photograph made especially for POPULAR RADIO by Hayles, Cambridge

How Intense Magnetic Fields are Studied in Scientific Laboratories

In his important investigations on the twin forms of atoms, called "isotopes," Dr. F. W. Aston, of Cambridge University, England, wished to expose streams of atoms to very intense magnetic forces. To do this he built this large electro-magnet, in which an electric current in the wire coil produces an intense magnetization of an iron core inside it. The same principle is used in iron-cored transformers, like those used in radio-frequency amplifiers. Laboratory researches with such intense magnetic fields have been used to discover the magnetic properties of atoms and of larger masses of matter and thus to help us to understand the magnetic phenomena of the earth.



From a drawing by Arthur Merrick for POPULAR RADIO

These Lines of Magnetic Force Have Important Effects on Radio

The white lines on this drawing indicate what are called the lines of force of the earth's magnetic field. They are imaginary lines which show the dip of the compass needle at each point on the earth's surface. The arrangement of the lines of force is much the same as it would be if the earth contained a very short but powerful bar magnet, placed close to the center of the globe. This cannot be the real explanation of earth magnetism. What the real causes are remain a mystery. It is certain, however, that the earth's magnetic field has profound influences on the propagation of radio waves.

forces of the earth are really like.

Suppose that the outside of this orange, having the short magnet at its center, is sprinkled with tiny iron filings. If the central magnet is strong enough (which is not likely to be true in an actual experiment) each of the tiny slivers of iron scattered over the surface of the orange will stand up on end, as iron filings actually do stand up on the poles of a powerful magnet. The direction in which each such sliver of iron points will indicate the direction of the line of magnetic force leaving the orange at that point.

That, indeed, is exactly what magnetic needles like those used in compasses actually do on the surface of the earth.

If the earth were sprinkled, all over its surface, with a multitude of such compass needles, each one freely suspended so that it could take any position at all, these needles would indicate the directions of the magnetic lines of force representing the earth's field.

Only at or near the equator would these needles be horizontal. At the two magnetic poles they would stand up on end. At places between the

(*Continued on page 250*)

AN AUTHORITY ON RADIO INTERFERENCE

The author of this article (who is pictured above in his experimental laboratory), is known among the old-timers in radio as "Father of the Institute of Radio Engineers," of which he was the first president. He started his radio experimentation in 1897 at Ohio State University; five years later he designed and built the first practical radio circuit in the United States—between Catalina Island and the mainland of California. For the past two years he has been working to eliminate interference; this article treats of one phase of this important and timely topic.

HOW TO GET THE BEST

Reception in Summer

Why receive distant stations poorly when you can receive local stations well?

By ROBERT HENRY MARRIOTT, B. Sc.

HERE is a typical incident that every radio fan will recognize.

Last December John Jones bought an X radio receiver—and promptly logged scores of stations. He picked up one station 2,000 miles distant and boasted about it so much that his neighbor, William Smith, decided to obtain a receiving set also.

So William Smith in June obtained a Y receiver expecting the same results.

With this Y receiver William Smith had difficulty in picking up stations over 50 miles away. And his reception was often marred by static.

William Smith's dissatisfaction extended not only to radio in general but to his Y receiving set in particular—and the Y receiver was branded as a poor one and not to be compared with John Jones' X receiver.

As a matter of fact, the X receiver and the Y receiver were practically identical and the results obtained from them were practically the same.

But the reputation of the X receiver was established by John Jones in December when reception conditions were at their peak, whereas William Smith's Y receiver established its reputation in June when reception conditions were at their worst.

Incidents like this are only too common. The William Smiths of radio who are unacquainted with the widely varying reception conditions throughout the four seasons of the year spread stories that tend to discredit everything and everybody connected with radio. And these stories prevent others from buying or assembling their own radio receivers and consequently from enjoying the benefits that the radio art has to offer.

During the past twenty-five years innumerable disappointments and considerable financial losses have resulted because the inexperienced fan has not taken into account the four radio seasons.

These four radio seasons may be summarized as follows:

WINTER
December, January and February
Radio's strong season;
Static's weak season.

SPRING
March, April and May
Radio's falling-off season;
Static's growing season.

SUMMER
June, July and August
Radio's weak season;
Static's strong season.

FALL
September, October and November
Radio's growing season;
Static's falling-off season.

These four radio seasons are about as uniform as weather seasons.

For example: the temperature on some cool summer day may be the same as it is on some warm winter day. And, likewise, radio may go as far and come in as loudly on some particular summer day as on some winter day. However, the recognition of winter as a cold season and of summer as a hot season was probably essential for the development of the white race. Just so the recognition of radio seasons is essential to the development of radio.

The man who wants to wear the headphones and use a very sensitive receiver with radio and audio-frequency amplifiers, for the purpose of receiving the longest possible distance, is affected the most by radio seasons. He gets encouraging and exciting distances in

winter and discouraging distances in summer. After he learns the seasons he does not expect unseasonable results; consequently he is no longer discouraged.

The man who lives near a first class broadcasting station and who is satisfied to get that station clearly on a simple detector in the winter, is affected the least by radio seasons. But even he needs an additional amplifier or two in the summer and possibly also in the daytime in the spring and fall. When he learns the seasons to the extent of providing for them with the necessary amplifiers, he is in the satisfactory position of being able to get the local broadcast at any time.

The subject of variations in the strength of radio signals is complicated. There are second-to-second, minute-to-minute, hour-to-hour and night-to-day variations; and there are different variations for different directions and for different wavelengths. Some of the variations may never be noticed in years of satisfactory broadcast reception.

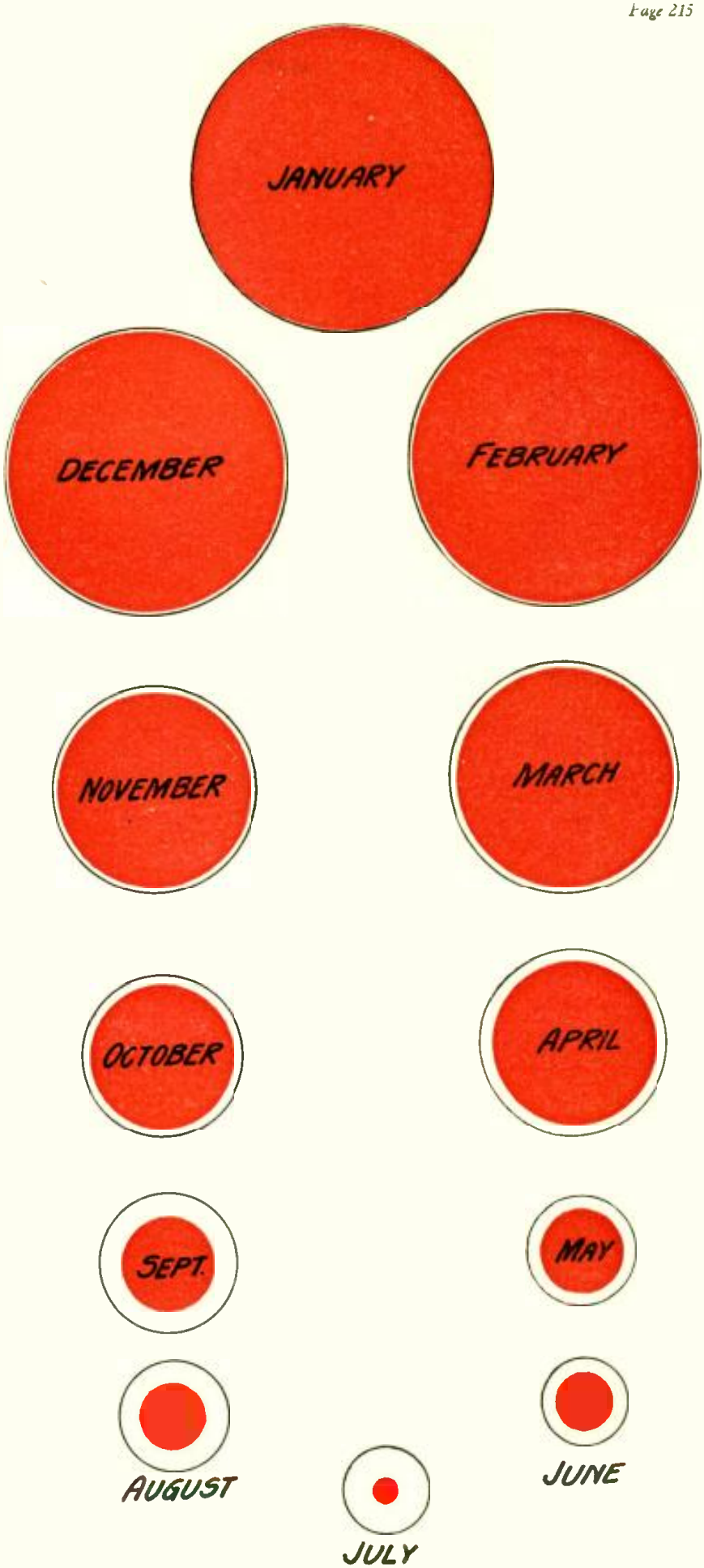
The best time to receive over extremely long distances and to hear interestingly rapid variations, is usually between one and two o'clock in the morning in winter. If the station that you hear is 2,000 miles or more away, you may notice that its signals vary in strength as often as once every second and at least as often as once a minute. And the station will usually weaken and fade out with the coming of daylight.

When receiving from a station a short distance away, the hourly variations may be noticeable. But when all the reception is from a station not more than ten miles away the variations will be practically unnoticeable. This is the reason why local reception is entirely satisfactory at any season.

The seasonable conditions that affect radio reception may be summarized thus:

1. Where the sun shines the most directly, the radio waves may meet many rapidly varying obstacles.
2. In the winter, when no sun is shining through the atmosphere between the sending and receiving station, the radio waves may meet many obstacles which vary very little.
3. Heat will cause dry air to absorb moisture in one locality; the next locality may contain humid air; the next may contain air which is in the process of giving up its moisture in rain and the next may

(*Continued on page 248*)



HOW THE ZONES OF QUALITY RECEPTION VARY BY MONTHS

The red circles indicate the relative zones over which good reception is possible without static and the white outline shows the relative zones for distance reception with static. For best hot weather reception, TUNE IN ON THE LOCAL STATIONS ONLY.

From a photograph made for POPULAR RADIO

THE COMPLETED SET IN OPERATION

With a pair of headphones, the listener may enjoy really good local reception within a radius of fifteen miles. The set is particularly serviceable in towns and cities

The Best Crystal Set *for* $13.00

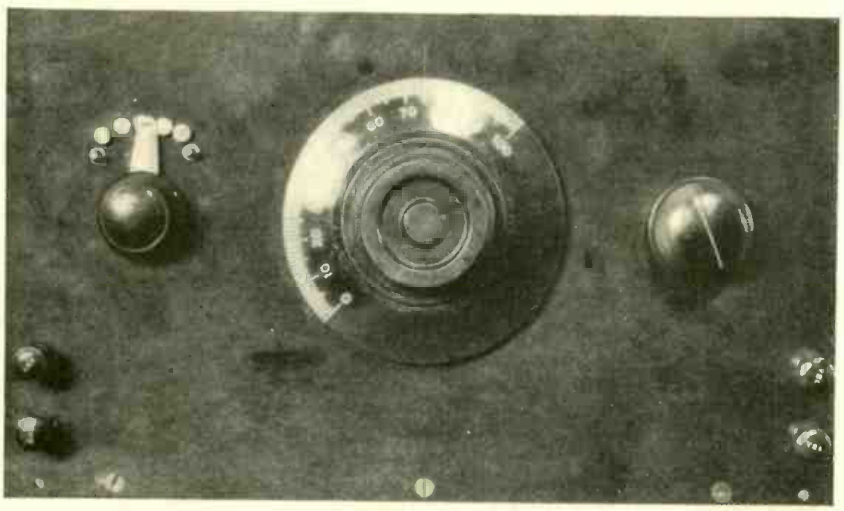
Here is a highly efficient little receiver that has been designed for the experimenter *who has never built a set before.*

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $13.00*
APPROXIMATE RANGE: *Up to 15 miles*

HERE ARE THE PARTS USED IN THE LABORATORY MODEL—

A—coupling coil (see Figure 4);
B—Pacent S. L. F. condenser No. 251-B, .00035 mfd.;
C—inductance switch;
D—five panel taps;
E—Carborundum stabilizing detector unit;
F—composition panel, 7 by 12 by 3/16 in.;
G—baseboard, 6 by 10¾ by ½-inch;
4 binding posts.



THE FRONT PANEL

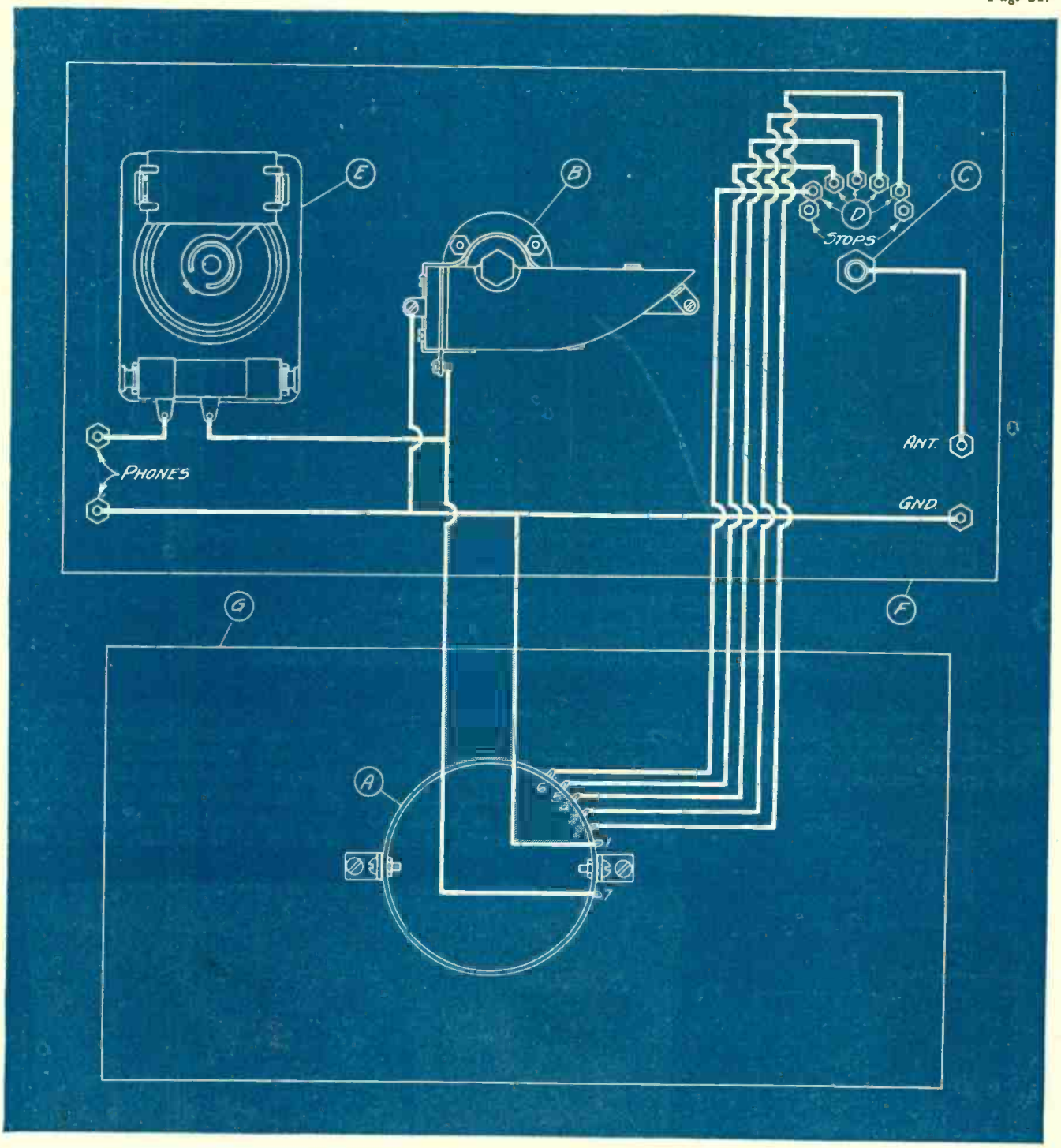
FIGURE 1: *At the left are the switch taps for cutting in or out the turns of the coil. The middle dial is used for tuning and the small right-hand knob is used for controlling the volume and quality of the sound.*

HERE is a simple, easy-to-build and inexpensive crystal receiver that may be built at home in a single evening by even the least experienced of fans. Indeed, this set has been designed by the POPULAR RADIO LABORATORY for the special benefit of the reader *who has never built a set before.*

This unit was built and carefully tested in the POPULAR RADIO LABORATORY and was found to give satisfactory results.

Take this issue of POPULAR RADIO to a radio store and ask the dealer to give you the exact parts that are listed at the head of this article (except coil A).

Then, wind the coil, following the instructions given on page 218, and drill the panel, F. The diagram in Figure 3 gives the size of the panel and the correct spacing for all of the holes that are used to mount the instruments.



THE BLUEPRINT FOR HOOKING UP THE SET

FIGURE 2: *All of the parts are mounted on the panel except the coil which is mounted on the wooden baseboard. The heavy white lines show exactly where to run the connecting wires so that even the most inexperienced radio fan should have no difficulty in doing a correct job.*

Next, mount the instruments in the correct positions on the panel and baseboard as shown in Figures 1, 2 and 5.

When this has been done, wire up the instruments with connecting wire, as indicated in Figure 2.

If you follow exactly the instructions given in Figure 2, you cannot make a mistake. All of the connections are clearly indicated; and the instruments are marked with designating letters that are identical with those that appear in the text and in the list of parts at the head of the article.

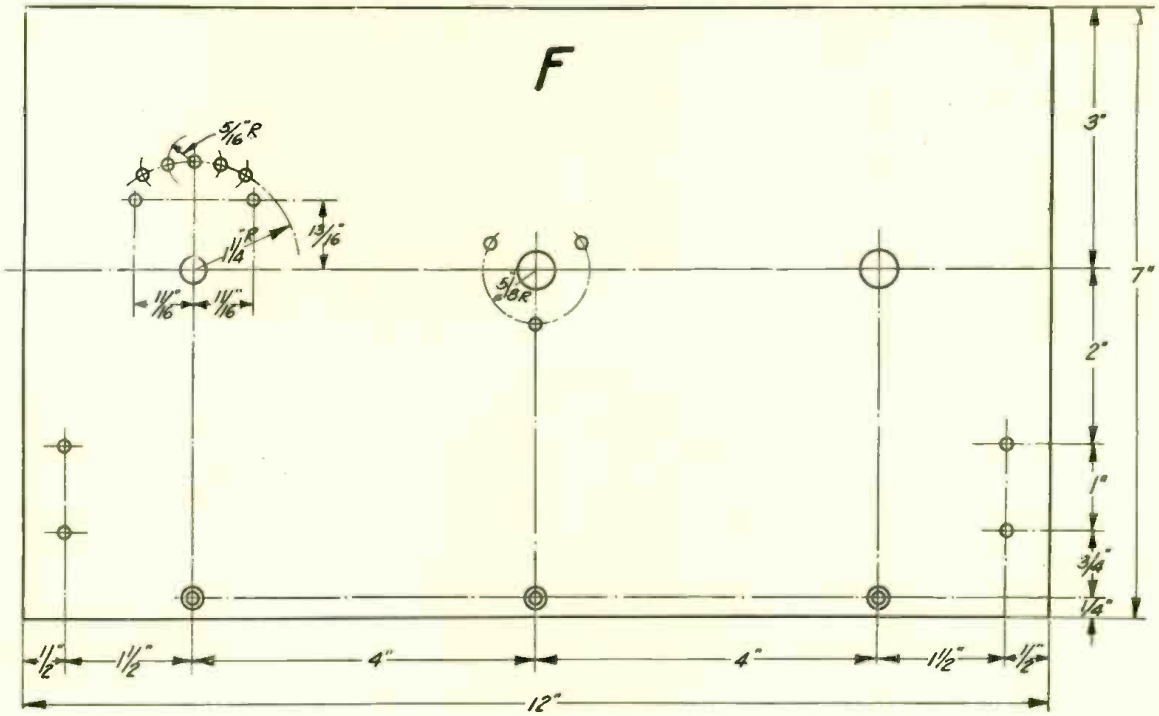
You are now ready to connect the antenna and ground to the top and bottom, left-hand binding-posts respectively. The two right-hand binding posts (as you face the panel) should be connected to the two terminals of a pair of headphones.

To make the initial adjustment on the receiver, turn the lever of the potentiometer on the stabilizing detector unit E, until it points directly down.

Then, set the switch lever, C, on the middle tap and rotate the middle dial, which controls the condenser, B, until you find the setting at which you hear the program from your local broadcasting station most loudly.

Then, leaving the condenser dial at this setting, carefully readjust the switch lever, C, until you find the particular tap that gives the best results.

Next, make a final adjustment of the



THE DRILLING PLAN FOR THE PANEL

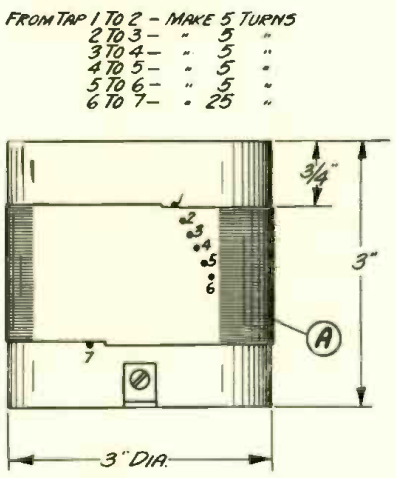
FIGURE 3: *The exact spacing between the holes that are to be drilled in the panel for mounting the instruments and the binding-posts is shown here. The three holes that are marked with double circles are for the screws that fasten the panel to the baseboard.*

potentiometer knob on the detector unit, E, until you find the adjustment that gives the clearest and best results.

The crystal detector needs no adjustment itself as it is of the permanent Carborundum type.

The correct antenna to use with this receiver is a single wire from 100 to 150 feet long (see drawing on page 238 for the best way to install it.)

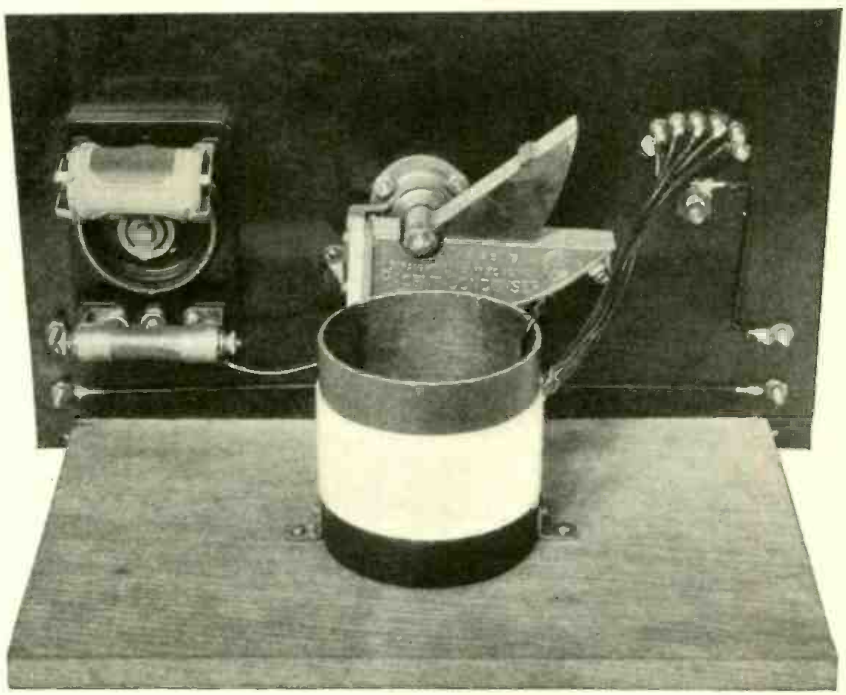
If the set is built correctly, as shown in the pictures and diagrams, the operator, after he has become familiar with the tuning characteristics of the receiver, will find that he will be able to get exceptionally clear and enjoyable headphone reception of stations within a radius of 15 to 20 miles on the set.



THE COIL SPECIFICATIONS

FIGURE 4: *This drawing shows exactly how to make the coil. It should be wound with No. 24 DCC copper wire on a coil form with a 3-inch diameter.*

The single coil, A, in the list of parts at the head of this article, cannot be purchased but it may be easily built by even the most inexperienced beginner in less than a half an hour. Obtain a bakelite tube, as shown in Figure 5. Its size should be 3 inches in diameter and 3 inches long. Bore two holes for the small brass brackets that are used to fasten it to the baseboard. Then, bore two more holes, as shown, for the two ends of the wire Nos. 1 and 7 in Figure 4. Wind the coil with No. 24 DCC copper wire taking a tap off at five turns for tap No. 2, five turns more for No. 3 and so on to tap No. 6. Then, wind twenty-five more turns to the last tap No. 7. The coil is then ready to be used in the set.



A REAR VIEW OF THE SET

FIGURE 5: *The general appearance of the completed receiver as viewed from the back. Notice the neat assembly and the small amount of wire that is used.*

¶ The dramatic episode of the "voice of one crying in the wilderness" that has won the award of the POPULAR RADIO MEDAL FOR CONSPICUOUS SERVICE to two radio amateurs.

The MEN WHO SAVED A MOTHER

By J. ANDREW WHITE

The Man Who Picked Up the SOS—

Harry Drew (9 EBT) of Fargo, North Dakota, whose prompt aid rescued two lives.

—and the Man Who Transmitted It

George Reynolds, (4AG), of Manitoba, Canada, at the base of his antenna mast.

ON a cold November morning three years ago, in the wind-swept wilderness of crags that is known as the Rice Lake district of Manitoba, there came a sudden turn for the worse in the condition of Mrs. E. G. Symes, the wife of the mill superintendent and an expectant mother.

The engineer of the mill, who had been pressed into emergency service as a doctor, was at the end of his resources. The medical supplies were inadequate. A real doctor was needed and needed at at once. And the only way to get one was to send a call somehow to Winnipeg.

Winnipeg was a hundred and fifty miles away. To reach it was a two-day journey by motor boat and canoe in summer time (or a four day journey when the streams were frozen and they were freezing then) to Riverton, the nearest railroad point. To send a messenger for medical aid would take days—and every hour was precious.

In desperation, the husband of the patient turned to George Reynolds, a radio amateur, who was engaged in the assay office of the local gold mine.

In the mine superintendent's shack Reynolds had installed a three-circuit regenerative radio receiver, that used spiderweb coils; it was considered a bear cat of a set in those days. There was to be a transmitter, too, some day. Forty feet overhead stretched an aerial about seventy feet long; a few feet above the rocks six wires were suspended to form the counterpoise, for no earth was available for a ground. Parts for a transmitter lay about, gathering the dust of disuse, for on the first night of attempted operation of the modified Colpitts circuit two 5-watt tubes blew out. And besides, there was only an 8-volt storage battery available for lighting the filaments of the transmitter tubes, and under the heavy current drain operation could be continued but a few hours, when it would be necessary to shut down and recharge the battery. A 65-kilowatt dynamo, delivering 220 volts, D.C., supplied lighting current for the mine and the camp, and on this line and through a bank of lights the storage battery could be charged; but the high voltage for the plates was dependent upon the whimsical functioning of an ancient generator which

delivered somewhere around 450 volts of direct current.

Little did Reynolds think, when he first gathered together this dusty array of parts, that some day a human life would depend upon them. But when the emergency came, Reynolds rose to meet it. Promptly he attacked the mass of metal and wires that might be made to respond with an electrical cry for help. Under skillful guidance this inanimate metal could be endowed with a living voice.

The whole day passed without a sign of success. Time and again the transmitter was tuned and retuned. With that makeshift aerial and counterpoise arrangement it seemed an impossibility to secure the radiation that would be delivered if only the antenna system was suspended over moist earth instead of solid granite.

For one moment a chance for success loomed. Then a sudden flash!

Two tubes had gone. The home-made grid-leak had not been able to withstand the strain of the high current.

Only two good tubes left; five-watters. The best that could be crowded out of them was three-tenths of an ampere in the aerial. But it would have to do.

Steadily, hour after hour, Reynolds' fingers moved the key up and down in patient repetition of the code symbols of the call for attention.

Twice there were faint responses from Americans across the border and Reynolds' fingers moved the key up and down with added intensity over the prospect of getting the precious import of that message across. But back came: "Your signals are very faint through the interference; sorry, old man; see you later"—and then a cheerful sign-off.

In the air crowded with cheery greetings back and forth, the voice of humanity's call by grim irony was too weak to be understood.

So the night passed.

At dawn the vigil ceased and the key was silenced. But the labors of the faithful assayer were renewed with increased vigor.

Patiently the transmitter was taken apart and reassembled into a new circuit, the "Reversed Feed-back," this time. It seemed to give slightly better results. But power was the thing. There was one possibility, and that was to increase plate voltage by hooking in series the 220-volt lighting generator with the little dynamo. It meant taking the chance of blowing something; but all of the work of the previous night had gone for nothing, and there could be no further delay.

Somehow, the call for help had to be jammed through.

At nightfall the key was again clicking off patiently its insistent appeal for attention. As to what wavelength the set was working on, Reynolds hadn't the faintest idea; he had no wavemeter and his receiving set had never been calibrated. But he did know that the aerial was now radiating seven-tenths of an ampere, and that was a boost that made all the daytime labors seem worth while. Now, if the transmitter only held together! A blow-out, however, and all would be over.

In spite of the increased power this night seemed worse than the previous one.

But the hand on the key never faltered. Mechanically, Reynolds reached over to throw the switch to listening position once more. Perhaps a thousand times by now he had faced disappointment, but with each repetition hope had buoyed him up. His message was a matter of life and death, someone must hear it eventually; it *had* to get through; perhaps this would be the time. . . .

And then—

4AG HEAR YOU VERY CLEARLY OLD MAN IF NO MESSAGE SEE YOU LATER
9EBT

The dreaded sign-off—he musn't lose him!

Reynolds' hand shot out to the throw-over switch and in the same motion his fingers again closed on the transmission key; dots and dashes tumbled over each other in the rush to get the message out. . . .

And thus it was in the small hours of that cold November morning an American amateur, 9 EBT, otherwise known as Harry Drew, idling away a few hours at his radio set, comfortably content in the midst of some 25,000 people who also called Fargo, North Dakota, home, instead of a lazy response to his greeting heard the dread call of the air lanes hurtling itself against the diaphragms of the headphones.

"S O S!" it shrilled. "I have a message. It's urgent. Will you take it?"

(*Continued on page 269*)

HUDSON, ORMOND, SPICE & SYMINGTON
BARRISTERS, SOLICITORS, ETC.

WINNIPEG.
CANADA

November 21st, 1923.

Mr. H. R. Drew,
FARGO,
North Dakota,
U. S. A.

Dear Sir:-

I have your letter of the 17th inst. enclosing further message from Mr. Smith from the Selkirk Mine.

I wish to convey to you the thanks of all parties concerned for your trouble in this matter, and undoubtedly you are the person to whom Mrs. Symms owes her life.

Yours truly,
AMERICAN DEVALOPMENT COMPANY LIMITED,
Per
H H Hudson
Vice-President.

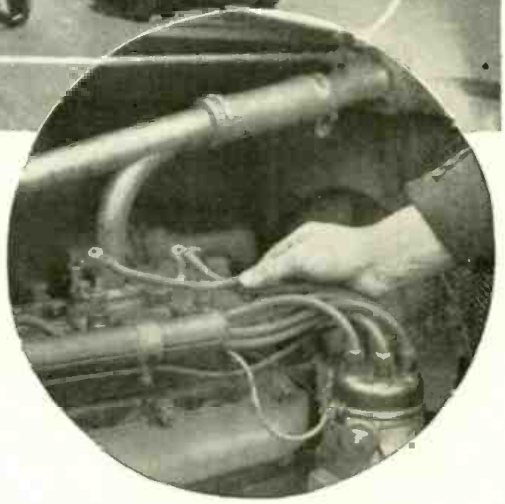
HVH-SS.

The Official Letter of Thanks

The vice-president and attorney of the Selkirk Mine, after he had traced down the identity of Drew by means of a news item in "The Fargo Forum," officially thanked him for his aid, in this letter.

Brown Brothers

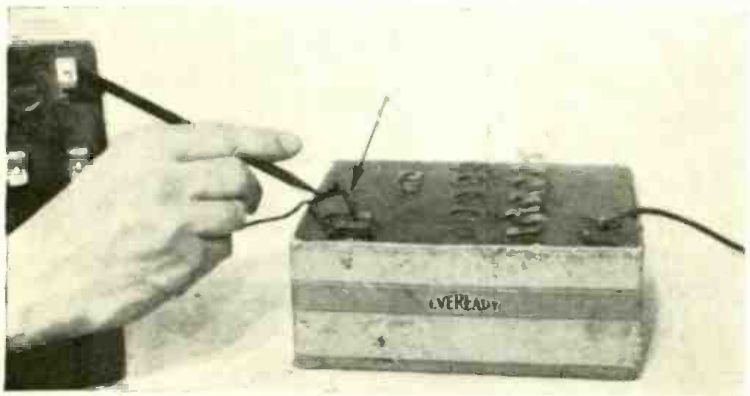
1 IN THE IGNITION SYSTEMS OF AUTOMOBILES—*where radio signals as distinct as those from a spark transmitter may be broadcast with the result that the discharge from crowded traffic may seriously interfere with reception on a sensitive receiver*



15 LAIRS OF THE

Demon Static

Does your set sometimes "go bad"? Perhaps the trouble is due to interference that may be eliminated in some way.

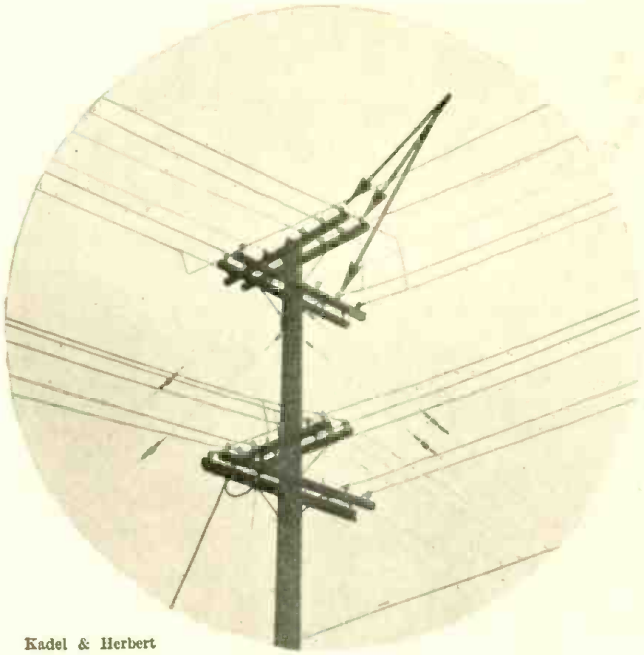


Brown Brothers

2 IN THE BATTERY TERMINAL OF YOUR SET—*a poor connection will make a loud, crackling noise that many people think is static from the air. If you disconnect your antenna and ground, real atmospherics will stop but a bad connection will make as much trouble as was evident before.*

Kadel & Herbert

3 IN THE ROTARY GAP *of the old-fashioned spark transmitters, signals are sent out that sound like static to the inexperienced listener.*



Kadel & Herbert

4 IN POWER LINES *currents may flash across the insulators in wet weather, sending out waves that sound like a steady buzz in the set. The power companies will usually cooperate in eliminating this source of trouble.*

Brown Brothers

5 IN ELECTRIC WASHING MACHINE MOTORS, *dirty commutators will transmit electrical impulses that sound on the loudspeaker like a thunderstorm.*

Brown Brothers

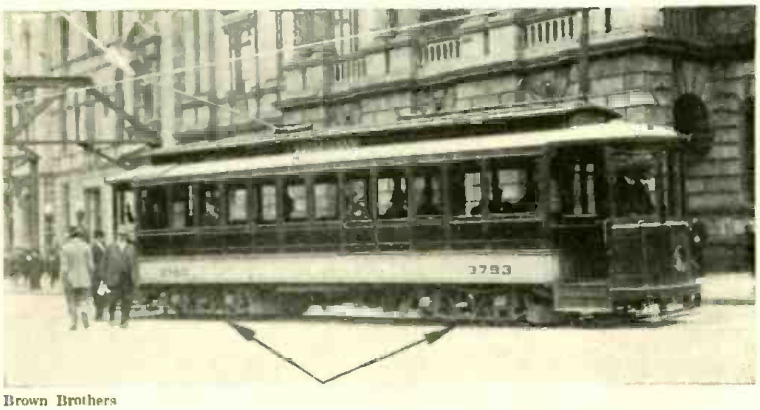
6 IN VIOLET-RAY MACHINES *and other similar devices. These machines should never be used during the evening broadcasting hours.*

Brown Brothers

7 IN THE ELECTRIC REFRIGERATOR, *where a sparking commutator may broadcast interference to the sets in the neighborhood.*

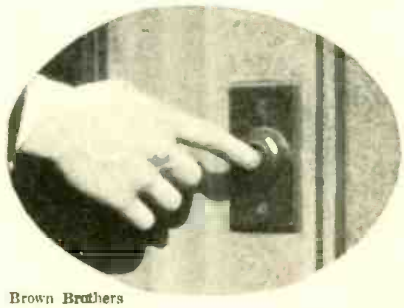
Brown Brothers

8 IN AN OIL BURNING FURNACE, *the motor that drives the fan may have commutators that will broadcast static to your receiver.*



Brown Brothers

9 IN THE TROLLEY WIRES *of street cars, where tremendous interference is sent out by sparks flying between the trolley and the wire and also by the sparking on dirty rails. The only real way to eliminate this source of static is to run the wires underground.*

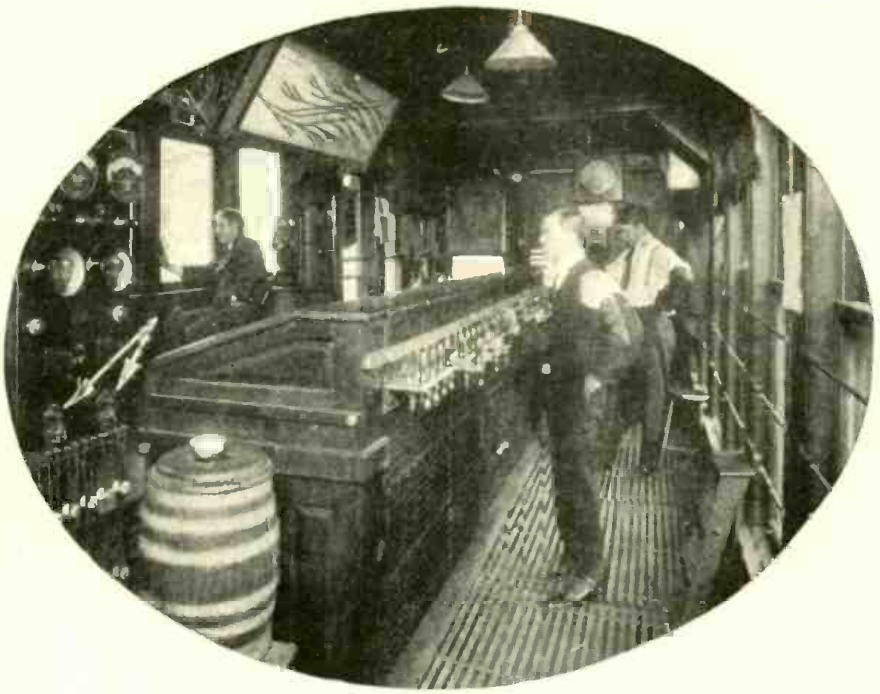


Brown Brothers

10 IN THE BUZZER DOORBELL, *whence signals are sent out into the house that interfere with radio reception.*

Brown Brothers

11 IN VACUUM CLEANERS *in which the dirt from the carpets may interfere with the proper operation of the motors and cause them to send out interference.*



Brown Brothers

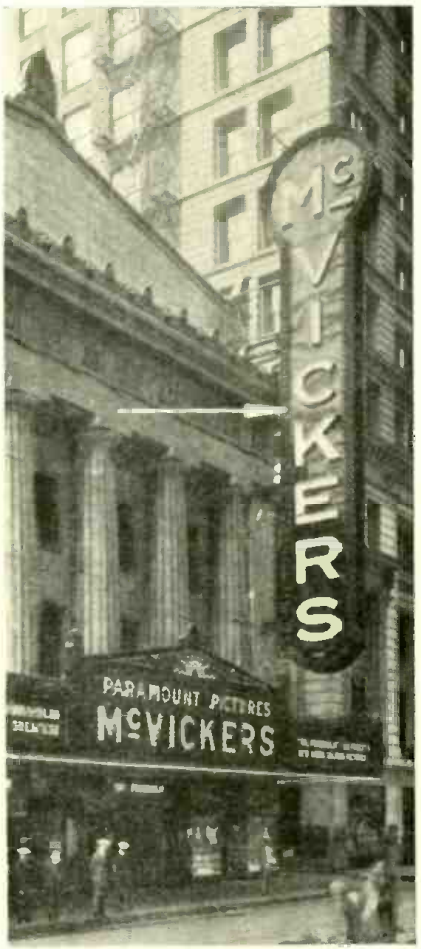
12 IN SWITCH-BOARDS *used for railway signalling, static may be generated that will spoil the programs of many listeners in along the line of the tracks.*

Brown Brothers

13 IN THE AUTOMATIC TELEPHONE; *the clicking that you hear when you call a number may be reproduced and sometimes amplified in radio receivers in the same building.*

Brown Brothers

14 IN TOY ELECTRIC MOTORS *that every Christmas brings, dirty commutators and sparking between the wheels and the rails often interferes with local radio reception.*



E. Olmstead

15 IN FLASHING ELECTRIC SIGNS, *the make-and-break devices that cause them to flash on and off may produce enough sparks in a single sign to disturb listeners in within a radius of three or four blocks.*

¶ Here is a practical receiver for motoring, for the camp, for the motor boat or for the home. It is a portable set with exceptional tone quality and distance range and is equipped with battery power that should last for from two to four months of ordinary use without replacement.

HOW TO BUILD THE NEWEST PORTABLE

"Town and Country" Receiver

By S. GORDON TAYLOR

COST OF PARTS: *Not more than $88.25*
RECEIVING RANGE: *Coast to coast.*
(For the list of parts used in this laboratory model, see page 269.)

¶ *The list of parts there given includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which may be used with equally good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

THE public demands much more of a portable receiver now than it once did. Time was when the "cigar-box" portable with its single tube and headphones was a novelty but its usefulness is now practically limited to boy scout camps and the like. The adult public is satisfied with nothing less than a receiver that will provide good loudspeaker volume even on distant stations; in addition it demands that the receiver operate with a loop antenna and dry cells, that it be simple to tune but highly selective and that it have good tone quality even under trying conditions.

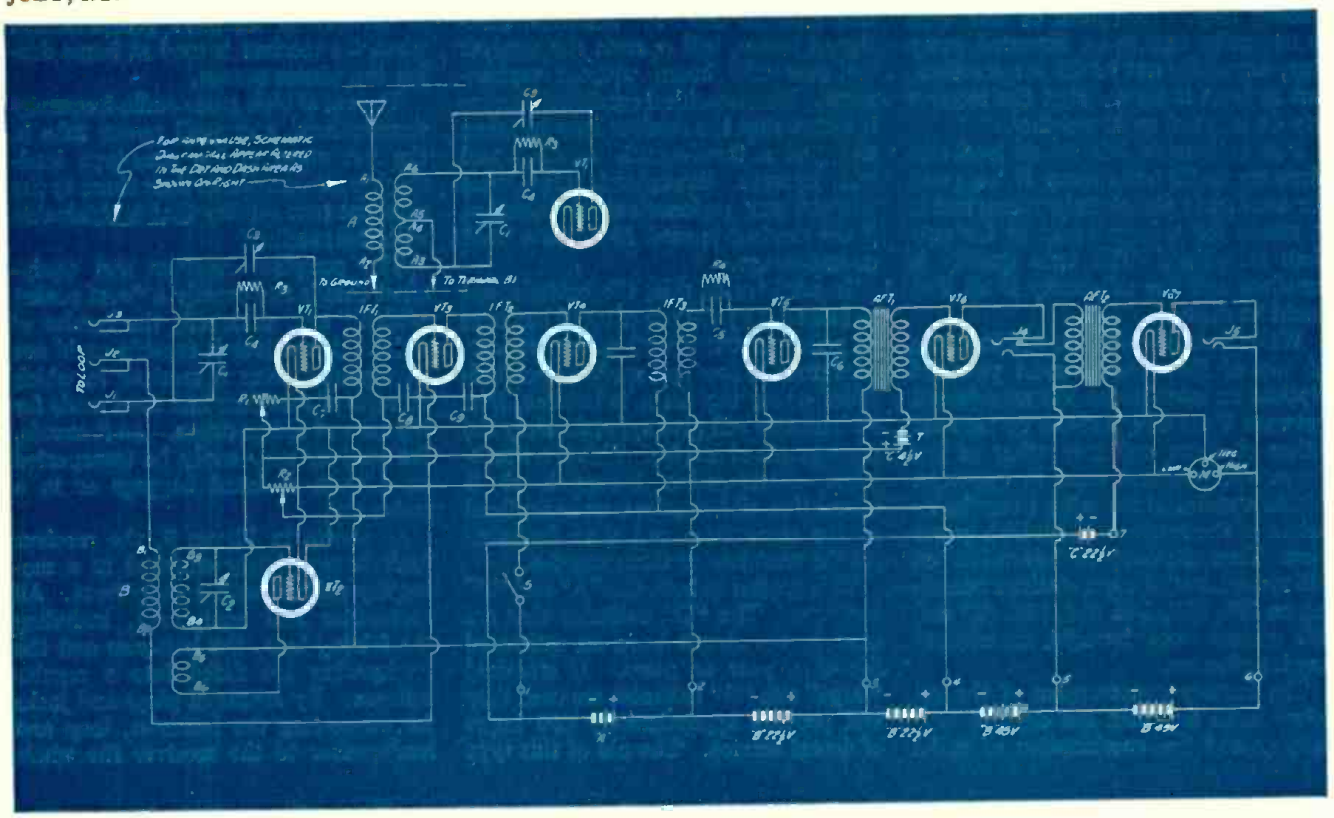
In designing the 1926 "Town and Country" receiver these requirements have been kept constantly in mind and others have been added to the list whenever this seemed to be advantageous.

It was believed, for instance, that the receiver should be fitted for home use in winter as well as for portable use in summer. This required an appearance fine enough for home surroundings and a construction sturdy enough to stand the knocks that a portable set receives. It should also be equipped to use a loop or an outdoor antenna.

It was not until all of these requirements had been met that the receiver was considered finished and the final model, as described in this article was made up.

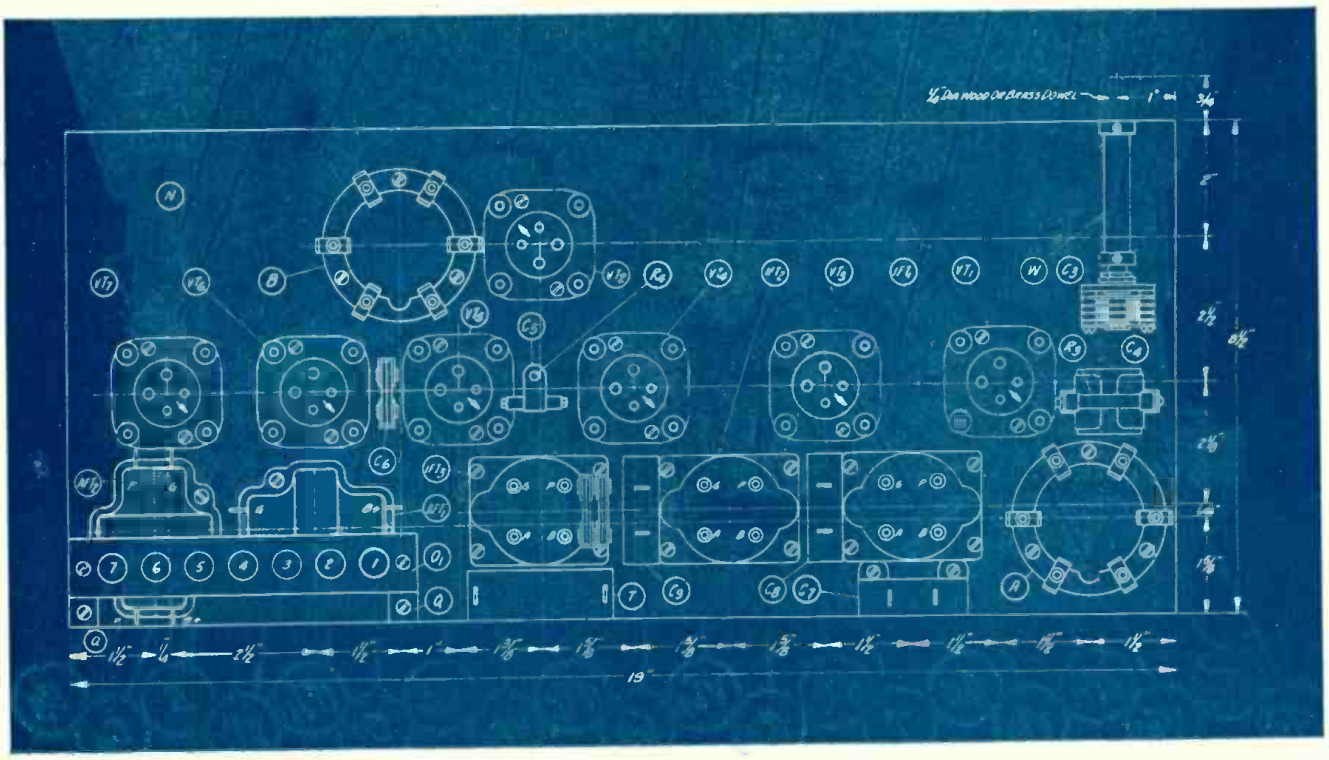
This receiver, during the tests that were conducted in and around New York City, accomplished everything that was desired of it. It proved to be sufficiently sensitive to bring in California stations on the loudspeaker with a volume great enough to be clearly understood across a medium sized room.

This reception was accomplished without the use of either a ground or a regular antenna but with only the small



The Hook-up of the New "Town and Country" Receiver

FIGURE 1: *All of the symbols for the instruments bear designating letters which reappear in the list of parts, the text and the following illustrations; this eliminates the possibility of mistakes in construction and wiring up.*



The Working Plan for the Baseboard Layout

FIGURE 2: *The exact positions in which the instruments are mounted on the baseboard. Extra care should be taken to fasten all instruments securely so that they will not jar loose during transportation of the receiver.*

folding loop. Reception of this type is naturally not to be expected every day, especially not in the summertime, but at least it shows what the receiver can do in good radio weather.

Full volume on this set on local stations up to 50 miles away is too great for comfort in the average room; and it is ample for a large room or for outdoor reception. The tone quality is excellent and the selectivity is all that could be desired.

While the set was in use within a mile of two of New York's most powerful stations no interference was experienced between these two stations or between either of these and any other of the dozen stations that were in operation within a radius of ten miles from the location of the receiver. With high power New York stations in operation on 316 meters, out of town stations operating on 300, 303, 306, 309, 319, 322 and 326 meters were brought in without any interference.

The battery consumption of the receiver is so low that the dry-cell "A" battery and the combination of small and medium size "B" batteries, mentioned below, will operate the receiver for over 120 hours without replacement. This is an ideal condition because it means that the receiver may be taken along on a three-month vacation and will operate throughout that time without any replacement of batteries, if the receiver is used 10 hours a week on an average.

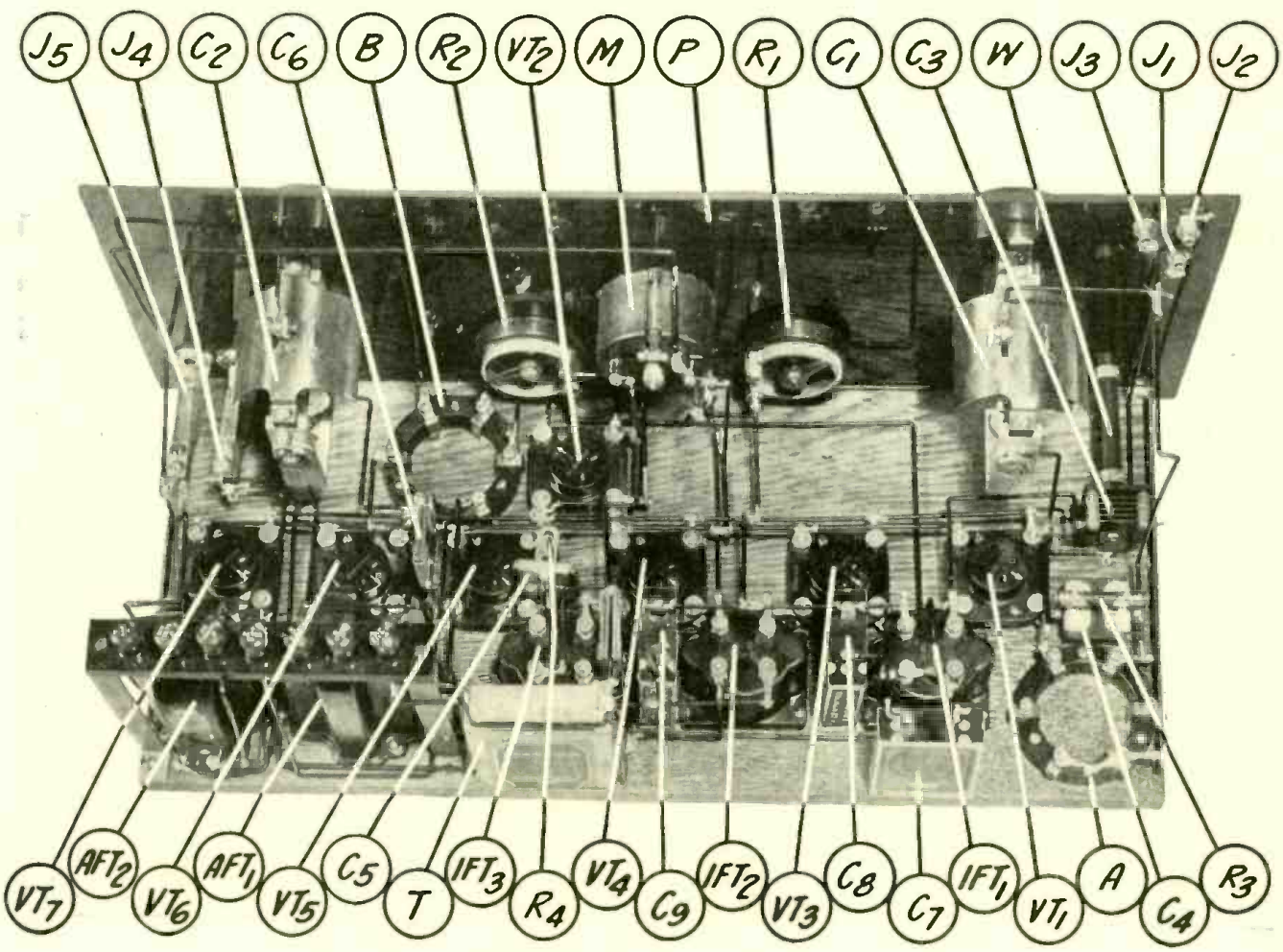
In addition to this, the batteries are so balanced by the use of small batteries at points in the circuit where the current drain is low and medium size batteries where the drain is heavier, that all batteries will give approximately the same length of service. This is a worthwhile consideration inasmuch as it means that all batteries may be replaced at the same time and then forgotten for the next two or three months.

This applies to both the "A" and "B" batteries. The "C" batteries that are used in the circuit have an estimated life of a year or more. If standard "large" size "B" batteries are used they will provide approximately 400 hours of actual service. The use of this type of battery is therefore recommended when the receiver is used at home during the winter season.

The use of high grade audio-frequency transformers, a dry-cell power tube in the last stage and a cone-type loudspeaker all contribute their share to the excellent tone quality that is obtainable with this receiver.

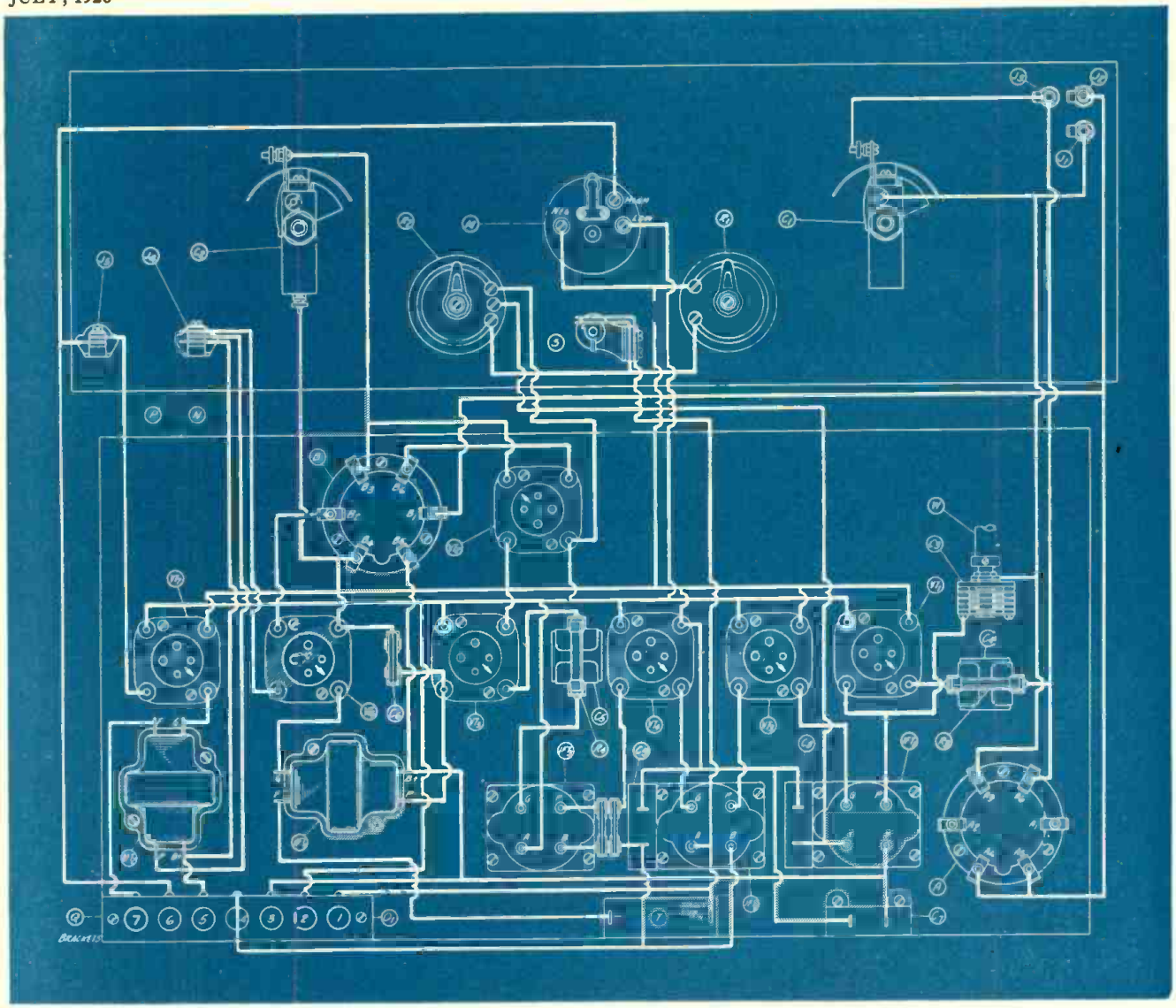
The complete receiver and equipment case is not exactly a "vest pocket edition" but, after all, the results of which this receiver is capable could not be expected from a receiver in which all sorts of sacrifices had been made for the sake of compactness. As it stands, the receiver may easily be transported on a train as hand baggage or in a motor car.

As shown in Figure 9, the receiver itself is completely enclosed in a mahogany cabinet with a drop front. All accessories and equipment, including the folding loop, the batteries and the loudspeaker are fitted into a regular suitcase. By means of plugs and jacks for connecting the batteries, loop and loudspeaker to the receiver the whole



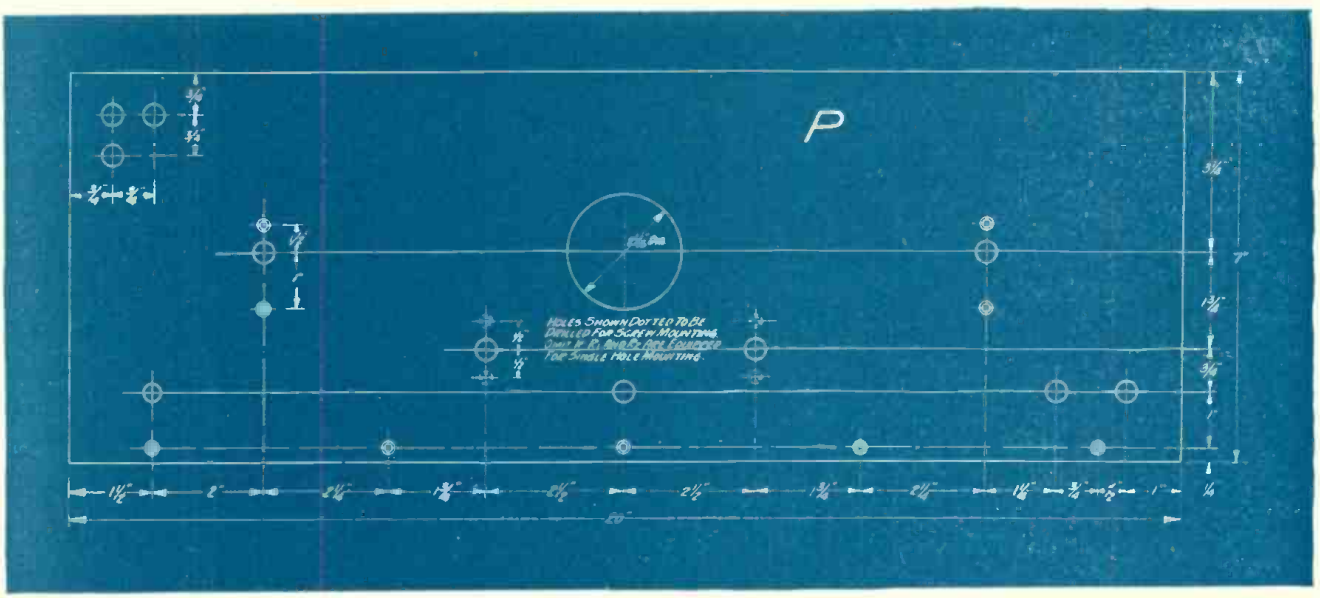
A Rear View of the Receiver

FIGURE 3: *The general arrangement of all the instruments on both the baseboard and the panel; it should be noticed that most of the wiring is kept down close to the baseboard and that a good deal of it rests directly upon it.*



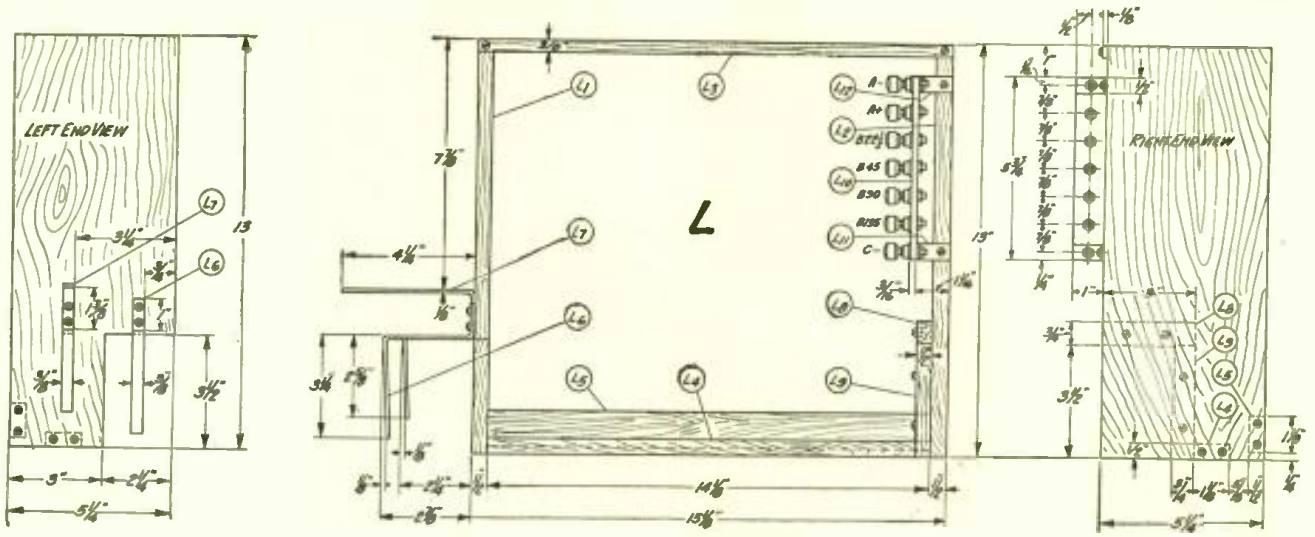
The Picture Wiring Diagram of the Receiver

FIGURE 4: *The upper rectangle represents the panel and the lower rectangle, the baseboard.*



How to Drill the Panel

FIGURE 5: *The exact positions in which to drill the holes for mounting the instruments.*



How to Build the Framework for the Equipment Case

FIGURE 6: *Complete details and measurements of the framework that fits inside of the suitcase are shown here. The assembled case, with the equipment in place, is shown in Figure 8 on page 260.*

outfit may be set up and put into operation in less than 60 seconds.

The picture at the head of this article suggests one of the uses of the 1926 "Town and Country" Receiver. It may even be put into operation when the entire receiver and loop are enclosed within the all-steel body of a closed car.

Under such conditions, the volume and sensitivity are somewhat reduced but ample loudspeaker volume is obtainable over 100 miles away from the New York City broadcasting stations. On the deck of a motor boat or yacht excellent reception is obtainable. In camp or in the summer cottage, conditions, of course, approximate those found in town and reception is equally good.

Radiation from this receiver is negligible. When the loop antenna is used, this receiver will not cause interference in another receiver operating ten feet away in the same room.

When an outdoor antenna is used, conditions are the same due to the loose coupling that is normally used in coil A and also to the fact that only 22½ volts are used on the plate of the oscillator tube. The first detector also uses only 22½ volts on the plate.

All of these things point to this as a real "all-purpose" receiver that will meet the demands of the most fastidious under any and all conditions.

How to Construct the Set

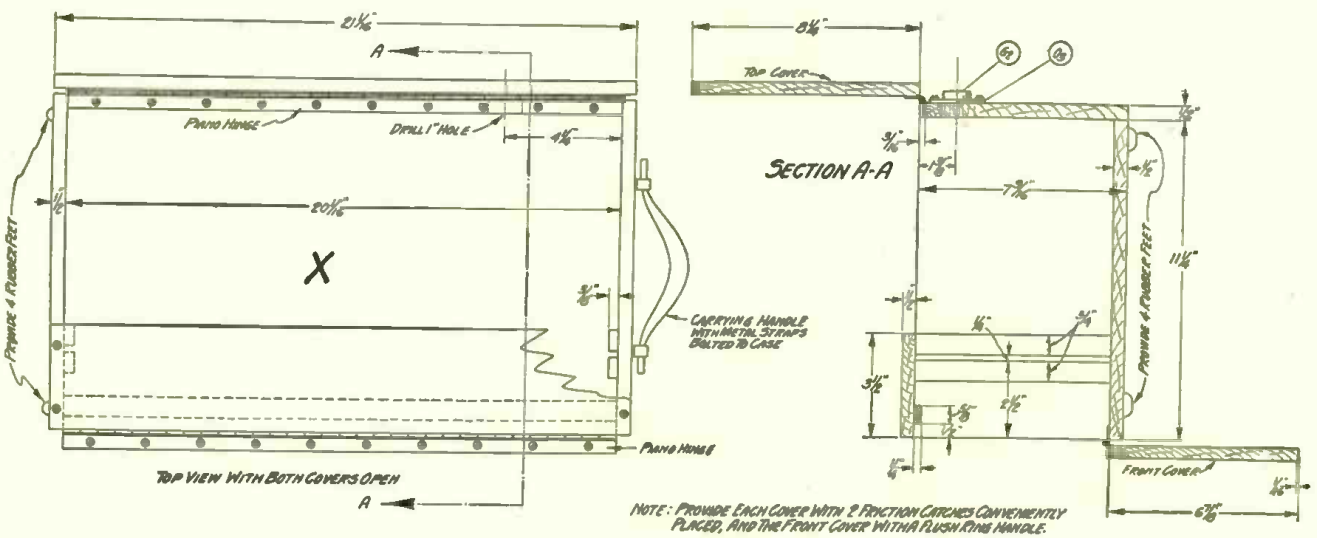
After all the instruments and materials for building the set have been procured, the amateur should prepare the panel, P, (shown clearly in Figure 5).

First of all, cut the panel to the correct size, 7 by 20 inches. Then square up the edges smoothly with a file.

The centers for boring the holes (that are necessary for mounting the instruments) should then be laid out on the panel, as shown in Figure 5. A convenient method of doing this is to lay out all center holes on a piece of paper the same size as the panel; then the piece of paper may be fastened on the panel and the centers marked directly on the panel by punching through the paper with a sharp, pointed instrument.

If all of the holes to be drilled are first started with a small drill, one-sixteenth of an inch in diameter or less, they may

(*Continued on page 260*)



The Cabinet for the Receiver

FIGURE 7: *Complete specifications for the construction of the cabinet are given here. This model cabinet, which was especially constructed for this receiver, may be duplicated by any cabinetmaker from these drawings.*

The NEW RADIO VIOLIN

An ingenious device that enables a lone soloist to play a concerto to the accompaniment of a full symphony orchestra

By
PATRICK WHELAN

HAVE you ever heard a violinist stand alone before an audience, sweep his bow across the strings—and hear emanate not only the familiar and expected sounds of the violin but the accompaniment of a piano, or even of a full orchestra?

No, of course not. Nobody has—at least not yet. But that remarkable sensation is in store for you.

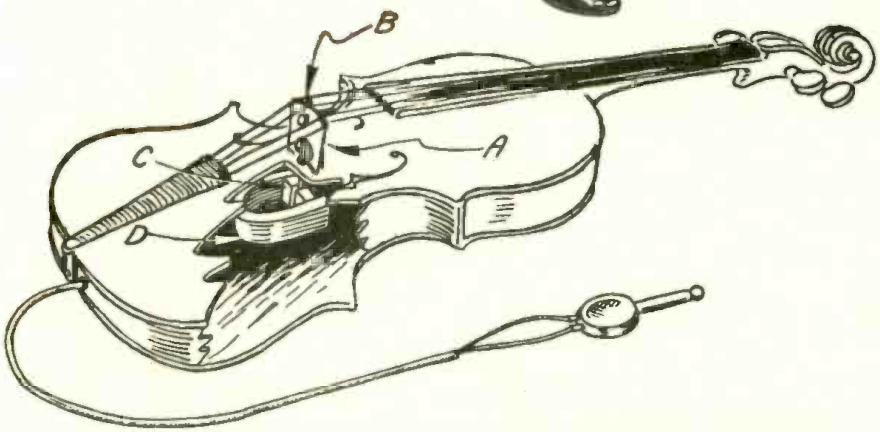
For this feat may now be accomplished by means of a compact loudspeaker unit that may be inserted inside of the violin and attached, by means of a wire, to a nearby receiving set. Both the receiver and the wire may be concealed.

Thus a broadcast program may be reproduced by the violin itself, which has been transformed into a practical reproducer.

This electrically operated instrument is not a toy; it is a real violin that has been augmented with a reproducing unit similar to that used in a loudspeaker. The unit comprises a permanent magnet, two coils and an armature affixed to a movable pin. It is mounted inside the violin after a portion of the back of the instrument has been temporarily removed and placed in position, as shown in the accompanying diagram. The magnet is fastened directly to the wooden frame of the violin and the pin is fastened to the bridge work, so that when the pin vibrates, due to the electrical impulses of music, the whole bridge and structure of the violin vibrate at the same time and in the same manner as if the strings were being played upon with a bow.

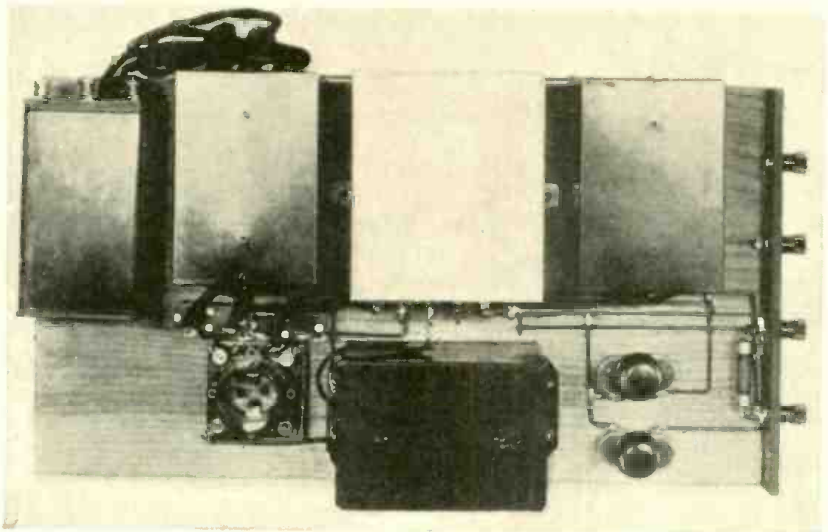
To violin students who find the grind of daily practice a bit wearisome this unique device offers the inestimable boon of an accompaniment, not only by the world's greatest artists, but by the world's greatest ensembles and orchestras.

For by means of this instrument Little Willie may now play a violin obligato—perhaps a bit falteringly—to Galli-Curci's *Ave Maria* of Gounod, or carry the simple melody of Handel's *Largo* to the accompaniment of the New York Philharmonic orchestra.



HOW THE REPRODUCER IS MOUNTED

This drawing shows the method of affixing the loudspeaker unit inside of the violin. A is the bridge to which is fastened the vibrating pin B that is energized by the coils C and the magnet D.



Four New Combinations of Units

For Assembling the Raytheon Power-Pack

By LAURENCE M. COCKADAY

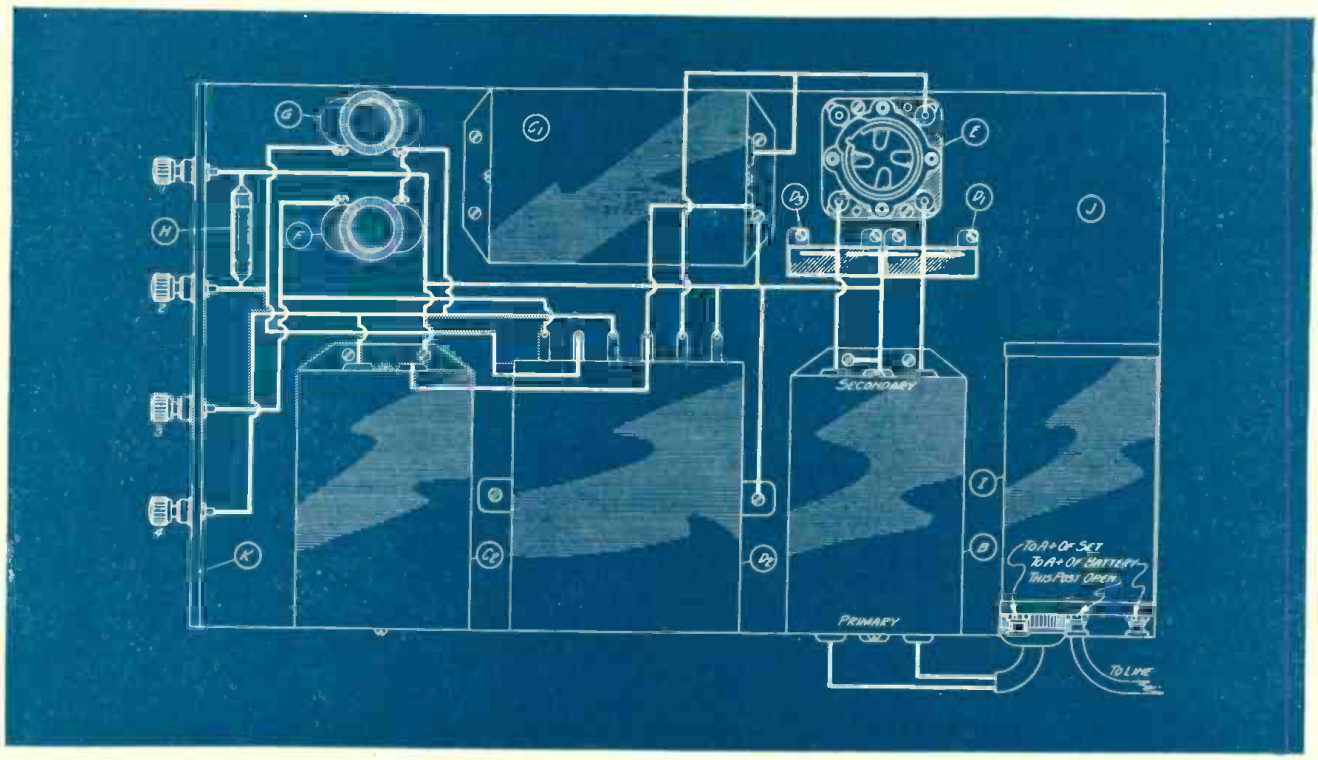
A High-Voltage Power-pack That Is Equipped With a Relay

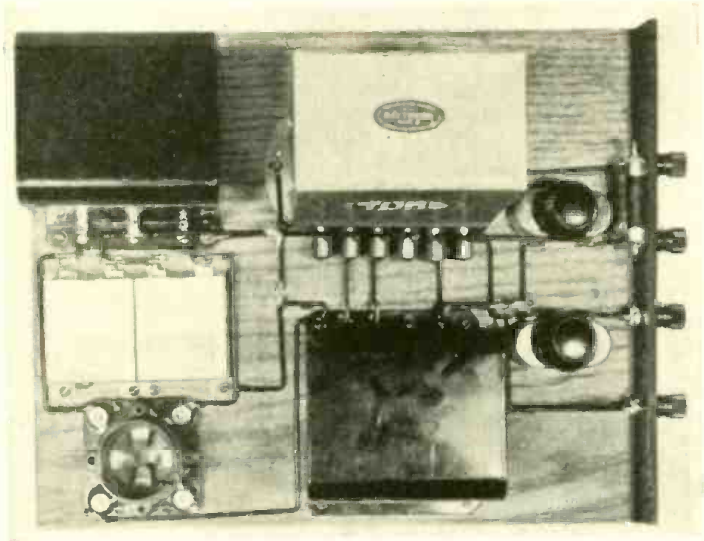
An extremely handy model that contains a relay that is connected in circuit with the "A" battery so that the battery switch on the receiver turns the Power-pack on and off without extra switching. The unit furnishes a high-voltage direct current with two intermediate taps.

HERE IS A LIST OF THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A—Raytheon tube;
B—Mayolian step-up transformer;
C1 and C2—Mayolian chokes;
D1 and D3—filter condenser, .1 mfd.
D2—Dubilier high-voltage, filter, condenser can for Raytheon circuit;
E—Benjamin standard tube socket (old style);
F—Bradleyohm, No. 10;
G—Bradleyohm, No. 25;
H—Bradleyunit; 7,500 ohms;
I—Brach relay;
J—wooden baseboard;
K—binding-post strip;
4 Eby binding posts;
brass wood screws.

Note: *This unit is Model IX.*





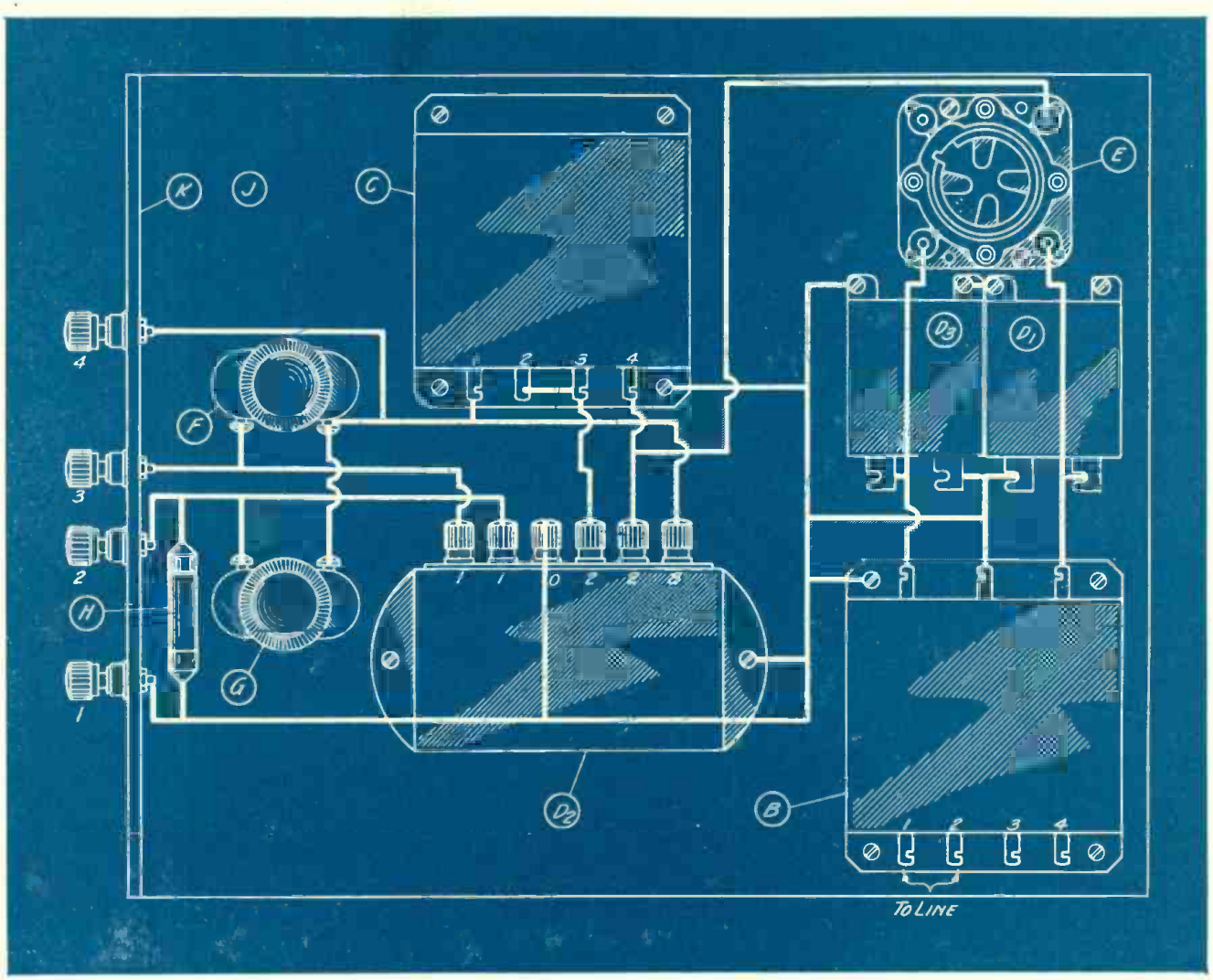
A Raytheon Unit That Will Light the Last Audio Tube

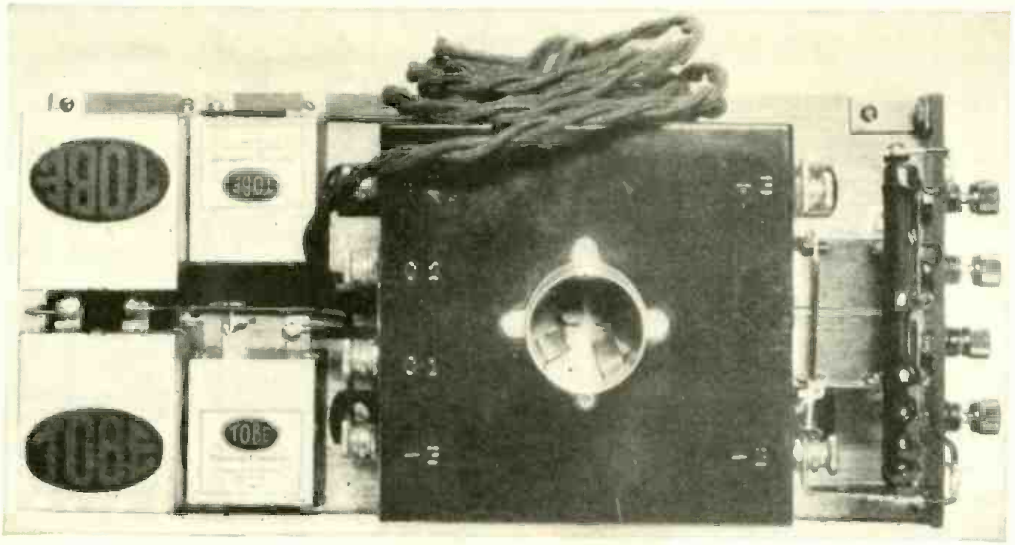
The step-up transformer, in this model of the Power-pack, has a tap for filament circuit so that the power tube may be supplied with energy on the filament as well as for the "B" current

HERE IS A LIST OF THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A—Raytheon tube;
B—General Radio step-up transformer;
C—General Radio double choke;
D1 and D3—Tobe filter condensers, .1 mfd.;
D2—Tobe filter condenser unit for Raytheon circuit;
E—Benjamin socket (old style);
F—Bradleyohm, No. 10—
G—Bradleyohm, No. 25;
H—Bradleyunit, 7,500 ohms;
J—wooden baseboard;
K—binding-post strip;
4 Eby binding posts.

Note: *This unit is Model VIII.*





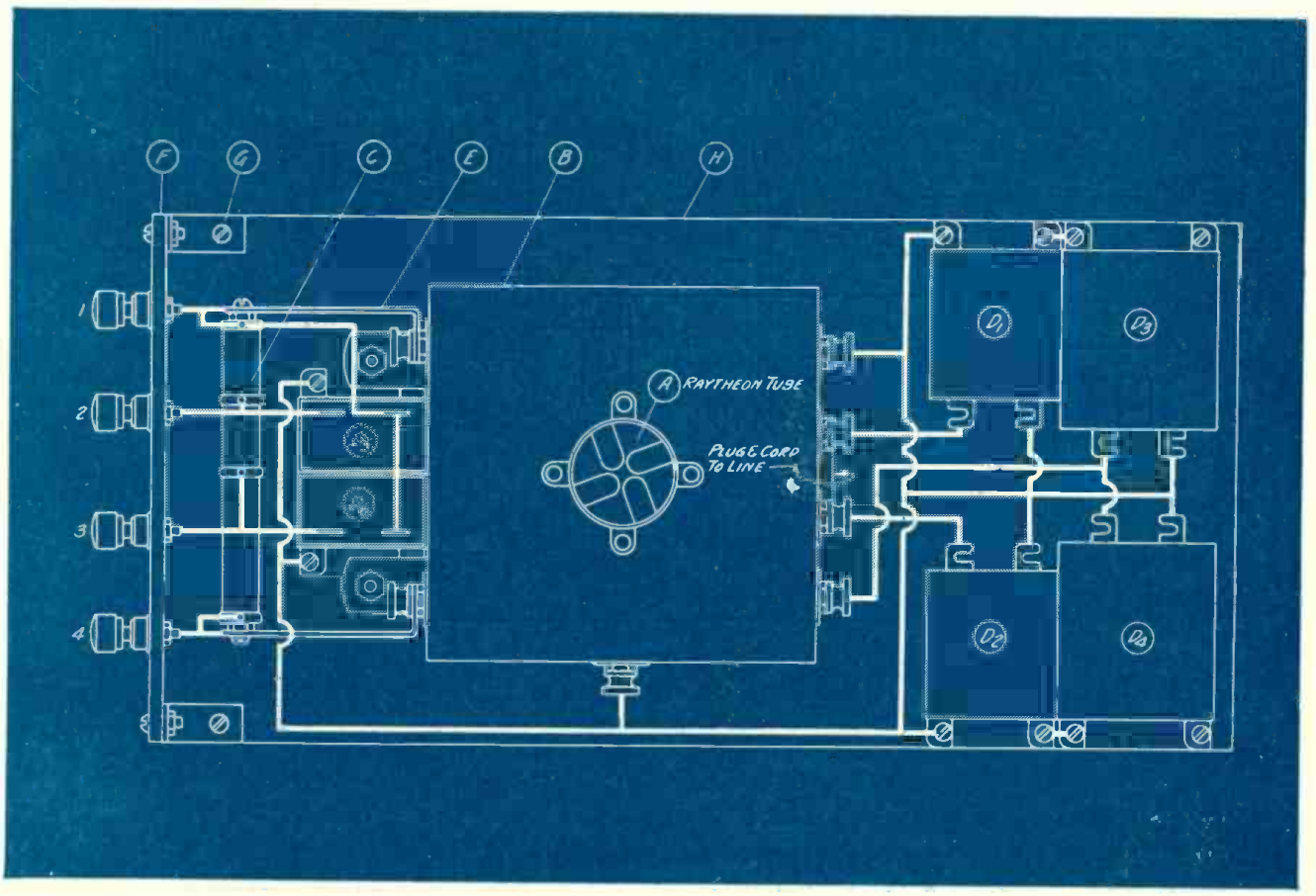
A Compact Power-pack Obtained by a Variation in Design

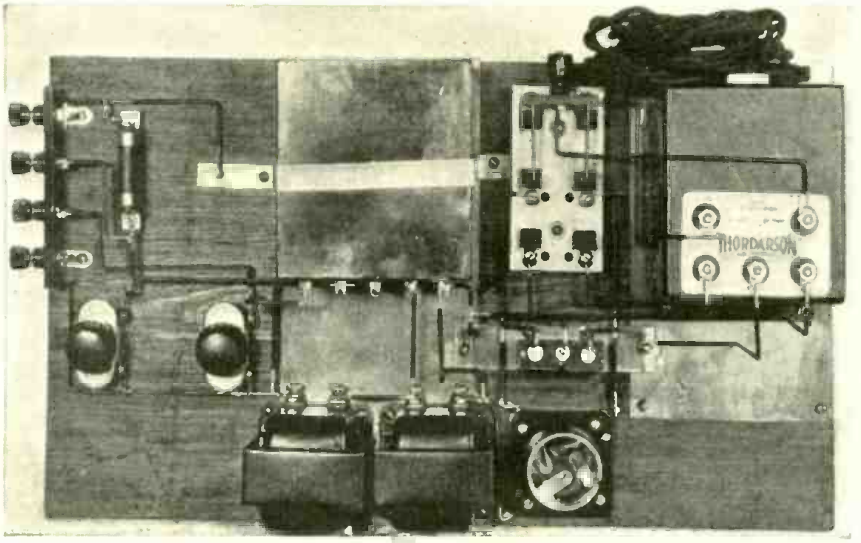
In this model a compact transformer, choke and socket arrangement has been employed. All of these units and their binding posts are in a black metal can with the tube socket mounted on top. Separate resistors and condensers are used.

HERE IS A LIST OF THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A—Raytheon tube;
B—Jefferson transformer and choke unit;
C—special Ward-Leonard unit with tap resistances of 7,500, 3,750 and 3,750;
D1 and D2—Tobe filter condensers, 2 mfds.;
D3 and D4—Tobe filter condensers, 4 mfd.;
D5 and D6—Tobe filter condensers, .1 mfd.;
E—brass brackets for mounting resistor C;
F—binding-post strip;
G—small brass brackets;
H—wooden baseboard;
4 Eby binding posts.
brass wood screws.

Note: *This unit was referred to in Part I as Model VII.*





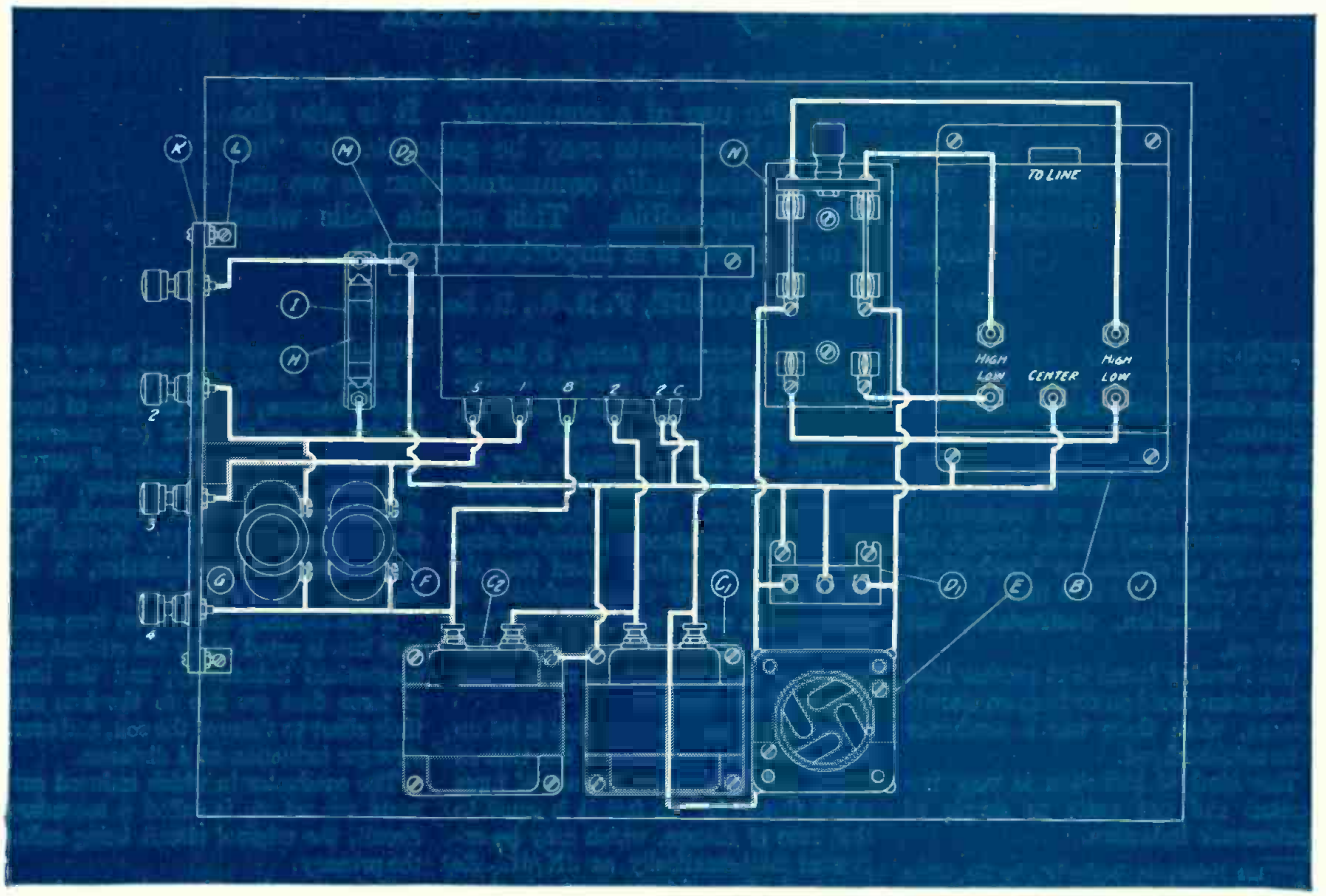
A Raytheon Unit for High or Low Voltages

This model of the improved Power-pack contains a switching arrangement by means of which either a high or a low voltage may be obtained on the input, step-up transformer. By this means a high or low direct current output may be obtained for plate supply.

HERE IS A LIST OF THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

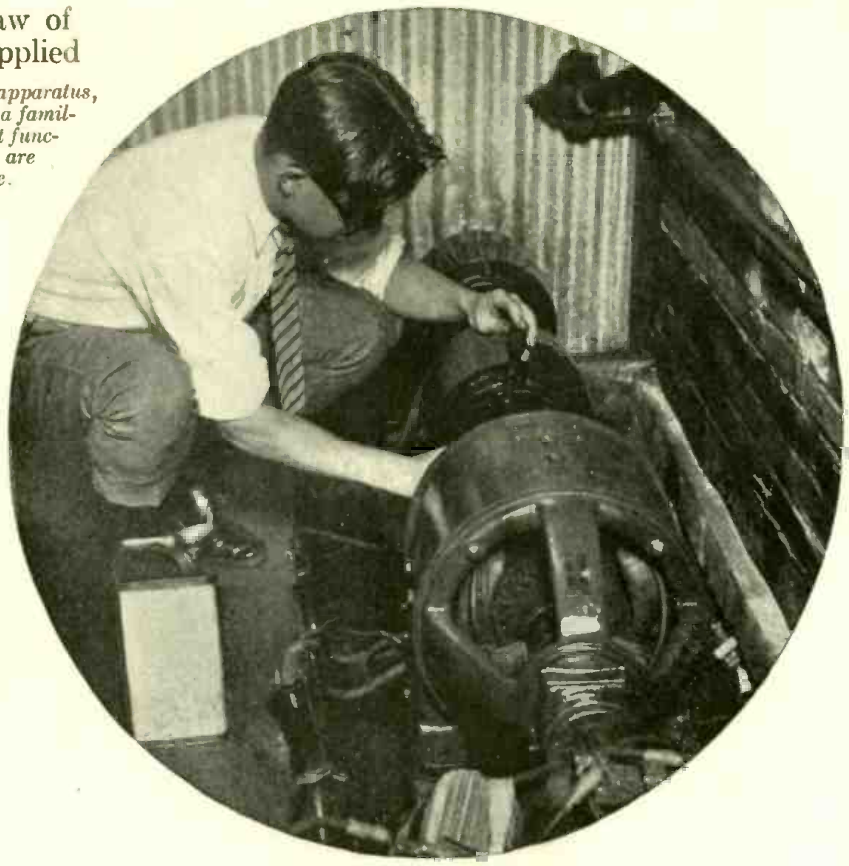
A—Raytheon tube;
B—Thordarson step-up transformer;
C1 and C2—Thordarson chokes;
D1 and D2—Aerovox filter units;
E—Walbert Safety Rim socket;
F—Bradleyohm, No. 10;
G—Bradleyohm, No. 25;
H—Bradleyunit, 7,500 ohms;
I—Electrad grid-leak mounting;
J—wooden baseboard;
K—binding-post strip;
L—brass brackets;
M—brass bracket for mounting condenser can;
N—double-pole, double-throw switch;
4 Eby binding posts.

Note: *Referred to in Part I as Model III.*



Where the Law of Induction Is Applied

All electrical generating apparatus, of which this generator is a familiar type, employ coils that function under the laws that are described in this article.



How Energy Leaps the Chasm *of* Space *by* "Induction"

"Induction" is our name for the force that carries energy across space without the use of a conductor. It is also the force by means of which currents may be generated or "induced." Without induction radio communication as we understand it would be impossible. This article tells what induction is and why it is important to radio.

By SIR OLIVER LODGE, F. R. S., D. Sc., LL.D.

INDUCTION may be generally divided into two main classes or types: electrostatic and electro-magnetic induction.

In an earlier article,* I told how Faraday first employed "induction" as a general name to indicate any electrostatic action across space; that is, through the ether only, as opposed to "conduction" through matter. At that time, the first kind of induction, electrostatic, was described.

But Faraday found that another kind of induction could go on from an electric current, when there was a conductor in its neighborhood.

This kind of induction is very important and not quite so simple as electrostatic induction.

When a current is steady, it has no inductive effect. To produce electromotive force by induction, therefore, currents must vary in strength.

When they rise in strength, they induce an opposite current in neighboring conductors. When they fall in strength they produce a current of similar sign to themselves. And they do this even in their own conductor, a phenomenon which was called by Faraday "Extra Current" but which is now known as self-induction, a name given to it by Clerk Maxwell.

The electromotive force that is set up in a conductor depends on the rate of change in the number of lines of force which thread it. In fact it is equal to that rate of change, which may be expressed mathematically as dN/dt. As long as the lines of force are steady there will be no current induced in the wire.

Faraday called this "the electronic state"; because, when the lines of force subside or are removed (or otherwise destroyed), a wave or pulse of current circulates in the conductor. The strength of this current depends upon the electromotive dN/dt, divided by the resistance of the conductor, in accordance with Ohm's Law.

If the inducing coil has an iron core, that iron is acted on by the current and magnetized inductively; and the lines of force that are due to the iron add their effect to those of the coil, and exert stronger induction at a distance.

The conductor in which induced currents are set up is called a secondary circuit, the original circuit being called the primary.

If the secondary circuit is wound over

*"What Inductance Really Is", by Sir Oliver Lodge in the March, 1926, issue of POPULAR RADIO.

the primary, or wound on some part of the common iron core, nearly all of the inductive lines of force can thread the secondary, and the inductance is then at a maximum.

This kind of a device is called an "induction coil."

The object of an induction coil is to generate a sudden and violent electromotive force in the secondary circuit; and for that purpose the amplitude of the primary current should be rapidly varied.

One way to produce this effect is to open and close the primary circuit in rapid succession. The "break" may be made more rapidly than the "make," because a complete break in the circuit may stop it almost dead—not quite dead, because you cannot introduce the insulator with infinite speed.

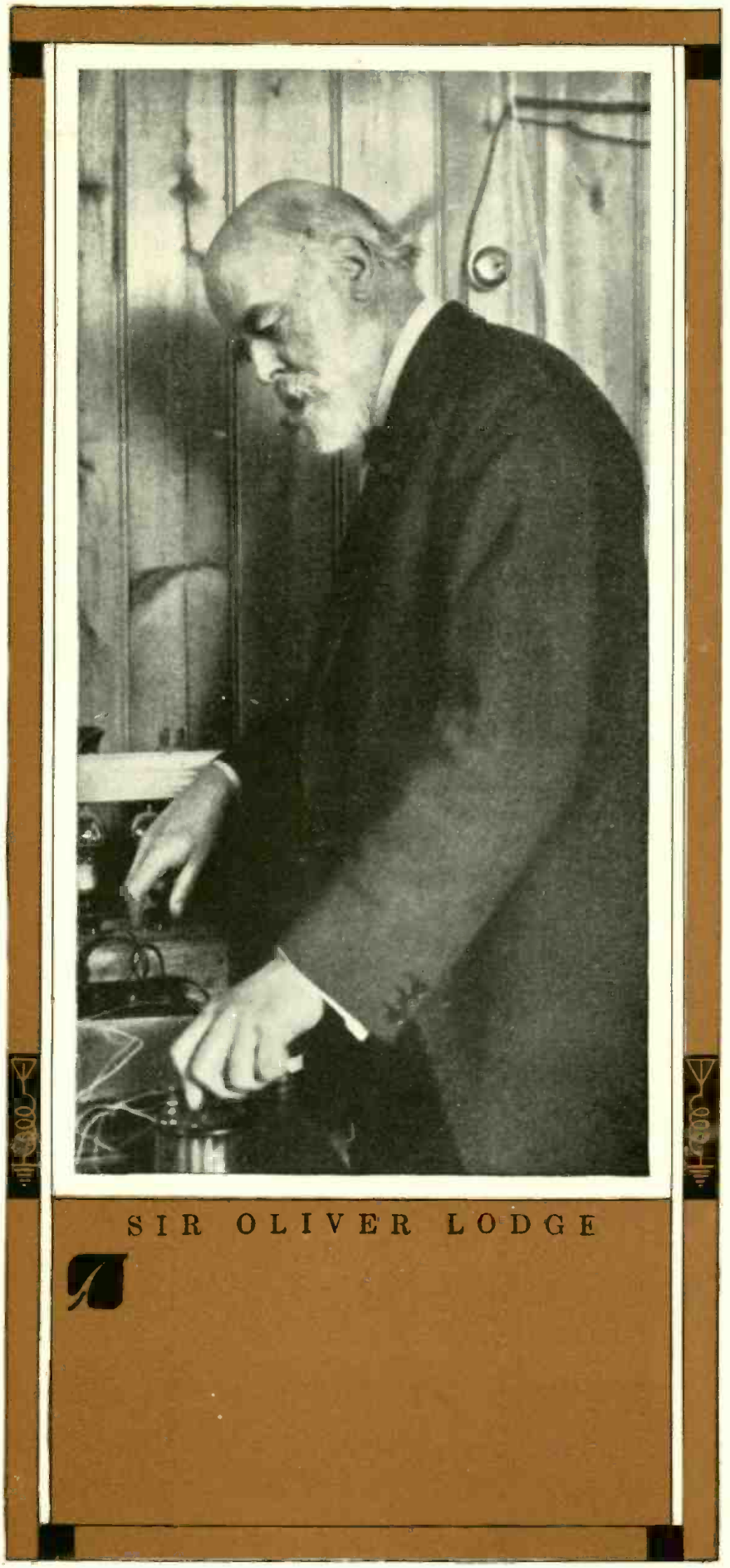
If you break the circuit in air, there is sure to be a spark, which prolongs the current for an instant. If you break it under a liquid that is an insulator, the stoppage is more sudden, due to the quenching action. Even in air, however, the stoppage may be made rather sudden by connecting a condenser across the terminals of the breaking device. Then the first rush of the self-induced or "extra" current expends itself in charging the condenser, so that the terminals have time to separate and to either avoid the spark altogether or to reduce it to a minimum. Moreover, the stored charge in the condenser immediately recoils back, producing a current in the opposite direction, so that the primary current is not only stopped, but reversed, thus giving a double effect on the secondary.

If the secondary has a large number of turns, so as to surround the magnetic lines of force a great many times, the induced electromotive force may reach a very high value, giving a spark in favorable cases a foot or more in length. The ratio of primary turns to secondary turns, therefore, governs the voltage obtained in the secondary.

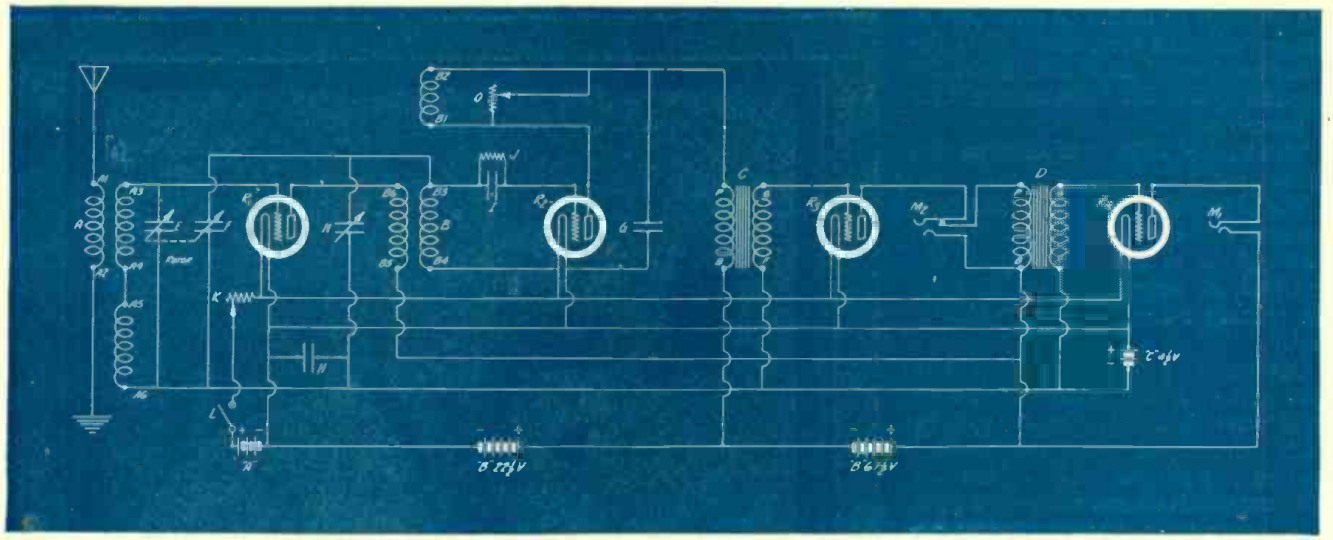
A dynamo also acts by induction; but in this case the current is induced in the armature not by making and breaking the primary current, which may remain steady, but by rapidly moving it, or, more conveniently, by rapidly rotating the armature coils so that the steady lines of force of the inducing magnetic field shall thread the secondary circuit or armature, first in one direction and then in the other. The more rapid the rotation becomes, the more vigorous is the induced electromotive orce.

The total induction in a magnetic circuit, say a horseshoe electromagnet with an air-gap (in which experiments may be made), is the total number of lines of force generated.

(*Continued on page 254*)



SIR OLIVER LODGE



THE WIRING DIAGRAM OF THE S-C RECEIVER

FIGURE 1: *The electrical connections for the receiver and all of the designations for the instruments are marked with letters that correspond with those in the constructional article that appeared in the March, 1926, issue of* POPULAR RADIO.

HOW TO GET THE MOST OUT OF YOUR

S-C RECEIVER

Every radio fan who has built or who intends to build the new S-C receiver will find in this article data on the theory of operation, the best type of antenna and ground to use with his set and general operating hints that will be of value to him in getting the best possible results out of this set.

By S. GORDON TAYLOR AND LAURENCE M. COCKADAY

THE S-C Receiver, which was described in the March, 1926, issue of POPULAR RADIO, seems to have drawn into the radio game many fans who have never before built a set, largely because of the simplicity of its construction.

This is due both to the harness arrangement of wiring and to the care which was taken in the article to treat every detail so clearly that no doubt could be left in the reader's mind about any point of construction.

Of course, the builders of this set were by no means limited to beginners; but in view of the special appeal which it offered to this class of fan it was believed that an article giving full operating data and information regarding the equipment to use with the set, as well as general instructions for obtaining maximum results in actual operation, would be decidedly useful.

This article which deals with the installation, care and operation of the S-C Receiver has therefore been inserted in this issue in place of the regular article on "How to Get the Most Out of Your Ready-made Receiver."

The Theory of Operation

The antenna circuit that is employed is of the semi-aperiodic type; that is, it does not have to be tuned to resonance with the incoming signals. Any signals that are transmitted in the broadcast waveband will be intercepted by this antenna circuit with practically equal facility.

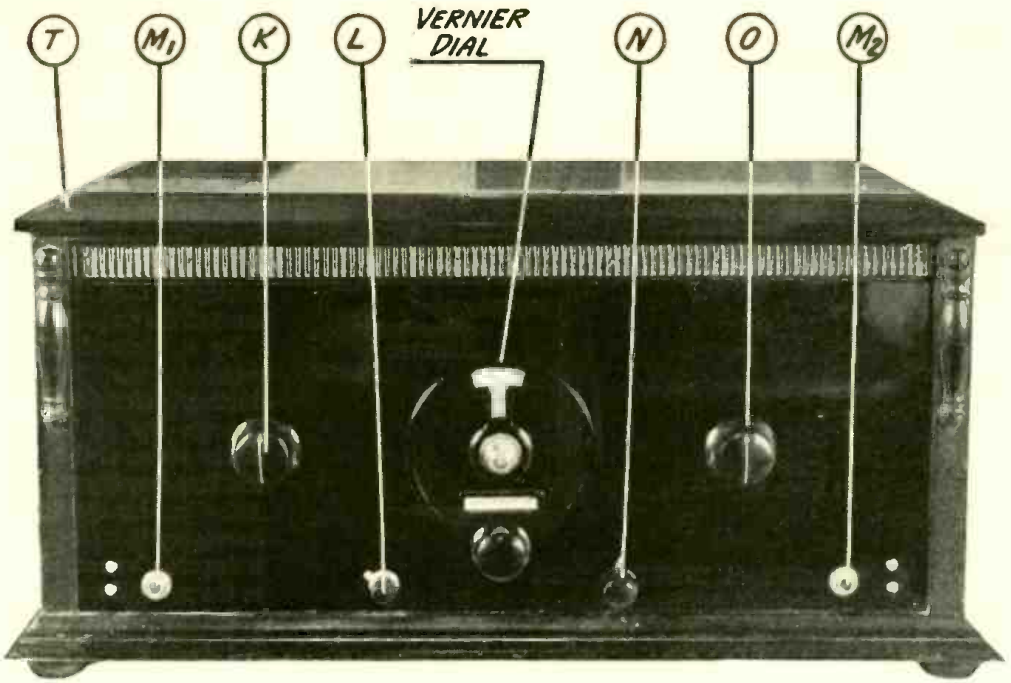
It is the purpose of the coil, A1-A2, of the coupler, A, to provide a means for transferring the signal energy from the antenna to the receiver. This is made possible by placing coil A1-A2 within coil A3-A6 so that, by a process of electromagnetic induction, a current flow will be set up or induced in coil A3-A6 when there is a flow of alternating current in coil A1-A2.

The signals from a broadcasting station are always in the form of a high-frequency, alternating current, the frequency depending on the adjustment of the apparatus of the broadcasting station. Each station is assigned a definite frequency upon which it may broadcast; and the Government requires each station to adhere to its assigned frequency with as much accuracy as possible.

Unlike the antenna circuit, the circuit represented by coil A3-A6 and the variable condenser, E, is sharply tuned. By this is meant, that, at a given adjustment of the variable condenser, signals of a certain frequency will be induced in this circuit but that signals which have other frequencies will be rejected. This is due to the fact that this circuit has a high resistance to all frequencies other than the one to which it has been adjusted.

An exception to this lies in the fact that when two stations are broadcasting on nearly the same frequency, one will be freely accepted by the circuit, that includes coil A3-A6 and condenser E, but the other may not be entirely rejected. When this is the case, the undesired signals would be heard along with those to which the operator desires to listen if it were not for another tuned circuit that follows this one. As it happens, this receiver does contain another tuned circuit which makes possible the rejection of the undesired signal.

Let us assume that the condenser, E,



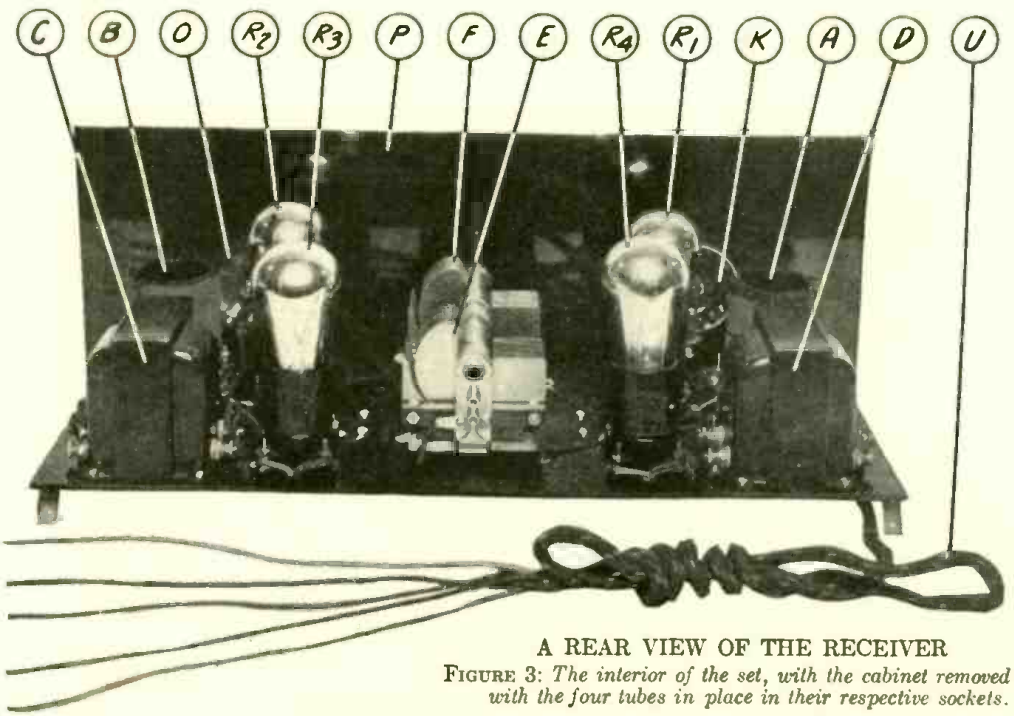
A FRONT VIEW OF THE RECEIVER

FIGURE 2: *This is the way your set should look. The various parts that are shown on the panel are lettered so that you will know exactly which ones the author is referring to when he tells you how to tune.*

has been adjusted so that its circuit is in resonance with a broadcasting station, or, in other words, that it is adjusted to the same frequency as that on which the station is broadcasting. The energy which is induced into the tuned circuit is impressed upon the grid of the first tube, R1, Figure 1, because of the wire connecting this circuit to the grid of the tube.

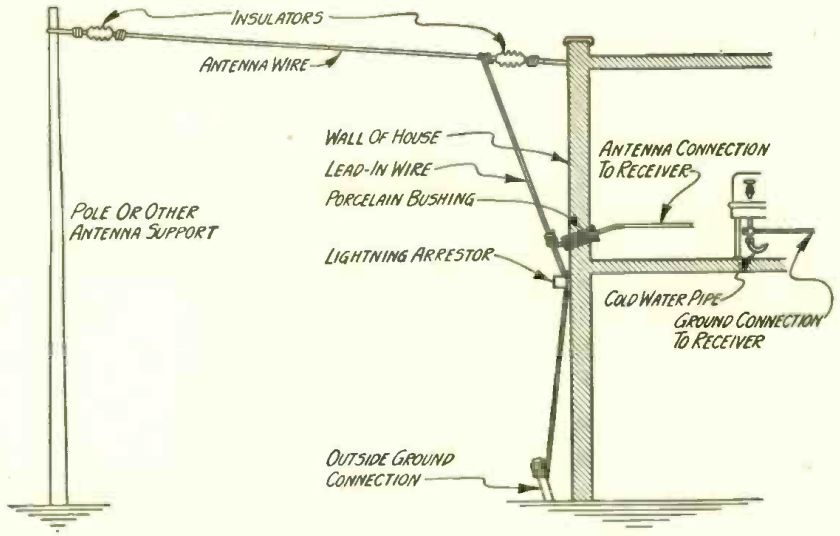
This tube acts as a radio-frequency amplifier, the purpose of which is to build up the weak incoming signal energy from distant stations. To accomplish this, the vacuum tube has been designed so that the grid serves as a throttle to control the amount of energy that is drawn from the high voltage "B" battery. All of the amplified energy is drawn from this "B" battery. The only purpose that the incoming signal energy serves, is to actuate the grid in its throttle action.

When a surge of electrical energy, representing the incoming signal, is impressed on the grid of this tube, it causes a like surge of current to flow from the "B" battery into the plate circuit of the tube. But the energy which is drawn from the battery and which flows in the plate circuit is many times greater than the energy which was impressed upon the grid; and it is this increased energy which represents the amplification that is obtained from the tube. A vital factor in this process is the fact that the



A REAR VIEW OF THE RECEIVER

FIGURE 3: *The interior of the set, with the cabinet removed and with the four tubes in place in their respective sockets.*



THE ANTENNA INSTALLATION

FIGURE 4: *With the aid of this drawing the set constructor should be able to install the proper type of antenna for use with the receiver.*

energy that is drawn from the battery, is an exact duplicate of that which is impressed on the grid, except in the matter of size. Every variation of the incoming energy, that is caused by the voice modulation at the broadcasting station, is reproduced in the energy flow that is set up in the plate circuit.

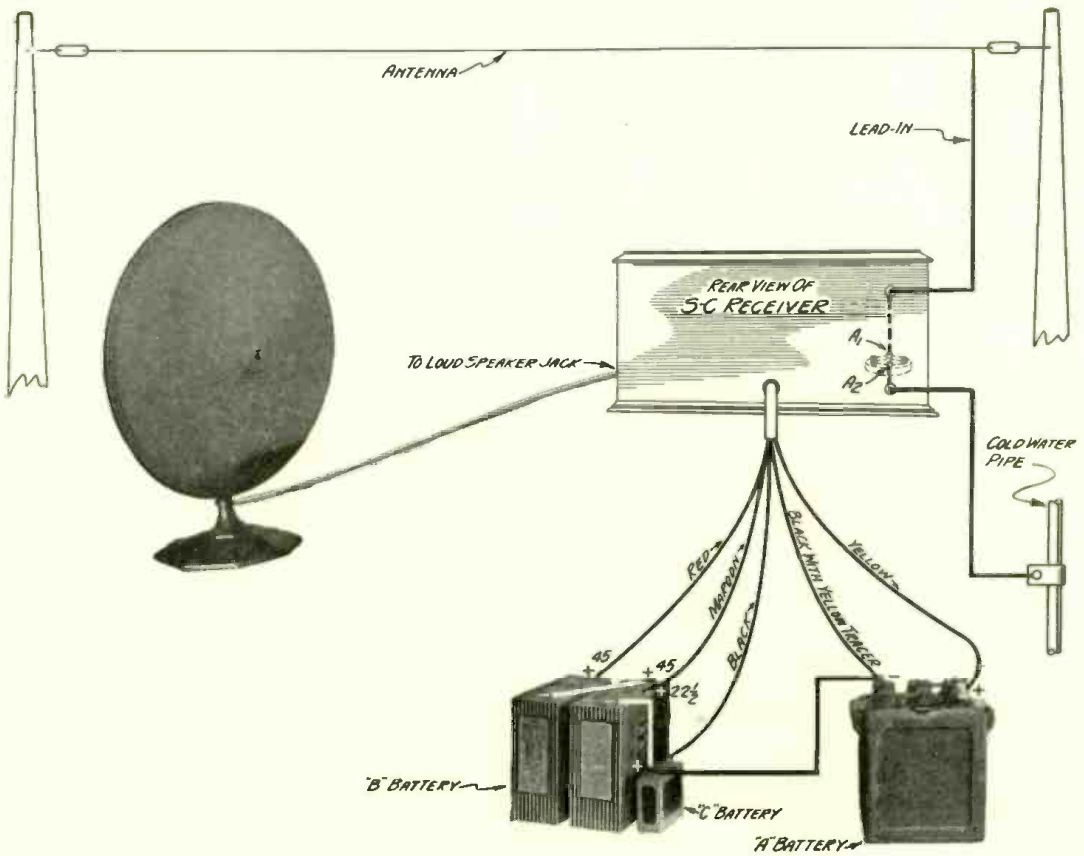
Up to this point in the circuit, the signals of the broadcasting station have been intercepted, passed along to the radio-frequency amplifier tube and there amplified. In this amplified form they are present in the coil B5-B6, which is connected in the plate circuit of the tube. Once more a transfer is made by induction, from coil B5-B6 to coil B3-B4. The variable condenser, F, is in the same circuit with this latter coil and this combination forms the second tuned circuit, which was referred to previously.

The next tube serves as the detector. Its function is to convert the radio-frequency energy into frequencies which fall within the audible band. The same type of tube is used here as for the radio-frequency amplifier tube. The different action is accomplished through the circuit which is designed so as to take advantage of both the detector action and some of the amplifier action of the tube.

To understand this, it must be remembered that the actual voice reproduction in electrical energy was brought through the air on a high-frequency carrier wave, of the frequency to which the broadcasting station was adjusted. Actually, this carrier wave is simply a conveyor, the purpose of which is to transport the modulated voice energy to the point where it is to be used.

It is in the detector tube circuit that the modulated energy is, in effect, separated from the high-frequency carrier wave. Thus, if a pair of headphones is connected in the plate circuit of the detector tube, the signals can be made audible for the first time.

If, instead of connecting headphones in the detector output circuit, an audio frequency amplifier is used, it is possible to build up the signals to tremendous strength thus making possible the



THE COMPLETE INSTALLATION DIAGRAM

FIGURE 5: *This composite hook-up shows exactly how to set up the receiver with the proper battery connections made to the various colored leads of the connection cable.*

use of a loudspeaker. This is exactly what is done in this case. The vacuum tubes, R3 and R4, are again the same type of tube as R1 and R2; but this time they are made to serve as audio-frequency amplifiers by means of the arrangement of the circuits in which they are placed.

In the S-C receiver, the detector tube is made to serve a double purpose through the use of regeneration or "feed-back." The output of the detector circuit flows through coil B1-B2, which is inductively coupled to the detector input coil, B3-B4. By means of induction, some of the energy from the plate circuit is again put into the grid circuit of the detector tube and additional amplification obtained.

If there is too much feed-back, the tube will break into oscillation. To prevent this, a variable resistance is connected across the coil B1-B2. The coupling between the two coils may be varied also, as coil B1-B2 is wound on a small pivoted rotor within coil B3-B6. Thus the amount of "fed-back" energy may be regulated by varying the resistance of O, or by turning the rotor coil.

The speed at which electrical energy travels is so great that the energy which is fed back reaches the output circuit again with no noticeable lapse of time and therefore simply adds to the strength of the original impulse. The total energy thus flows through the primary of the audio-frequency transformer C. This is a step-up transformer; so the energy set up in the secondary winding by induction is of higher voltage than that in the primary winding. The signal is then impressed on the grid of tube R3 and is amplified through the action of this tube. A jack is provided in the plate circuit of tube R3 in order that headphones may be used if desired. For the use of a loudspeaker another amplifier tube is provided, the action of which is the same as that of R3.

The Antenna and Ground

Considerable experimentation with the S-C receiver seems to indicate that an antenna with an overall length of about 75 feet is best. This does not mean, of course, that longer or shorter antennas cannot be used, because, as a matter of fact, good local reception may be obtained on a short, indoor antenna.

In general, the signal strength and sensitivity of the receiver increases with an increase in the straight-line length of the antenna up to about 75 feet. Above this point there will be some further increase in signal strength; but what is gained in this direction may be lost in the way of selectivity, if the receiver is used in locations where there are nearby broadcasting stations. This latter fact is no reflection on the receiver but applies equally well to almost all broadcast receivers. Figure 4 will offer some ideas on proper antenna construction to the novice.

The use of an outdoor antenna is to be preferred if space is available. If this is not the case, an indoor antenna tacked up along the picture moulding or in the attic will serve. Whether the antenna proper is indoors or out, it should be erected in as straight a line as possible. If the available space is only 30 or 40 feet in length it is better to use two parallel wires about three feet apart and joined together, at the end nearest the receiver, than to use a single wire erected in the form of a right angle or any angle less than about 135 degrees. It is better to run an indoor antenna straight through several rooms, or along a hall, than to run it around one or more rooms.

An indoor antenna may be made of insulated wire, such as single lamp cord, bell wire or annunciator wire. Uninsulated wire is best for outdoor antennas for the reason that the weather rots the insulation and the antenna soon presents an unsightly appearance. The author's preference is for seven strand copper wire with each strand individually enamelled. Such wire may be purchased in most radio stores. In any event the wire should be strong enough to support its own weight and should not be the extremely soft, pliable wire which is carried by many radio stores.

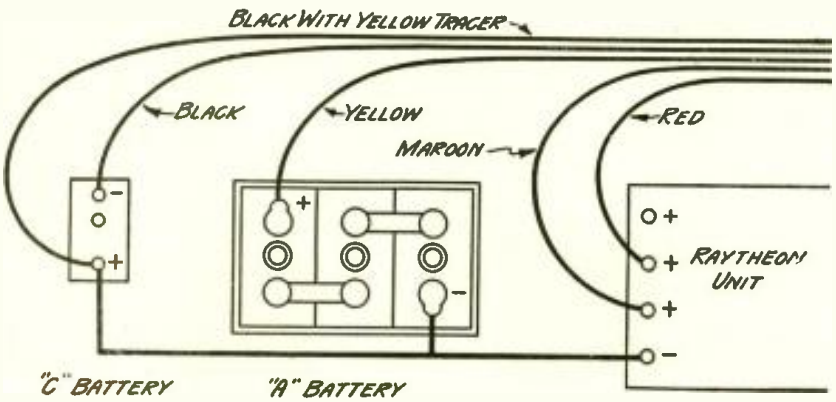
THE BATTERY WIRING

FIGURE 6: *The exact connection for hooking-up the dry-cell batteries, if UX-199 tubes are used.*

Needless to say, the antenna should be well insulated from any objects with which it comes in contact. It should also be kept at least 10 feet away from trees or metallic bodies such as tin roofs. The lead-in wire (which by the way is included in the 75-foot length that was mentioned above) should be kept a foot or more from the wall down to the point where it enters the house.

There it may be brought through a porcelain tube for which a hole has been drilled in the wall; or a "lead-in strip" may be used. This is a thin insulated copper strap which lies on the window frame and is thin enough so that the window may be closed down on it. Unless the antenna and lead-in are one continuous piece of wire, the connection between the two should be soldered. It is not enough to twist one around the

(*Continued on page 256*)



THE HOOK-UP FOR THE RAYTHEON UNIT

FIGURE 7: *The connections to the wiring cable when a Raytheon unit such as described in the May, 1926, issue of* POPULAR RADIO *is to be used with the set.*

ODD ITEMS *from* RADIO LAND

What happens when the experimentally-minded radio fan puts on his thinking cap and starts out to find what radio will do.

Broadcasting in a Shop Window

This shows what happened on a street corner in San Francisco when station KFRC installed an orchestra and a microphone in a downtown store.

Kadel & Herbert

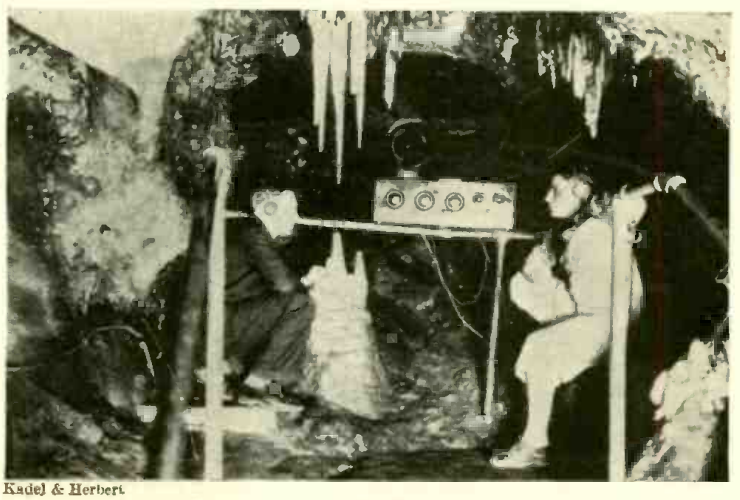
The Biggest Little Set in New York

Space means nothing to this tiny fellow for, though he doesn't ask much of it for himself, he can pick up a program a good thousand miles away. A one-tube regenerative circuit is used.

Kadel & Herbert

Talking Through Her Hat.

That's what the radio waves do for this Irish lass, who is here revealed as making a manly bow to the readers of this magazine. The crystal set in the brim was built by Irwin Lawn.



Kadel & Herbert

A Real Route of "Underground Gossip"

Now that broadcasters are beginning to bootleg forbidden wavelengths we may yet be driven to hip-pocket radios and secret listening in. This "radio cellar" is located 2,000 feet down in a mountain in the "Bridal Chamber" of the "Cave of the Winds".

Kadel & Herbert

He Picks Up Broadcasts in a Pail

Because his aerial space was limited Harold Heitmiller went up on the roof and hung this receptacle on a ten-foot wire. He says that it is as easy to pick up the radio waves with this strange antenna as with any kind of aerial.

Kadel & Herbert

A Unique "Special Service" to Jersey Fans

When a broadcaster goes as far as to show his listeners-in how to tune their sets and how to use a specially constructed wave-trap, we should say he is giving an unbelievable amount of service. Yet that is just what WJZ did for the residents of Bound Brook, N. J., when its new 50 K.W. station began to blanket the district.

Kadel & Herbert

Bottling Radio Waves

Radio programs don't usually improve with age but they pour sweetly enough out of the crystal set built about this old wine bottle. But it's easy to guess that Radio Operator John Conx's smile is due more to memories of what once filled the bottle than to the program.

Kadel & Herbert

A Home Made Receiver for Thirty Cents

This set may look its price—but it brings plenty of pleasure to James Deneene who built it out of a sawed off curtain pole, some wire and tinfoil and a cast-off telephone receiver.

Pacific & Atlantic

Enlightment from Radio

A talking lamp may be handy to have around if you need company as much as Irving P. Wolfe, who made it.

WITH THE EXPERIMENTERS

CONDUCTED BY LAURENCE M. COCKADAY

A Handy Means of Connection to "B" Battery Terminals

THE ordinary binding posts on the top of "B" batteries are sometimes inconvenient for use in the home laboratory in making quick connection to receivers that are being experimented with.

For this use the new insulated *Rajah* radio terminals will be found of considerable help. They are illustrated in Figure 1 and are made in two parts—one of which screws directly onto the "B" battery terminals while the other may be fastened quickly to the wire that leads to the set.

A number of these lead wires should be made up in varied lengths. By using these leads, various receivers may be connected or disconnected in a jiffy.

The Schnell Short-wave Receiver

F. H. SCHNELL, former Traffic Manager for the American Radio Relay League, was chosen by the Navy to accompany the fleet during the Pacific maneuvers, because of his activity in short-wave communication, to demonstrate the effectiveness and usefulness of the shorter wavelengths.

The resultant short-wave demonstration, during a six months cruise, was convincingly successful. As there is an undoubted interest in the particular receiver that was used by Mr. Schnell, POPULAR RADIO takes this opportunity to describe it and to give the circuit diagram of the set (shown in Figure 4).

As the drawings and pictures in Figures 3 to 8 inclusive are complete in themselves there is no need for a detailed description. For the man who likes to know the names of things, the essential portion of the circuit, the detector, is the well-known "tickler" regenerative arrangement with a variable condenser used as a bypass instead of the more usual fixed condenser. The coils are changeable to permit flexibility in covering a large range of frequencies.

The antenna is coupled to the grid-circuit of the detector through a small condenser (Figure 7). This method of coupling reduces the number of coils necessary to cover the range. The "B" battery is mounted directly within the cabinet. For loudspeaker results the usual 90 volts of "B" battery and the usual "C" battery should be used. The proper connection of the "C" battery is indicated in Figure 4.

The sizes of coils which are necessary for the different amateur wave-bands are as follows:

Secondary Turns	*Wavelength Range*	*Tickler Turns*
19	58–113	4
10	35– 70	4
6	23– 45	4 or 3
3	15– 26	3 or 2
1	00– 12	3 or 2

This of course assumes the use of the 5-plate secondary condenser, that was specified. The coils will differ with different sets.

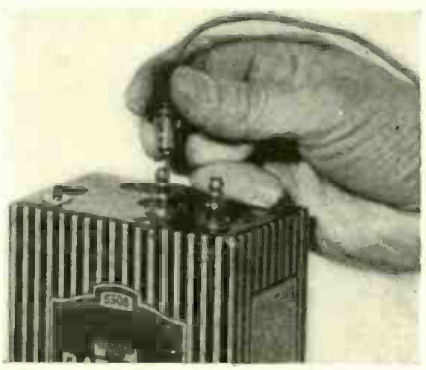
The approximate coil sizes for some other wavelength ranges are below:

38	110–220	10
75	200–400	20

The coils are basket-weave, wound on a circle of 13 pegs and are tied with thread (Figures 5, 6 and 8). They have no other support. White or striped bell-wire was used.

If the set fails to work, the tickler connections may have been made backwards.

—L. W. HATRY



A "B" BATTERY TERMINAL

FIGURE 1: *How the new terminal is used in making quick connections.*

Trouble Shooting in the Cockaday Eight-tube Superheterodyne

PART II

Where the same tube is used both to rectify and to produce oscillations it is not a simple matter to satisfactorily control the oscillations and still keep the detection efficiency high. Some detection will occur almost regardless of what is done; and it is this fact which has erroneously led some to believe that the first detector is not a detector.

The detection efficiency of the tube may, for example, be increased by connecting a .00025 mfd. condenser in series with the grid lead of the Duratran (between the post, G, on this transformer and the grid binding-post of the socket). Connect a 2 megohm leak from the post G to the upper left hand binding-post of socket I2 (Figure 2). This arrangement, however, alters its characteristics as an oscillator.

A better arrangement is to connect a "C" battery in series with the short lead going from the lower right-hand terminal of E to the negative "A" battery lead (Figure 2). This puts a negative bias on the grid of this tube both increasing its detection efficiency (when no grid condenser is used—the change in slope of the plate current, grid voltage curve is used for rectification) and its efficiency as an oscillator. It minimizes harmonics by operating on a better portion of the plate current, grid voltage curve (dynamic not static curve) and by preventing an increase in grid current due to the grid going positive.

The amplitude of the oscillations may be controlled by connecting a variable 300 or 400 ohm resistance in series with either of the secondary leads of the Autodyne coupler that go to the condenser B. A potentiometer may be used by using the slider arm as one side and one side of the resistance unit as the other; that is, by using it as a rheostat. (VII)

Harmonics May be Almost Entirely Eliminated on Local Stations

On local or moderately distant stations, where the efficiency need not be high, the harmonics may be almost entirely eliminated and the fundamental of the oscillator may be used thus giving only two reception points. The frequency range of the oscillator is such

that only stations operating below about 900 K.C. (above 340 meters) may be received in this way.

To adjust the receiver so that only the fundamental is used, tune to one of the settings on the oscillator dial at which a station is normally received (the approximate setting shown in the tuning chart that is given in the original article may be used). Increase the resistance of the potentiometer (just inserted) until the signal disappears or becomes very weak. The two settings (which are much lower than the normal ones) at which you will then receive the station use the fundamental of the oscillator.

In some cases it is possible to reduce the amplitude of the third harmonic to the point where it is negligible. This will reduce the number of points at which a station may be received by two.

To do this, tune to a setting on the oscillator dial which is considerably above the normal setting which you would expect from the tuning chart. Increase the resistance of the potentiometer until the signal is inaudible, or nearly so. Then tune back to one of the normal settings. You will find that you can now receive some stations which cannot be received using the third harmonic.

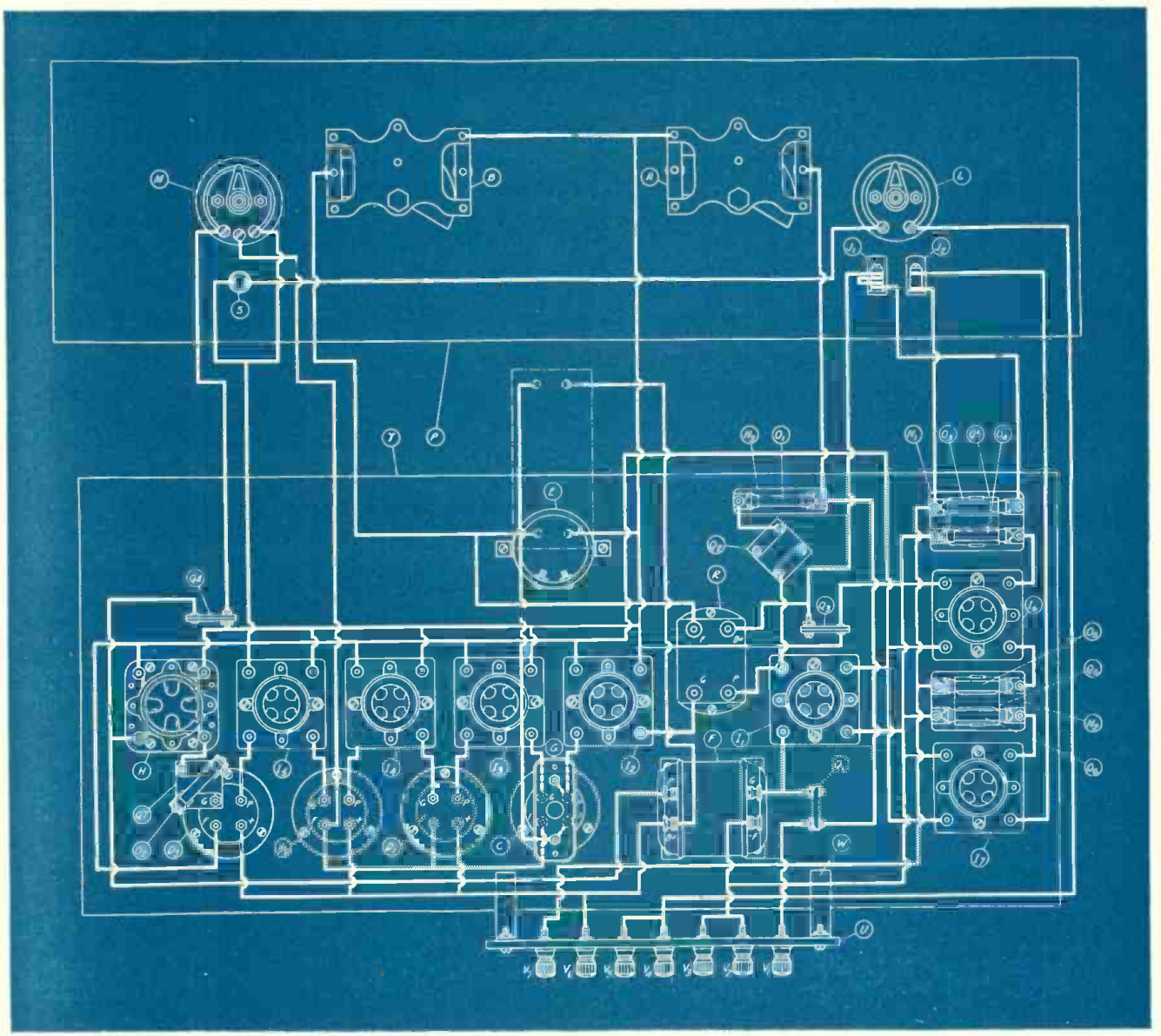
Other methods for reducing the number of repeat points which include the use of a fundamental frequency oscillator will be discussed in the near future.

If no signal is heard when the oscillator dial is rotated or if no beat note of any kind is heard it is possible that the oscillator is not oscillating. Try another tube in the detector-oscillator socket. I2. Try reversing the connections to the tickler of the Autodyne coupler. (VIII)

How a Transformer Determines Selectivity

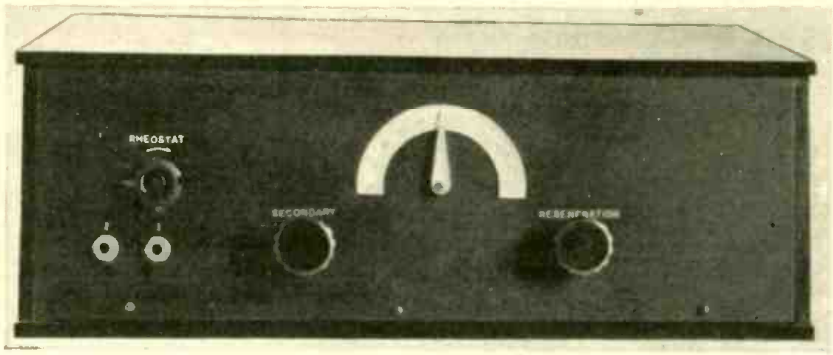
The primary circuit of the first intermediate-frequency transformer is tuned to the frequency at which maximum amplification takes place in the three intermediate-frequency stages. This tuned circuit serves to exclude or to amplify only very slightly frequencies other than the desired ones. It is the sharpness of this circuit (or lack of damping) which largely determines the selectivity or sharpness of tuning of the oscillator dial.

The intermediate-frequency oscilla-



THE PICTURE WIRING DIAGRAM OF THE REFLEX SUPERHETERODYNE

FIGURE 2: *This drawing shows the approximate positions for the various instruments and parts that go into the set. The heavy white lines indicate the exact wiring details for hooking up the receiver. All of the parts are designated with letters that correspond to those that are given in the text.*



A FRONT VIEW OF THE SET

FIGURE 3: *The panel of the Schnell short-wave receiver as it looks when the set is completed. The two tuning knobs are for the secondary and the regeneration controls.*

tor in this receiver is tuned to approximately 136 K.C. (2200 meters). When the Griddenser, G, has to be completely screwed down to secure best results it is an indication that at least the maximum capacity of this condenser is necessary to resonate the primary circuit of the transformer, C, to 136 K.C. In some cases the maximum capacity of this condenser is insufficient; and it is then advisable to use a larger condenser. An X-L Variodenser type G-10 (maximum capacity .0013) may then be used. (IX)

To secure maximum amplification in the intermediate-frequency stages (I3, I4 and I5) they are operated near the oscillating point. The tendency to oscillate is controlled by the potentiometer, M. This potentiometer permits from zero to 6 volts positive bias to be placed on these tubes. As the positive bias is increased the grid to filament current increases and hence the grid to filament resistance decreases. This increases the damping of the secondary circuit and stabilizes the amplifier.

If the potentiometer does not control the oscillations, one of the secondary windings of the transformers C, D1 or D2 may be open in which case no positive bias is placed on the grid. The grid is then "floating" and accumulates electrons until its negative potential is sufficient to prevent further accumulation. It is also possible that the resistance wire in the potentiometer is broken or that the slider arm does not make good contact. The remedy in either case is obvious. (X)

The Second Detector Tube

The signal after going through the intermediate frequency amplifier goes through the transformer, D3, to the detector tube, H. This tube performs only the function of detection and it therefore has a positive grid return and a grid-leak and condenser to increase its detection efficiency. As in the case of other detector tubes it will be found that some particular value of the grid-leak resistance 02 gives best results. This may be varied between the limits of 2 and 8 megohms. (XI)

The need for a second detector is obvious as the signal which comes through the intermediate-frequency amplifier has a frequency of about 136 K.C. (2200 meters) which is far above audibility. This signal must be demodulated (as detection is sometimes called) to produce an audio-frequency current that resembles as closely as possible the original microphone current, to actuate the loudspeaker.

The condenser, Q4, is connected directly across the output of the second detector. This condenser has a capacity of .006 mfd. It is connected in shunt to the primary of the Karas transformer (and the "B" battery).

It is evident that for even moderately high frequencies the primary circuit of the transformer will have capacitative reactance. In other words, the amplification at the higher frequencies will be reduced. If this capacity can be reduced to say .002 the amplification at the upper frequencies will be improved. It will be found that in most of these receivers this cannot be done, however, as the amplifier then becomes unstable. (XII)

The audio-frequency output of the second detector goes to the Karas transformer, and through it (where the voltage is increased) to the input of the tube I1. The loop would short-circuit these audio-frequencies if the capacity of condenser Q1, were very high; and it is for this reason that its value is kept below .0005 mfd. This condenser is connected directly across the secondary of the transformer as far as audio-frequency currents are concerned (the reactance of the loop at these frequencies being negligible). The higher the capacity of this condenser, the less the amplification of the higher audio-frequency currents.

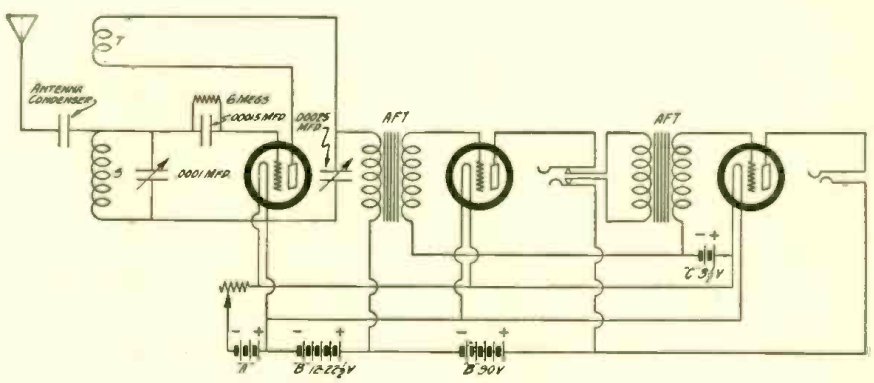
The signal then goes through the tube I1 (it is evident that this tube amplifies at both high and low frequencies and is, therefore, a reflexed tube), is amplified, goes through the primary of R (this offers negligible impedance to the audio-frequency current), through the jack, J1, and the resistance O3. The capacity of the condenser, Q3, is sufficiently high (.006 mfd.) so that some of the alternating current goes through it to the filament—particularly at the higher frequencies. This portion of the alternating current in the output circuit of I1 is not effective as the speaker is either plugged in jack J1 or J2.

In the former case, only the current flowing through the lead going to the resistance O3 goes through the speaker. In the latter, it is the variation in voltage drop across O3 which is amplified and which goes through the speaker. The capacity of Q3 should, therefore, be kept just high enough to offer very little reactance to the radio frequencies and yet offer as much as possible to the audio frequencies. A .001 to .002 mfd. will work very well. (XIII)

Howling in the Amplifier

In the original circuit, O3 has a resistance of 5,000 ohms. (.005 megohms).

(*Continued on page 270*)



THE HOOK-UP OF THE SCHNELL RECEIVER

FIGURE 4: *The electrical connections for the various instruments that go into the circuit. The set should be grounded on the positive "A" battery (not shown in the diagram).*

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

Probable Errors in Electron Counts

ONE of the ways of counting electrons, for example in experiments on their emission from hot bodies like the filaments of vacuum tubes, is to allow the electrons to enter a small hole or slit in the end of an otherwise closed metallic cylinder mounted on insulating supports. This is frequently called a "Faraday" cylinder, the principle of its use having been devised years ago by that remarkably brilliant experimenter. Of the electrons which are projected toward the slit in the cylinder, like the bullets of a machine gun, those which happen to hit the hole are assumed to pass inside and not thereafter to escape. They add, accordingly, to the negative electric charge on the metal cylinder. Measurement of this charge or of its rate of increase, serves to indicate the number of electrons which have entered.

This is a simple way of counting electrons and it has been much used. It appears, however, that it is not so sure a method as had been imagined.

Incidentally to some other investigations, Mr. Ernest O. Lawrence, National Research Fellow at the Sloan Physical Laboratory of Yale University, has tested the accuracy of the Faraday cylinder principle in making electron counts.* It does not pass the test. All the counts are too low, some of them greatly so. It appears that some of the electrons which enter do not remain. Small as is the slit and large as is the inside space, the electrons move about so actively that some of them escape again, backward through the entrance, before they are captured by the cylinder walls to add their charges to it. Like flies which enter a chamber lined with fly paper, many are stuck fast, but a few find the door again and escape.

The counts indicated by a Faraday cylinder, thus used as an electron trap, depend, Mr. Lawrence concludes, on the velocities of the entering electrons, on the absorbing capacity of the chamber wall and on other factors. All measurements previously made in this way must be re-examined, possibly repeated.

It is improbable that the major conclusions of modern electron theory will be revised, but some details are likely to need correction.

*"The Rôle of the Faraday Cylinder in the Measurement of Electron Currents," by Ernest O. Lawrence. *Proceedings of the National Academy of Sciences* (Washington, D. C.), volume 12, pages 29-31 (January, 1926).

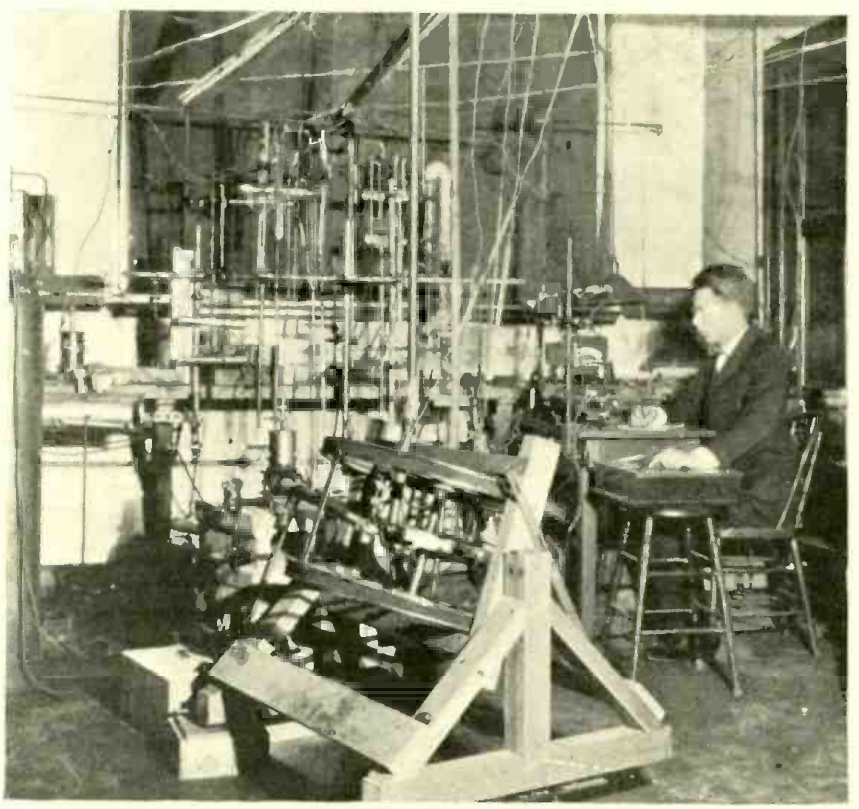
A New Theory of Electric Waves

IN science as in other matters it is desirable to scrutinize occasionally what we have been considering the fundamentals of our knowledge. Perhaps it is just these fundamentals which have grown obsolete and need revision.

Einstein's famous theory of relativity was such an attempt at re-examining basic principles. It threw away nearly everything that physicists had believed and began anew.

Now no less an authority than Sir Joseph J. Thomson has done a similar thing for our ideas of electric force.

The attraction of two unlike electric charges for each other is familiar to everybody. Similarly, like charges repel each other. The charged gold leaf of an electroscope stands away from the other leaf. The end of a charged rod repels a suspended pith ball. An electrostatic charge on a person may cause his hair literally to rise on end, each individual hair repelling each other one because all share the same static charge. These are manifestations of electric force. Similar forces are supposed to keep the electrons in their specified orbits inside atoms and to control the movements of free electrons, for example those inside radio vacuum tubes. It is these electric forces, in fact, which keep the material universe, including ourselves,



From a photograph made especially for POPULAR RADIO by Goldenblum, New Haven

THE DISCOVERER OF ERRORS IN ELECTRON COUNTS

Mr. Ernest O. Lawrence, of Yale, has discovered that the customary way of counting electrons, by accumulating them in a Faraday cylinder, is open to serious errors. The apparatus in Mr. Lawrence's laboratory, shown in the illustration, is used in his detailed investigations of some of the actions of electrons. Its complexity suggests the care that is necessary for precise work with these tiny electric particles.

Courtesy Pease Laboratories

THE PHENOMENA OF POLARIZED ETHER WAVES ARE DIFFICULT TO EXPLAIN

The instrument shown in this picture is a polariscope, used to study the behavior of polarized light. Such light has been supposed to consist of ether waves all vibrating in the same plane. Similar polarized waves of radio have been invoked by Alexanderson to explain some of the effects of radio transmission. If the new light-particle theory proposed by Sir Joseph Thomson is accepted, it will be necessary to reject the usual theories of polarized waves and to formulate new theories, both for light waves and for radio.

from dissolving into dust and chaos.

It has usually been assumed that these electric forces act continuously. The attraction which pulls two oppositely charged pith balls together is supposed to be a uniform and continuous attraction, as though the two were connected by a cord of stretched rubber. Similarly, the electron is supposed to be bound to the central nucleus of its atom by a continuous attraction, as though another rubber cord fastened the two together.

Sir Joseph suggests that this—which is our customary idea—may be quite wrong. Electric force may be, he thinks, not continuous at all, but intermittent.*

A thought of the rubber cord connecting two bodies will make this idea clear. We think of the attraction of this cord, tending to bring the two bodies together, as being a continuous attraction, as no doubt it is.

But suppose that instead of a rubber string the bodies were connected by a cotton cord, which possessed no tendency to shorten but which was periodically shortened by someone pinching a little of it together at its middle. If these pinches came frequently enough after one another—if, that is, they had a high enough "frequency"—there would be no apparent difference between this action and that of the rubber cord. In each case the two bodies at the ends of the cord would feel a pull tending to draw them together.

Another example, which will be still clearer to students of the theory of gases, is that of the pressure produced by gas inside a closed vessel, such, for example, as a gas-filled electric lamp. Apparently, as measured by ordinary instruments, this gas exerts a continuous pressure on the glass walls that hold it in. We know, however, that the pressure is not really continuous. It is produced by the vibration of the gas molecules. It is due to a vast number of tiny repeated blows by these vibrating molecules against the containing wall. It appears to be continuous; actually it is intermittent.

This is what Sir Joseph suggests for electric force. Instead of continuous, uniform attractions between two unlike charges or continuous, uniform repulsions between two like ones, he assumes a vast number of very short and frequent electric impulses. Electric attraction is a succession of tiny jerks. Electric repulsion is a succession of tiny kicks.

This is the hypothesis. We have always been assuming continuous electric forces. Let us look at the facts again, says Sir Joseph. Let us assume intermittent forces and see whether this idea will not fit the facts as well or better. This requires, of course, the development of new mathematical theories of electric action, and some of these Sir Joseph has worked out and reported. The results include some new and interesting ideas of the nature of electric waves.

Readers of this department are already aware that there is great scientific uncertainty just now about the real nature of light and radio waves and other kinds of what are commonly called "ether waves." On one hand is the familiar wave theory, competent to explain many phenomena of light and of other radiations. On the other hand is the newer "quantum theory" of

(Continued on page 274)

*"The Intermittence of Electric Force," by Sir Joseph J. Thomson. A paper read before the Royal Society of Edinburgh (Scotland) on December 21, 1925. Reviewed in *Nature* (London), volume 117, page 70 (January 9, 1926). Published in full in the *Proceedings* of the above Society, volume 46, part 1, pages 90-115 (1926).

Improve Your Radio Reception this Summer!

Use a Majestic "B" Current Supply in place of the ordinary "B" batteries. It attaches to your lighting circuit and is easily adjusted to the voltage desired for your particular set. It gives you a constant, dependable, and uniform power (voltage does not drop with use) and brings in full tonal strength, yet with ample filtering capacity to eliminate all A-C hum, thus allowing you to operate your set at its highest efficiency. Current costs average 1/10 cent per hour.

Uses Nationally Known Raytheon Tube

All Majestic B Current Supply Units are equipped with the Raytheon tube (endorsed by numerous radio engineers and editors) which is a non-filament tube with full wave rectification, no liquids or back surge.

No Acids Used

The use of acid is objectionable because of the possibility of damage to furnishings and the corrosive action makes periodical replacement of the elements necessary.

Try a Majestic B Current Supply at our risk

Go to the dealer from whom you bought your set or any other reliable dealer and get a Majestic B, and attach to your set. We want you to judge for yourself. If you are not convinced that it improves your reception—that it is the most satisfactory as well as most economical unit you have ever owned after a week's use, return it and your money will be cheerfully refunded. ***Every Majestic is positively guaranteed for 1 year.*** It is the most remarkable improvement yet made in Radio reception.

List Prices

Majestic Super B Current Supply complete with Raytheon Tube capacity 1 to 12 tubes including the use of new 135-150 volt power tubes. Price..... **$39.50**
West of Rocky Mts..... **42.50**

Majestic Standard B complete with Raytheon Tube, a smaller unit designed for sets having not more than six 201-A type tubes or five 201-A, plus one 135-150 volt power tube. Price..... **$32.50**
West of Rocky Mts..... **35.00**

Operates on 100-120 volt-60 cycle alternating current.

GRIGSBY-GRUNOW-HINDS COMPANY

4562 Armitage Ave. **Chicago, Illinois**

How to Get the Best Reception in Summer

(Continued from page 215)

contain dry air with a minimum of moisture.

4. Water is a better conductor than air. Wet air may absorb radio waves more than dry air. The junction between wet and dry air may reflect or refract radio waves and scatter them.

5. Water, snow and dust in the air are said to carry little and big charges (static and lightning). These charges have stationary fields. When they combine or discharge to earth they have moving fields. The radio waves are moving fields and must encounter those stationary and moving fields. And you know what happens to a wave in water when it repeatedly strikes other waves, currents and whirlpools.

6. Light and heat waves are also said to be moving fields somewhat like the radio waves, but shorter in length.

7. The air itself, without respect to moisture, is said to be variously ionized by the sun's rays.

8. Look over any long surface like a railroad track, or lake or stretch of flat sand and notice how clearly you can see objects at various distances when that surface is cold and notice again how the picture is fogged and how it varies when that surface is hot. In this case consider among other things, that your eye is the receiver; that what you are looking at is the transmitter; and that the light from it comes to you in the form of short radio waves.*

In the diagrams that accompany this article are shown circles which show diagrammatically the comparative effectiveness of radio during different months and seasons of the year.

In January, for instance, you may be able to hear stations 2,000 miles away in all directions; and there may be as many as 400 stations within this radius.

Let us suppose then, that the January circle has a radius of 2000 miles and contains 400 stations. By comparison the July outer circle will have a radius of about 500 miles and will contain about 25 stations.

But in July the static is so strong that you can only occasionally hear the station 500 miles away. And then, you only hear it between crashes of static. The result is that you pick up stations nearer by until you get a station probably within 100 miles, that is loud enough to be heard clearly without interference from the static. Thus, static has reduced your range and area from that of the outer to that of the inner July circle.

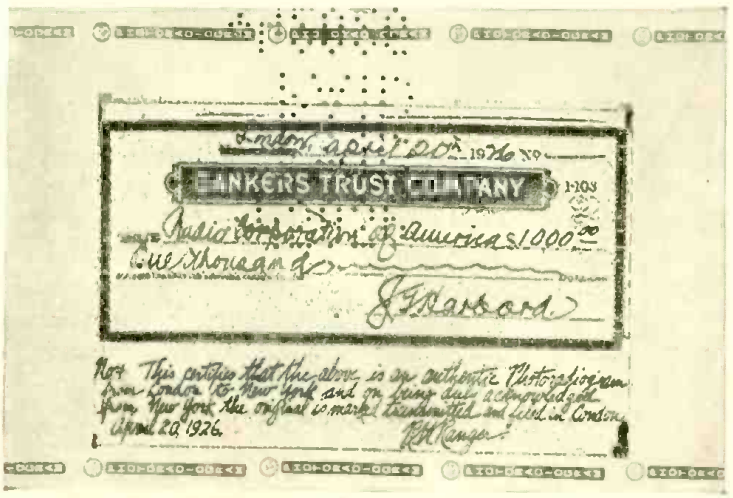
In other words, the man who tries to get long distances and many stations is reduced, between January and July, from 2000 miles to 100 miles, and from 400 stations to one station.

On the other hand, the owner of a broadcast receiver who receives, the year around, from a nearby station, and who uses a loudspeaker, may find that his speaker reception is loud enough for a room of a size corresponding to the largest circle, in January, and only loud enough for a room of a size corresponding to the outer July circle, in July.

The relative sizes of these circles were derived from averages of daily observations covering periods of more than one year which were made in two parts of the United States. Data was also derived from about twenty-five years of general experience with such variations in many parts of the country, on wavelengths corresponding fairly well to the wavelengths which are now used by the higher power broadcasting stations.

Remember, that local broadcasting is the only source of enjoyable radio reception all the year round.

*Papers which contain measurements and description in detail have been published on the subject of wave-strength variation. Some of these are included in the past volumes of the *Proceedings of the Institute of Radio Engineers*. Dr. Louis W. Austin of the U. S. Naval Radio Research Laboratory has contributed scientific papers which relate to variations at very long wavelengths to the *Proceedings of the Institute of Radio Engineers* in connection with the work of the International Union for Scientific Radio Telegraphy. These volumes and proceedings may be found in any large city and university library or obtained direct from The Institute of Radio Engineers, 37 W. 39th St., New York City.

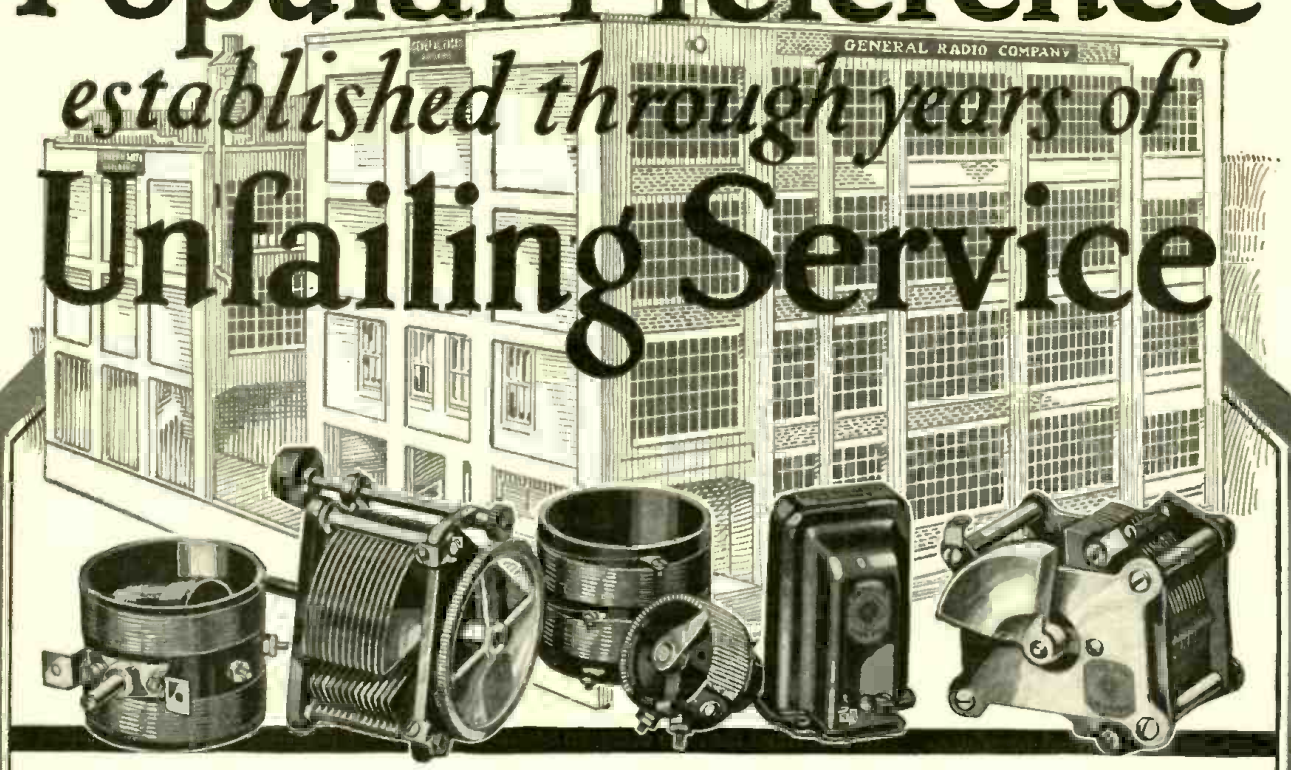


Another Milestone in the History of Radio

When Major General James G. Harbord (retired), a director of the Bankers Trust Company and also president of the Radio Corporation of America, transmitted this check for $1,000 from London to New York on April 20th, 1926, he recorded the first check ever to be sent by radio.

Popular Preference

established through years of Unfailing Service



"By ye deeds shall ye be known," is an old yet significant proverb that applies to industry as well as to the individual. It is but natural that a pioneer organization which has pursued a steadfast policy of integrity should be the present day leader in its particular field of endeavor.

The General Radio Company has attained its position as the outstanding manufacturer of radio parts and laboratory instruments through the recognized merits of its products.

Since the early days of radio, amateur operators and set-builders have looked upon the General Radio Company as a time-tried producer of dependable apparatus.

The careful and conservative buyer of radio parts looks first to the reputation of the manufacturer. He knows from his own experiences and those of others whether this reputation warrants his confidence. It is this self-same confidence upon which the popular preference for General Radio parts is based.

All products of the General Radio Company whether for the scientist or set-builder embody the same outstanding craftsmanship and materials in their construction.

As a consequence the General Radio Company has gained the esteem and confidence of amateur operators and experimenters—an enthusiastic group who are thoroughly familiar with the technique of radio design and to whom the science of radio owes much of its rapid advancement.

You will invariably find General Radio parts "behind the panels of better built sets."

Today General Radio precision instruments are standard equipment in nearly all the commercial and technical school laboratories throughout this and many foreign countries.

Every instrument made by the General Radio Company is thoroughly guaranteed.

Write for Parts Catalog 924-P.

GENERAL RADIO CO. CAMBRIDGE 39, MASS.

GENERAL RADIO PARTS

Behind the Panels of Better Built Sets

The Great Magnet that Rules Radio

(*Continued from page 213*)

equator and a pole they would incline between the vertical position and the horizontal one, agreeing with the inclination of the lines of force. These lines of force dip down into the ground, as they would do if the earth were the orange with the short magnet inside it.

At New York this dip is quite sharp, the angle being about 72 degrees from the horizontal. In the western and southwestern part of the United States the dip is not quite so pronounced; decreasing, in the southern part of California, to less than 60 degrees from the horizontal.

This angle is what scientists call the "dip" or the "inclination" of the earth's magnetic force at any specified place. It is one of the three things commonly measured by the experts who survey earth magnetism. The other two are the intensity of the magnetic force and the "declination," formerly called the "variation."

This last figure represents the degree to which a horizontal needle points away from true north (or south). Centuries ago in China the magicians discovered that the compass needle did not point truly to the south, all their reckonings being made southward instead of northward. Nowadays this declination has been mapped in every country in the world, so that surveyors can know just how much they will be in error if they take the directions of their magnetic compasses as true. The true north is determined, of course, from the stars. The magnetic declination at any place is obtained by comparing the position of the compass needle with this.

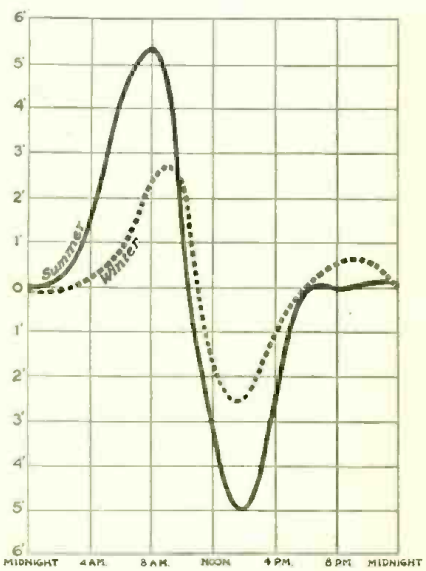
The idea of making magnetic surveys of the earth originated with the great German mathematician Johann Karl Friedrick Gauss in 1838. A survey was made in England two years later. In 1840 Dr. Alexander D. Bache, one of the foremost of the early American scientists, began his magnetic survey of the State of Pennsylvania, the first such survey made in America. Since that time the United States Coast and Geodetic Survey, similar governmental agencies in other countries and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington have been actively at work surveying magnetic forces in every part of the globe. The last institution actually constructed a non-magnetic ship, the *Carnegie*, built entirely of wood and of non-magnetic metals, in order to obtain reliable measurements of the magnetic forces at sea.

Virtually the entire earth has now been mapped. The maps show the declination of the needle from true north, the angle of dip and the intensity of the magnetic force. The declination is the most important practically, for it is this which is significant for ordinary compasses. Such compasses, including all those used by surveyors and by ship captains, are swung horizontally. They cannot move vertically, hence they do not indicate the dip. The dip is measured, when desired, by a special compass needle, balanced on a horizontal axis so that it can point downward toward the ground, if that is the direction of the magnetic force. As the magnetic forces come to be considered in radio work this dip, as well as the intensity, will have to be taken into account, in addition to the declination.

The chief radio interest of the earth's magnetic behavior resides, however, not in the mere existence of these forces but in the variations of them from time to time. The declination, for example, does not remain a constant thing.

If a surveyor measures the declination from true north this year and then comes back five years later he will have to measure the value all over again. The figures found by Dr. Bache in his Pennsylvania survey eighty-six years ago are no longer the correct ones. The dip shows similar variations, as does also the intensity of the magnetic force. Whatever be the causes of the earth's magnetism, that magnetism is in continual ebb and flow.

Some of these variations follow a daily cycle. At most places, for example, the declination of the needle away from true north is not absolutely constant from hour to hour. In the United States, for example, the needle usually swings east in the forenoon, to a



THE DAILY MAGNETIC CHANGE

This curve shows the change of the compass declination at Cheltenham, England, for each hour of normal days during the two seasons. The left-hand figures indicate the swings, eastward and westward, from the normal position of the compass needle. The figures are minutes of arc. This curve resembles closely the curve of daily variations of atmospheric electricity, published on page 181 of POPULAR RADIO *for June, 1926.*

maximum at about eight A.M. Thereafter it swings slowly back again to a westward maximum at about one or two P.M. Toward evening a renewed eastward swing commences. Shortly after sunset the needle takes about its average position, which it commonly holds until the morning swing begins, at about five or six o'clock. Stations differ greatly in the details of this behavior, but it is apparent that the normal, daily movement is surprisingly similar to the daily variation of the atmospheric electricity, as described in the preceding article of this series. Almost certainly, the two are due to the same cause, probably to some effect of sunlight during the day.

Other variations of the earth's magnetic forces occur in annual cycles and still others show what is called a "secular" variation, that is a slow drift over a period of years, probably part of a cycle which is years long. For example, from the first observations, in 1540 A.D., until about 1600, the declination in London, England, slowly increased eastward. About the latter year the direction of change altered. The eastward declination slowly decreased, year by year. In 1660 it was zero. After two hundred years more, in 1860, the increasing westward declination had reached a maximum of 30 degrees. Since then the westward error has been decreasing, being now less than 20 degrees.

The intensity of the earth's magnetism is subject to similar variations. By a careful analysis of all the available data Dr. Louis A. Bauer, of the Carnegie Institution of Washington, has calculated that during the past eighty years the average intensity of the earth's magnetism has been decreasing at the rate of about .07 percent a year. No one supposes, however, that this is a permanent decrease. Like the other changes, it is doubtless part of a cycle which presently will swing the other way.

There exist, also, those sudden changes of the earth's magnetism which are called "magnetic storms" and which have already been described in POPULAR RADIO.* These usually accompany other electric and magnetic disturbances, both on earth and in the sun. They are commonly accompanied, also, by serious radio disturbances, unusual atmospherics, "blanketing" and fading. It is from these magnetic storms, most scientists believe, that we will obtain some day the clue to the causes and sources of the earth's magnetism.

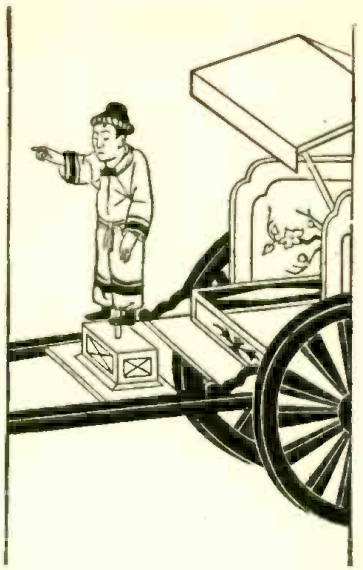
At present these causes are completely unknown. It is not possible to ascribe the earth's magnetism to a magnetized core of iron or to any similar permanent magnet inside the earth. The heat of the earth's interior would destroy any such magnetism. Even regardless of this, the form and variations of the earth's field are not what they should be if our earth really were like our magnetized orange and had a short but powerful magnet within it. Nor can the earth's magnetism be explained by the idea of electric currents circulating in its interior, like the current in the coil of an electromagnet. About the only thing of which we can be sure is that the cause of the earth's magnetism, whatever it may be, is something internal. Dr. Bauer examined all of the existing data from this viewpoint also. He concluded that about 94 percent of the earth's magnetism is due to factors inside the earth. The remaining six percent is probably related to the movement of electric charges through the atmosphere and in the Heaviside region, high up in the air.

Professor Swann, who has studied earth magnetism as well as earth electricity, is inclined to ascribe both of them to the same fundamental cause, to some variation in the electric charges of the atoms of matter, as explained in the preceding article of this series. Such variations might be used, also, to explain gravitation, the cause of which is still one of the great mysteries of science.

It is apparent, in any event, that the electricity and magnetism and perhaps the gravitation of the earth are parts of the same fundamental group of problems —problems which it is probable that investigations of terrestrial radio waves will greatly help to solve.

It is up to the experimenter to constantly check and record any phenomena dealing with this work in order to correlate the facts in the case before any definite solution can be found.

*"Radio Ills from Sunspots," POPULAR RADIO for April, 1926, pages 367-369.

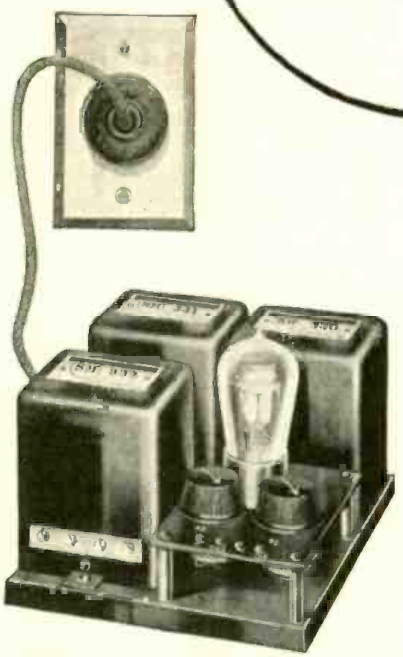


From "The Earth's Magnetism," by D. L. Hazard

THE SOUTH-POINTING CART

The ancient Chinese had carts equipped with pivoted magnets like modern compasses and so arranged that a small figure always pointed towards the south.

SM "Plug-In-B"



"Plug-In B" is conservatively rated at 85 milliamperes and can be operated at 100% overload. This 650-B kit has incorporated in it an absolutely new principle in filter design, developed in the Silver-Marshall laboratories and fully covered by patents. This is the greatest single advance made in "B" eliminator construction and places the assembly above all competition for power—constant power—and all around efficiency. Compact and small in size 6¼ x 7¼". Fully mounted on a metal base—all that is needed are a few wires to complete it.

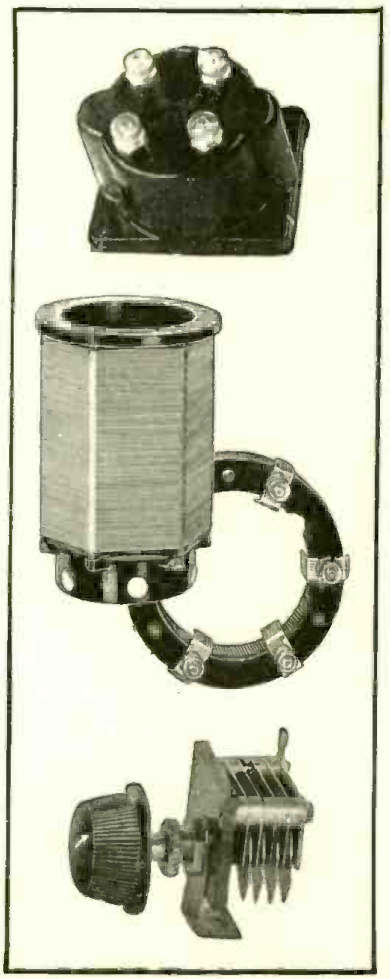
THE Silver-Marshall "Plug-In B" power supply is by far the most outstanding "B" eliminator on the market. It is as steady and constant as your electric light current. It has better voltage regulation and a higher power output than any similar product. It will not heat or distort on the heaviest continuous load. There is less of even a semblance of a hum than in any other "B" eliminator. No "static-like" distortion due to run down "B" batteries. Attach it and forget it. It is an economy and a necessity on every good receiver. $35.00.

The 220—The Audio Transformer with a Wallop

With the advent of the 220 transformer comes a revolutionary idea in audio amplification—the falling frequency characteristic at high frequencies. This tends to compensate for actual loud speaker characteristics of a reverse nature. 220's and 221's are the only audio transformers ever really *designed* to operate with cone speakers—and to do it with *real* quality from thirty cycles up—and absolutely without hiss.

—and with as "true to color" tone reproduction as you ever heard. Guaranteed to be superior to anything on the market including impedance and resistance coupling and every transformer or practical audio amplifying device. It is a power job; designed for this fall's power tubes as well as those now available. It is husky—it's the biggest transformer built, and is *unconditionally guaranteed* to be better than anything else. The price is $6.00.

Type 221 output transformer is designed for use between the receiver and loud speaker. It is to be used optionally with 220's and power tubes for exceptional quality.



SILVER-MARSHALL, INC.

844 West Jackson Blvd., Chicago, U. S. A.

210 AND 211 LONG WAVE TRANSFORMERS—measured and **GUARANTEED** by the sensitive measuring equipment of Silver-Marshall laboratories. Actual amplification to the fraction of one percent is predicted in tests that these transformers have to pass. The 210 is an untuned iron core and the 211 a sharply tuned air core filter. Supplied measured in any quantity for 199 or 201A tubes. $6.00 each.

UNIFORMLY INTERCHANGEABLE INDUCTANCES made in ranges from 30 meters up. Space wound with enameled wire, the uniformity is better than one-quarter of one percent. They are used wherever efficient coils are needed.

A Type 30-75 meters; B type 70-210 meters; C type 190-550 meters $2.50 each; No. 515 Universal socket. $1.00.

340 COMPENSATING CONDENSER is a small compensating condenser of .000025 MFD. capacity employing brass plates. Mounted on a Bakelite head. Furnished complete with knob, for base board or panel mounting. $1.50.

601 LOOP—a center-tapped loop of highest efficiency yet completely collapsible. Wound with Belden stranded cable—low loss construction in every respect. Price $6.50.

How Energy Leaps the Chasm *of* Space *by* Induction

(*Continued from page 235*)

If A is the sectional area of the circuit, l, the width of the air gap, μ, the magnetic permeability of the iron core, n, the number of turns of wire wound on it and I the strength of the current circulating through it, then a first approximation of the total amount of induction is "the magneto-motive force," that is, 4π n I divided by the "reluctance" l/μ A. This is in close analogy with Ohm's law for an electric circuit.

Consequently the total induction is

$$N = \frac{4\pi\mu n A I}{l}$$

If a wire is moved across the gap it cuts all of these lines; and the electromotive force that is induced in it is proportional to the speed with which it moves, (dN/dt). If an armature is resolved in the gap it can cut all of these lines twice at every revolution.

This is the beginning of dynamo theory.

As magnetic lines of force always form a closed circuit and thus have no ends, they cannot be made to thread a coil as you thread a needle, by pushing their ends through it. They must be moved sideways into its aperture; and, when they are removed, they must shift out sideways. Hence in entering and leaving, they must "cut" all the wires of the coil.

One way of expressing the act of induction is, therefore,—a coil is arranged to cut the lines of force as quickly as possible.

But it is not really the cutting that does the business; for, if you move a coil in a uniform field, with the lines always perpendicular to the coil the total number of lines through the coil remains constant and no effect is produced. (It may be said however that one-half of the coil is cutting the lines one way and the other half the other way: so discrimination is not easy.)

If, however, the coil is turned through a right angle in a steady uniform field, all of its lines are taken out; and if it is turned through another right-angle, all of the lines are put in again in the inverse direction. This goes on at every revolution. But such induced currents are always in opposite directions.

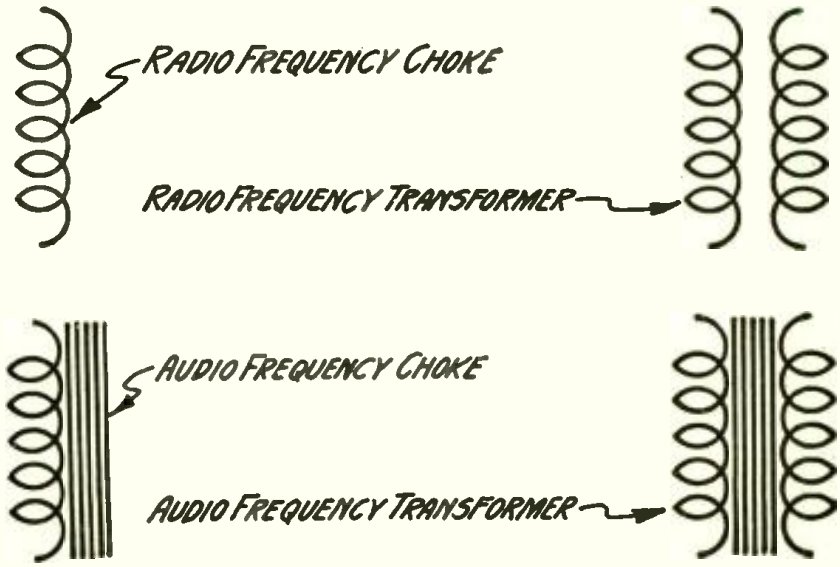
To get a one-direction current from such a coil, therefore, a commutator must be used. And a commutator always means a sliding-contact of some kind.

It is possible to have an expanding or a contracting circuit and in that way to change the number of lines of force and induce a current. But you cannot go on contracting or expanding forever without a sliding-contact, such as might be given by a revolving copper disc with one spring touching its axle and the other spring resting on its rim.

If such a disc rotates in a magnetic field, a steady current is produced in any circuit joining the two springs.

This was Faraday's first dynamo, the origin and precursor of all the dynamos of the present day. He also made alternating dynamos in their most elementary form; but these do not need a commutator: though even in them there must be a sliding-contact.

When a primary and secondary circuit are brought close together, so that lines from one easily thread the other, they are said to be closely coupled.



ELECTRICAL SYMBOLS FOR INDUCTANCES

There are two general kinds of inductances—one for radio-frequency currents and another type for low-frequency currents. The radio-frequency currents employ a coil with an air core but the low-frequency coils employ coils with iron for the core material.

When they are far apart, they are said to be loosely coupled.

It is possible to put two coils quite close together and yet to adjust their position so that no lines from one thread the other. Their mutual induction is then zero; but this is a rather delicate adjustment to get, except when they are far apart.

Practically every moving conductor is moving in a magnetic field, that is, the field of the earth. Hence, induced currents of insignificant strength are exceedingly common. The rings of a horse's harness, as he trots, must have currents induced in them. If we stir up the coins in our pockets, currents are induced in them.

If the variation of a magnetic field is considered a kind of motion, we may generalize and say that current induction is the result of magnetism and motion. Even if there are no conductors in the neighborhood of a varying or moving magnet, electromotive force is still produced; but it only results in electric displacement, not in a conduction of current. And such electric displacement would be permanent as long as the magnetism kept on varying in the same way, and would only subside, with a kind of condenser-like recoil, when the magnetic field became constant.

The interlocking of magnetism and electricity is most important. It may be likened to the interlocking of two curtain-rings threaded together, like the two links of a chain. A current started in one induces magnetism in the other. And conversely, magnetism generated in one induces a current in the other.

The fact of this reciprocal interlocking, and the fact that it goes on, though less obviously, in insulators and even in empty space—where the current must be of the displacement and not of the conduction kind, therefore furnishing an elastic recoil—is responsible for the generation and transmission of electromagnetic waves.

The electric force and the magnetic force in space are at right angles to each other; and their advancing wave-motion is at right angles to them both. The electric and magnetic forces are in the plane of the wave; and the line at right angles to them both is the direction of advance of the wave.

The advancing energy depends upon the product of the electric and magnetic forces; and the speed with which they can advance through so-called empty space, that is through the ether, is the velocity of light.

That is what light is; and there is no other kind of light. That is what radio waves are. Hence induction dominates the whole field of electrostatics—current electricity, magnetism and optics.

Induction is a sign that all material objects are intimately connected and thoroughly impregnated with the ether of space. Without that, there could be no action at a distance.

How to Get the Most Out of Your S-C Receiver

(*Continued from page 239*)

other because corrosion due to the weather will interfere with a proper contact.

The ground connection may be made to the nearest water or steam pipe. Preference is usually given to cold water pipes but any other pipe lines which are grounded at some point are usually just as effective. Gas pipes should not be used because such use of a gas pipe is against the law in most localities; and, moreover, gas pipes are usually insulated from the ground by insulating gaskets between the street and the meter. The ground lead wire should either be soldered to the pipe used, after the latter has been scraped clean to insure a good electrical contact, or else attached by means of an ordinary "ground clamp."

The Batteries

The batteries which are required are: (1) a six-volt radio storage "A" battery; (2) two 45-volt "B" batteries; and (3) a 4½-volt dry-cell "C" battery.

The storage "A" battery may have a rated capacity of anywhere from 60 to 100 ampere hours. It is used to supply the electrical energy that lights the tube filaments. Inasmuch as the current that is consumed by the filaments of four 201-a type tubes is one ampere per hour, it is evident that a 60 ampere hour capacity is sufficient to operate the tubes for a considerable period of time without the necessity of recharging the battery.

The charging process may be accomplished at home by means of a battery charger which is connected to the house lighting line. Before purchasing a charger it is essential to know whether the house line carries direct or alternating current. In the former case, a direct current charger is needed; and this consists simply of a suitable resistance to reduce the direct current to the proper charging voltage. Figure 8 shows a simple charging device that may be constructed at home for use where the house supply is direct current.

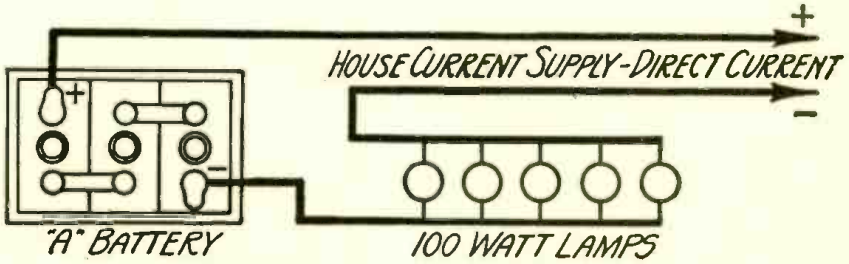
If the house supply is alternating current, a different type of charger is needed. This may be purchased in any radio store. The charger should have a charging rate of 2 or 2½ amperes per hour for batteries smaller than 100 ampere hour capacity; and even for this charging rate is high enough.

"B" batteries are used to provide the high-voltage supply for the tube plate circuits. They may be either the dry-cell type of radio "B" battery such as are shown in Figure 5, or they may be of the storage type of "B" battery. Or, if desired, the "B" batteries may be eliminated and the high-voltage plate supply obtained from the electric light lines through the use of a reliable plate supply unit. The Raytheon Plate Supply Unit, which was described in the May, 1926, issue of POPULAR RADIO, will give excellent results, for instance, and it may easily be constructed at home. Figure 7 shows the connections for using this unit in place of the "B" batteries.

In view of the small plate current consumption of this receiver the dry-cell type of "B" batteries provide the most practical plate supply source. The plate current consumption is only about 5 milliamperes per hour. At this rate, a set of two standard 45-volt battery blocks will operate the receiver for approximately 800 hours or for something over a year if the receiver is in use an average of two hours per day. The operating cost is so small at this rate that there seems to be little to recommend the more expensive storage "B" batteries or plate supply units.

The "C" battery is a small 4½-volt battery that was made expressly for this use. Its purpose is to supply the proper grid biasing voltage to work the tubes to the best advantage and it also has a decided effect in reducing the plate current consumption. Its life will be approximately a year.

The dry-cell "B" and "C" batteries require no attention except an occasional measurement of their voltage by means of a small, pocket voltmeter with a double scale; one to measure voltages up to 10, for measuring the "C" battery voltage, and the other, for voltages up to 50, for measuring the "B" battery voltage. When the "B" battery voltage drops to 34 for each 45-volt block, it is time to buy new batteries. The "C"



THE HOOK-UP FOR THE DC CHARGER

FIGURE 8: *How 500-watt lamps may be connected in series with the direct current line for charging the regular 6-volt 100-ampere-hour storage battery.*

battery is useful until its voltage drops to about 3.

A hydrometer is used to keep a check on the state of charge of the "A" battery. This tests the "A" battery by giving a reading of the specific gravity of the electrolyte or liquid that is inside of the battery. When the reading is between 1280 and 1300 the battery is fully charged. As it becomes discharged the reading drops until it has reached approximately 1150 for a fully discharged battery. If the battery is charged at home it is advisable to keep the specific gravity at 1200 or higher, at all times. Where the battery must be carried to a service station for recharging the desire will be to have it recharged as infrequently as possible. In that case the battery may be continued in use until the specific gravity drops to 1185. Discharging below this point is harmful and shortens the life of the battery.

The battery should be handled carefully as the electrolyte is a strong sulphuric acid solution that will leave its imprint on anything it comes in contact with, such as clothing, floors and rugs. Be sure to see that the hydrometer does not drip on the floor when this instrument is removed from the electrolyte.

The Right Tubes to Use

It is recommended that storage battery tubes be used with this receiver. Dry-cell tubes, such as the UX-199, may be used, but only with a material sacrifice of volume. If dry-cell tubes are used, it is advisable to use the UX-199 type in the sockets which are indicated as R1, R2 and R3. A UX-120 tube should be used in socket R4.

The "A" battery, in this case, should consist of six radio type 1½-volt dry-cells connected in series parallel, as shown in Figure 6. Three of these cells may be used in series if desired, but their life will be considerably less than one-half of that of six cells connected as shown.

The recommended tube equipment consists of three UX-201-a tubes for R1, R2 and R3 and a UX-112 for R4. A 201-a may be used in R4 also, but the UX-112 provides better tone quality.

The Operation of the Receiver

Preparatory to putting the receiver into operation, the batteries, antenna and ground should be connected, as shown in Figure 5. Next, be sure that the battery switch, L, is in the "off" position and then insert the four tubes in their respective sockets.

The coils should then be inserted in their sockets, the 110-A coil being placed in the socket at the left and the 114-A coil in the right-hand socket. The rotors of the two coils should be turned so that their windings are at an angle of about 45 degrees from the stator windings, or half way between a hor-

izontal and a wholly vertical position.

The volume control knob, O, may be turned all the way to the left, in the beginning; and the rheostat, K, should be turned half way on.

Finally, the battery switch, L, should be turned to the "on" position; and the four tubes will light up. If the main tuning control is turned, at this stage of the operation, signals from the broadcasting stations should be heard.

When the first station is heard, the main tuning dial should be carefully adjusted for best results and the volume control knob, O, turned to the right to the point where suitable volume is obtained. The rheostat knob should also be turned to its best adjustment, as determined by the loudest signals.

In this connection it is well to bear in mind the fact that, as the rheostat knob is turned in a clockwise direction, the volume of the signals will increase, up to a certain point, but beyond that point no further increase of volume will be obtained.

This point is the one at which the rheostat should be left adjusted.

When the adjustments have been made, as outlined above, signals should be received; but the receiver is not adjusted for maximum results. The adjustment of the rotor coils inside of the couplers, A and B, and the adjustment of the balancing condenser, N, are of great importance in obtaining maximum efficiency from this receiver. A little time spent on the adjustment of these units will be well worth while.

Where two sharply tuned circuits are tuned by a single control, it is essential that some sort of a compensating or balancing device be used to make up for slight differences in the fixed values of the two circuits. When the antenna is coupled to the circuit which includes the condenser E, for instance, the values of this circuit change slightly; and, to overcome this change, the values of the circuit that include condenser F must be changed proportionately.

It is for this reason, particularly, that the small balancing condenser, N, is used. If this balancing device were not in the receiver, a station could not be tuned in with maximum effectiveness, because, if the main tuning control were set to bring the circuit of condenser E into resonance with the broadcasting station, the other circuit would be slightly out of resonance. Or, conversely, if the dial were set to bring the circuit of condenser F into resonance, the circuit which includes condenser E would be slightly off.

It follows that, where the circuits are unbalanced, most broadcasting stations will be heard at two points on the tuning dial. Once, when the circuit of condenser E is in resonance, and again when the circuit of condenser F comes into resonance.

This condition gives the clue to the test to determine whether the balancing condenser is properly adjusted. If loud local stations come in at two points, the circuits are not balanced. In such a case a note should be made of the number of degrees that separates the two points at which a given station is heard.

The balancing condenser rotor plates should then be turned a little and readings again taken at the two points. If the points are closer together this time it is an indication that the balancing condenser has been adjusted in the right direction, but not quite enough. If the points are more widely separated the balancing condenser has been turned in the wrong direction. When the balancing condenser is exactly balanced there will be only one point at which a station can be heard; and at this point the signals will be much louder than before because both of the circuits will be in exact resonance.

The purpose of the rotor of the coupler coil, A, is to provide variable coupling between the antenna and the receiver. If the rotor coil is turned so that its winding is parallel with that of the stator, the maximum amount of signal energy will be transferred from the antenna to the receiver. On the other hand, if the rotor winding is turned at right angles to the stator winding little or no energy will be transferred.

If the coupling is too tight, the transfer of energy will be so great as to make tuning of the receiver broad, especially on loud local signals. If the coupling is extremely loose, the receiver becomes highly selective, but signal strength falls off considerably. The proper adjustment of the rotor coil in coupler A is therefore one which provides the required degree of selectivity with ample volume.

To make this adjustment, it is well to start with the rotor winding parallel with the stator winding (tight coupling) and tune in a fairly loud broadcasting station. Then, turn the rotor coil an eighth of an inch and retune the same signal. Continue this until the coupling has been loosened to such a degree that there is a slightly noticeable falling off in signal strength. This will usually be proper adjustment for this rotor.

The adjustment of the rotor of coil B is determined by the amount of volume control that is obtainable with the volume control knob. When this rotor is properly adjusted, the receiver can be made to oscillate by turning the volume control knob to the right. If it does not oscillate turn the rotor one way or the other until oscillation is obtained; and then continue the adjustment until the point is found where the control of oscillation by the volume control knob is smooth and stable. When this point has been found try swinging the rotor around 180 degrees and leave it set at whichever one of these two positions is best.

The obverse of the medal; this original is two-and-one-half inches in diameter.

The reverse; the name of each recipient will be engraved in the space provided.

THE POPULAR RADIO

Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio in that it shall be awarded, not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An advisory Committee, which shall cooperate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 627 West 43rd Street, New York.

The Committee of Awards

HIRAM PERCY MAXIM, *President of the American Radio Relay League.*
E. F. W. ALEXANDERSON, *Chief Consulting Engineer of the Radio Corporation of America.*
MAJOR GENERAL CHARLES McK. SALTZMAN, *Chief Signal Officer of the Army.*
REAR ADMIRAL W. A. MOFFETT, *Chief of the Bureau of Aeronautics, U. S. Navy.*
DR. JOHN H. FINLEY, *publicist and journalist.*
Secretary: Dr. E. E. Free, 627 West 43rd Street, New York.

Advisory Committee

SENATOR JAMES W. WADSWORTH, JR., *of New York.*
HON. JOHN BARTON PAYNE, *Chairman, American Red Cross.*
ADOLPH LEWISOHN, *Publicist.*
JUDGE BEN S. LINDSAY, *of the Juvenile and Family Court, Denver, Col.*
DR. J. MCKEEN CATTELL, *Past President, American Association for the Advancement of Science.*
DR. J. H. DELLINGER, *Past President, Institute of Radio Engineers.*
FARLEY OSGOOD, *Past President, American Institute of Electrical Engineers.*
C. E. GRUNSKY, *Past President, American Society of Civil Engineers.*
DR. DAYTON C. MILLER, *President, The American Physical Society.*
W. L. ABBOTT, *President, the American Society of Mechanical Engineers.*
W. J. HOLLAND, *President, Carnegie Hero Fund Commission.*
GEORGE K. BURGESS, *Director, Bureau of Standards.*
COLIN H. LIVINGSTONE, *Past President, Boy Scouts of America.*
DANIEL C. BEARD, *Chairman, National Court of Honor, Boy Scouts of America.*
MISS SARAH LOUISE ARNOLD, *President, Girl Scouts.*
DR. W. D. HAGGARD, *President, American Medical Association.*
K. A. BICKEL, *President, United Press Association.*
KENT COOPER, *General Manager, the Associated Press.*
H. P. DAVIS, *Vice-President, Westinghouse Electric & Manufacturing Company.*
DR. VERNON KELLOGG, *General Secretary, National Research Council.*
JESSE LYNCH WILLIAMS, *Past President, Authors' League of America.*
PROFESSOR GEORGE B. PEGRAM, *Dean of the Faculty of Applied Science, Columbia University.*
PROFESSOR H. H. SHELDON, *Professor of Physics, New York University.*
WM. HAWLEY ATWELL, *Grand Exalted Ruler, Order of Elks.*
PROFESSOR EDWIN B. WILSON, *Harvard University, National Academy of Science.*
W. E. HARKNESS, *Vice-President, American Telephone & Telegraph Company.*
WILLIAM L. SAUNDERS, *President, United Engineering Societies.*
COL. J. R. MCQUIGG, *Commander, the American Legion.*
JOHN R. MOSS, *President, Kiwanis International.*
W. D. TERRELL, *Chief Supervisor of Radio. Department of Commerce, Washington, D. C.*

How to Build the Newest Portable "Town and Country" Receiver

(Continued from page 228)

The Equipment Case Completed and Packed

FIGURE 8: *The case ready for transportation but with the loop case removed to show the whole interior arrangement. At the left are the "A" batteries and the small 22½-volt "C" battery; at the right are the four "B" batteries, the two smaller ones placed one on top of the other in the lower right-hand corner. The case is an ordinary suitcase with inside dimensions (cover open) of 13 x 23½ x 6½ inches.*

be more nearly centered in their positions.

The holes that are outlined with a double circle should be countersunk, so that the flat-head machine screws that are used for fastening the instruments are flush with the panel. All the rest of the holes are straight drill holes. Sizes for the diameters of these holes have not been given, but the builder can readily decide what size hole is necessary by measuring the diameter of the screws and shafts of the instruments that must go through the holes.

The drilled panel may be laid aside temporarily. The baseboard is next cut to the dimensions shown in Figure 2. The instruments may now be mounted on the baseboard.

The tube socket and coil socket for the oscillator are first mounted at the front of the baseboard (next to the panel), as shown in Figure 2.

The row of six tube sockets may next be placed on the baseboard, using two screws to each socket. The two audio transformers, AFT1 and AFT2, are then mounted in position and after these the three long-wave transformers are mounted, as shown in Figure 2.

The socket for the antenna coil is attached at the rear left-hand corner of the baseboard and the midget condenser, C3, is placed in position and fastened to the baseboard by means of a single screw through the holes in the small brass angle which is attached to this condenser. In mounting this instrument, it is necessary to first detach the brass bracket by removing the two large nuts on the shaft bushing. The bracket is then screwed to the baseboard after a soldering lug has been slipped under the head of the screw mounting.

The condenser is then assembled on the bracket and the large nuts tightened in place. The extension bushing, W, should be slipped over the shaft of this condenser and made fast to the shaft by means of the two small set screws which come with the bushing.

In mounting the three bypass condensers, C7 is mounted by means of two, small, wood screws.

To mount condenser, C8, the two screws are first removed from the right-

hand end of the transformer, IFT1. The mounting lugs of the condenser are then slipped under the base of the transformer so that the screw holes coincide with the holes in the transformer from which the screws were just removed. These two screws are now replaced and will serve to fasten both the transformer and the condenser securely in place.

The condenser, C9, is mounted in the same manner with the screws at the right-hand end of transformer, IFT2.

The "C" battery may now be mounted in position. Remove the battery from the cardboard case and fasten the case to the baseboard in an upright position, by means of two wood screws with washers placed under their heads. The battery is then slipped into the case and its cover closed. When in position the shorter minus (—) of the two connection lugs should be at the left-hand end, facing the baseboard from the front.

The final job is to mount the binding-post strip, O1, by means of the two brass brackets, Q; specifications for which are given in Figure 12.

The baseboard with the instruments mounted on it may be set aside for the time being and attention turned to the mounting of the various instruments on the panel.

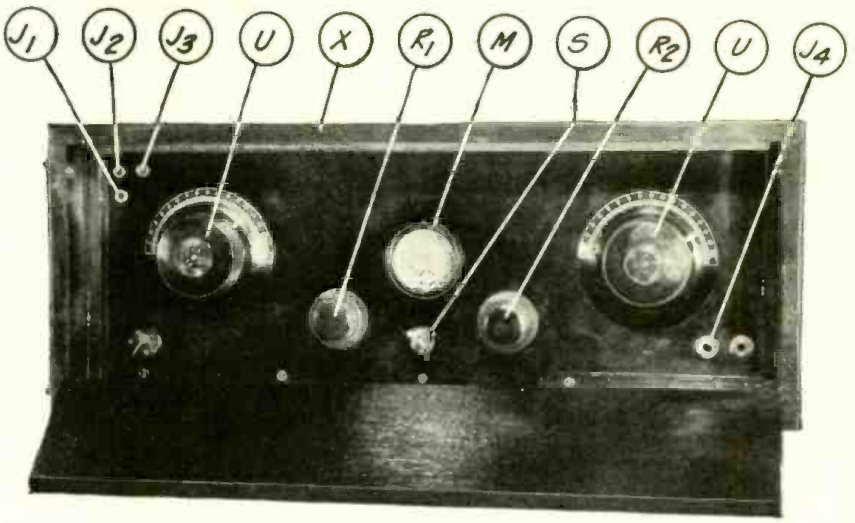
The two variable condensers are mounted in the position shown in Figure 3. The variable condenser, C1, is mounted at the left-hand end of the panel (facing the panel from the front), and the variable condenser, C2, is mounted at the right-hand end of the panel.

The mounting is accomplished by means of the two 6/32 flat head screws which are supplied with the instrument. The large nuts that are screwed on the shaft bushing at the front of the condenser frames should be removed entirely as they are used only in case of a single hole mounting.

These two condensers should, of course, be mounted with the metal shields uppermost as these shields are provided to keep dust from lodging between the condenser plates.

The voltmeter may next be mounted. The lock nut at the back of this instrument is removed and the outer shell slipped off. The voltmeter is then inserted in its proper place from the front of the panel with the flange snug up against the front of the panel. The outer shell is then slipped over the back of the meter and the lock nut screwed into position. This shell presses up against the back of the panel, thus clamping the meter securely in place.

The rheostat and the potentiometer are mounted in the usual manner. The battery switch, S, is mounted directly beneath the voltmeter in such a position that the two long springs are uppermost and the two soldering terminals are next to the rheostat, R1.



A Front View of the Receiver

FIGURE 9: *The receiver with the front cover of the cabinet open to show the operating controls.*

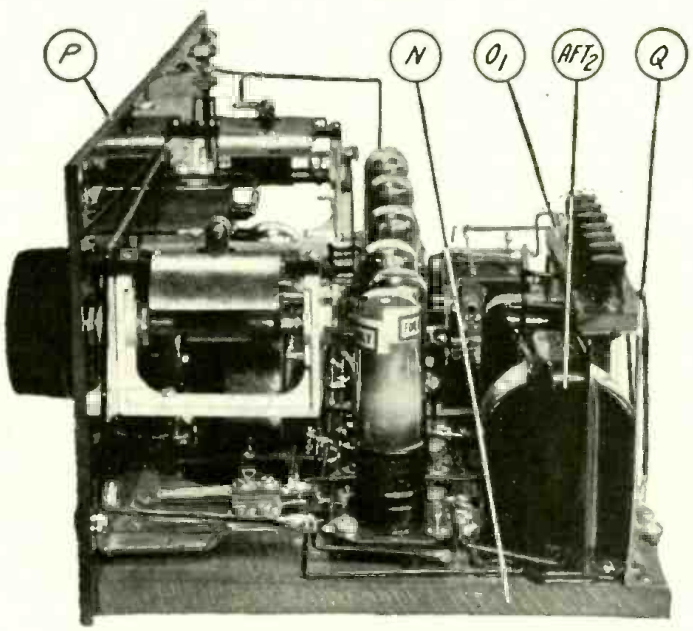
In mounting this instrument the large nut, washer, engraved plate and knob are removed from the front end of the device. In removing the knob, it is first necessary to unscrew the small set screw indicator which projects from the side of the knob. The entire knob may be then slipped off and the large nut unscrewed from the shaft bushing.

The bushing is then projected through the panel from the rear and the front assembly is accomplished by first slipping on the name plate and then the washer. The large nut is then screwed on the bushing. This will hold the framework of the switch firmly in place. The knob is next slipped over the end of the shaft and the set screw tightened in such a position that it points toward "off" when the switch is open.

The two jacks at the lower right-hand end of the panel are mounted in their proper positions with the single-blade jack, J5, at the extreme right. In mounting these instruments, make sure that the washer is placed between the panel and the lock nut rather than behind the panel.

The three, small, loop jacks are next mounted in the upper left-hand corner of the panel. The soldering lugs which accompany these three jacks are placed between the lock nuts and the rear of the panel.

To complete the work on the panel the dials and knobs are mounted on the shafts of the various instruments. If Univernier dials are used on the two condensers, C1 and C2, they must be the type with the scale that starts with zero at the left when the dial is held against the panel with its scale upper-



A View of the Receiver from the Right

FIGURE 10: *This illustration should give the builder a good idea of how the finished receiver should look. The general arrangement of the audio-frequency transformers, the tubes, the phone jacks and the binding-post strip are clearly shown.*

most. If the type of dial is used in which the scale moves with the dial, the scale should be laid out with zero at the right because the capacity of these condensers increases as the shaft is turned to the right.

In order to mount the knob on the condenser, C3, it is necessary to provide a 1½-inch length of wood or metal rod ¼-inch in diameter. The small knob is attached to one end of this rod and the other end is slipped through the panel into the end of the extension bushing, W, and made fast there by means of the two small set screws provided with the bushing.

How to Wire the Set

A written description of the wiring of of the receiver is hardly necessary even for the novice, in view of the ease with which the wiring as shown in the picture wiring diagram, Figure 4, may be followed. A few general suggestions may be helpful in this connection, however.

The free use of soldering lugs is recommended.* Then the connections may be firmly soldered to the lugs and the lugs held securely in place under the binding-post nuts. The latter should be firmly tightened down on the lugs with a pair of pliers or some other device such as a "spintite" wrench. Throughout it should be borne in mind that the receiver will presumably be subjected to considerable jarring while in transportation; therefore, *all connections must be absolutely secure.*

It is advisable to use insulated bus wire for the connections. In many cases it is most convenient to run connecting wires rather close together and the insulation will serve to prevent short circuits. In any case insulation should be used on all wires which run close to one another.

In general, all leads should be kept well down toward the baseboard and the long connecting wires should rest directly upon it. This method of wiring not only adds to the appearance of the job, but, if the long leads are supported on the baseboard, there is less chance for them to vibrate and work loose.

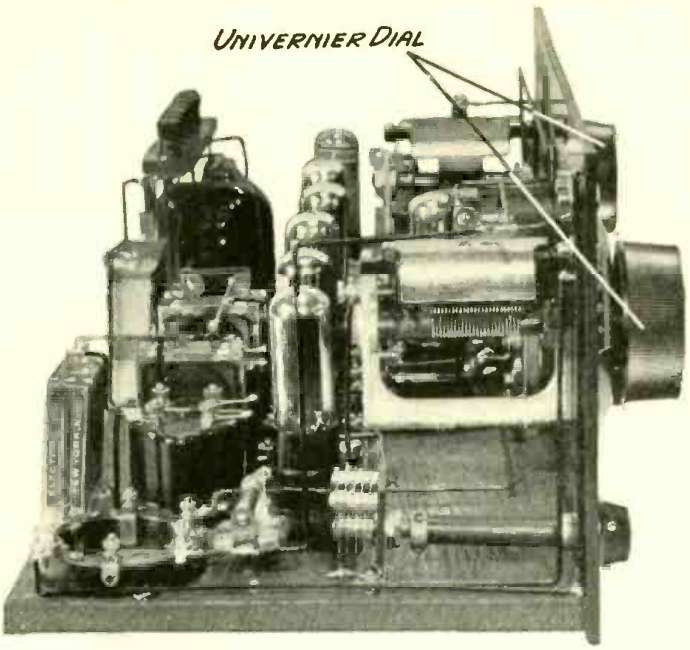
The wiring of the filament terminals of the sockets may be kept on a level with the socket binding posts.

The wiring job will be easier if the connections close to the panel are made first and then the long connections which are to be run along the baseboard. Following this the constructor may work back gradually toward the rear of the receiver. By following this plan of procedure the more out of the way connections are completed first.

The Preparation of the Equipment Carrying Case

D—Suitcase (see Figure 8 for dimensions);

* In the model receiver the flat type of soldering lugs were used and of two lengths, ⅛-inch and ½-inch.



A View of the Receiver from the Left

FIGURE 11: *The arrangement and mounting of the antenna coil socket and condensers C1 and C3 are shown here. Note the extension bushing on the shaft of C3. This is used to avoid the detuning effect of body capacity.*

E—Silver-Marshall tapped loop antenna, No. 601-A;
F—Crosley Musicone loudspeaker with plug;
2—Burgess No. 3508, 45-volt "B" batteries;
3—Burgess No. 4156, 22½-volt "B" batteries;
6—Burgess No. 6, 1½-volt radio "A" batteries;
G1—Jones multi-plug with cable;
G2—Jones multi-plug socket, type PM for panel mounting;
H—composition binding-post strip;
K—two small brass brackets;
L—Wooden framework for case (see Figure 6);
Miscellaneous—lumber and brass strip for construction of framework, as shown in Figure 6; insulated leads and soldering lugs for battery connections; 7 Eby engraved binding posts; wood screws.

The specifications for the suitcase, D, and the framework, L, which constitute the carrying case for the receiver equipment are given complete in Figures 6 and 8. If the builder of the outfit happens to have an old suitcase of somewhat different dimensions it will be necessary to alter the dimensions of the framework accordingly.

If the batteries, loudspeaker and loop are placed in the suitcase in the positions shown in Figure 8, it will be a simple matter to determine the proper dimensions for the framework to fit any particular suitcase. The suitcase illustrated in this picture is a standard size and may be purchased in any luggage shop for $5.00 or less.

As indicated in Figure 6, the framework consists of two main partitions, L1 and L2, braced at the rear by the brass strip, L3, and at the front by the two wood strips, L4 and L5.

To L1 two brass angles are attached, the lower one, L7, to serve as a holder for the small 22½-volt "B" battery (which is used as a "C" battery in this case) and also the "A" batteries, the upper, L6, to serve as a stop for one end of the loop case.

The other end of the loop case is supported by the two wood strips, L8 and L9, which are fastened to the surface of the partitions, L2. The front top corner of L1 is cut out to accommodate the loop case.

When the framework has been finished it is slipped into place in the suitcase and the batteries are all placed in their proper positions. In this way the proper position of the framework in the suitcase may be determined.

The framework is made fast in this position by means of wood screws through the walls of the case and into the ends of the partitions, L1 and L2. Substantial washers or brass strips should be placed under the heads of these screws, or they are liable to cut their way through the walls of the suitcase.

The last job in constructing the carrying case is to prepare and attach the binding-post strip, L10, and its brass brackets, L11 and L12, details for which are given in Figure 6. In mounting the brackets on the strip, they are slipped over the screws of the two end binding-posts and fastened by means of the usual nuts. The assembly is then mounted on the top of L2.

The connections between batteries and from the batteries to the binding-post strip are next made in accordance with the diagram, Figure 13. Soldering lugs should be used for the terminals of all the flexible wire leads, which are shown by light lines in Figure 13.

The bus wire connections, which are

indicated by the heavy lines, require no soldering lugs as the wire may be bent in the form of loops to fit over the battery terminals.

The three, long, flexible leads running from the "A" and "C" batteries to the binding-post strip should be run along the partitions and tacked in place, leaving a little slack between the tacked portions and the terminals of the batteries to allow for a little play when the case is being carried.

The loudspeaker is slipped into position with the point of the cone *up*. The top edge of the cone is slipped between the two front supports, L4 and L5, of the framework and the base is then lowered until it rests on the bottom of the suitcase. This will bring the base up against the rear wall of the suitcase and will prevent the top edge of the speaker from working its way out from between the two front strips.

The loop is packed away in the position provided at the front of the suitcase; and in this position it will be supported by the cut-out notch in partition L1 and by strips L8 and L9. The brass angle L6 will serve to hold the loop firmly against L2.

The dimensions of the space provided for the loop allow for the cardboard tube which is furnished with the loop. In packing the loop in the equipment case it should always be placed first in this tubular case. Incidentally, if the space provided between L6 and L2 is not sufficient to accommodate the length of the tubular loop case a little may be cut off the end of the tube with a hacksaw. The cover may also be left off the tube if space is limited.

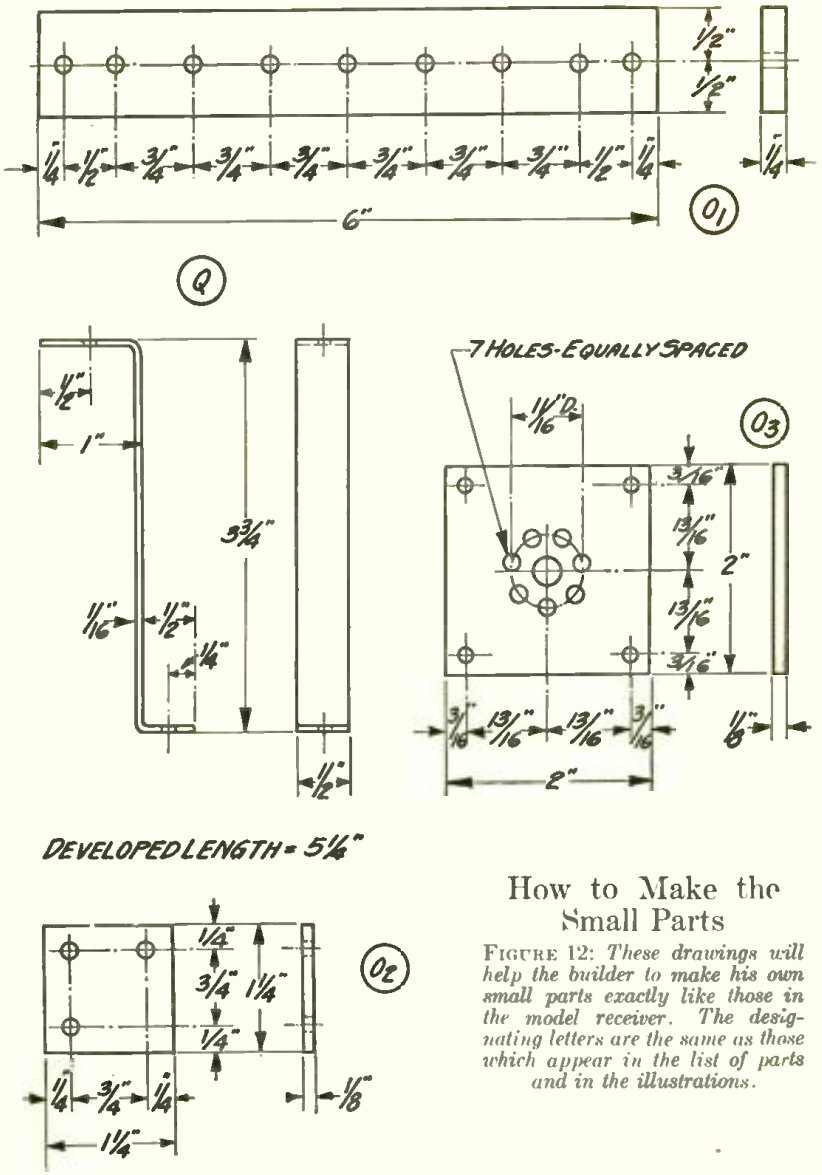
The battery cable is coiled up and slipped into the front corner of the suitcase, between the left end and the brackets L6 and L7 when the suitcase is being packed for transportation.

Preparing for Operation

The receiver may be placed in the cabinet by removing the top strip at the front of the cabinet and sliding the panel of the receiver down in the grooves formed by the two vertical strips at each end of the cabinet. With the receiver in place the front top piece of the cabinet is put on and securely screwed down.

The multi-plug battery connector socket, G2, should next be made ready and mounted. The small composition block, O3, shown in Figure 12 is cut to size and the twelve holes drilled. The round marker tag which accompanies each socket will serve as a template for locating the eight center holes.

When the block is completed the socket may be mounted on it by first removing the threaded sleeve from the center guide and inserting the eight prongs of the socket through the corresponding holes in the composition block. Next replace the threaded sleeve and tighten it against the inner side of



How to Make the Small Parts

FIGURE 12: *These drawings will help the builder to make his own small parts exactly like those in the model receiver. The designating letters are the same as those which appear in the list of parts and in the illustrations.*

the small composition block. (Figure 12)

Seven lengths of insulated wire, each 8 inches long, should be cut and one end of each bared back ¼-inch. These bared ends are then soldered to the ends of the seven socket terminals. These terminals are partly hollowed out and when the solder on the ends is melted the wire will slip in to the terminal about 1/8-inch.

If colored wires can be obtained to match the colors painted on the terminals of the socket it will help matters. If not, a piece of paper may be slipped over each of the seven leads with the colors of the terminals to which they are connected marked on the papers. Disregard the colors marked on the round tag which was used as a drilling template and use the following index:

Brown	C−
Red	B+135 volts
Pink	B+ 90 volts
Blue	B+ 45 volts
Yellow	B+ 22.5 volts
Green	A+
Black	A−

Before mounting the multi-plug socket in the hole provided in the rear wall of the cabinet, make sure that the seven leads are soldered well and that there is no chance of them short circuiting. It is a good plan to weave a piece of rubber tape in and out between the terminals, thus providing plenty of insulation even if some of the bared ends of the leads next to the soldered ends should become bent over.

When this precaution has been taken, slip the wires through the hole in the cabinet and fasten the composition block to the outside rear of the cabinet by means of four, small, wood screws. The free ends of the seven leads are cut to the proper length, bared and connected to the binding posts of the receiver, as indicated in the color index given above.

It is not absolutely essential to use the multi-plug connector. The leads to the batteries may be made directly from the binding posts at the rear of the receiver. The use of the multi-plug is recommended, however, inasmuch as it not only simplifies the connections between the receiver and the batteries but it also eliminates the possibility of short-circuiting the batteries, as often happens when making connections by

means of unprotected lead wires.

If the set is equipped with the multi-plug and cable it is never necessary to disconnect the battery end of the cable. When packing up the equipment it is only necessary to pull the multi-plug out of the socket, coil up the cable and drop it in the equipment case.

The final step in preparing the receiver is to cut three wires to serve as connections between the receiver and the loop. These should each be about 4 feet in length and may be of any kind of semi-flexible, insulated wire. The wires are attached to the three binding-posts on the loop and the other ends are soldered to the three small plugs, J1, J2 and J3 which are mounted on the composition block O2 in Figure 12.

The wire from the top binding post on the loop should connect to the plug which fits into J3, the mid-tap of the loop to J2 and the bottom terminal of the loop to J1. It may be well to try reversing the top and bottom connections to the loop, however to determine the best connections.

Operation of the Receiver

The multi-plug on the end of the battery cable is inserted in its socket at the rear of the receiver. To accomplish this it is necessary to rotate the plug until it is in a position where the slot in the center guide coincides with the pin in the center guide of the socket. Then push the plug in as far as it will go. This procedure makes all of the battery connections to the receiver.

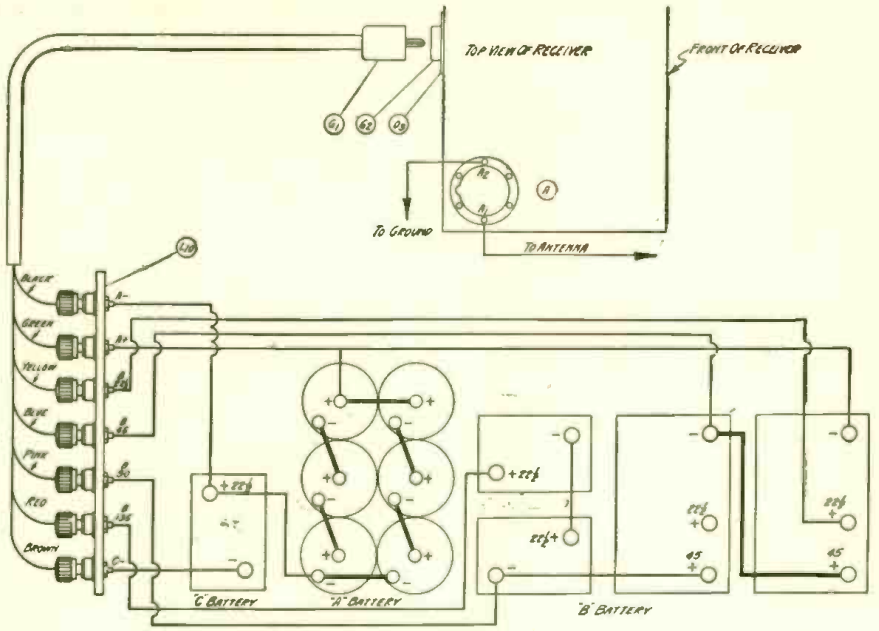
Next make sure that the rheostat knob, R1, is turned all the way to the left, or in the direction opposite to that indicated by the arrow on the knob. The UX-120 tube is then inserted in its socket, which is the one at the extreme right (facing the receiver from the front).

Now turn the battery switch to the "on" position and turn the rheostat knob slightly in the direction indicated by its arrow, just enough to cause the sliding arm to make contact with the beginning of the rheostat winding.

If the voltmeter shows a reading of about three volts, the filament-battery connections are correct and the other six tubes may be inserted in their sockets.

Coil B is now plugged into its socket (next to the panel) and its rotor winding turned parallel with the stator winding; the loop is plugged into the jacks in the upper left-hand corner of the panel and the loudspeaker is plugged into the jack, J5, at the lower right-hand corner of the panel.

The loop is, of course, unfolded and stood at the left of the receiver but the loudspeaker may be left in the open suitcase if desired. The small knob at the lower left-hand end of the panel should be adjusted so that the plates of the midget condenser, C3, are entirely unmeshed.



How to Make the Battery Connections

FIGURE 13: *The batteries, which are in the equipment case, should be connected exactly as shown here. The connections shown with heavy lines should be made with insulated bus wire so that the batteries will be held rigidly together. The light lines represent flexible, insulated connecting wires.*

The receiver is now all "set to go."

Turn the rheostat knob to the right until the voltmeter shows a reading of three volts or slightly less. As the potentiometer knob, R2, is turned to the right a point will be found where maximum amplification is obtained.

If the potentiometer is turned to the right, beyond this point, there will be a "plop" and a hissing sound from the loudspeaker. If this hissing sound is obtained, it is a pretty fair indication that connections in the intermediate-frequency amplifier are correct.

If all these conditions have been met in the receiver it is practically certain that the receiver is in working condition.

The next step is to actually tune in a broadcasting station. This is accomplished by setting the potentiometer knob just to the left of the point where the hissing starts, then, with the right-hand tuning dial set at 40, the left-hand tuning dial, which tunes the loop circuit, is slowly rotated throughout its entire scale.

If no signals are heard during this process, it should be repeated but this time with the oscillator condenser (right-hand tuning dial) set at 45. If still unsuccessful the oscillator should be set at 50 and the loop tuning condenser dial rotated as before and so on until a station is heard.

When a station is heard the two main dials should be readjusted to bring the station in with maximum volume. Then, the potentiometer knob may be turned to the right to increase the volume or to the left to reduce the volume.

At this point become familiar with the operation of the midget condenser, that is controlled by the small knob at the lower left-hand corner of the panel. This condenser controls the sensitivity of the circuit of the first detector. The sensitivity will increase as the plates are interleaved up to a certain point. Beyond that, the signals will be lost.

The final adjustments to be made after a station is tuned in, especially if it is a distant station, are to rotate the loop and also the rotor of coil B.

The best position of the rotor will be that which will give maximum signal strength on distant stations but keeping the rotor as close to right angles with the stator winding as possible.

The last step in getting the receiver into proper operating condition is to try interchanging the tubes to determine which of the tubes function best in the various positions of the circuit. This applies to the first six tubes only and not to the UX-120, which should always remain in the socket furthest to the right.

If it is desired to use either an indoor or outdoor antenna in place of the loop, it is necessary to connect the antenna and ground to terminals 1 and 2 of the socket at the left-hand, rear of the receiver. Coil A is then plugged into this socket and from this point on the operation of the receiver is exactly as described above. Tuning of the left-hand condenser will be somewhat broader with this arrangement but this can be regulated by adjusting the rotor of coil A. When the rotor winding is parallel with the stator winding, tuning will be broader than when the rotor is turned at right angles with the stator winding.

The calibration of the right-hand dial for any given wavelength will remain constant so that when a station has

once been tuned in and a notation made of the setting of this dial, that station may always be brought in again by referring to the previous notation.

Each station may be brought in at two distinct points on the right-hand dial. These two points will be approximately 20 degrees apart on the dial and one will learn from experience which one of these points to use for maximum results.

HERE ARE THE PARTS USED IN THE LABORATORY MODEL OF THE NEW "TOWN AND COUNTRY" RECEIVER—

A—Silver-Marshall antenna coil, No. 110-A equipped with coil socket No. 515;
B—Silver-Marshall oscillator coil, No. 111-A equipped with coil socket No. 515;
C1 and C2—Samson uniform-frequency variable condensers, No. 67, .00035 mfd.;
C3—Silver-Marshall, type No. 340 midget variable condenser, .000025 mfd. equipped with knob;
C4 and C5—Dubilier fixed condensers, .00025 mfd. with grid-leak clips;
C6—Dubilier fixed condenser, .002 mfd.;
C7, C8 and C9—Electrad bypass condensers in cans, .5 mfd. each;
AFT1—General Radio audio-frequency transformer, No. 285, (1 to 6 ratio);
AFT2—General Radio audio-frequency transformer, No. 285-L, (1 to 2 ratio);
IFT1 and IFT2—Silver-Marshall No. 210 long-wave radio-frequency transformers for use with 199 type vacuum tubes;
IFT3—Silver-Marshall No. 211 long-wave radio-frequency transformer for use with 199 type vacuum tubes and equipped with calibrated fixed shunt condensers;
J1, J2 and J3—General Radio miniature jacks and plugs—No. 274-J and No. 274-P;
J4—Yaxley jack, No. 2-A;
J5—Yaxley jack, No. 1;
M—Jewell "A" and "B" battery voltmeter, pattern No. 135, panel mounting and equipped with push button (Range 0-4 and 0-160 volts);
N—hardwood baseboard, 8½ by 19 inches (see Figure 2);
O1—composition binding-post strip, (see Figure 12);
O2—composition mounting block for loop plugs (see Figure 12);
O3—composition mounting block for multi-plug socket (see Figure 12);
P—composition panel, 7 by 20 inches (see Figure 5);
Q—two brass brackets (see Figure 12);
R1—Amsco 20-ohm rheostat with knob;
R2—Amsco potentiometer, 400 ohms with knob;
R3 and R4—Daven grid-leak resistors, 2 megohms;
S—Yaxley battery switch, No. 10;
T—Eveready 4½-volt flashlight battery;
U—2 Walbert "Univernier" dials, scale reading left to right (4 in. diameter);
VT1, VT2, VT3, VT4, VT5, VT6 and VT7—Benjamin UX type sockets, No. 9040;
W—Precise condenser shaft extension bushing connector, No. 744;
X—"Town and Country" cabinet (see Figure 7 for specifications); ready-to-use cabinets, if you prefer, may be secured from your dealer;
7 Eby engraved binding posts;
Soldering lugs and wood screws.

The Men Who Saved a Mother

(*Continued from page 220*)

Would he take it?

Drew got into action. Sputtered dots and dashes assured 4 AG up in the windswept wastes of Manitoba that his brother in the fraternity of amateur radio was his to command at all times.

And clear, connected and concise along came the appeal to humanity that Reynolds had labored incessantly for two long days and nights to give to the outside world. Though wearied and wan from his long and faithful vigil, and borne down with the strain of apprehension lest the overloaded transmitter give way, the details were punched out steadily and zipped their way through the ether straight to the home in Fargo. Not only was the message clearly given and accurately transmitted in detail so there could be no misunderstanding of the urgency of the appeal, but instructions in detail followed as to what Harry Drew was to do next.

Marvelling at the nerves of a man who could send a message like that after all he had gone through, Drew gave his assurance *via* radio that no time would be lost in getting the message off, and a few minutes later telegraph wires were singing out of Fargo.

Up in Winnipeg, across the border, it so happened that a doctor was just starting off on the journey to Riverton. Quickly he was made acquainted with the contents of the message and an immediate agreement was arrived at for deflecting his course for a journey across Lake Winnipeg and thence to strike north on the opposite shore.

All of which was reported by Drew through the air as reassurance to the loyal assayer to whom came the opportunity of forsaking his scales for weighing gold to turn aside when human life was weighed in the balance.

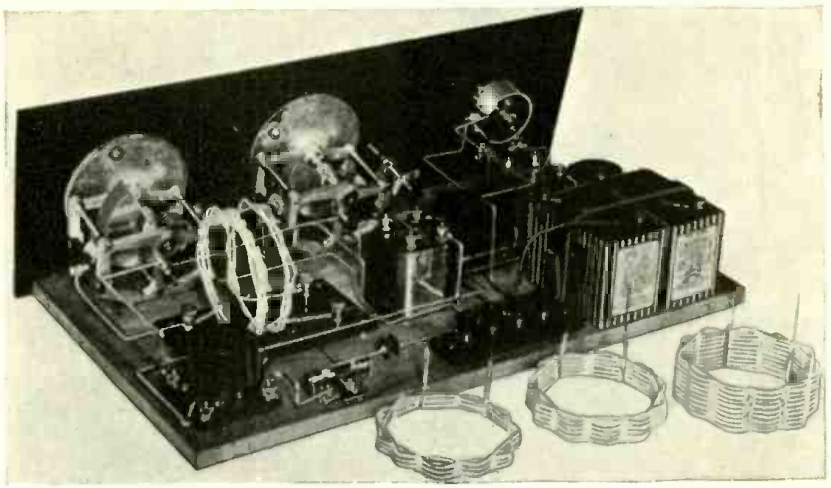
* * *

Somewhere in the sunlight a tiny tot, now nearly three years old, is running about under the loving eye of a mother who has known the hardships of winter in the desolation of the north country. Some day the little one will hear the story of the good doctor man who arrived in the nick of time to usher a baby into the world, although it required of him an all day and an all night trip across Lake Winnipeg from Gimli to Manigatogan and a thirty mile journey on horseback to the dun and drab colored wastes of rock where that little one first saw the light of day.

Perhaps, too, a copy of this magazine will be saved for the day when the story can be read of the response to the call of humanity made by George Reynolds and Harry Drew, otherwise known as 4AG and 9EBT—a story that finds its happy ending in the presentation to them of the POPULAR RADIO *Medal for Conspicuous Service*.

With the Experimenters

(Continued from page 244)



A REAR VIEW OF THE SET

FIGURE 6: *The positions of the "C" batteries are clearly indicated here together with two of the short-wave coils. Three other coils for slightly longer waves are shown in the foreground.*

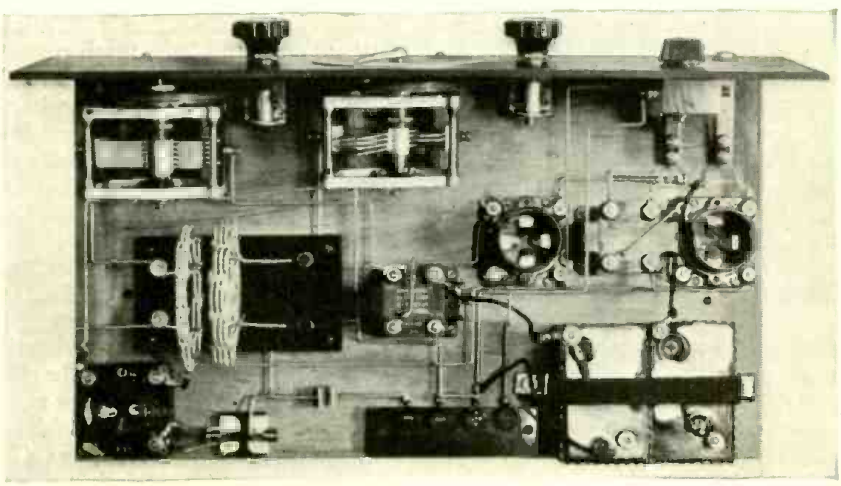
It was found that the amplifier howled when this was increased. If then, O3 is defective or has too high a resistance the amplifier may either howl or the signal strength may be very poor. If it is defective, substitute another resistance or connect two 10,000 ohm resistances in parallel and use them. (XIV)

A good idea of what will occur in a circuit when the variable is to be changed may frequently be gained by considering the limiting values. In this case, if the resistance of O3 is zero, there can be no variation in potential drop across it and hence no possibility of getting a signal in the input circuit of I6 to amplify.

If, on the other hand, the resistance is made infinite, that is, if the circuit is opened, no voltage is impressed on the plate of I1 and hence no amplification can take place through it. The correct value represents a compromise between these two limiting values. An inspection of the formula for the amplification which may be obtained as O3 is varied (neglecting Q3) shows that it increases as O3 is increased. This resistance is nothing but a coupling resistance of the type that is normally used in resistance-coupled amplifiers.

From here on we are dealing with two straight stages of resistance-coupled amplification. All of the considerations which normally enter into the design of such an amplifier enter here. Increasing the capacity of Q5 and Q6, for example, increases the amplification at the lower frequencies.

The higher capacity condensers should have a value of between .1 and 1 mfd. These condensers may be connected in place of Q5 and Q6 or in parallel with them. Some trouble will be experienced in mounting them as the amplifier is very compact. If the builder is satisfied with .1 mfd. condensers he may use the new type Daven interstage



A TOP VIEW OF THE SET

FIGURE 5: *The general layout of the parts on the wooden baseboard; notice that the two condensers are driven by a cord and pulley.*

coupler which incorporates a .1 mfd. condenser in the base. This is the simplest solution to the space problem. (XV)

The Use of a "C" Battery

The amplification may be improved by the use of a "C" battery. This also decreases the plate current or "B" battery drain of the whole receiver. Where 201-a tubes are used, a 7.5 volt "C" battery will be sufficient. Connect the positive side to the negative "A" battery lead. Connect the filament end of the leak, O4, to the 1.5 volt negative tap, and the filament end of the leak, O5, to the 4.5 to 7.5 volt negative tap. (XVI)

Increasing Amplification by Means of a High-mu Tube

The amplification may be increased by using a high-mu tube in the socket I6. The use of such a tube, however, requires special precautions. The bias on the grid should be increased to 3 or more volts. The "B" battery voltage should preferably be increased to 157.5.

In this case, a power tube may be used in the last stage (socket I7). If this tube is the type that requires 6 volts on the filament (that is if the terminal voltage is 6 instead of 5) the right-hand, rear binding post of the socket I6 should be connected to the lead that goes from the binding post, V4, to the rheostat. The former lead should, of course, be disconnected.

The use of a UX-112 in the last stage is recommended. The rheostat is already heavily loaded and heats considerably, so a type 112 Amperite or a .5 ampere Brach-Stat should be used to control the filament current of this tube This should be connected from the right-hand, rear binding post of the last audio-frequency stage socket (looking at the set from the front) to the positive "A" binding post (V4). To turn off the filament of the UX-112, as well as the other filaments, the switch must be connected between the lead that now goes to the negative "A" binding-post, V3, and the binding-post. Solder the two leads that now go to the switch, together. The "B" battery voltage should be increased to 157.5 and the "C" battery voltage to 12.

A convenient way of biasing the last tube is to insert a small piece of cardboard between the right-hand end of the grid-leak and the clip that holds the leak, to insulate the metal cap from this clip. Connect the negative side of the "C" battery to the cap of the leak and the positive side to the mounting clip (unless the positive side is already connected to the "A—" (minus) lead at some other point).

Care must be taken if the negative lead is soldered to the cap to keep from melting the solder or metal in the leak (generally a metal having a low temperature melting point such as Woods

metal). A leak of the Bradley type should preferably be used to prevent this.

The "C" battery that is used in the A.F. stages may be likewise used to bias the first detector-oscillator, as was previously mentioned. Further details on operating such an amplifier were given in the article "How to Reduce Distortion in Amplification" in the February, 1926, issue of POPULAR RADIO.

Test the Batteries First

The first place to look for trouble is in the batteries. Be *sure* the "B" batteries are O.K. Test them with a voltmeter. If they get low the amplifier may howl.

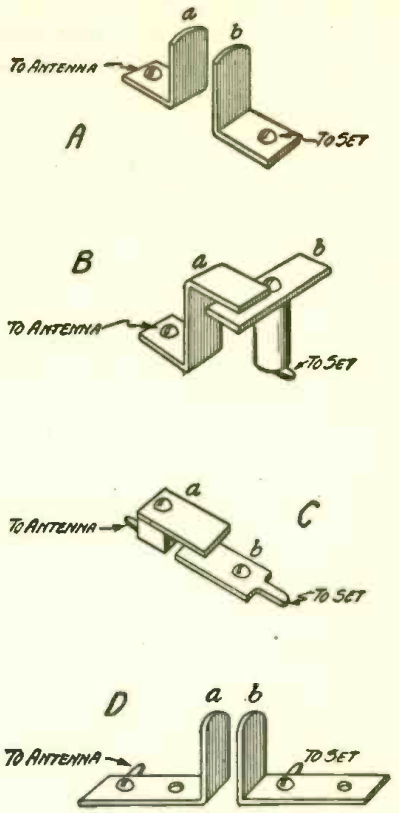
Perform each test carefully as you go along so that you feel *certain* that the trouble is not in the part tested. If an instrument is found to be unsatisfactory, replace it. Don't start a whole series of substitutions, however, without being sure of what you are doing. In this way you can systematically eliminate possibilities and troubles without introducing additional ones.

Condensers and Transformers Should be Tested for Short Circuits

All transformers should have been tested for continuity of winding and short circuits between the windings before the receiver was assembled. The condensers should also have been tested for short circuits and leaks. If the transformers were in good condition when you assembled the receiver it is improbable that trouble has developed in them. This is about the last place to look for trouble if you have previously tested them.

The condensers, on the other hand, may have been damaged in assembling the set. If the wire is soldered directly to the rivet which holds the condenser together and the job was poorly done so that the soldering iron had to be held on it for some time, there is a possibility that the foil melted or that the condenser was damaged in some other way. A great many readers have reported trouble from this cause. In testing condensers in the receiver care must be taken to see that there is no conductive circuit across the condenser which could produce a click. The condensers B and G, for example, are shunted by windings which provide a conductive path. To test these condensers, one side must be disconnected from the circuit.

The ordinary method of matching tubes is of very little value in a receiver of this type. If the reader is in a position to measure the mutual conductance and the mu of the tubes, those having similar characteristics should be used in the intermediate frequency stages. The secondaries of the transformers that are used in these stages are shunted only by the effective input capacity of the tube which is not a constant. A slight rearrangement of the tubes will frequently improve the operation of the receiver.



HOW TO CONSTRUCT THE ANTENNA CONDENSER

FIGURE 7: *Four different ways to make the antenna, series, tuning condenser. Any one of them may be adjusted to obtain the correct capacity for the antenna used.*

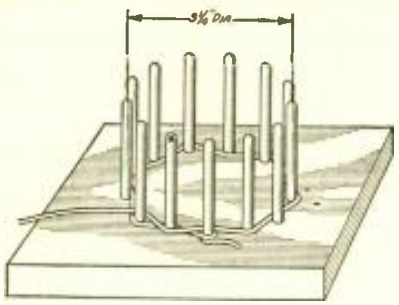
The Use of Regeneration in the Loop Circuit for DX Work

For those who like to fish for DX and who do not mind manipulating another control we suggest the introduction of regeneration in the loop circuit. (Where this is done, O1 and Q2 no longer serve any purpose and they may be removed from the circuit.)

To accomplish this, connect the outside turn of the Korach loop to the binding post V1. Connect the switch to V2 (which then becomes the "mid-tap"). Connect a small condenser of the midget type, or one that has a capacity of about .0001 mfd., from the plate binding post of I1 to the inside turn of the loop. Adjust the capacity of this condenser until the loop circuit approaches oscillation.

This will improve both the selectivity and the sensitivity. At the same time it must be remembered that this increases the possibility of getting howls, shrieks, moans and other noises that readers complain of by about 1000 percent.

This control may be set by tuning in a short-wave station and increasing the capacity until the desired regeneration is secured. The regeneration at the low frequencies (long waves) will be very slight but the higher wave stations have more power, as a rule, and may be



HOW TO MAKE THE COIL FORM

FIGURE 8: *The coil form for winding the coils for the Schnell receiver. It is made by driving pegs into a flat board and then weaving a wire in and out between adjacent pegs.*

received satisfactorily without resorting to regeneration.

An approximate idea of the relative importance of the various points which have been discussed both in this part of the article and in Part I (which appeared in the June, 1926, issue of POPULAR RADIO) may be obtained from the following list where the various paragraphs are given in the order of their importance. The order is roughly in accord with the frequency with which the trouble occurs: IX, VII, XVI, XIV, VI, III, VIII, II, V, X, XIII, IV, XV, XI, XII, I.

—HUGH S. KNOWLES

Advice on Winding Coils

By S. R. WINTERS

IF you "roll your own," let them take the shape of a cylinder!

This injunction, of course, has no reference to "roll-top" hose or cigarette; it is advice relating to the form in which you should wind your wires in constructing inductance or tuning coils for radio receiving sets.

Tests conducted by the Radio Laboratory of the Bureau of Standards indicate that cylindrical inductance coils are better than other shapes—round, flat, square or multilayer.

This Government bureau finds, during the course of exhaustive experiments, that when the wires of your tuning coil are wound in a single layer around a cylinder-like form it is more capable of conserving the minute electric energy in your radio receiver than when the inductances assume other shapes. Or, when translated in the popular language of the radio fan, the cylindrical coils may be referred to as "low-loss" coils.

The Bureau of Standards is publishing a technical paper that gives results of extensive tests with inductance coils —how they should be wound, the kinds of wire to use, and the manner of proper spacing. When this paper is published —several months hence—a limited supply will be free, upon request, to radio fans and the Government Printing Office, Washington, D. C., will sell unlimited quantities at the price of about ten cents each.

In the meantime, when you "roll your own" let them take the shape of a cylinder if you want to get the best results for your trouble.

Harris & Ewing

THE MOST EFFICIENT TYPE OF HOME-MADE COIL

This single-layer, solenoid type of coil is by far the best for the fan who likes to do his own coil-winding, for it is not only the easiest to construct but also the most efficient according to the Bureau of Standards at Washington, D. C., which has conducted exhaustive experiments on coils of every type and variety. A solenoid coil may be made by winding a number of turns of DCC wire (the number of turns and the size of the wire depend upon the inductance desired) upon a cylindrical form; the length of the coil should never be more than 1½ times the diameter.

In the World's Laboratories

(Continued from page 246)

light particles, apparently incompatible with every present form of the wave theory and yet capable of explaining certain puzzling phenomena which the wave theory will not explain.*

Physicists have been searching, with small success, for some way of reconciling these two theories. Both seem true, at least for certain phenomena. Yet they are mutually contradictory. Sir Joseph Thomson suggested last year that perhaps light, equally with radio, might be composed both of particles or "quanta" and of waves. He now uses his new hypothesis of intermittent electric force to point out how this union might be brought about.

One of the consequences which may be established mathematically, once one has made the assumption of intermittent force, is that ether waves of the ordinary variety cannot spread out indefinitely into space. If the wave is supposed to arise from a single electron it cannot go far. The very nature of an intermittent force requires, Sir Joseph's calculations show, that it must presently be reflected back against the electron which emits it, much as light inside a mirror-lined sphere will be reflected back against the lamp which sends it out. This would happen, presumably, for any particle which was emitting light or radio waves or any kind of etheric radiation.

It is possible, on this basis, to devise a reconciliation of the two opposing theories of radiation. It is this. Suppose that light, as one example of radiation, consists of flying particles, or quanta. Suppose then that each of these quanta is itself emitting waves, just such waves as the older theory assumes the whole glowing body to emit. These wave systems, each belonging to an individual quantum, cannot go far from the quantum. They will be reflected back against it, as just described. Thus each flying quantum will consist of a central particle surrounded by a sphere of radiation, pulsating between the particle and the limit of this sphere. Each quantum possesses, so to speak, a spherical halo of ether waves.

This is a direct and apparently inescapable consequence of the assumption of intermittent electric force. There are other consequences also. One is the production of X-rays when electrons pass through matter. Another is the occasional spontaneous ejection of electrons from atoms, without the application of any external force. Some of these consequences appear to be susceptible to experimental test and no doubt such tests will be made.

In the meantime, there is no doubt that Sir Joseph's new idea has accomplished one thing. It has provided us with a conceivable mechanism harmonizing the wave theory and the quantum theory, for the idea of flying quantum particles, each bearing its surrounding halo of wave radiation, seems capable of explaining, in kind if not in degree, the facts which previously have seemed to be in conflict.

*For brief statements of these two theories see "Rolling Hoops Through the Ether," POPULAR RADIO for February, 1926, pages 165-167, with earlier items there referred to.

How Radio Amateurs May Study Lightning

THE recent publication of the full text of Dr. Austin's paper† given last year before the American Geophysical Union emphasizes a suggestion which has received less attention than it deserves. This is the suggestion of wider and more intensive studies of the relation between static and lightning.

After summarizing what is now known with reasonable certainty about the causes of static, Dr. Austin concludes that it is by no means certain that the majority of the heavy crashes of static are due to lightning flashes, either nearby or far away. Some undoubtedly are, but it is found that many cannot be so correlated. There is some evidence also, that the static impulses connected with visible lightning flashes are less powerful than would be expected or than other static impulses the sources of which are still unknown.

"It must be concluded," Dr. Austin writes, "that the connection between lightning and atmospherics is still not clear, and that valuable work may be done by anyone who will watch the lightning and listen to the atmospheric crashes from thunderstorms in the neighborhood."

The annual lightning season is approaching and the observations which Dr. Austin suggests deserve the careful attention of radio listeners. The only requirements are a radio receiver, a pair of eyes and an interest in helping the progress of science.

Place the receiver so that you can look out of a window, preferably in the direction from which most of the thunderstorms approach your neighborhood.

When a thunderstorm threatens, sit down at the receiver, tune it to a fairly long wavelength (500 meters is about right) and listen.

Whenever you see a lightning flash note the kind and intensity of the static noise that you hear simultaneously. More importantly still, note any strong static crashes which are *not* associated with visible lightning. Many hours of such observations, carefully made by many observers in different parts of the country, ought to yield valuable data.

†"The Present Status of Radio Atmospheric Disturbances," by L. W. Austin. *Journal of the Washington Academy of Sciences* (Baltimore, Md.), volume 16, pages 41-46 (January 19, 1926).

My First Thrill from Radio

NOT all of the prophecies that touch upon the marvels of science emanated from the imaginative brains of Jules Verne or H. G. Wells. Indeed, one of the most definite prognostications of radio may be found in the writings of an author whose work is not so widely known among American readers as it might be. The significance of his prophecy—made in 1887, when Marconi was but twelve years old—is thus reported by a mother in California:

The other day my son brought home a radio receiving set. When he had tinkered a while with wires and batteries and what-not, he invited us into the room and, bidding us be seated in our easy-chairs, he turned some dials and lo! the room was filled with music.

Simultaneously with the burst of music there arose from memory where it had lain for a generation, a word picture painted in a book I once owned—a cheap copy of a best-seller of bygone days. I found a copy of it later in the public library, and this is what I read to my children:

"Would you really like to hear some music? . . . Come, then, into the music room . . . please look at today's music," she said, handing me a card. . . . "It is now five o'clock." . . .

Several selections were bracketed with the words FIVE P.M. *. . . . I indicated an organ piece as my selection. . . . She made me sit down comfortably and, crossing the room, so far as I could see, merely touched one or two screws and at once the room was filled with the music of a grand organ anthem. . . .*

There is nothing in the least mysterious about the music as you seem to imagine. It is not made by fairies or genii, but by good, honest and exceedingly clever human hands. . . . There are a number of music rooms in the city adapted acoustically to the different sorts of music. These houses are connected . . . with all the houses of the city whose people care to pay the small fee. . . . The programs are so co-ordinated that the pieces at any one time simultaneously proceeding in the different halls usually offer a choice, not only between instrumental and vocal, and between different sorts of instruments, but also between different motives from grave to gay, so that all tastes and moods can be suited. . . .

"Now as to hearing a sermon, to-day, if you wish to do so, you can either go to a church or stay at home. . . ."

I followed into the music room. . . . We had not more than seated ourselves comfortably when the tinkle of a bell was heard and a few moments after the voice of a man at the pitch of ordinary conversation addressed us, with an effect of proceeding from an invisible person in the room.

The author of these words was Edward Bellamy; the book was "Looking Backward."

The pathos of the prophecy lies in the fact that Edward Bellamy died just before radio communication was accomplished. Yet we who thought at the time that he wrote of the impossible, sat in our Los Angeles home and listened to music played in San Francisco.

—OLLA JOSEPHINE SELLARGS

* *

It Works Both Ways

Why some men don't leave home: Radio.

Why some others do: Radio.—*Miami Tribune.*

WHAT READERS ASK

CONDUCTED BY HUGH S. KNOWLES

IN justice to our regular subscribers a nominal fee of $1.00 per question is charged to non-subscribers to cover the cost of this service, and this sum must be inclosed with the letter of inquiry. Subscribers' inquiries should be limited to one question or one subject.

How to Build a Trickle "A" Battery Charger

QUESTION: In the March, 1926, issue of POPULAR RADIO there was a notice to the effect that there would be an article on how to build a charger in the April issue. I have gone through the issues which have appeared since then and have not found a description of the charger. Would you mind giving me the specifications for such a charger or letting me know in which issue this information will appear? I am badly in need of an "A" battery charger and would like to build one.

—JAMES HABOR

ANSWER: We regret that, due to our limited space it was necessary to hold over the charger article until the May issue. The notice merely said that a storage battery charger was to be described and you doubtless interpreted this as meaning that it was to be an "A" battery charger.

The charger was described in the May, 1926, issue, on page 36. This is a "B" battery charger, however, and several modifications are necessary to permit its use as an "A" battery charger.

The usual chargers of this type have a charging rate of between two and five amperes. This means that the average storage battery having an ampere-hour capacity of about 90 may be charged in between 20 and 50 hours. If the battery had an efficiency of 100 per cent the charging time would be 18 and 45 hours respectively. Actually the charging time will be considerably greater than this, particularly with an old battery in which the efficiency is low.

The rectifier cells that were described in the May issue will not economically handle over 250 milli-amperes (.25 ampere). This is the current supplied by the average trickle charger and these cells may be used to make such a charger.

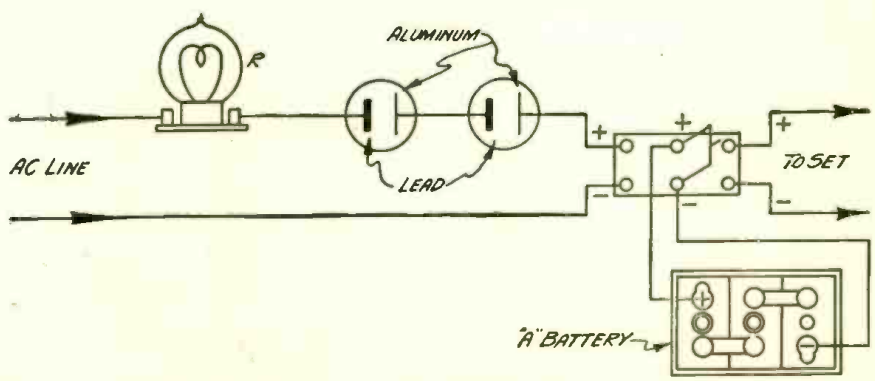
Refer back to Figure 1 on page 36 of the May, 1926, issue of POPULAR RADIO. To convert the unit to an "A" battery charger it is only necessary to connect the "A" battery to the two terminals B plus (+) and C of the diagram. The two lower cells on the branch "Z" and the B minus (−) terminal should be removed, if the charger is to be used only as an "A" battery charger.

The charging rate will be roughly proportional to the rating in watts of the series lamp used at "R". A 25-watt lamp will be sufficient for charging batteries which are to be used with sets that require a moderate "A" battery current. Sets that use five or more tubes require more "A" battery current (depending, of course, on the type of tubes used) and a 40-watt lamp should be used to charge the "A" battery.

A double-pole, double-throw switch should be used to disconnect the "A" battery charger from the receiver and connect it to the charger at all times when the receiver is not in use.

The complete charger diagram is shown just below in Figure 1.

A rough calculation will serve to give an approximate idea of the necessary charging rate. Let us suppose that the receiver uses five UV-201-a or UX-201-a type tubes. The normal filament requirement for each tube is .25 ampere and the total requirement is 1.25 ampere. If the receiver



THE DIAGRAM FOR AN "A" BATTERY CHARGER

FIGURE 1: *How the leads for the lamp, the rectifier jars, the switch and the battery should be connected to the AC line and to the set.*

is used for four hours a day the total requirement is five ampere hours (4 x 1.25).

This means that the charger has to supply five ampere hours to the battery plus sufficient to compensate for the fact that the battery is not 100 per cent efficient. In the remaining 20 hours the charger will supply 20 x .25 or five ampere hours which would be sufficient if an overcharge were not necessary. For these requirements a higher charging rate is necessary.

To secure a higher charging rate, either the size of the cell as a whole (including the physical dimensions of the electrodes), may be increased or two more cells may be made and connected in parallel with the first two. In this case a 60-watt lamp may be used giving a charging rate of nearly half an ampere. Frequently only one cell is used in series with the line but this practice is not advisable where the charger is to be operated continuously and where good efficiency is wanted.

The cells and the solution should be made in accordance with the instructions given in the article in the May issue and the charger should be used only on alternating current.

Specifications for Intermediate-frequency Transformers

QUESTION: Please give me specifications for building intermediate-frequency transformers that I may use in a standard superheterodyne circuit. I would prefer to experiment with some of the air-core type which would have a high enough high-frequency cut off to prevent amplification of audio-frequency disturbances such as microphonic noises.

—E. PILAT

ANSWER: Specifications for transformers of this type were given in the January, 1924, issue of POPULAR RADIO. As the question is a common one, however, and as this issue is no longer available, we will repeat these specifications.

The spools on which the coils should be wound should be turned on a high speed wood turning lathe from hardwood. The flanges of the spool should have a diameter of approximately 1⅜ inches.

Cut two slots ¼-inch wide by ⅜-inch deep and spaced ⅛-inch. The two slots will then have a ⅝-inch core and be separated by ⅛-inch.

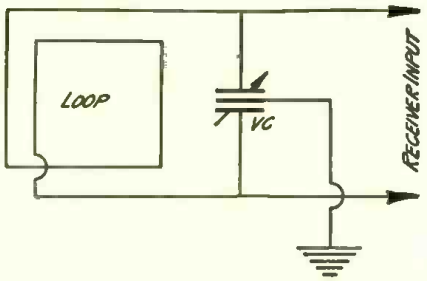
For the tuned stage, wind 300 turns of No. 36 DSC wire in one slot for the primary and wind 1,000 turns of the same size wire in the other slot for the secondary. The primary may be tuned with a small, variable condenser of the X-L Variodenser type having a maximum capacity of .00055.

The untuned transformers should be made by winding 850 turns for the primary and 1,000 turns for the secondary.

The outside turn of the secondaries on both types should be the grid lead; and the inside lead of the primaries should be the plate lead.

Oscillation may be controlled in the intermediate-frequency stages, by bringing the common grid return lead from all but the last transformer to the slider arm of a potentiometer connected across the "A" battery circuit.

The grid return of the last transformer, which is connected to the input of the second detector, should be connected to the positive "A" battery lead when a hard detector tube of the 201-a or 199 type is used. The detection of this tube may be improved by using a .00025 mfd. grid condenser and a leak that has, approximately, 2 megohms resistance.



A RADIO COMPASS DIAGRAM

FIGURE 2: *How a split-stator variable condenser is used to tune the loop*

How to Locate Interference

QUESTION: I would appreciate any suggestions you can give me about how I may locate various types of interference. Interference to reception has become very objectionable here recently and all attempts to locate it have been futile. The power company has cooperated with us in an effort to locate the trouble by having the insulators in the neighborhood inspected and the transformers tested. We have been handicapped by the fact that the loop receivers that were used were not sharply directional. Is there some method of improving the directional properties of such a receiver?

—GEORGE HOLMES

ANSWER: One of the main difficulties that are ordinarily encountered in the location of sources of interference is the inability to get accurate bearings with a loop. It may be shown both from a theoretical analysis of the rate of change of signal strength with rotation of the loop and from a practical demonstration that the use of the minimum signal rather than the maximum is advisable where accurate measurements are to be made. By taking the midpoint between the two minimum points a more accurate determination of the direction of the axis of the loop on the maxima may be determined.

In the average loop receiver there is no sharp point at which the signal fades out and this makes measurements of this kind inaccurate.

The loop and the various parts of the receiver itself have a certain capacity to ground which is comparable to the capacity of an ordinary antenna and which may be effective in "picking up" the signal. This component of the received energy is practically independent of the orientation of the loop and results in reception even when the loop axis is parallel with the wave front.

If we consider the loop alone, there will be a resultant difference of potential at its terminals (which may actuate the first tube) when there is a difference in the effective capacity to ground between the loop terminals. Or, to put this differently, when there is more or less capacity from the grid terminal of the loop to ground than from the filament terminal to ground, a signal may be received.

Figure 2 shows a method of overcoming this difficulty that is commonly used in radio compass installations. VC is a split stator, variable condenser the two stators of which are connected to the two sides of the loop. The rotor plates are connected to the ground and then adjusted until the capacity to ground is "balanced" or until there is a sharp minimum.

The coils in the receiver will pick up some energy; to reduce this condition the coils, condensers and tubes should be carefully and *completely* shielded. This means that the various parts have to be completely enclosed in the shield.

If the receiver is of the superheterodyne or multi-stage tuned-radio-frequency type the various stages in the high-frequency amplifier should be shielded from each other, especially where high amplification is used If this is properly done this type of shielding will be sufficient.

Both for the sake of portability and to minimize any pick up from leads and batteries the set should preferably be operated on dry cells which can be included in a shield.

Ground the whole receiver and shield using a *short*, direct, ground lead.

A receiver that has a sensitivity that is comparable to the type that is commonly used with loops should be used both to increase the intensity of the signal and thus permit a sharper reading of the minima and to allow observations at some distance from the source of disturbance so that accurate triangulation may be obtained.

Power disturbances which originate on power lines are very hard to locate in some cases because of the fact that the disturbance is carried for several miles along the transmission line. This phenomenon is the same one that makes possible the carrier current telephone or what is popularly known as "wired wireless." The transmission line acts as a guide for the high-frequency disturbance and this makes it difficult to find the point of origin.

By the use of a sensitive receiver that permits observations to be made at some distance from the source and the careful choice of points for triangulation, the approximate locality of the interference may generally be located A device such as an audibility meter with which it is possible to make audibility measurements will also prove helpful in difficult cases.

A Corrected Diagram

QUESTION: I noted a correction on the three-tube, four-circuit, single-control receiver, which was described in the March, 1926, issue of POPULAR RADIO, in the May issue. The change in connections is not perfectly clear to me. Would you mind making a sketch of this?

—M. ROBINSON

ANSWER: A diagram of this correction is shown in Figure 3, which gives the reversed order of the binding posts.

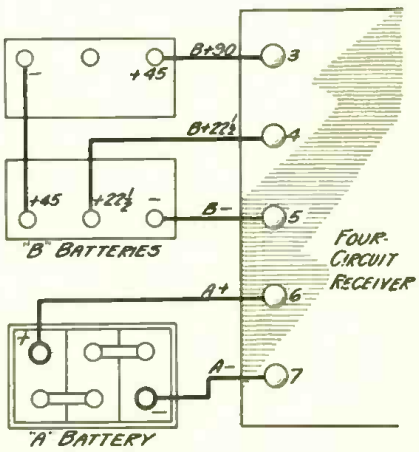


FIGURE 3: *This simple diagram shows clearly the correct order of the binding posts as well as the "A" and "B" battery connections.*

Standard Frequency Stations

QUESTION: I understand that the government has discontinued its practice of sending out standard frequency signals from various stations. This has been the only way I have had of calibrating my wavemeters and oscillatory circuits. Can you suggest some reliable method or someone to whom I could send such apparatus for calibration? I am primarily interested in the frequency band from 500 to 1,500 kilocycles and I would use broadcasting stations except for the fact that I find some of them vary from their assigned frequency and are therefore unreliable.

—W. F. GUERNEY

ANSWER: A list of standard frequency stations is given in the *Radio Service Bulletin* (issued monthly by the Bureau of Navigation). This bulletin is published monthly and it may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C. The subscription rate is 25 cents per year and it contains, in addition to information of this type, a bibliography of current radio literature which should be of interest to the experimenter.

The list of standard frequency stations, as given in the last bulletin (between 500 and 1,500 kilocycles), is as follows:

Station Call Letters	Assigned Frequency in Kilocycles	Average Deviation in Percentage
WJR, WCX	580.00	.0
WEAF	610.00	.0
WCAP	640.00	.1
WRC	640.00	.1
WSB	700.00	.2
WGY	790.00	.1
WBZ	900.00	.1

There are few stations at the higher frequencies but calibration points may be secured where only moderate precision is necessary by using the harmonics of an oscillator oscillating at the lower frequencies. Where precise calibration is desirable we suggest that you secure the Bureau of Standards Letter Circular No. 171 from the Bureau of Standards, Department of Commerce, Washington, D. C.

The Bureau of Standards does direct calibration work on instruments that are sent to them. This work is done for a moderate fee, considering the type of service that is rendered but due to their limited personnel they are unable to handle all such work promptly. There is the additional disadvantage of change in calibration in shipping and, consequently, the standard frequency station type of calibration is more satisfactory.

Fire Hazard from "B" Eliminators

QUESTION: Is there any danger that my "B" battery eliminator might start a fire?

—JAMES WILLS

ANSWER: The possibility that a commercial or a properly constructed home-made AC eliminator will cause trouble is practically negligible. There is no more danger than in the use of any electrical appliance.

In the case of eliminators for DC circuits care should be taken to see that the secondary of the receiver is not grounded. The manufactured types of "B" eliminators always include proper operating instructions. Home constructed eliminators should include a fuse block and two low amperage fuses in the supply circuit.

The YES *and* NO MAN

POPULAR RADIO *is receiving so many inquiries about broadcast artists—intimate questions concerning their private lives, the details of their professional training and their personal eccentricities—that it has finally been forced to broadcast the information for the benefit of all of its readers. Address both your questions and your information about broadcast artists to* THE YES AND NO MAN *of* POPULAR RADIO, *627 West 43rd Street, New York City.*

J.K.L.—The leading man of the WGY players is Ten Eyck Clay. * * * We would have you know that we went to a great deal of trouble digging up this photograph of him. * * * He is shown as *Horatius* in "Aphrodite." * * * If you will examine the picture *very* closely you will see that he has just dried off after having swum the Tiber between the New York Central Bridge at Schenectady and the collar factory at Troy. * * * When we look at Clay we cannot help but think of the actor who appeared in a revival of "East Lynne" at Little Falls; in the middle of the second act a well-directed carrot struck him squarely on the chest. * * * He picked it from the floor and took a bite out of it saying, "Humiliating but nourishing." * * * Our informant at Schenectady tells us that Mr. Clay ran away from home at the age of twelve to join a circus as a tight rope walker. Can you *imagine?*

S. W. P.—No, Hollywood McCosker was *not* born in Hollywood. * * * He is a subway-broken New Yorker and lives on University Avenue, in the Bronx, when he is not writing publicity for WOR. * * * Yes, we also think that he is one of the best humorists in broadcasting.

B.H.G.—Norman Brokenshire does *not* wear white spats, my dear, although it is said that he is an ardent tea-goer. * * * If we are not mistaken he comes from Geneva, N. Y. where men are men and the taxi service is something fierce. * * * If you want to think that Norman is modest go right on thinking so.

C.C.M.—The "Silver Masked Tenor" is married and has one child. * * * No, he never had the smallpox; on the other hand we understand that he is quite proud of his physiognomy. * * * Sorry to learn that you are having such a terrible time falling in love with voices. * * * Try some of the Western stations for a change.

T.H.J.—The Zionists (WCBD) are one of the religious sects. * * * Of *course* they are fundamentalists. * * * It is said that they all take a large dose of novacain at 11.30 each Saturday night so that they will have no feeling on Sunday. * * * This keeps them free from sin involving sensory responses and makes them sing very well at Church and believe *all* they hear.

F.H.—Godfrey Ludlow (WJZ) is an Australian and *not* an Austrian. * * * He is in this country with his mother. * * * He *does* fiddle nicely, doesn't he?

G.V.—That nice announcer at WGY is Kolin Hager. * * * Yes, he *has* had some musical training. * * * When a bashful young man it was his gnawing ambition to stand in the center of the Metropolitan stage and sing the members in the horseshoe seats to silence. * * * He hopes to be pelted with roses and to bring tears as big as Spanish onions to the eyes of Gatti Gazzass—Oh, spell it yourself. * * * Since you appear to be so curious, we might also add that Mr. Hager had a soprano voice when he was young and that he exercised it nobly at the Cathedral of Saints at Albany. * * * His voice later changed to barytone and things went from bad to worse until he finally became the chief announcer at WGY. * * * If you should ask us in a dark hallway, we might tell you that Hager was one of the best announcers in the business. * * * All of the *real* freshies seem to come from New York and Chicago.

A.J.B.—NTG'S (WHN) real name is N.T. Granlund and he is Mr. Marcus Loew's publicity representative. * * * He has not yet been arrested for reciting "Boots," but that is no fault of ours. * * * If you come around to this office and tell us that he is a wonderful elocutionist, you will receive a *terrible* sock on the nose.

G.F.H.—Your request for the personal history of Ernest Hare of Hare and Jones reached us in a goofy mood. * * * Ernie Hare was once a baking powder salesman. After this strange venture in business, he poured his heart into the selling of pianos. He carried a line of song books on the side, and while demonstrating songs from his books, Mr. Hare unexpectedly sold his voice to the Peabody Oratorical Society of Baltimore. * * * Years later (biographical material with "years later" in it is bad, but we cannot help it) he sang with Al Jolson in "Sinbad," and eventually, he starred in other shows. * * * Goodness, we almost forgot to tell you that Mr. Hare was born in Norfolk, Va., in 1883.

G.F.H—Billy Jones, although New York born, at the tender age of seventeen was herding sheep on his uncle's farm in Wales. * * * He sang to the sheep until one day he noticed a dirty look in the eyes of several of the flock, so he became an iron ore miner in the Adirondacks. * * * Then he became a fireman on a big boiler * * * His friends said he had a beautiful voice and so he tried it on small-town concert goers. * * * Lew Fields blew in one evening accompanied by John McGraw; they were both looking for raw material, and they both wanted Billy. * * * That is how Billy sang in "Midnight Suns." * * * Ernie Hare and Billy met in a phonograph recording studio one day and having nothing else to do they teamed up and went into vaudeville. * * * Then Mr. Happiness of the Happiness people jumped out of the box of Keith's Palace Theater one night and signed them up to sing on the radio. * * * Billy is thirty-seven but looks older and he eats at Keen's Chop House.

T. J. J.—No, T. J., Goldy and Dusty are not really colored, as you seem to think. * * * The publicity man of WEAF tells us that they have been in the oratorical singing business and that they only recently took up twinning for the Gold Dust people. * * * Of course, they are not

real twins. They are not even remotely related although it is said that they use burnt cork out of the same can. * * * Since the first publication of their photo, Goldy and Dusty have received over 6,000 mush notes from the Lenox Avenue section of New York City. * * * At 12.15 each day you will find them distributing free samples of Gold Dust at the corner of Vesey and Church Streets.

W.W.K.—Don't let Uncle Geebee (WGBS) annoy you. * * * While we can sympathize with you, we cannot accept your invitation to join your *posse*. * * * Uncle Geebee spends his spare time at the Bronx Zoo waiting to see the big brown bear laugh. * * * We have not heard that he was once disappointed in love but he has evidently been disappointed about *something*.

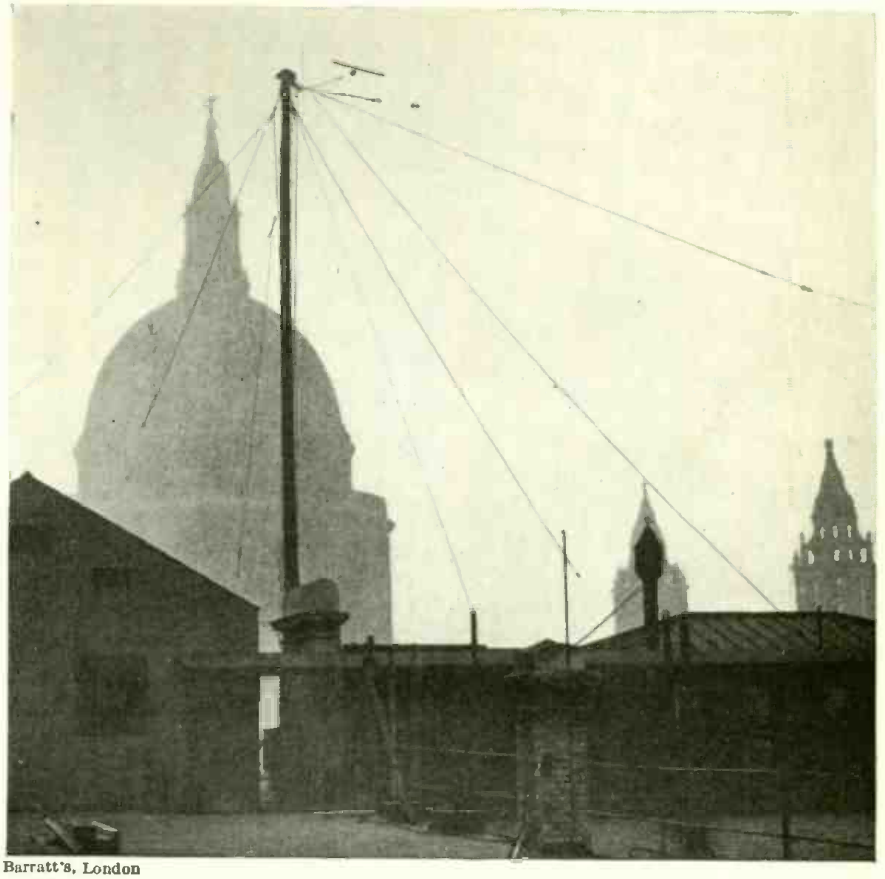
A.L.L.—The sports announcer at WGN is Quinn Ryan. * * * Yes, he is a newspaper man; his wit should tell you *that*.

R.S.—Rothafel "Roxy "will be on the air again just as soon as his new Theater is open. * * * He is 42, has a wonderful son and daughter and lives in the Spuyten Duyvil section of New York City. * * * Yes, he served in the Marine Corps during the war.

L.N.Z.—Don't believe *all* that you hear about the radio announcers and performers, Larry. * * * Pat Barnes is the sleek-haired ballyhooer of station WHT. * * * Yes, he *is* a lovely fellow. * * * We don't know where he buys his buttoned shoes.

H.J.K.—*Please* don't ask us "Don't you think that E. L. Tyson (WWJ) is a fine fellow?" * * * Not that he isn't, but questions like that make us *awfully* angry. * * * No, that was not Mr. Tyson's photograph you saw in the Nuxated Iron advertisement; it must have been another Tyson.

R.W.T.—When you ask us to what lengths an individual may go in exterminating child talent on the air, we know just exactly how you feel; we have never been much of a hand for "little tot" entertainment ourselves. * * * But mothers and fathers will be mothers and fathers, you know, and when a mother and father decide that little Anabelle would make a big hit on the air, there is no power in this wide, wide world that will prevent them from carrying out their plans. * * * The entertainment value of a singing or a reciting tot is comparable to a paper tearing act wherein a battleship is unfolded from a copy of the *Troy Bulletin* and the orchestra smashes into the "Star Spangled Banner." * * * We saw such a performance only two years ago, and we were so mad that we left our rubbers in the theater and never went back to get them.



Barratt's, London

THE RADIO VOICE OF JOHN BULL IN STRIKE-INFLICTED ENGLAND

Some conception of the tremendous importance that radio has assumed in time of emergency may be derived from the immediate control that the British Government took of all English broadcasting stations upon the outbreak of the general strike on May 4th. Here is the antenna of the General Post-office station, which became an important factor in maintaining communication.

BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

A Clog Dance by Radio

IT is very difficult for us to be cranky where WGY is concerned, for, say what you will, WGY is an intelligently managed station. For nearly four years now, it has been radiating programs free from bilge and bunk; and it has, to an amazing degree, been original without seeming either fresh or superficial. No student of the radio could listen to it for any great period of time without seeing back of its programs a painstaking, alert and thinking personnel.

And what a relief to listen to its announcers, always polite, adroit and unaffected. Hagan too is a delicious relief! Never troubled with the McNamee-Brokenshire complex, he stands before the microphone and delivers purely masculine English that *genus homo* may listen to without feeling that the world is full of romancing and highly susceptible high school girls waiting to be "romeoed" *via* the loudspeaker.

But a few weeks back, WGY once more demonstrated that it was doing something more useful than sitting on a good wavelength and flooding the country with etherial pfui. Although we cannot accuse WGY of any great flash of genius, the clog dancing act, recently broadcast, was at least novel and entertaining merely as a change. A thing of this sort invariably refreshes our outlook on the art, for it shows, in a convincing way, that some studio managers are thinking beyond the limits of cracked-voiced sopranos, choir barytones, parlor-storming tenors, the canoeing lovebird type of adolescent banjoist, the jazz band that sounds like a bad accident in the kitchen utensil department of Woolworths, the gaseous and extemporaneous lecturer who attempts to caress you with a stream of unctuous nothingness, the violinist who rubs his bow, not on his strings but on the 14th vertebra of your spinal column, and the humorist

fresh from a diet of the latest edition of "Big Laughs, 10 cents a copy."

Little wonder that we all but lapse into a fit of ecstasy over a clog dance before the microphone. We are getting old now; and, God knows, we have waited long and patiently for the radio to give us a thrill that will transcend the sensation of a ride on the merry-go-round or a trip down the children's slide at playground No. 5. Some day, the strain of waiting for new things like clog dances and other little novelties will become too great, and, thoroughly maddened by the incessant trickling of conventional whatnot, we shall dash into the nearest studio and fiendishly murder every one from the office boy to the manager.

* *

Why Not Broadcast More Musical Comedies?

JUST as WJZ had succeeded in mastering the technique of broadcasting musical comedies direct from the stages of the various New York theaters where such things are born and die, it abandoned the practice and permitted a promising branch of the radio art to go to the bow-wows. It is a pity, too, for not only was WJZ doing a laudable piece of work but was at the same supplying a brand of entertainment that radio needs and needs badly. The musical comedy is modeled for broadcasting and the average show may be put on the air with every prospect of turning out to be a potential broadcast.

The musical comedy is essentially ear entertainment. If it cannot master the interest of its audience by its message to the ear drum, its scenery will be stored away after the second performance. Music and comedy, unless the latter be pure pantomime, must be an acoustical success, and for this reason the musical comedy always makes a more or less brilliant success on the air.

We do not know why WJZ gave up the idea of broadcasting Broadway's foolishment but we do know that it has neglected a mighty effective program and we can only hope that some other alert studio will see the opportunity of building up a large audience by continuing the work.

WOR might be a desirable candidate for the job.

* *

The Hand of the Press Agent Revealed

WE recently decided to check up the accuracy of the radio publicity material that reaches our desk. The entire staff of the Intelligence Department has been instructed to report back to us and we are also going to ask our readers to assist in the campaign for "Truth in Publicity and Announcements."

It seems that everybody who broadcasts is either "well-known," "widely known," "famous," or "brilliant." We are too much of a listener to believe this

and yet we do not want to issue random instructions for the punishment of every studio publicity man. We would much rather fix the guilt and so, Dear Reader, we are going to ask you to check off on the following list the performers who really are famous. In each case we have quoted from studio publicity:

"Emil Lengyel, well-known Australian writer;"

"The famous Clara Louise Thurston Harp Ensemble;"

"Well-known Dental College Quartette;"

"Charlie Correll and Freeman Gosden's widely-known harmonizers;"

"Margaret Bonar, well-known style expert;"

"Haeckle and Berge, well-known to the radio audience;"

"Carleton Cummings, well-known for his work on the concert stage;"

"Mr. Larsen, well-known Chicago organist;"

"William W. Lockwood, brilliant young American violinist."

We are strongly suspicious of these statements, but it is best to be cautious before passing a rash judgment.

* *

A Dire Warning to Disgruntled Fans

EACH and every month our readers write many letters to us wherein they claim that we are the rankest kind of a straight-eight knocker and many, many times (yes, many, many times) we feel like retiring to our boudoir and crying until our little heart will break.

It seems that every letter is a knock and if we could only believe that every knock is a boost we should be the happiest person in the whole wide world.

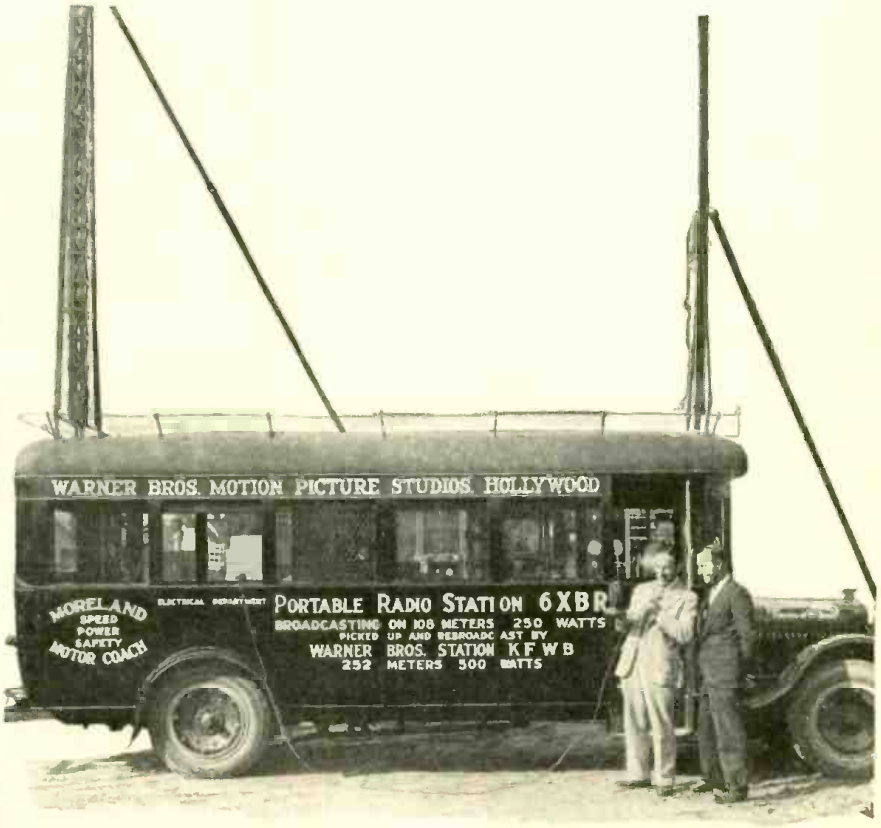
It is funny, isn't it, how a man will write a letter to us, maintaining in language full of knocks that we are the worst crank they have ever read? He usually winds up, "Well, Old Sour Dough, just remember every knock is a boost."

A critic, in the minds of the laity, is a guy who should perfume everything he sees or hears. If he disagrees with this or that and states an honest opinion, he is the veriest kind of a bloke and a knocker. If he agrees with everything like the dearest kind of a Pollyanna, he is a silly goof full of sentiment.

Sometimes we think about retiring to a monastery where we can get a magnificent view of the cock-eyed world without suffering unduly from its cock-eyedness.

If you want to knock, Dear Reader, go right on knocking and perhaps our office will some day sound like a boiler factory when we open the morning mail. For two cents, we'd lock ourselves up in the kitchen and turn on the gas.

Then, you'd be sorry!



"THE WORLD'S LARGEST PORTABLE BROADCASTER"

All California is the studio of the novel 250-watt broadcasting station contained in this motor-coach. Sports events and musical entertainments are broadcast on 108 meters and rebroadcast by station KLWB on a 252-meter wavelength.

Why Shakespeare Is Easy to Broadcast

EVER so long ago, we up and told the world that Shakespeare should be exploited more on the radio. Not that we quote freely from the bard, for we excel in no department of literature as well as in bridge and the Charleston.

Shakespeare, like Laura Jean Libby, is so—well, you know what we mean. Shakespeare was never obvious. Reading "Macbeth" with your lunch will tell you that. Because of a scarcity of talent and the high cost of soldiers' uniforms in the neighborhood of Avon, Mr. Shakespeare (Bacon is out of it as far as we are concerned) had to keep his casts small but tasty. The small size of the stages was also another factor, because Mr. Houdini had not yet started his sensational straight-jacket escape and the buck and wing dancers had not mastered the new steps.

In case you are dull and don't know what we are talking about, we shall descend to the level of other words. In tossing off his stuff, Mr. Shakespeare, always mindful of the high cost of soldiers' uniforms and the small stages of the pre-Cohan playhouses, kept his list of characters down to a minimum. This prevented doubling up in the dressing rooms and saved the expense of a mixed chorus of bathing girls and flannel trousered cake-eaters.

Although Mr. Shakespeare probably never dreamed of it, this curb on his genius was both bad and good. It was tough on the playgoers of his day, but good for our radio. When you put more than four players (voices) in a radio play, you have a terrible time keeping your who's who. If you are not real careful, the villain, instead of taking the papers to the blacksmith shop to have them forged, will marry the millionaire's daughter and join the Lotus Club. Then when you get into the Lotus Club, you might just as well be listening to the Dental College Glee Club as far as the continuity of the plot is concerned.

The small population of the Shakespearian stage gives you more than an even break in keeping tabs on the radio players. For this reason, this department has felt that Shakespeare is ideal for the radio.

All of which reminds us that WEAF has organized the WEAF Shakespearian Players, *not* Incorporated. The Players, leaving out the possibility of interference on the part of the American Society of Composers, Authors and Publishers because of copyright, will appear each Sunday evening at six, throughout the winter seasons.

Although information concerning the players is not available, we feel safe in recommending the performances to you. If the performances are good, we shall ask you to save your United Cigar Store coupons for us. If they are bad, we shall have the actors arrested.

LISTENING IN

PRACTICAL *pointers from experimenters and broadcast listeners. What helpful hints can* YOU *offer to your fellow fan? Readers are invited to address their letters to the Editor of this Department.*

CONDUCTED BY LLOYD JACQUET

How the Use of Two Good Loudspeaker Units Will Improve Tone Quality

THE report of Jack Healy's experiment with "stereoscopic reception" (which was given in this department in the April, 1926, number of POPULAR RADIO) is very interesting. Everyone cannot, however, have both long and short wave receivers, nor do all broadcasting stations transmit on high and low wavelengths.

I have obtained somewhat similar results to Mr. Hawley with my "LC-26," but with the use of a different method which is a little easier for the average fan to apply.

I have two loudspeaker units. One of these, which is particularly good for reproduction of the higher frequencies, was selected with this in mind. A larger one reproduces the low tones exceptionally well.

Removing the bottom board of my piano, I placed both units inside. As there was not sufficient place for the horns, I constructed two long cones of parchment paper to take the place of them. I connected the two units in series, bringing the wires out through the thumb hole at the top of the board to my shunt plate feed, and thence to my set.

The effect was a great improvement in quality over a single speaker. Not only were high and low notes faithfully reproduced, but the music filled the room without seeming to come from any particular point.

—EDWIN J. FREUDENVOLL, *New York City.*

A Simple Test for Oscillation

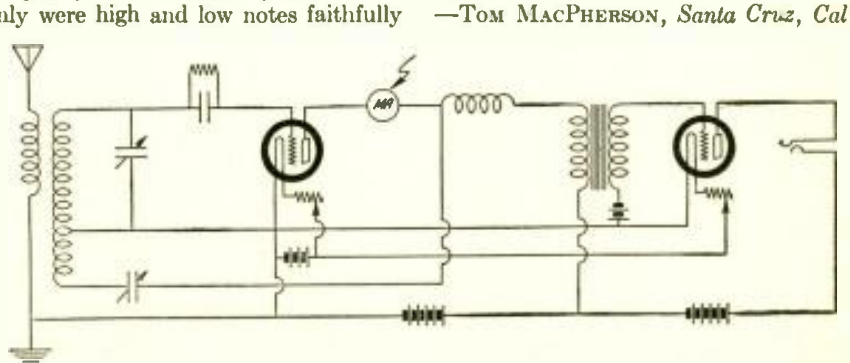
LISTENERS-IN who are becoming converted to the short waves, and who have built short-wave receivers, sometimes experience difficulties in the operation of these sets. It is specially difficult for them to tell, for instance, when the receiver is oscillating, a condition essential for the reception of undamped waves from amateur and other transmitters.

For some time I have been using a method which is so simple that any novice can use it. Instead of depending upon the characteristic "thud" which tells the experienced ear of oscillation in the circuit, I have connected, in the plate circuit of the detector tube, a small sensitive milliammeter.

The scale should not be more than 5 milliamperes maximum. With a voltage of 45, the needle will deflect one or two milliamperes when the set goes over into oscillation.

Experimenters who want to be sure that their three-circuit tuners do not oscillate can apply this idea to their circuits too.

—TOM MACPHERSON, *Santa Cruz, Cal.*



A MILLIAMMETER AS A TEST FOR OSCILLATION

Figure 1: *By connecting this instrument in the plate circuit of the detector tube, a visual indication of oscillation may be obtained.*

How I Can Use a Transformer or Resistance-Coupled Amplifier at Will

NOT only to test out the relative superiority of one type of amplification over the other, but also to make various tests, I have devised a simple way of changing over from transformer to resistance-coupled amplification.

The resistance-coupled amplifier unit that I used was an Alley-Bradley, neatly mounted in a box. It had its own tubes and batteries, with plugs for the output.

For the receiving set, I used a standard five-tube, tuned-radio-frequency instrument, with jacks for plugging in on the detector and the first and second audio-frequency stages.

The input of the resistance unit was connected to a regular loudspeaker plug. When I wanted to change over from the regular transformer-coupled audio amplifier, which was part of the set equipment, I placed the plug of the loudspeaker in the output jack of the resistance-coupled unit, and inserted its own jack in the set's detector jack.

In this manner, the output of the receiving set was directed into the resistance-coupled circuit, instead of the audio-frequency transformer circuit.

I have been able to make interesting comparisons by means of this simple and effective arrangement, which requires no change in the receiver itself. I have been able to see the advantage of one type of amplifier over another for receiving various types of transmission. At the same time, by making the connections from the resistance-coupled amplifier long enough, I may locate it with the horn in another room, or on another floor.

—JEROME MCNALLY, *Aurora, Ill.*

What I Can Get With My LC-26

THE first night that I had my LC-26 working, I logged about 20 stations in all parts of the country. During the transatlantic tests, I heard several foreign stations, the call letters of which I could not check up on, because of interference.

Last year, I also built the old four-circuit tuner type, and had wonderful results with it. Down in this district there are few stations; but with the LC-26, I can cover the whole country.

Only a few days ago, I was able to tune in station WJZ, New York, with full volume. There are no other fans down here who have been able to do this. Among the stations which have been logged with this LC-26 receiver are: WGY, WLS, KYW, KFI, KOA, KSD, WWJ, and many others.

I really think the LC-26 is the best receiver one can build.

—GODFREY DICKINS, *Lake Worth, Fla.*

Transatlantic Reception on One Tube

I SHOULD like to submit to you the following long distance records:

From January first to March 31st, 1925, using a simple regenerative receiver, with one tube only, the following stations were logged: WGY (many times); WBZ (many times); KDKA (occasionally); WPG (four times); WOR (once); WDAF (once); and CNRA (Canada) (once).

In the early part of 1926, I have been able to hear WGY clearly on 380 and 109 meters; KDKA on its short wave of 63 meters, WDAF and WSAI (once only). This was done on a two-valve receiver, using a detector and one stage of audio-frequency amplification. The short-wave receiver was a two-tube Reinartz.

—WALTER PATTISON, *Heaton Park, Manchester, England.*

An Ingenious Use of Transformers as Choke Coils

THERE has been so much said about impedance-coupled amplification, that I decided to try it out on my old Four-circuit Tuner, which is still giving good service.

However, as I did not have the time to get to the nearest radio dealer, who is about 54 miles away, it occurred to me to use the transformers in the receiver for the experiment.

This was done by connecting the primary with the secondary winding, in a series connection. In this way, the transformers acted as choke coils with iron cores, and they could be placed in the audio-frequency circuit in the way in which regular choke coils are wired.

It is of course necessary to secure coupling condensers. These are of the flat type, using mica insulation, and of about 0.006 microfarad capacity. The grid-leaks are of about one-half megohm resistance. There is nothing critical in either of these components when used in this circuit.

Although I did not secure as much amplification as with the original transformer installation with the choke coil arrangement, there was plenty of volume and there was a great difference in the quality of the reception. For those who are interested in experimenting with one type of amplification or another, this simple way of doing it will be helpful.

—ALBERT ROSS, *Fullerton, Neb.*

How I Test My Audio-frequency Amplifier

It was with the idea of finding out how well my audio-frequency amplifier was performing that I devised the following method of testing:

The output end of the amplifier is throttled down by means of resistances, such as a Royalty resistance or a Bradleyohm. The resistance unit is adjusted so that the signals that come from the audio amplifier are no louder than those obtained directly from the detector, when headphones are plugged in.

Now, if a signal is tuned in, it is possible to make a quick comparison of the quality at the detector, and at the output of the audio amplifier. This is done by quickly plugging in from the detector to the last audio stage with a pair of telephones.

—GEORGE KENT, *New Rochelle, N.Y.*

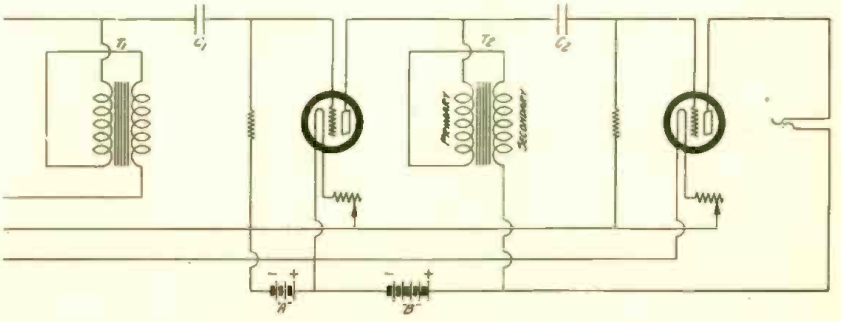
How I Logged Eighty-eight Stations in Ten Days With the LC-26 Receiver

I HAVE been using the LC-26 receiver for some time now (built from plans published in POPULAR RADIO for December, 1926), and have never seen or heard a set that will outdo it. I introduced one modification; instead of using the resistance-coupled audio-frequency amplifier, I utilized a standard transformer-coupled circuit.

The most remarkable reception which I have obtained with this receiver occurred on the evening of February 20th. I started to listen in at 11.30 p.m. When I finally finished at 2.30 the next morning, I had recorded sixty stations, all of which were brought in on the loudspeaker.

After ten days' trial, I had logged altogether eighty-eight stations, most of the reception having been done after eleven o'clock in the evening.

—DONALD M. HOOD, 1 BGA, *Fall River, Mass.*



TRANSFORMERS CONNECTED AS CHOKES

Figure 2: *If the primary and secondary of the transformer are connected in series, it may be used as an impedance.*

How I Made My Set a Featherweight Receiver

VACATION receivers must be lightly constructed if they are to be popular and truly portable. My set, a short-wave outfit, has been cut down to the bone.

I have used the frame method of assembly, and have mounted everything on a shelf that is held together by a set of brackets. As you can see from the picture, I use no panel. The entire set may be placed in its box; and, with the cover closed, it is fully protected from any injury.

The two condensers are mounted on the sub-panel by means of brass angles. The rheostat is mounted in the center under the condensers.

All of the other apparatus, such as the sockets, posts for connecting the coils, and the radio-frequency choke are placed on, or under, the shelf.

Not only is this construction simple, but it is rigid and strong.

This construction may be applied to any other type of set. It should prove ideal for any kind of a portable outfit.

—HOWARD PITTMANN, *Burlington, Iowa.*

How I Simplified My LC-26

I RECENTLY built an LC-26 receiver and I find that the results have far exceeded my greatest expectations. It is certainly the best set I have yet seen, and you are certainly to be congratulated upon your design.

I substituted a 0.00025 microfarad condenser for the 0.00015 microfarad unit that was specified in the list of parts. Either the first 0.00015 mfds. condenser I purchased was defective or short-circuited, for I could not get the results that I expected at first. The change helped a lot. I also changed the Bradley-leak for a fixed leak.

—JOHN F. KRUSCHKE, *Lancaster, N. Y.*

Changes in the List of Broadcasting Stations in the U. S.

These corrections and additions to the list which was published in the March, 1926, issue of POPULAR RADIO *(together with the changes which have been published in succeeding months) make the list correct as of May 20, 1926. Further changes will be published each month in this magazine.*

STATIONS ADDED

WKJC	Lancaster, Pa.	258*

STATIONS DELETED

WFBD	Philadelphia, Pa.	234
WGBM	Providence, R. I.	234

CHANGES IN CALL LETTERS

KFVW	San Diego, Cal., *change to*	KFSD
KLDS	Independence, Mo., *change to*	KLDS† KMJP
WCBQ	Nashville, Tenn., *change to*	WBAW
WHAV	Wilmington, Del., *change to*	WDEL
WHBH	Culver, Ind., *change to*	WCMA
WWGL	Richmond Hill., N. Y., *change to*	WMSG

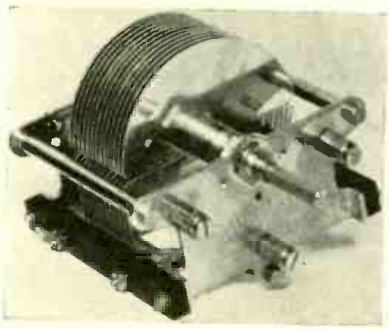
CHANGES IN LOCATIONS

WWGL	Richmond Hill, N.Y., *change to*	New York, N.Y

*License renewed under new call sign (formerly WDBC)
†One station operating under two call signs.

WHAT'S NEW IN RADIO

THIS *department is conducted by* POPULAR RADIO LABORATORY *for the purpose of keeping the radio experimenter and the broadcast listener informed concerning the newest inventions and the approved developments in radio equipment. Only such apparatus as has been tested and endorsed by the Laboratory is noted in these columns.*



A STANDARD CONDENSER

Name of instrument: Variable condenser.

Description: This instrument is similar in general construction to this manufacturer's regular type of tuning unit but it contains specially cut-out plates for obtaining straight-line-frequency tuning. The stator plate is cut with rather a wide groove and the rotor plate is made with a smaller cut away portion for reducing minimum capacity to a lower value. The stator portion is mounted on two strips of hard rubber in the regular fashion employed in the straight-line-capacity tuning units.

Usage: In any radio-frequency circuit for tuning.

Outstanding features: Ruggedness. Straight-line-frequency tuning. High efficiency. Smooth action. Good appearance.

(*Further details furnished on request.*)

A NOVEL CONE LOUDSPEAKER

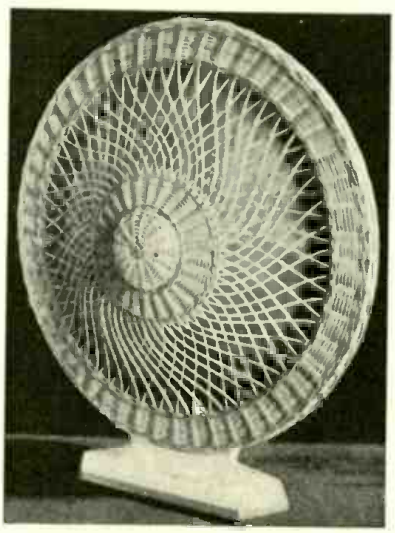
Name of instrument: Cone-type loudspeaker.

Description: This is the Bosch type cone loudspeaker equipped with a new dress. It is finished with a wicker frame casing mounted upon a white enamel base that is particularly suitable for summertime and matches up with the usual summer furniture.

Usage: In connection with a receiving set as a loudspeaker.

Outstanding features: Neat appearance. Fine tone quality and volume.

(*Further details furnished on request.*)



Apparatus Approved by Popular Radio

This list of apparatus approved by the POPULAR RADIO LABORATORY will be continued as a part of the WHAT'S NEW IN RADIO department until all instruments, parts and complete sets have been included. The listing is alphabetical by manufacturer's name and the installment in this issue includes the letters N through Q.

AERIALS

Omni-Directional aerial; Portable Globe Aerial Co.

AUDIO-FREQUENCY TRANSFORMERS

National audio-frequency transformer; National Transformer Mfg. Co.
Audio transformer; New York Coil Co.
Pacent Superaudioformers; Pacent Electric Co., Inc.
Perry A. F. transformer; Perry Wire Works.
Precise A. F. transformers; Precise Mfg. Co.
"Hedgehog" A. F. transformer; Premier Electric Co
"Quam" A. F. transformer; Quam Radio Corp..

BATTERIES

"Eveready" storage "A" battery; National Carbon Co., Inc.
"Eveready" dry cell "A," "B" and "C" batteries; National Carbon Co., Inc.
"Eveready" "Layerbilt" "B" battery; National Carbon Co., Inc.
Presto-O-Lite batteries; Presto-O-Lite Co., Inc.
Jumbo battery; Primary Mfg. Corp.

"B" BATTERY ELIMINATORS

Radio Pep "B" battery eliminator; Pep Mfg. Co., Inc.

CRYSTAL DETECTORS

Oscillaformer; Oscillaformer Co.
"Death Valley" crystal; Pacific Radio Specialty Co.
"Death Valley" permatect; Pacific Radio Specialty Co.
De-Tec-Tone crystal detector; Pyramid Products Co.
Big Pyramid crystal; Pryamid Products Co.

DIALS

National velvet vernier dial; National Co., Inc.
Pacent Microvern; Pacent Electric Co., Inc.
Ultra-vernier tuning control; Phenix Radio Corp.
"Bruno" magic dials; Powertone Electric Co.

FIXED CONDENSERS

By-pass condenser; New York Coil Co.
Fixed condenser; New York Coil Co.
Potter by-pass condenser; Potter Mfg. Co., Inc.
Filter condenser; Potter Mfg. Co., Inc.
Potter paper condenser; Potter Mfg. Co., Inc.

GRID-LEAKS AND RESISTANCES

Variable grid-leak; New York Coil Co.
Cartridge resistances; Pacent Electric Co., Inc.
Grid-leak and condenser; Pfanstiehl Radio Co.
Clarostat; Phillips Radio Co.

HEADPHONES

"Red-Head" phones; Newman-Stern Co.
Headset; Pacent Electric Co., Inc.
Perfectone phone; Perfectone Radio Corp.
"Stromberg" phone; Quaker Light Supply Co.

INSULATORS

Bakelite hot-moulded insulators; W. G. Nagel Electric Co.

JACKS

Jacks; Pacent Electric Co., Inc.

KITS

National regenaformer kit; National Co., Inc.
Kit for Roberts circuit; J. Nazeley Co.
Superheterodyne kit; New York Coil Co.
Ultradyne kit; Phenix Radio Corp.
Pink-A-Tone superheterodyne kit; Pinkerton Radio Corp.
"E-Z" 3-stage resistance-coupled amplifier kit; Polymet Mfg. Corp.
Cockaday "B" battery eliminator kit; Precision Coil Co., Inc.
Premier 5-tube Ensemble; Premier Electric Co.

LOOPS

Portena folding loop; J. Nazeley Co.
Suportena folding loop; J. Nazeley Co.
Selecto loop; J. Nazeley Co.
Curtantenna; Pathe Phonograph & Radio Corp.
Pollard loop; Pollard Bros. Mfg. Co.

LOUDSPEAKERS

Dual amplifiers; National Transformer Mfg. Co.
Audiophone; O'Neil Mfg. Co.
"Pathe" cone-type loudspeaker; Pathe Phonograph & Radio Corp.
Perfectone loudspeaker; Perfectone Radio Corp.

MISCELLANEOUS ACCESSORIES

Bakelite form for spider-web coil; J. Nazeley Co.
All-Radion products; New York Hard Rubber Turning Co.
Antenna adapter; Norden-Hauck, Inc.
2-stage R. F. amplifier; Norden-Hauck, Inc.
Radio wall map; Ozarka, Inc.
Peerless Twin-Aud amplifier; Peerless Radio Corp.
"Nodust" cleaner; Peiffer & Co.
Phenix radio cement; Phenix Aircraft Products Co.
Phenix liquid spaghetti; Phenix Aircraft Products Co.
"PRSH" A. C. leads; Pittsburgh Radio Supply House
Adjustable aerial base; Ponoma Hardware Co.
Precise No. 1600 protector; Precise Mfg. Co.
Redi-Mast with outrigger attachment; Pressed Metal Mfg. Co.
Wire-wound resistance strips; Perry Wire Works

PANELS

Panelyte radio panels; Panelyte Board Co.

PHONE PLUGS

Plugs; Pacent Electric Co., Inc.
Poly Plug; Polymet Mfg. Corp.

PHONOGRAPH ATTACHMENT

Perfectone phonograph attachment; Perfectone Radio Corp.

POTENTIOMETERS

Potentiometer; Pacent Electric Co., Inc.
Double disconnect potentiometer; Premier Electric Co.

RADIO CABINETS

Solid mahogany radio cabinet; Nassau Cabinet Co.
Campbell radio cabinets; Perkins-Campbell Co.

RADIO-FREQUENCY TRANSFORMERS

National radio-frequency transformer; National Transformer Mfg. Co.
Naxon toroidal transformer; Naxon Electrical Laboratories

Intermediate-frequency transformer; New York Coil Co.
Tuned-radio-frequency transformer; New York Coil Co.
Self-balanced transformer; Noalte Mfg. Co.
"Pathe" phusiformer; Pathe Phonograph & Radio Corp.
Ultraformer; Phenix Radio Corp.
Pink-A-Tone transformer; Pinkerton Radio Corp.
Super-multiformer; Precise Mfg. Co.
Precision R. F. transformer; Precision Coil Co. Inc.

RECEIVING SETS

Somerset receivers; National Airphone Corp.
Improved regenerative superheterodyne; Norden-Hauck, Inc.
Standard loop superheterodyne; Norden-Hauck, Inc.
C-7 and C-10 superheterodyne receivers; Norden-Hauck, Inc.
No-Dial receiver; Ohio Stamping & Engineering Co.
6-tube Operadio receiver; Operadio Corp.
Low-wave receiving set; Ott Radio, Inc.
Ozarka receivers; Ozarka, Inc.
"Minute Man" receiving set; Pathe Phonograph & Radio Corp.
Pathe "Universal-Five" receiver; Pathe Phonograph & Radio Corp.
"Penn C" receivers; Pennsylvania Wireless Mfg. Co.
Pfanstiehl "Single-Dial Six" receiver; Pfanstiehl Radio Co.
Pfanstiehl "Overtone," Model 10; Pfanstiehl Radio Co.
Ultradyne receivers; Phenix Radio Corp.
McCullough A. C. receiver; Pittsburgh Radio Supply House
"S-P-Z" receivers; Pittsburgh Radio Supply House
Powerola 5-tube radio receiver; Powerola Radio Corp.

RHEOSTATS

Rheostat; Pacent Electric Co., Inc.
E-Z-Stat; Polymet Mfg. Corp.
Precise vernier rheostat; Precise Mfg. Co.
Microstat; Premier Electric Co.

SOCKETS AND ADAPTERS

Universal Isolantite socket; Pacent Electric Co., Inc.
U. X. Isolantite adapter; Pacent Electric Co., Inc.
Bakelite socket; Pioneer Radio Corp.
"Lo-Loss" tube socket; Premier Electric Co.
Ballgrip bakelite socket; Quality Molded Products. Inc.

TESTING INSTRUMENTS

Dry cell tester; W. G. Nagel Electric Co.
Ammeter; W. G. Nagel Electric Co.
High-resistance voltmeters and voltammeters; W. G. Nagel Electric Co.

TOOLS & EQUIPMENT

Premax Radio Rench Set; Niagara Metal Stamping Corp.
Radio socket wrenches; Park Mfg. Co.
Set of 6 Radio Tools; Perry-Fay Co.
Metalectric soldering iron; Post Electric Co.
Radio panel engraving machine; H. P. Preis & Co.

TUBES

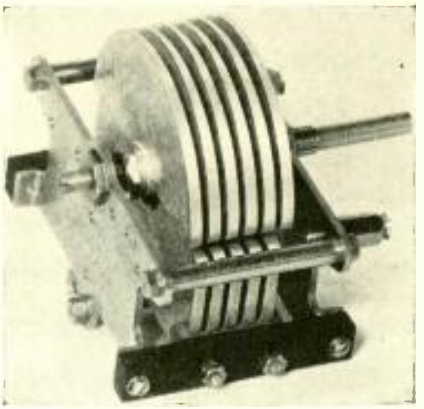
"Eveready" vacuum tube; Herman A. Nussbaum Sales Co.
Solodyne tube; Nutron Mfg. Co.
Matched tube; Nutron Mfg. Co.
"Silvertone" tube; O & T Electric Corp.
Amplitron vacuum tube; Pennant Radio Laboratories
"Ceco" vacuum tube; Providence Distributing Co.
Q R.S. "Redtop" radio tube; Q.R.S. Music Co.

TUNING INDUCTANCE UNITS

National tuning units; National Co., Inc.
Roberts units; J. Naseley Co.
Oscillator coupler; New York Coil Co.
Self-balanced T.R.F. transformers: Nolte Mfg. Co.
Journal Filter Tuner Coils; Nolte Mfg. Co.
Journal One Knob set Coil; Nolte Mfg. Co.
Wave-trap Filter Coil; Nolte Mfg. Co.
Duo-Lateral coils; Pacent Electric Co., Inc.
"Pearlco" variocoupler; Pearl Radio Corp.
"Pearlco" variometer; Pearl Radio Corp.
Low-loss Supercoil; Perfection Radio Mfg. Co.
3-circuit tuner; Pfanstiehl Radio Co.
Inductance for Reinartz circuit; Pfanstiehl Radio Co.
Variometer; Pfanstiehl Radio Co.
Pink-A-Tone oscillator coupler; Pinkerton Radio Corp.
Variometer; Pioneer Radio Corp.
Variocoupler; Pioneer Radio Corp.
Precision Octaform coil; Precision Coil Co., Inc.
Precision autodyne coupler; Precision Coil Co., Inc.
Precision Cockaday coils; Precision Coil Co., Inc.

VARIABLE CONDENSERS

"Selector" variable condenser with self-balanced coils attached; New York Coil Co.
"Selector" grounded rotor low-loss condenser; New York Coil Co.
Mignon condenser; Niagara Sales Corp.
Pacent "True" S. L. F. condenser; Pacent Electric Co., Inc.
Variable condenser with vernier; Pearl Radio Corp.
Perlesz S. L. F. condenser; Perlesz Radio Corp.
Ultra low-loss condenser; Phenix Radio Corp.
Precise Syncrodenser; Precise Mfg. Co.
Crofoot variable condenser; Premier Electric Co.
Quam low-loss condenser; Quam Radio Corp.



A VARIABLE CONDENSER WITH PLATES OF VARIABLE THICKNESS

Name of instrument: Straight-line-frequency variable condenser.

Description: In this instrument a novel method for obtaining straight-line-frequency tuning is obtained by using plates that are thick at one end and run down to a point at the other, so that as the rotor plates are rotated within the area covered by the stationary plates, the spacing between them decreases and the capacity increases at a rate that gives this tuning characteristic. The plates are heavy die-cast material and the unit makes an extremely rugged and efficient condenser.

Usage: In any radio-frequency circuit for obtaining straight-line-frequency tuning.

Outstanding features: Efficiency. Simplified tuning. Easy operation. Rugged construction.

(Further details furnished on request.)

A METER OF MANY USES

Name of instrument: Automatic voltmeter and ammeter.

Description: This unit comprises a meter mounted on a wooden base which is equipped with suitable binding-posts for connections. The meter itself is rotatable and the connection to the meter is made through a series of contacts that cut in and out the various resistances and coils in the meter itself, so that it may be used as a voltmeter with a number of scale readings or as an ammeter or milliammeter with various scale readings.

Usage: In the experimental laboratory as a general testing instrument.

Outstanding features: Variable scale readings when used either as a voltmeter, ammeter or a milliammeter. Neat appearance. Suitable accuracy.

(Further details furnished on request.)

A SIMPLE "B" UNIT

Name of instrument: "B" power-pack.

Description: This unit contains electrolytic rectifier cells for converting alternating current into direct current and it is equipped with various voltage taps for use on the detector and the radio-frequency and audio-frequency amplifiers. A small battery switch located on the front turns it "off" and "on." The unit also contains a suitable filter circuit for eliminating hum.

Usage: As a "B" power supply for a receiver.

Outstanding features: Simplicity. Neat appearance. Operation from 60 cycle, 110-volt lighting lines.

(Further details furnished on request.)

ONE OF THE FIRST WINDOW-TYPE TUNING CONTROLS

Name of instrument: Vernier tuning dial.

Description: This new dial operates through a small control knob to which is attached two rollers that engage a large metal disc upon which the designating numbers are printed. The metal disc itself is fastened to a center bearing which is equipped to fit the standard ¼-inch shaft of tuning instruments. The dial is also furnished with two smaller windows spaced horizontally in which call letters of stations may be written down by the operator.

Usage: In a radio receiver for controlling tuning.

Outstanding features: Neatness of design. Ease of adjustment. Good appearance. Dial may be easily logged for broadcast stations.

(Further details furnished on request.)

BROADCASTS

"Libel" by Radio

THE first libel suit brought against a radio station for slander transmitted through its system has not been sustained; it was brought against the National Radio Company, operators of station KFJF, by C. W. Friss, undersheriff of Oklahoma County, following the broadcasting of a sermon by Rev. Lincoln McConnell, pastor of the First Baptist Church of Oklahoma City.

It was alleged that the minister made references, in the course of the broadcast, to alleged illegal acts committed by county officials. The case was dismissed on a demurrer filed by station KFJF, the argument being that as a telephone company could not be held liable for a slanderous conversation passing over its wires between two individuals, neither could a broadcasting station be held liable.

It is an odd coincidence that this case should have been settled within a few days after an amendment making slander over the air a criminal offense was defeated in the House of Representatives in Washington.

* *

A Share of Stock for Every Receiver Sold

IT was revealed recently that purchasers of radio stocks had lost more than $96,281,650 on their investments during the past two years.

Over-saturation of the radio market has been given as the principal reason for the situation. This was brought about by the numerous radio corporations which were financed for the production of radio apparatus. Hundreds of these mushroom concerns have disappeared.

It has been estimated that for every radio set sold in 1924, the public bought a share of stock.

Now that the radio industry is more stabilized, the future is much brighter.

* *

Another Short-wave Record

ANOTHER record has been hung up by short waves. During some recent tests between the Naval Stations at Bellevue, D. C., and Mare Island, Calif., regular messages were exchanged on a wavelength of 13.1 meters, in full daylight.

Further tests included the 13.4 meter channel. It is believed to be the first time that successful transmission of such low waves has been accomplished for distances of 3,000 miles in daylight.

The aim of this particular experiment at the Naval Research Laboratory was to determine the most economical and reliable channels of communications. Low waves have been found to possess unusual "carrying power," even with a very low-powered transmitter.

* *

The New Short-Wave Stations

To the increasing number of broadcast listeners who are getting interested in short-wave reception the tests that are being conducted by the General Electric's short-wave stations are of special interest.

Altogether, there are five short-wave stations in operation. Two of them, 2-XK on 65.5 meters and 2-XAF on 32.79 meters, broadcast the same programs as WGY every evening, except Wednesdays and Sundays.

Those who can "copy" code, or who want to learn, should listen in to stations 2-XAW on 15 meters, 2-XAD on 26-4 meters and 2-XAC at 50.2 meters. They are on the air practically twenty-four hours a day.

The waves of the first two stations, 2-XK and 2-XAF, are remarkably steady. They are crystal-controlled, and may be heard up to several thousand miles.

* *

Reducing the Cost of Applause Telegrams

BROADCAST listeners who are enthusiastic enough about radio programs to spend their money on telegrams to the broadcasting stations have been paying at the word-rate for each of the call letters.

Both of the big telegraph companies have now decided that call letters up to five letters may now go as one word, providing that they are written close together in the form of a single word.

Who Owns the Broadcasting Stations

THE ownership of broadcasting stations indicates a large number of interests that serve the radio public. Schools and colleges lead in the number of broadcasting stations, with 94, radio and electric equipment stores stand second; they have 73 stations listed.

Next in line are the miscellaneous stores, numbering 65; the total mercantile organizations that participate number about 138. Churches and religious organizations operate 44 stations; papers and publishers 37, and electric equipment manufacturers own 30. Eighteen stations are controlled by states and municipalities, while 10 are listed as broadcasting corporations. Banks and financial associations broadcast from 15 stations, and hotels have 12. Theatres and radio clubs are believed to own 4 stations each.

* *

The Champion Long-distance Female Talker?

THE Spanish station at San Sebastian is becoming increasingly popular with the DXer's who scorn to listen to anything short of overseas transmission. This station has a woman announcer, and her voice comes over clearly on the 346 meter wavelength, usually after 2LO London has closed down.

* *

Invention Wanted

AN insulated bus bar insulated with a material hard and resilient when bent. The insulation is to be of such composition that when heat is applied to it it will be odorless, will melt at that spot where the soldering iron is applied, and the insulation will act as a flux.

Herbert

A NOVEL RADIO RECEIVER THAT CHARTS WEATHER REPORTS

This radio picture receiver is expected to be of invaluable assistance to mariners as it will automatically chart weather reports sent out by radio. Professor Max Dieckmann, the inventor, recently tested it out so successfully on board the S. S. Westphalia that it has been added to the ship's radio equipment.

Radio Programs by Telephone

WHEN one of the telephone subscribers of The Hague, Holland, lifts the receiver off the hook, hereafter, he may ask for and get a radio program. That is, he will if the plans of the Telephone Company to supply radio programs by telephone lines to their subscribers are approved, as everything of this nature must be, by the government of Holland.

Technical details have been worked out so that no interference with the ordinary telephone service is anticipated through the switching on of the radio connection. Automatic discontinuance of the program is arranged, should a listener be called. A fee of about $7.00 a year has been mentioned as the cost to the subscriber, although this amount will not apply to those who are not telephone users but who want a radio connection. In that case, the fee will be increased.

* *

Radio-Beacons Increase in Number

ALTHOUGH there are 24 radio-beacons in operation in the United States, it was not until this spring that Alaska and the Hawaiian Islands were provided with this latest safety device modern science has given the mariner.

So great has become the value of the radio-beacon to the captains of coastwise and seagoing ships that radio compasses are being installed on a majority of the vessels. Long Island Sound will be soon equipped with a low power radio-beacon, as a test to aid the very important and heavy Sound traffic.

Additional radio-beacons will soon be established on Lake Michigan; at Los Angeles, Calif.; Grays Harbor, Wash.; and at Portland, Me.

The substitution of tube for spark transmitters, and the control of neighboring signals by synchronizing clocks for the prevention of one signal interfering with another are technical developments which have increased the utility of the radio-beacon.

* *

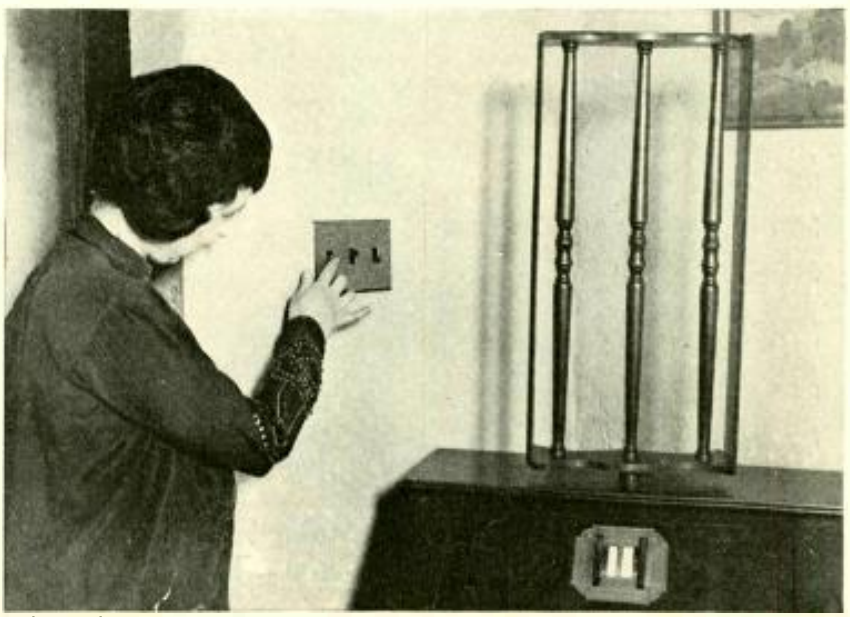
A Personally Conducted Broadcast

RECENTLY, when there were a number of marine disasters in and around New York Bay, and SOS signals were almost of daily occurrence, the broadcasting stations were silenced for long periods of time. One woman who had been buying a set on the installment plan complained bitterly, saying that she was behind in her payment, and she just knew that the store that had sold the set to her cut off the entertainment to get even with her!

* *

The Skeptical Gentleman of Bagdad

THE ancient city of Bagdad, whence came the flying carpet and other intriguing bits of mythology, doesn't intend to tolerate anything of the eerie order, so far as radio is concerned, in those communications which take place within its boundaries or in the territory of Iraq. The minister of communications has issued an order that foreign ships and aeroplanes, particularly warcraft, must secure permission from the British Naval Commander in these waters before using their radio apparatus, and must give the type of apparatus, the wavelength and the time of operation desired.



Kadel & Herbert

A CORNER IN THE "RADIO HOUSE"

In every room of this residence on Staten Island, New York, is a wall plug where broadcast programs may be switched on like the electric light. A separate program may be brought in on each of the receivers, all at the same time, and the programs may be switched from room to room of the house.

Novel Local Laws to Govern Radio Reception

RESIDENTS of Mount Vernon, N. Y., will have to put the brakes on their loudspeakers or take their medicine, as it is now an offense to operate a radio set that "makes too much noise" in that town. An ordinance was passed by the Mount Vernon Common Council fixing a penalty of $5 fine, or five days in jail, on the owners of noisy radio sets and phonographs.

The aldermen passed the ordinance in an effort to check "merchants seeking to meet competition by increasing the volume on their loudspeakers." What would they do if they had ever visited Cortlandt Street, New York, where some thirty or forty odd radio merchants provide the passers-by with concerts in competition with the "L" and the klaxons!

On the other hand, they are "sold" on radio in the little town of Sublette, Ill., where they have passed an ordinance making it illegal for any person to have, operate or maintain any instrument or device which interferes in any way with radio reception.

So the score is even.

* *

How Radio Un-made and Re-made the Phonograph

MUCH confusion has apparently existed in the public mind as to what effect the advent of radio had upon the phonograph business. Accordingly when John G. Payne, counsel for the Victor Company, recently appeared at the Congressional copyright hearings he was asked this question by Representative Sol Bloom, of New York, a member of the committee.

"With the coming of radio the sales of our instruments dropped—tremendously," Mr. Payne replied. "However, we didn't come to Congress with our troubles but instead we called in the radio people and said, 'How are you going to help us?' As a result of their assistance and devices, we were able to put on the market an entirely new type of machine. Our business began to pick up immediately and we are now working overtime and nights in an effort to fill all the orders."

* *

Talking Spanish

WHEN a radio fan in central New York recently picked up a Spanish program with his set, he thought that he had succeeded in getting Spain. When the truth was known, he had merely heard a Spanish program from station KDKA, in Pittsburgh.

MORAL: If you hear the sound of dishes being broken, don't tell your friends you heard China.

His Sister's Voice

RADIO has now penetrated the vast solitudes of the lonely ranch lands of Texas. No longer is the vagrant howl of the coyote and the lonely whistle of the norther across the divide the sole companion of the cow punchers. Ranchmen of the Big Bend district and the Panhandle are up-to-date in their entertainment and numerous ranch houses in isolated sections of the Lone Star State now get an occasional thrill from receiving machines as this adventure tells:

Radio took so well with cow punchers that one outfit in the Panhandle equipped a receiving apparatus to a "chuck wagon" and while veteran riders of the range sat about the round-up fires in the late evening and smoked cigarettes, they listened by radio to the baseball returns of the big leagues, the stock market and a concert furnished by artists in Dallas or Fort Worth.

A rancher from Amarillo was playing poker with companions in a box canyon near the Colorado line. A late spring norther was swipping over the plains, and the cow punchers sought protection behind the southern bank of the canyon where a camp fire was built and the evening meal served from a chuck wagon. Then the poker game started while the radio "bug" attached a loudspeaker to the radio equipment fixed to the chuck wagon.

The young cowboy heard a familiar voice. He dropped his hand of cards and gasped in astonishment.

"Why, that's Sis," he asserted, "that's Sis over in Dallas, singin'."

The cow puncher was right. His young sister, a student in a Dallas university, was singing in the local broadcasting studio. Other cow punchers left the card game and surrounded the radio and listened to the sweet voice of the young singer hundreds of miles away.

—WM. ALLEN WARD

* *

A Manslaughter Witness Is Located by Radio

THE shock of surprise that comes to a listener who suddenly hears himself paged by one of the big broadcasting stations was the experience of this radio fan in Cleveland. Here is his own first-hand account of it:

A year ago last summer I and my friend, Harry W. Gaines, of Cleveland, Ohio, were motoring through Rhode Island. We were approaching the little town of Warwick on the Boston Post road when a large car approached us; at the same moment a woman stepped into the road and the large car struck her. She died within a few hours.

The large car sped on; in the excitement no one secured the license number.

Gaines and I lingered long enough to see that the woman was cared for and then we proceeded to New York.

Several months later, while I was listening in on a radio set, I was suddenly thrilled to hear the announcer at radio station WTAM make the following request:

"Will the two young men driving on the Boston Post road near Warwick, Rhode Island, on July 4, 1924, in a car bearing an Ohio license plate and a tire cover reading Gainesboro Studios, Cleveland, Ohio, kindly communicate at once with the Cleveland chief of police?"

The next morning I reported to the chief of police that we were the sole witnesses to the accident. The information was relayed to the attorney general of Rhode Island, who authorized a firm of Cleveland lawyers to take depositions. Only a few days ago our testimony went forward to Rhode Island. Our statements, we have been told, will make up the most damaging evidence against the prisoner who is now facing a charge of manslaughter in the superior court of Kent county, Rhode Island. He was finally chased and cornered, but little real evidence could be secured against him unless the only two witnesses could be reached.

Radio turned the trick.

—BILL STOCK

* *

Radio Is Better Off Without—

THE bird who cusses the S.O.S. call because it interfered with his program:

The fan who thinks he can make somebody else stop "squealing his set" if he "squeals" his own set savagely:

The announcer who continually points out to his ignorant listeners the good points of his station's broadcasting:

The radio serial story employed by some stations to fill unexpected gaps in their programs:

The radio gyp dealer who sells a "guaranteed coast-to-coast five-tube set" for $17.50:

Listeners who ever allow their sets to "squeal" while tuning for nearby stations to which thousands are always listening in the immediate vicinity.

—St. Louis Globe-Democrat

Foto Topics

"THE WHISTLING BIRD" OF THE BEDTIME STORY LADY

Here is the magic flute, the fairy bells and the white bird that are so familiar to thousands of children who listen in each night to the adventures of Sir Hobgoblin as they are told by Miss Blanche Elizabeth Wade through a chain of nine broadcasting stations.

ANNOUNCING

A New DAVEN Discovery!

N. B. Glastor though embodying this vital new principle and though it has cost us thousands of dollars and more than three years of laboratory and field work to develop and perfect, is no higher priced than the old type Daven Resistors.

GLASTOR

THE *TRANSPARENT* RESISTOR

A DISCOVERY that makes for greater accuracy, for absolute permanence, and for the abolishment of receiver noises.

In Glastor we have entirely eliminated the use of impregnated fibre, paper or similar substances for the resistance unit. We have replaced it with an entirely new Daven discovery—

DAVEN PROCESSED GLASS

The result—a resistor that will carry the highest current known in the field of radio resistances.

A resistor whose resistance can be accurately fixed and which *does not change* —even with rough handling.

Radio engineers have tested Glastor for resistance—then abused it, shaken it. In testing again, they find the *resistance unchanged.*

Glastor comes in a complete range of resistances, .0025 to 10. megohms. Try it in your own set. You'll notice the difference. Leading Radio Dealers are now selling Glastor.

THE DAVEN FAMILY OF RADIO ACCESSORIES

DAVEN SUPER AMPLIFIER
Revolutionizes Reception

DAVEN LEAKANDENSER
Grid Resistor and Condenser in One

DAVEN RESISTOR MOUNT
Bakelite. For all Types of Sets

DAVEN D R F COILS
For the Daven "Bass Note" and other Tuned Radio Frequency Circuits

DAVEN AMPLIFIER KIT
Complete set Daven Resistance Coupling Units

DAVEN BALLAST RESISTOR
Eliminates Rheostat, Needless Controls, etc.

DAVEN TUBES
MU-6 and MU-20, for Clear, True Tone

DAVEN RESISTO-COUPLERS
Unit Mounting for Limited Space

DAVEN CONDENSER
Type A. Space Saving. Moisture-Proof

FOLDER FREE
This Folder tells in detail what Glastor is and what it will do for your radio set. Write for a copy today. It is Free.

The Sine of Merit

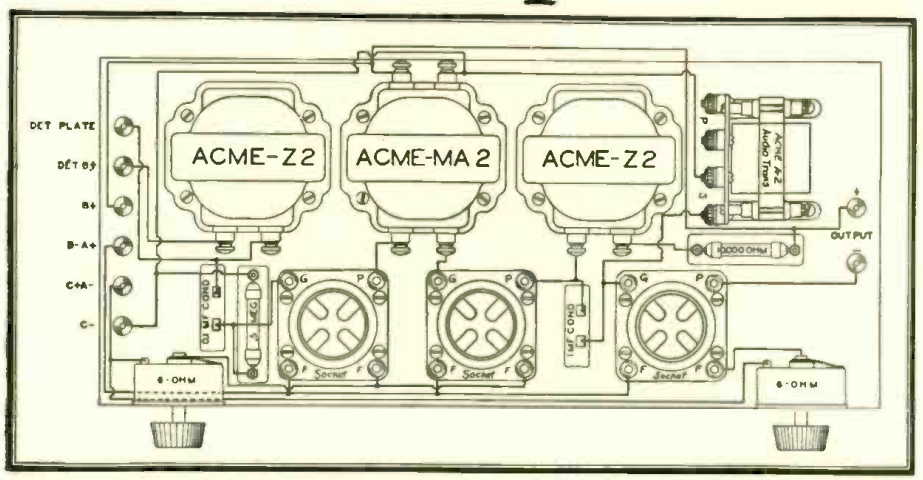
DAVEN RADIO CORPORATION

TRADE MARK "Resistor Specialists" Reg. U.S. Pat. Off.

153 Summit St., Newark, N. J.

RESISTOR MANUAL
A complete authoritative Handbook on Daven Amplification. 25c at Dealers. Or sent by mail for 30c.

The Last word in audio amplification



Impedance .. Transformer .. Impedance

THE diagram above will give you some idea of the very latest step in audio amplification. This is the outgrowth of nearly 7 years of experience in working on proper amplification—the problem of "How well you can hear."

Whether you want to get a distant station or one right around the corner, the main thing is "How well you can hear." Today's broadcasting demands clear, understandable, full-noted music and voice. All the greatest artists are on the air; the greatest men talk to us. We don't want to miss a note or word, nor do we want this music or these speeches distorted in any way. You will probably remember the football game or the prize fights which were spoiled for you right in the most exciting part simply because you couldn't understand the announcements or they were so muffled you had to strain to hear.

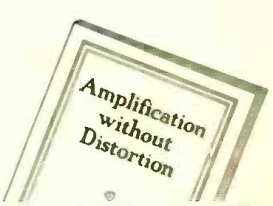
The Latest Hookup

Acme research work has been confined to audio amplification and reproduction and here you find the latest result. An audio amplifier using the combination of impedance and transformer coupling with over-all amplification greater than two transformers and far superior in quality, no matter what the type of transformer used. Whatever set you have, just add this amplifier to your detector and notice the difference.

Illustration above shows the Acme MA-2 Transformer, price $5, and the Acme Z-2 amplifying impedance, price, $4. Both look alike, yet both serve a separate purpose. You need them both.

Send for Wiring Diagram

A complete working diagram of the above chart will be sent you for 25c. in stamps or coin. It is easier to follow than the plainest road map. With this chart we shall be glad to send you free a copy of "Amplification Without Distortion," a famous radio book over 300,000 radio fans have found helpful. It tells the whole story of distortion and how it can be overcome. In it also is complete information on the famous line of Acme products including radio and audio transformers, amplifying impedance, the new Acme "double-free edge cone" loudspeaker, the new Acme B-eliminator. Use coupon below for convenience. Acme Apparatus Company, pioneer radio and transformer engineers and manufacturers, Cambridge, Mass., U. S. A.



ACME

~for amplification

ACME APPARATUS CO.
Dept. C-13, Cambridge, Mass.

Gentlemen: Enclosed find 25c. (stamps) (coin) for which please send me full diagram as shown above and a copy of "Amplificat on without Distortion."

Name.....

Street.....

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

Better now for $9.75 than it was in 1920 for $85

Recall that in 1920 a one-tube radio sold for $85. Today Crosley makes a better one for $9.75 (The Crosley Pup). There's the picture of Crosley manufacturing genius.

This year will see the millionth Crosley radio set produced. And somewhere, the first hundred still bring joy and satisfaction to their owners. Only this winter, one of Crosley's early one-tube radios won a nationwide radio reception contest, in which one-tube sets of all makes and dates were entered.

Powel Crosley, Jr., has so improved tuned radio frequency circuits in the present Crosley sets, that experts the country over have grown wildly enthusiastic over their performance.

"The first set to beat my pet——", says one fan. *"The only set I have ever seen that would tune out our local station in our building"*, writes another. *"How can Crosley do it for the money!"* is one exclamation, typical of hundreds of letters.

These new Crosley sets are truly wonderful for they not only represent a tremendous forward step in radio development, but are offered for even less than the closing-out prices of questionable and obsolete sets.

See and hear the new Crosley sets at your nearby Crosley dealer's.

Prices slightly higher west of the Rockies—For descriptive catalog write Dept. **16**

THE CROSLEY RADIO CORPORATION, CINCINNATI, OHIO

Powel Crosley, Jr., President

Owning and Operating WLW, first remote control super-power broadcasting station in America

CROSLEY RADIO

Better-Costs Less

Manufactured under Armstrong U. S. Patent No. 1,113,149, or under patent application of Radio Frequency Laboratories, Inc.

Mass manufacturing operations on the million scale has so saved pennies in production that the public sees them reflected in dollars saved on the retail prices of Crosley radios.

One great example of this is the Crosley Musicone.

Its success created so great a demand that a saving to the public of $2.75 was soon effected through increased production. Today it is the fastest moving item in radio—its quality of reproduction and its low price is inducing the rapidity by which it is replacing thousands of other type speakers.

PRESS OF WILLIAM GREEN, NEW YORK

bring your radio set up to date

for greater distance for bigger volume— for finer tone

RADIOTRON UX-200-A— *special detector tube for storage battery sets.*

NEW RADIOTRONS—new performance—better radio! By keeping up with the progress of the Radiotron laboratories, you can get new results with your old set—keep it up to date. If you have a storage battery set, here is the way to equip it now, to make it *many times better:*

1. Distance! Take out the detector tube and put the new RCA Radiotron UX-200-A in the socket. This newest development of RCA research means greater sensitivity—longer distance reach.

2. Quality! Put all genuine RCA Radiotrons UX-201-A in the radio frequency sockets, and the first audio stage

3. Volume, and finer tone! Use either power tube, Radiotron UX-112 or Radiotron UX-171 in the last audio stage, for volume—full, clear-toned volume.

With the laboratories of RCA, General Electric and Westinghouse steadily at work to develop Radiotrons, radio reception is being improved year by year. Many of these improvements can be made right in your old set. Keep pace with Radiotrons. And, for your own protection, always look for the RCA mark on the base and inside the glass of every tube you buy.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA