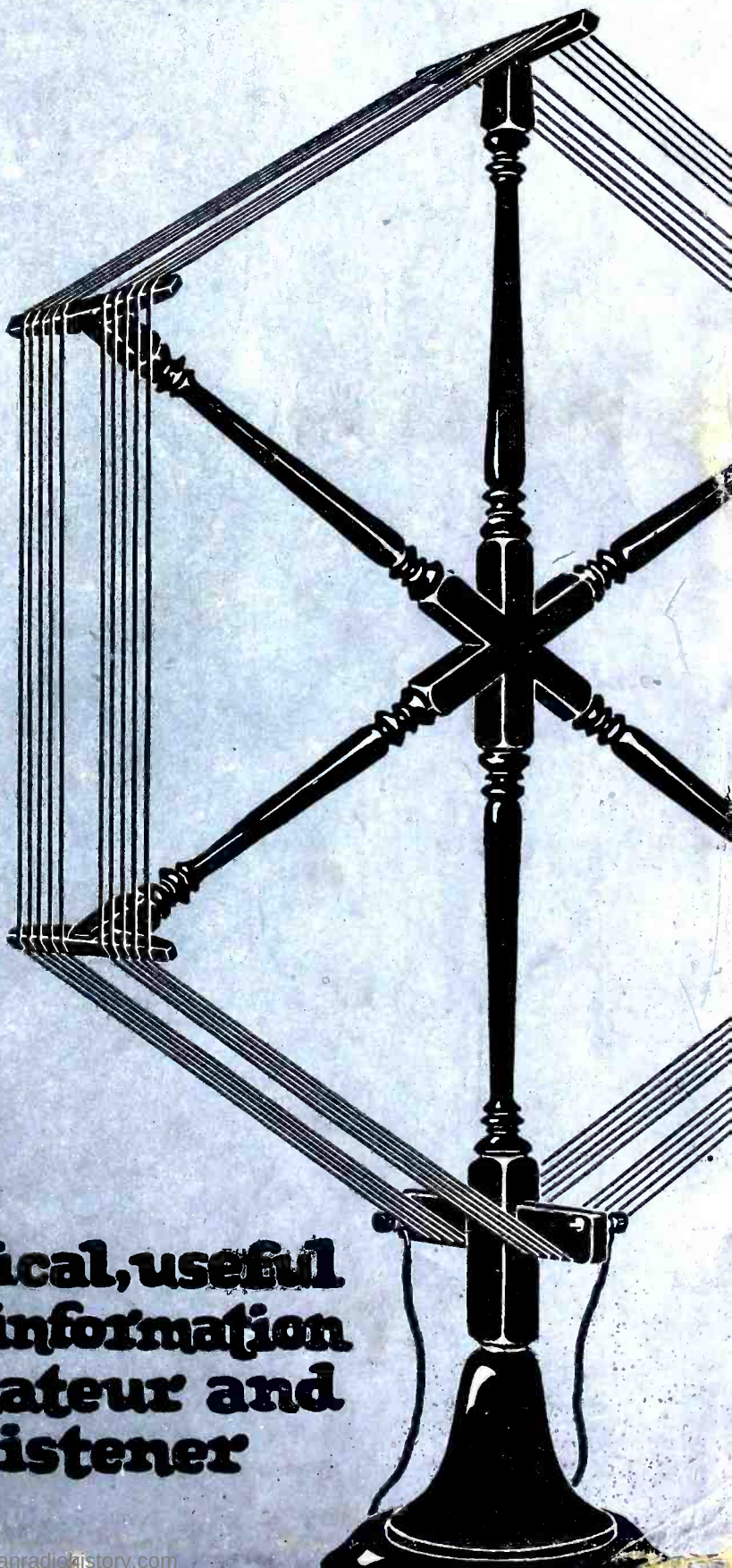
Popular Radio

with which is combined The Wireless Age

Edited by KENDALL BANNING

25¢

★SEPTEMBER
1925



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100 pages of practical, useful and authoritative information for the Radio Amateur and the Broadcast Listener

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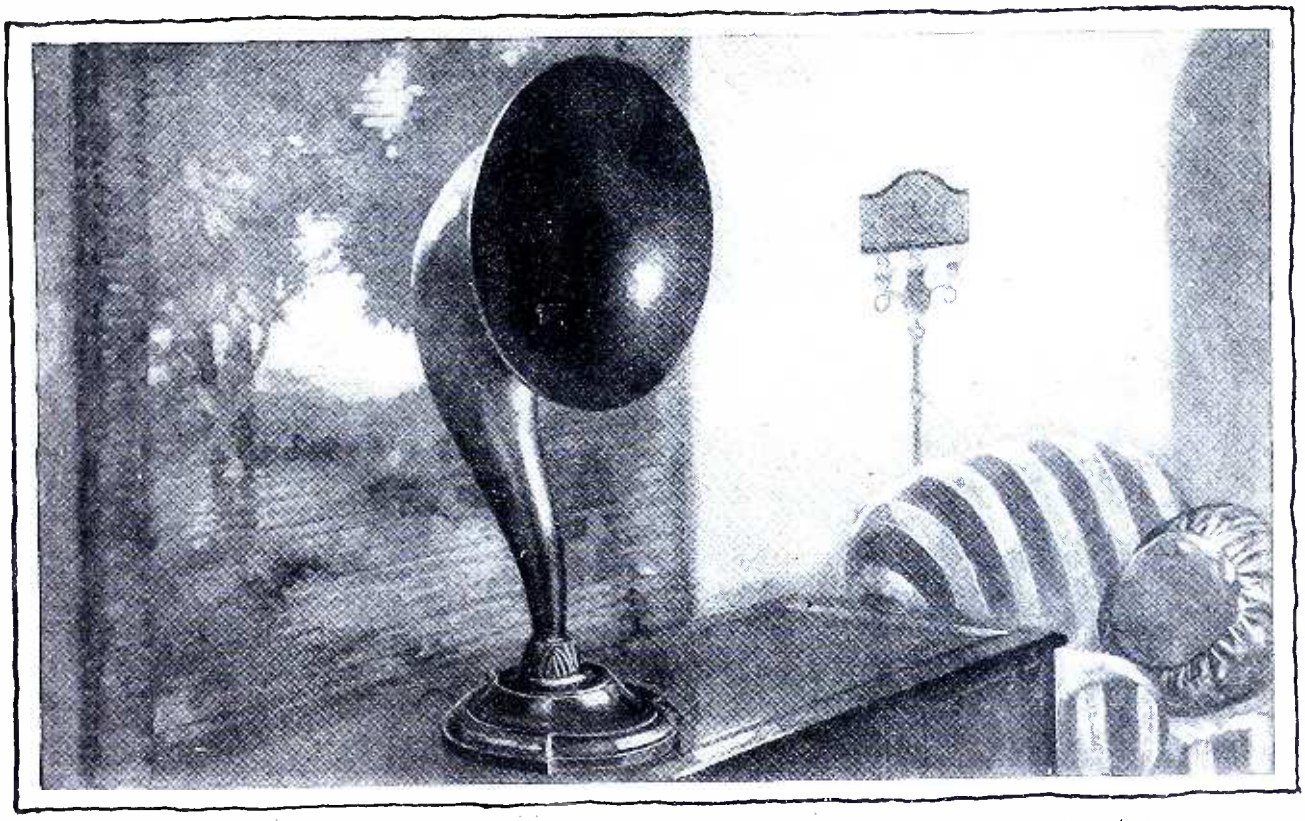

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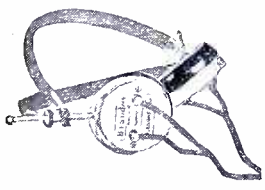

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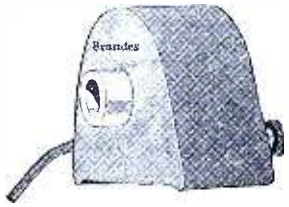

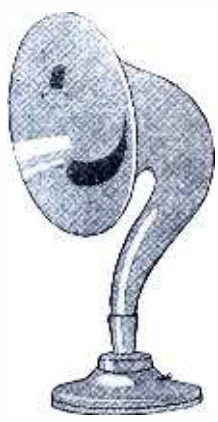

Prices slightly more west of the Rockies and in Canada.

POPULAR RADIO

WITH WHICH IS COMBINED "THE WIRELESS AGE"

EDITED *by* KENDALL BANNING

FOUNDED 1911

CONTENTS *for* SEPTEMBER, 1925

VOLUME VIII (*Cover design by Frank B. Masters*) NUMBER 3

VOLUME VIII SEPTEMBER, 1925 NUMBER 3

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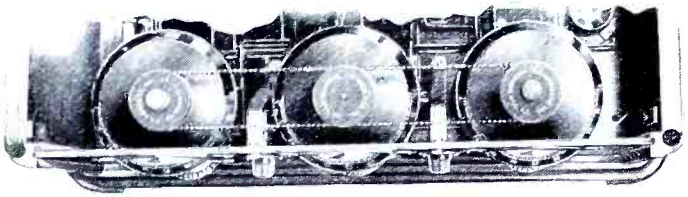
Printed in U. S. A.

LAURENCE M. COCKADAY, *Technical Editor*

E. E. FREE, Ph.D., *Contributing Editor* JOHN V. L. HOGAN, *Contributing Editor*



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Again Grebe steps ahead—

The Synchrophase now has One, Two or Three-dial Control

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It is great wisdom to buy the Synchrophase.
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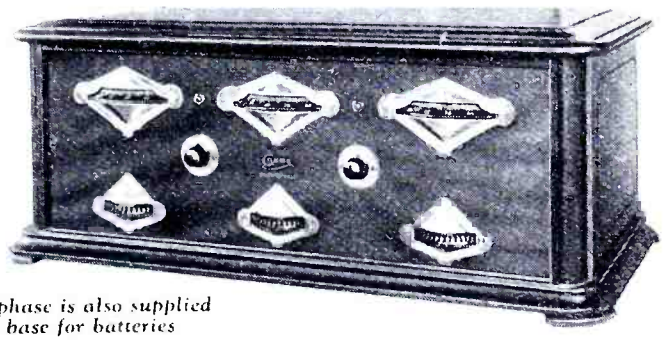


Synchrophase is also supplied with base for batteries

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

PAGES WITH THE EDITOR

Radio Corporation of America

"NO COMBINATION COULD BE MORE IDEAL THAN THE COMBINATION OF THE *WIRELESS AGE* WITH *POPULAR RADIO*"

With this issue THE WIRELESS AGE, *the oldest radio magazine in the United States, is consolidated with* POPULAR RADIO. *Mr. J. Andrew White, for ten years the popular editor of* THE WIRELESS AGE *and known to radio fans throughout the country, takes this occasion to welcome his former readers to the large and growing army of readers of* POPULAR RADIO. *The Editor takes pleasure in calling upon his friend Mr. White for a few remarks!*

The Dean's Declamation

ALTHOUGH the surroundings are unfamiliar, looking up from this page into the eyes of old friends gives me the comfortable feeling of having strayed into the hearthside circle after being far afield for a time. If home is where the heart is, then I have never gone away; for nothing is dearer in the memories I have stored up than the many happy years when it was my good fortune to guide and govern feeble footsteps into radio for a host of loyal followers of that brave little pioneer publication, *The Wireless Age*.

* * *

IT is a very easy thing to be sentimental about old associations, and it doesn't embarrass me a bit to say that on an occasion like this there is no little emotion welling up within me.

* * *

As an Editor, there were thousands among my readers I counted as my friends. We wrote to each other, we met occasionally; neither, as often as we would have liked to; but as years rolled by and the same familiar names kept repeating themselves on the subscription lists there was no resisting the feeling that we were welded into one large but never cumbersome family.

* * *

AND now this move into a new community, where there will be more room for the growth of the true ideals and high purposes that served so well in cottage days and made the mansion possible.

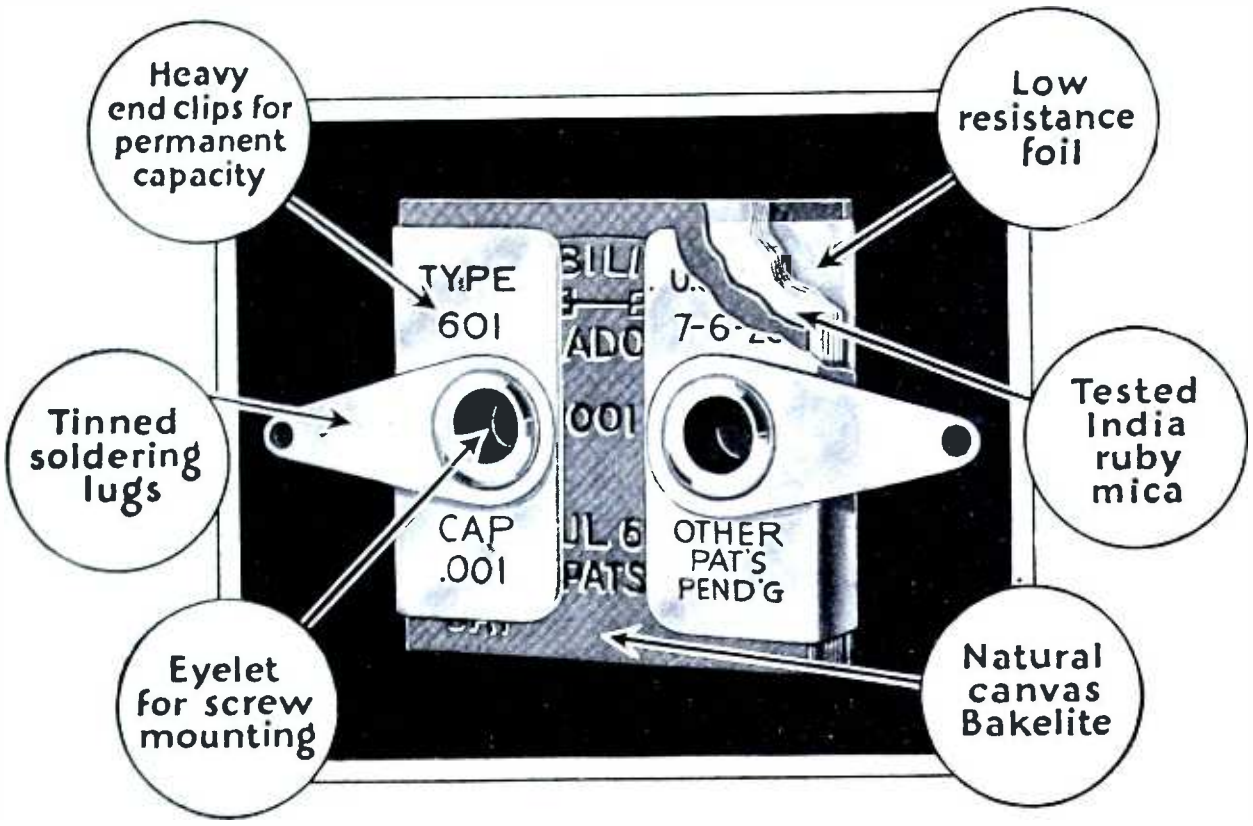
* * *

GOOD neighbors, these POPULAR RADIO folk! They looked like it at the beginning and they have proved it since. A happy culmination of the romance in radio, that is the way I see it; the words consolidation and combination seem too cold.

* * *

POPULAR RADIO and *The Wireless Age* have always had so much in common, interests and

(*Continued on page* 6)



What makes for efficiency in fixed condensers?

This diagram indicates the efficient details of construction that have made Micadons the standard* fixed condensers of radio.

Dubilier engineers have developed these standard condensers of accurate and permanent capacity. Micadons are known the world over —and are used in 90% of all radio sets.

**Standard—anything recognized as correct by common consent . . . of a high degree of excellence.—Webster*

Dubilier

CONDENSER AND RADIO CORPORATION

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

(*Continued from page 4*)

aims identical—I simply can't picture their coming together in the light of anything as stiff and formal as is suggested by the phrase, a merging of corporate property. No, it may be whimsical, but I see that first born brain-child wedded to the big boy next door, and hordes of friends welcoming the new communion of interest.

* * *

I LIKE the idea of these two magazines as one. No combination could be more ideal.

* * *

I AM proud of the mutual respect in which the staffs of each have held each other, and in every way I look for the readers to come out ahead in the newer, bigger and better magazine resulting from a fusion of interests identical in purpose but characteristically individual.

* * *

PERSONALLY, I feel more than a tinge of regret that I can have no hand in fashioning the new periodical; it is a task worthy of any man's finest effort; but fate eased the editorial blue pencil out of my fingers some two years ago, and it looks that it might be for all time, for the growing pains of infant broadcasting allow of no digressions into the pleasant paths of journalism.

* * *

So I shall stand aside and envy Kendall Banning—who unquestionably will do a better job than anyone else could, anyhow. To him, success. To you, congratulations.

* * *

FOR myself, it is but a step back to the ranks of interested readers, whence I came, just for an occasion which seemed to call for a verbal handshake all around.

* * *

GLAD to have been with you for these few minutes—73s for now and all time.

J. ANDREW WHITE

* * *

BUT the Editor has no intention of letting Mr. White slip off the editorial harness quite so easily. Since Mr. White wrote the above he has accepted the Editor's invitation to conduct the "Broadcasts" department of this magazine—a department that will give him the opportunity of keeping our readers informed of the progress of radio throughout the world.

* * *

So if you turn to page 294 of this issue, you will find Mr. White's department, written in his own characteristic vein—and illustrated with a portrait of the "Major" (as he is popularly known) at the head!

* * *

HERE is a letter that makes the Editor appreciate the disadvantages of being confined in an editorial sanctum in New York: "You may be sure that I am not going to miss a single number of POPULAR RADIO. It is the only radio magazine that thinks of the reader *first*. If you are in Atlanta just let me know and I will try to show you a good time."

—MORRIS DORSEY, *Atlanta, Ga.*

* * *

ON page 68 of POPULAR RADIO for July appeared some data concerning the Type C receiver of the Standard Radio and Electric Company. But the picture that accompanied it, as well as the title, applied to the Standardyne receiver made by the Standard Radio Corporation—an entirely different concern with a name that is somewhat similar. The data concerning the Standardyne receiver, accompanied by a picture of the set, appears in the present installment of the "What Set Shall I Buy" series.

* * *

To the cynics who insist that the broadcasting of an event adversely affects the paid attendance, the extraordinary success of the outdoor concerts given at the Lewisohn Stadium in New York by the Philharmonic Orchestra comes as both a refutation and a rebuke.

* * *

UNTIL the first of these great concerts were broadcast (an event that was initiated by POPULAR RADIO on August 11, 1922), the paid attendance at these concerts averaged between 6,000 and 7,000. As soon as the concerts were broadcast, the attendance jumped conspicuously—reaching the record figure of 20,000.

* * *

THAT is why the Philharmonic concerts are now broadcast regularly three times a week through WJZ. The reason is obvious. It pays.

* * *

WITH this issue POPULAR RADIO welcomes to its subscription list the subscribers of *The Wireless Age*—whose unexpired subscriptions will be filled by this magazine.

* * *

AS POPULAR RADIO costs $3.00 a year, and as *The Wireless Age* cost $2.50 a year, an adjustment on all unexpired subscriptions to the latter magazine will be made on a pro rata basis. Thus, any subscriber who has a six months' unexpired term on *The Wireless Age* will receive POPULAR RADIO for five issues. And subscribers to POPULAR RADIO who have also subscribed to *The Wireless Age* will have their subscriptions extended proportionately.

* * *

THE consolidation of these two subscription lists gives POPULAR RADIO far and away the largest subscripiton of any radio magazine in this country, according to the last available figures of the Audit Bureau of Circulation.

Kendall Banning

Editor, POPULAR RADIO

Again They said it couldn't be done!

Here it is

New and Improved
FRESHMAN
MASTERPIECE

$60

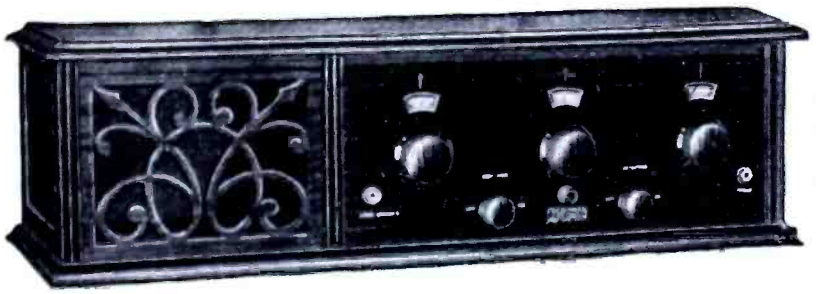
And how!

But now - - -

Complete with built-in loud speaker of great volume and superb tone quality.

Encased in - - -

As fine a heavy genuine solid mahogany cabinet as ever graced any radio set.



Model
5-F-5

At sixty dollars - - -

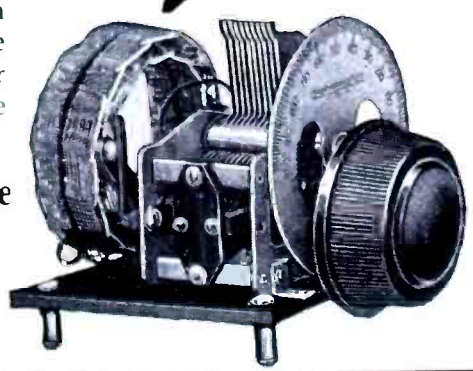
Not only complete with built-in loud speaker and massive mahogany cabinet, but this wonder circuit has been scientifically perfected and each and every single part strengthened and co-ordinated.

For example - - -

The new Freshman Masterpiece straightline wave length condenser with vernier attachment which assures hair-line selectivity—permitting you to tune in the station you want without interference over the entire wave length range. This is merely one exclusive feature of the

New and Improved Freshman Masterpiece

Other Models from $39.50 to $115.00



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Chas. Freshman Co. Inc.
Radio Receivers and Parts
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240-248 WEST 40TH ST.—NEW YORK, N.Y.
CHICAGO OFFICE — 327 S. LA SALLE ST.

The Progressive Policy of POPULAR RADIO is Serving the Interests of Science

"POPULAR RADIO, *one of the first magazines in the broadcast field, has kept abreast of the extremely rapid development of this science in a manner that reflects much credit upon its editorial direction. The progressive policy of this magazine in giving publicity to developments in the radio field which will affect the future of the science is particularly commendable.*"

H. P. Davis

VICE-PRESIDENT, WESTINGHOUSE
ELECTRIC & MANUFACTURING COMPANY

Courtesy of Mr. H. P. Donlé

The Man Who First Found a Use for Ionization in Radio

THE *sodion detector tube, invented by Harold P. Donlé, operates by virtue of a swarm of ionized atoms which it contains. Other ionized atoms, formed from the gases of the air, are now believed to be of great importance in the transmission of radio waves through the upper levels of the atmosphere.*

Popular Radio

WITH WHICH IS COMBINED "THE WIRELESS AGE"

VOLUME VIII SEPTEMBER, 1925 NUMBER 3

How the Air Affects Radio

Theories of the transmission of radio waves have created much argument among radio engineers. Controversies over the Heaviside Layer are still fresh in everyone's memory. During the past twelve months some new theories of great interest have been formulated; among the important factors are the atoms and electrons of the air and the magnetic field of the earth.

By E. E. FREE

IF a fish at the bottom of the sea knew how to build himself a radio transmitter we might expect his broadcasts to be hampered somewhat by the fact that above and around his apparatus there lay a vast ocean of salty water through which radio waves could not be expected to move with complete freedom. Indeed, we know from the experience of the man-made fishes which we call submarines that the ocean of water really does hamper the progress of radio waves.

We forget, however, that all our ordinary broadcasting takes place at the very bottom of another great ocean; the ocean of air that surrounds the earth and in the depths of which we live. The radio waves with which we work do not move in a vacuum or in pure ether. They move in the air. "On the air" and "on the ether" are used popularly as synonymous terms. "Through the air" and "by means of the ether" would be more exact, but, in any case, the air gets into it.

Does this air through which we *must* do our broadcasting affect radio in any way? A year ago most engineers would probably have answered no, except as the upper levels of the atmosphere became involved in the supposed phenomena of the Heaviside Layer.

Now we are far less sure. It appears that the atoms and electrons of the air do have some rather important effects on the propagation of radio waves. Not only is the difference in transmission between day and night now ascribed to effects in which these atoms play a controlling part, but such things as fading, the deviation of the apparent direction of radio waves and other anomalies of transmission are now believed to be affected quite materially by things that happen to the particles of the air.

The work which has led to these ideas began with the attempt to define more

exactly and surely the nature of the famous Heaviside Layer. This layer was supposed, you remember, to consist of a stratum of very thin air, high up above the earth and possessed of a considerable electric conductivity. It acted, the physicists thought, as a sort of mirror for the radio waves, forcing them to travel around the curvature of the earth instead of moving off in straight lines into space.

There were two theories of long-distance radio transmission. One was this Heaviside Layer theory. The other and opposing theory was the Gliding Wave theory. It assumed that the waves traveled along the surface of the ground in much the same way in which the waves of "wired radio" travel along the copper wire that guides them. Arguments between the advocates of these two theories were rife up until about two years ago.*

Gradually it became apparent that both of these theories might be right. A radio wave moving outward from a transmitting antenna seems to be split into at least two parts. One of these parts moves upward into the upper levels of the atmosphere and travels along something, perhaps a Heaviside Layer, which exists there to provide a path for the waves. The other part of the wave moves outward along the surface of the ground (or of the water) just as the Gliding Wave theory assumed that it did. Actual experiments carried out in England on December 11, 1924, and repeated on February 17, 1925, resulted in a virtual proof of this two-path transmission.† Still more convincing evidence was obtained by Mr. Greenleaf W. Pickard and his collaborators in their radio investigations during the eclipse of the sun on January 24, 1925.‡

This idea of two waves helped greatly in explaining some of the phenomena of fading and of daytime absorption but it still left us essentially without an understanding of what actually happened to the upper wave—the one in the supposed Heaviside Layer—or of why the two waves split off from each other and sought their different paths through space. It is in attacking these problems that we come to the effects of the atoms and electrons in the air.

As long ago as 1912 the distinguished English physicist and radio expert, Dr. W. H. Eccles, had suggested that the conductivity of the Heaviside Layer might be caused by "ions" in the upper air. An ion is a particle of matter which carries an electric charge. Most atoms are electrically neutral. But once in a while an atom may pick up an extra electron or may lose one of its own electrons. This gives it a charge; negative in one case, positive in the other. It becomes a negative or a positive *ion*.

Many of these charged ions might exist, Dr. Eccles thought, in the upper part of our atmosphere. Being charged, they might serve to carry electric currents, just as do the similar ions which exist in the solutions used in storage batteries. Thus the Heaviside Layer would be rendered conducting and would have the property of reflecting radio waves. This ionic idea lay, rather vaguely, at the bottom of most of the reasoning about the Heaviside Layer.

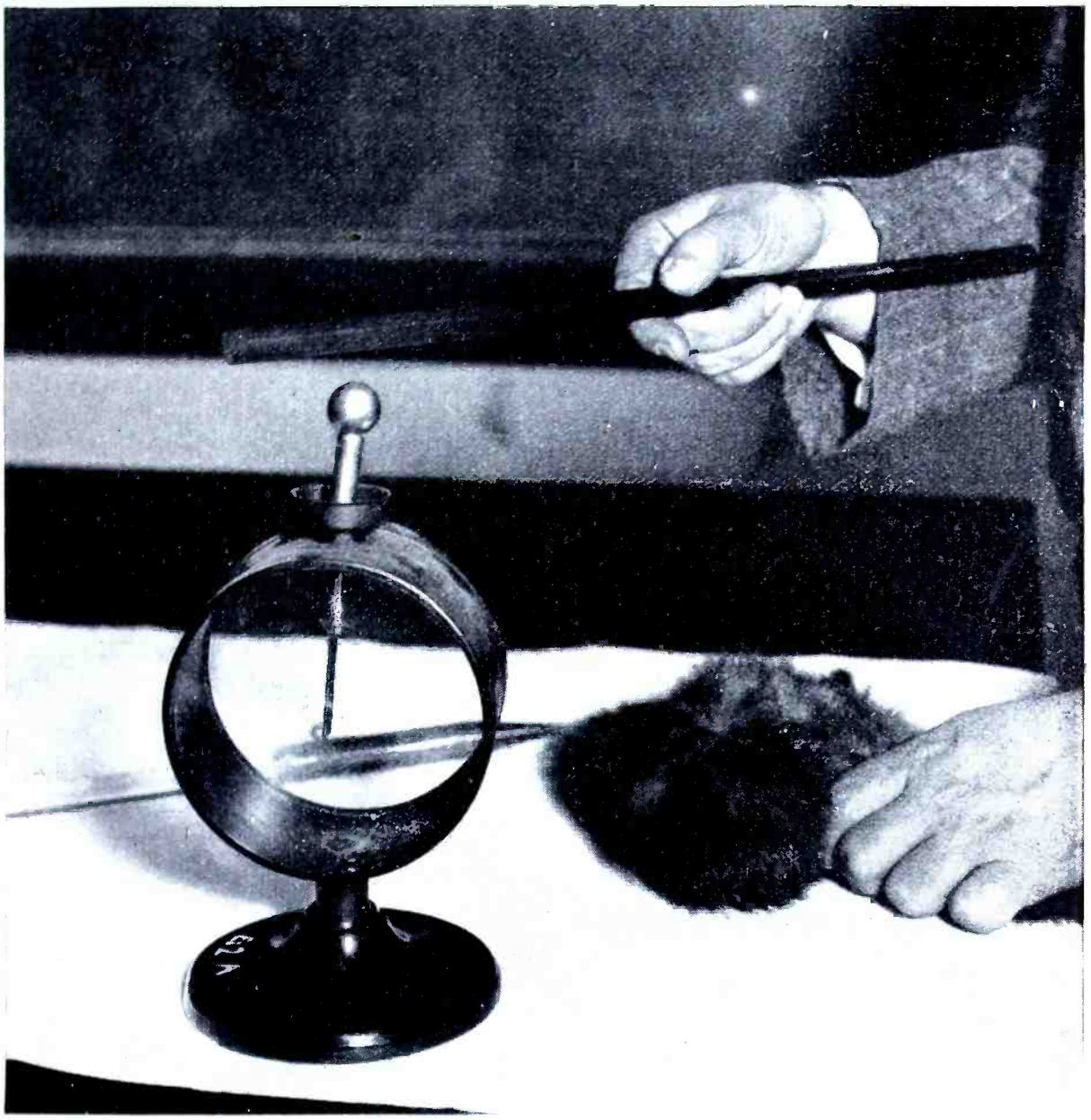
On October 27, 1924, Sir Joseph Larmor, one of England's greatest mathematical physicists, read before the Cambridge Philosophical Society an important contribution to radio theory. He took this vague idea of ions in the upper air and gave it precise and definite meaning. He showed just how these ions would react on the waves and how they could produce the bendings and absorptions of the waves which we know to occur.*

*See the papers by Dr. Elihu Thompson, Sir Oliver Lodge, General George O. Squier and Professor R. A. Fessenden in POPULAR RADIO for December, 1922, and January, March and November, 1923.

†"Local Reflection of Wireless Waves from the Upper Atmosphere," by E. V. Appleton and M. A. F. Barnett. *Nature* (London), vol. 115, pages 333-334 (March 7, 1925).

‡"The Effect of the Solar Eclipse of January 24, 1925, on Radio Reception," by Greenleaf W. Pickard. Read before the Institute of Radio Engineers, New York City, April 1, 1925. To be published in the *Proceedings* of that Institute. See also the summary note in POPULAR RADIO for July 1925, pages 85–86.

*Larmor's paper was published, in abstract, in *Nature* (London), vol. 114, pages 650–651 (November 1, 1924) and in full in the *Philosophical Magazine* (London), vol. 48, pages 1025–1036 (December, 1924).



Brown Brothers

A GOOD DETECTOR OF AIR IONS

The familiar gold leaf electroscope will serve very well to detect ionization in the air. The thin gold leaf, just visible to the left of the downward projection inside the glass case, stands out from the projection because it is repelled by the electric charge. In ionized air the ions rapidly carry this charge away, so that the gold leaf falls against the projection.

To see just why these ideas of ions are so important for radio theory we must examine a little more closely the nature of the air. At the surface of the earth—that is, on the bottom of the air ocean—the air has a pressure of about fourteen and one-half pounds on each square inch of surface.

A cubic foot of air weighs a little over one ounce. Approximately eighty per cent of this air, by volume, consists of nitrogen gas; approximately twenty per cent is oxygen gas. There are very small amounts of other gases; argon, carbon dioxide, hydrogen, helium, neon and others. The atoms of all these gases are relatively free. They move about rapidly in a vast cloud, like a swarm of bees.

As one goes up above the surface of the earth the air becomes thinner and thinner. At a height of seven miles,

which is approximately the record for a man in an airplane, the pressure and density of the air are only about one-fourth of their values on the surface of the earth. At fifteen to twenty miles, which heights have been explored to some slight extent by means of recording instruments sent up on balloons, the density of the air is less than a twentieth of its value at the surface. At a height of fifty miles there is probably only about one one-hundred-thousandth as much air as we are accustomed to. But even up as high as three hundred miles, and possibly even higher, there are still a few scattered atoms of the various gases.

To get an idea of how the air affects radio we must think of it as a vast assemblage of individual atoms. Let us make use once more of the idea of enlargement which is so convenient in thinking about atomic dimensions.

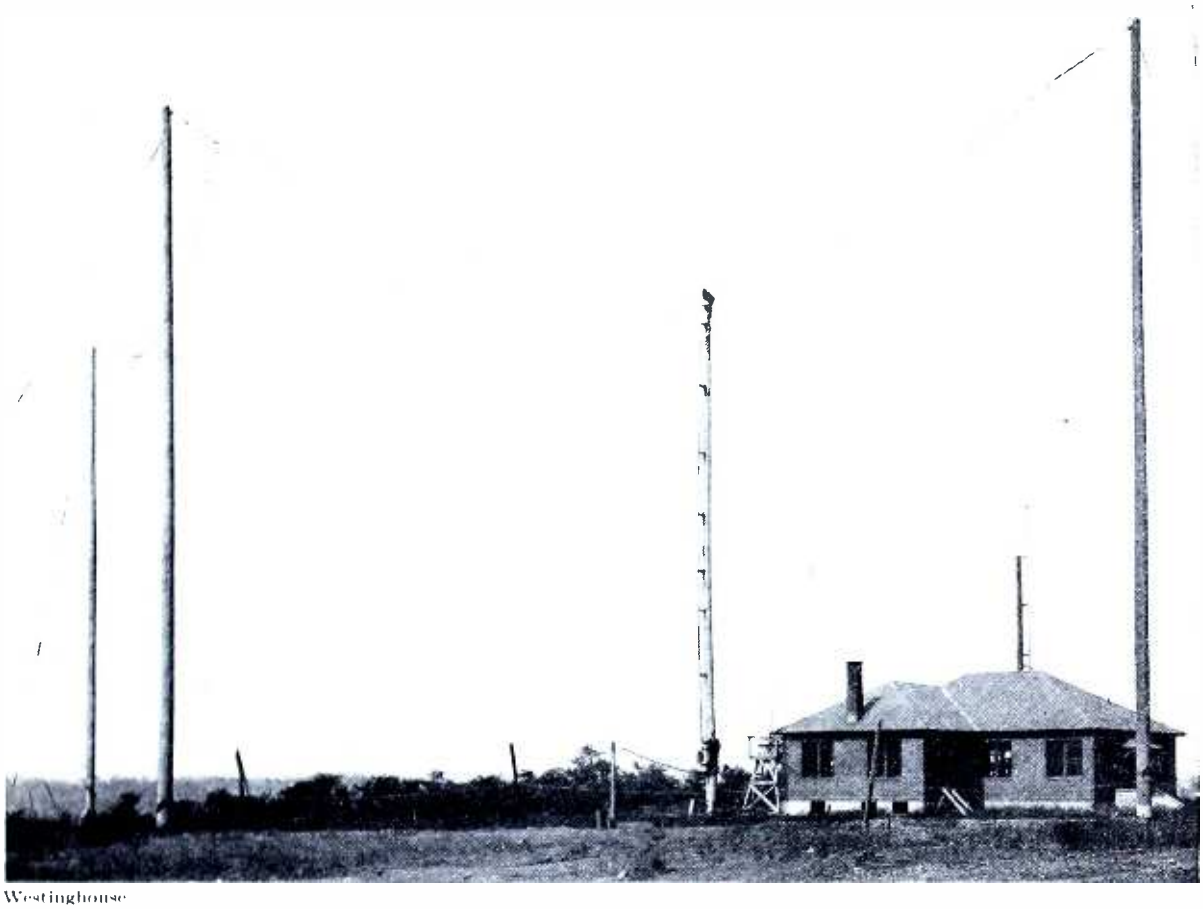
Imagine a cubic inch of air, cut out of the atmosphere somehow and contained in a small glass box. Imagine, now, that some obliging magician enlarges this small block of air for you, atoms and all, until it is a hundred million times as large as in its normal state. The glass box holding the air will now be a little more than fifteen hundred miles square. Set down on the United States it would reach from New York to Denver and from the Canadian boundary to the southern tip of Texas. Of course, it would reach up into the sky the same distance of fifteen hundred miles.

Now suppose you investigate the interior of this swollen cubic inch of air. If your eyes are quick enough you will see the rapidly moving atoms of nitrogen and oxygen and other gases in the air.

Brown Brothers

HOW IONS STOP WAVES

If a water wave entered this mass of floating logs, each log would be swung up and down by the wave. The logs would rub together and thus use up energy. This would absorb the energy of the wave. Just so, the swinging ions in the air may hit together and use up the energy of the radio waves, as is described in this article.



Westinghouse

TWO ANTENNAS FOR TESTS OF WAVE TRANSMISSION

Work with this short-wave experimental station of KDKA, near Pittsburgh, is reported to have led already to significant new data concerning the effect of atmospheric conditions on waves of different wavelengths. The horizontal cages on the tops of the masts constitute one antenna. The other one is the vertical rod visible just beyond the house.

Each of these atoms consists, you remember, of a few electrons revolving around a central nucleus, much as the planets of our solar system revolve around the sun. On the scale of enlargement which we have adopted each of these solar-system groups constituting an oxygen atom will be about one inch across. Each nitrogen atom will be a trifle larger.

All these atomic systems will be flying about inside the glass box very rapidly indeed. They collide with each other every moment. Others collide with the glass walls of the container that holds them. On the average, in our enlarged model of a cubic inch of air, the atoms will be about twenty-three feet apart. Each one will collide with another one many times a second. The average distance of travel of an atom between collisions will be about thirty-three feet.

The number of atoms in even so small a bit of air is almost incomprehensible. In ordinary air some of the atoms are attached to each other, two by two, to form what chemists call molecules. Ignoring this, and counting each such molecule only as a single atom, the number of individual particles in one cubic inch of ordinary air is expressed by the figure 440,000,000,000,000,000,000.

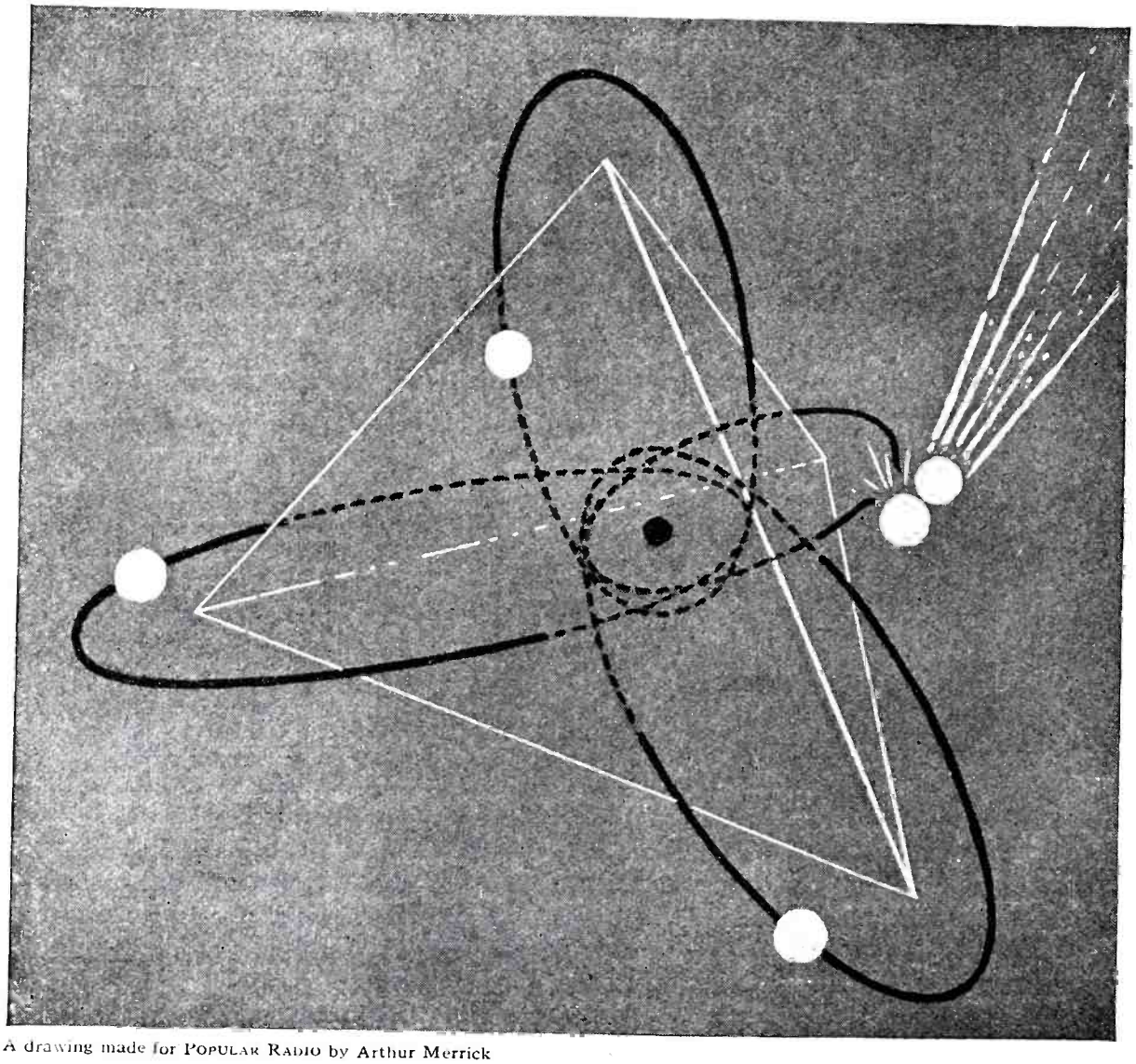
Imagine all of the atoms in our enlarged cubic inch of air piled up on the ground, like billiard balls. They would cover the whole United States to a depth of nearly three hundred feet. Even if the atoms were only as large as peas, there would be enough of them to cover our country up to the chin of a moderately tall man.

All this applies to a cubic inch of air at

the earth's surface. As one goes up higher and higher in the atmosphere the atoms remain individually of the same size but the number of them in a cubic inch decreases greatly. At a height of fifty miles, which is about where the chief radio phenomena probably occur, the number of atoms (or molecules) in a cubic inch is probably about 1,000,000,000,000,000,000; still a very large number but vastly less than are present in one cubic inch of air near the ground. On the same scale of enlargement which we have been using, the one-inch atoms of this upper air would be, on the average, about two thousand feet apart instead of twenty-three feet apart. At higher levels the atoms would be scarcer still.

But our interest is not so much in the ordinary air atoms as it is in the few of them which are electrically charged or "ionized." Sir Joseph Larmor estimated that at a height of fifty miles there might be one charged atom—one "ion"—for each 100,000,000,000,000 neutral atoms. There are also a few free electrons, electrons that are flying about by themselves without being attached to atoms at all.

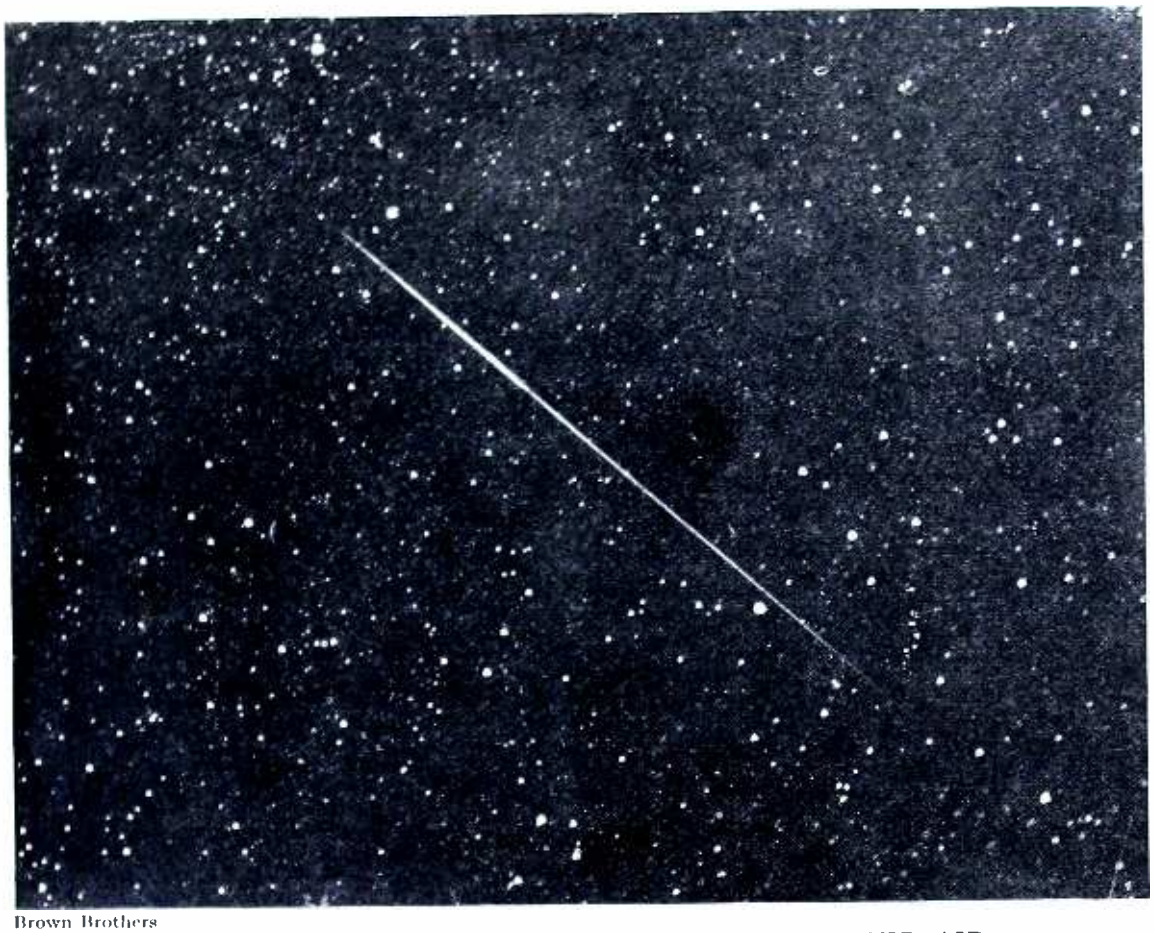
It is these charged ions and free elec-



A drawing made for POPULAR RADIO by Arthur Merrick

ONE WAY TO CONVERT AN ATOM INTO AN ION

This diagram shows how a speeding electron may hit an atom of carbon and knock out one of the atomic electrons. This atom, then, minus one of its full complement of electrons, will be an ion. It will have a positive charge, the charge on the atomic nucleus being no longer neutralized in full by the outer electrons.



Brown Brothers

SHOOTING STARS TELL MUCH ABOUT THE UPPER AIR

This picture shows the track of a shooting star that happened to cross the field of the telescope while a star field was being photographed. Shooting stars are small solid bodies that encounter the earth and are heated by friction with the air. Observations of them have proved that there is still some air as high as three hundred miles above the earth.

trons which effect the radio waves.

A radio wave represents electric and magnetic force. If it hits against a charged particle, such as an ion or an electron, the wave tends to make the particle move. A single ion or a single electron is swung backward and forward by the wave in exact time with the frequency of the wave.

A five-hundred meter wave, for example, has a frequency of 600 kilocycles, which means 600,000 alternations of force each second. Such a wave will swing an ion back and forth 600,000 times a second. It is much as though a water wave on the ocean came along and swung a floating stick upward and downward in time with the successive crests and troughs of the wave.

But the important thing about this is that the swing of the ion in time with the wave may have a reaction on the wave itself. To lift and drop the floating stick on the ocean may absorb some energy. That may take away a little of the energy of the water wave. Similarly, if the ions or electrons in the air absorb some of the energy of the radio wave that may slow up the wave or deplete its energy.

There is at least one way in which this really does happen when radio waves traverse the air. This is by collision of the swinging ions with other ions or with ordinary uncharged atoms. Such collisions absorb energy. The energy must come from the thing which started the swings, namely from the radio wave. In the lower part of the air the atoms are very close together. An ion, swinging in response to a passing radio wave, is practically sure to hit many other atoms

during even a single back-and-forth swing. That is why the absorption of energy from radio waves is so great in the lower part of the atmosphere. The wave is wasting its energy in bumping the swinging ions against the neutral atoms of the air.

In the upper part of the air the ions and atoms are much farther apart. When the ions swing in response to a passing wave they have a much lesser chance of hitting something and losing energy. Accordingly the loss of wave strength by such ionic absorption is much less. At a high enough level it is virtually zero.

This matter of energy absorption is but one of the effects of air particles on the wave. In the higher parts of the atmosphere, where the Heaviside Layer is supposed to be, free electrons are supposed to be even more effective than the ions. These electrons may actually assist the passage of the wave. They can make it move faster. That is one reason why the wave is bent around to follow the curvature of the earth.

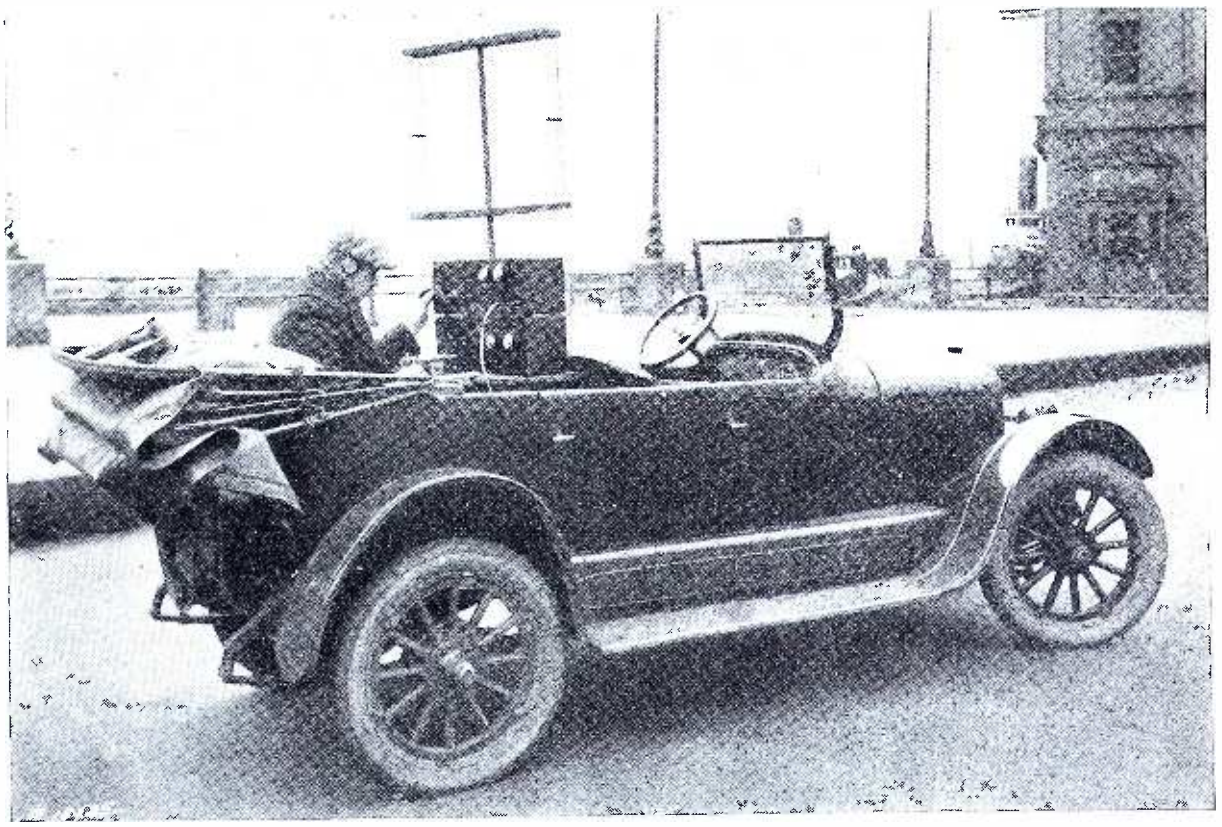
Other effects of the swinging ions and electrons are due to the reaction between the particles and the magnetic field of the earth. Like all moving electric charges, an electron which is set swinging by a radio wave will be affected by any magnetic field. It is swinging in just such a field, the field due to the earth's magnetism. Two American physicists, Drs. H. W. Nichols and J. C. Schelleng, have calculated some of the effects of this terrestrial magnetic field on the vibrating electrons of the upper air and, through them, on the propagation of radio waves.* It appears that the effects are considerable; amounting, on certain probable assumptions, to a sufficient cause of fading, as well as an explanation of some of the mysterious alterations of direction which radio waves so frequently exhibit when they have travelled considerable distances. There is a probability, also, that a magnetic effect is the chief factor in dividing the original wave into the two or more parts which follow different paths.

Further complexities are introduced by the fact that both the magnetic field of the earth and the number of ions in a cubic inch of air may vary from hour to hour. For example, sunlight increases the number of ions. That is probably why radio transmission is better at night than in the daytime. When these new ideas of the reactions between radio waves and the charged particles in the air shall have been worked out in detail we will be able it is already evident, to understand the day-by-day vagaries of radio much more completely than ever before.

*This work will be described in detail by Drs. Nichols and Schelleng in an article in an early issue of POPULAR RADIO. The mathematical theory has been set forth in "Propagation of Electric Waves Over the Earth," by Nichols and Schelleng. *Bell System Technical Journal* (New York), vol. 4, pages 215–234 (April, 1925).

The Effect of Earth Magnetism on Radio Waves

IT *is now believed that the magnetic field of the earth—the same field which keeps the magnetic compass pointing toward the North—has marked effects on the ions and electrons of the air, and through them on the propagation of radio waves. This theory has been worked out by Dr. H. W. Nichols and Dr. J. C. Schelleng, who will themselves describe their conclusions in an important article in the next issue of* POPULAR RADIO.



A. T. & T. Co.

THE MOBILE RECEIVING SET USED IN THE TESTS

In order to determine the electromagnetic field strength at various places around a city, measurements are taken in small areas. This data is then plotted on a map of the city which will show approximately where the good locations for transmitting and receiving are.

HOW RADIO DEAD-SPOTS ARE FOUND BY

A Wandering Broadcasting Station

Recent tests that are of great value to the radio fan in improving reception in places where receiving is difficult or at some seasons almost impossible.

By J. O. PERRINE

RAPID fading of radio signals, differences in day and night transmission and geographical distribution, are peculiarities of radio transmission known to almost every enthusiast.

"Just how are radio waves distributed about a broadcasting station" is often a topic of discussion among the radio fans.

All of these questions are receiving effective answers through extensive ether surveys.*

For the past three years radio transmission and distribution measurements have been made in three fields, trans-oceanic, ship-to-shore and broadcasting.

In POPULAR RADIO of March, 1924 the diurnal and seasonal variations of signal intensity and noise revealed by transatlantic tests were reported. The present article is concerned with the distribution over city districts of radio waves from broadcasting stations.

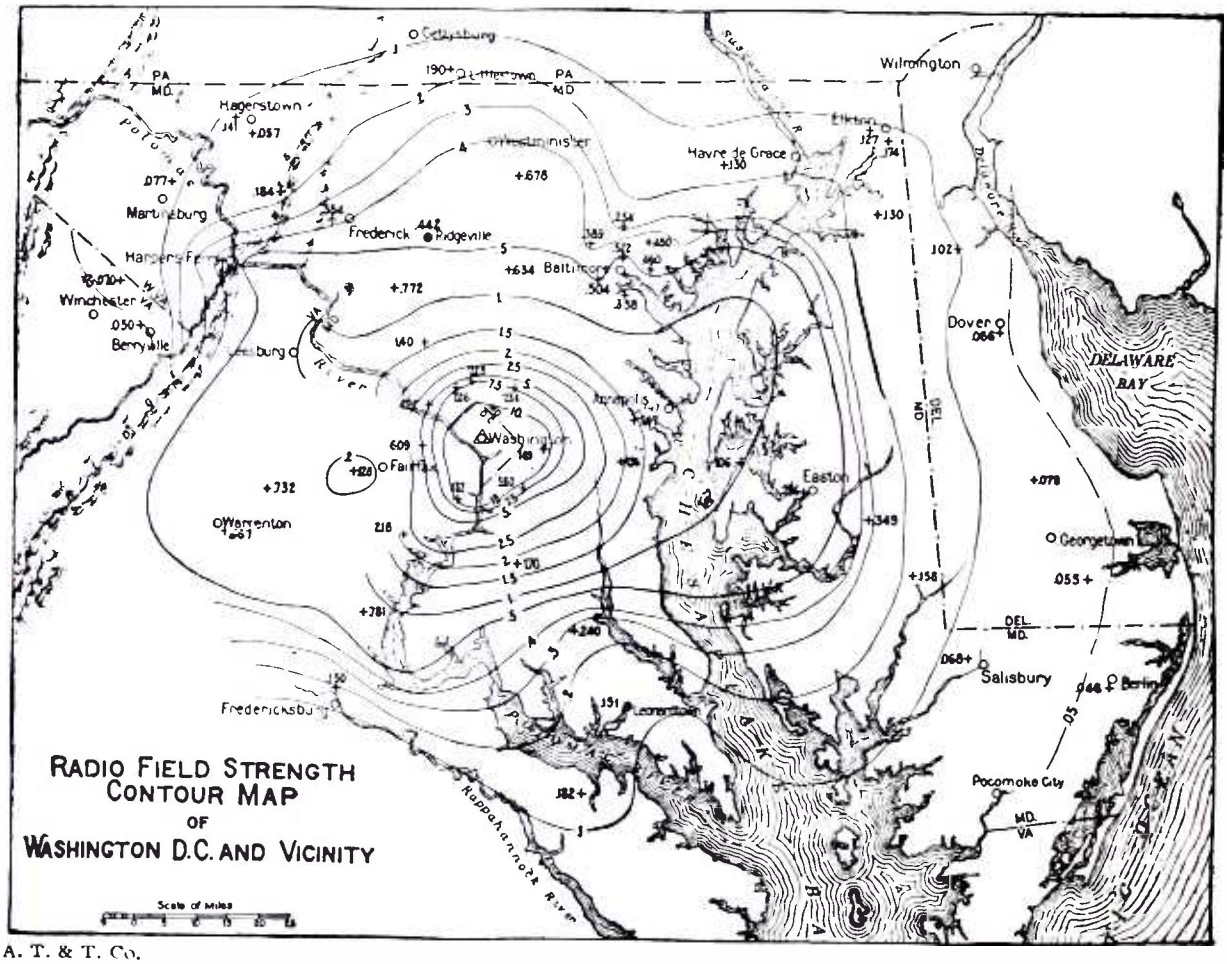
All of the work of radio transmission measurement has been made possible by the design of practical and portable ap-

* Carried on by the engineers of the American Telephone and Telegraph Company and the Bell Telephone Laboratories.

paratus by means of which the intensity of received signals can be accurately measured. The receiving set is provided with a carefully shielded local oscillator associated with the loop antenna, through a calibrated potentiometer. This system makes it possible to compare the received antenna current with similar current from the local oscillator and by calculation obtain the value of field strength in microvolts per meter; field strength being a measure of signal power. The comparisons are made through the agency of a micro ammeter at the output of the receiving set, and by this method the human ear is entirely eliminated in the actual recording of data.

Using this specially designed receiving set, mounted in an automobile, it was possible to take measurements for many points in all directions and at distances varying from a few blocks to about 50 miles in the territory surrounding Station 2XY, 24 Walker St., New York City, and Station WCAP, 725 13th St., N. W., Washington, D. C. The points at which the field strength was the same were spotted on a map or airplane picture and connected by a line; "signal contour lines" they might be called.

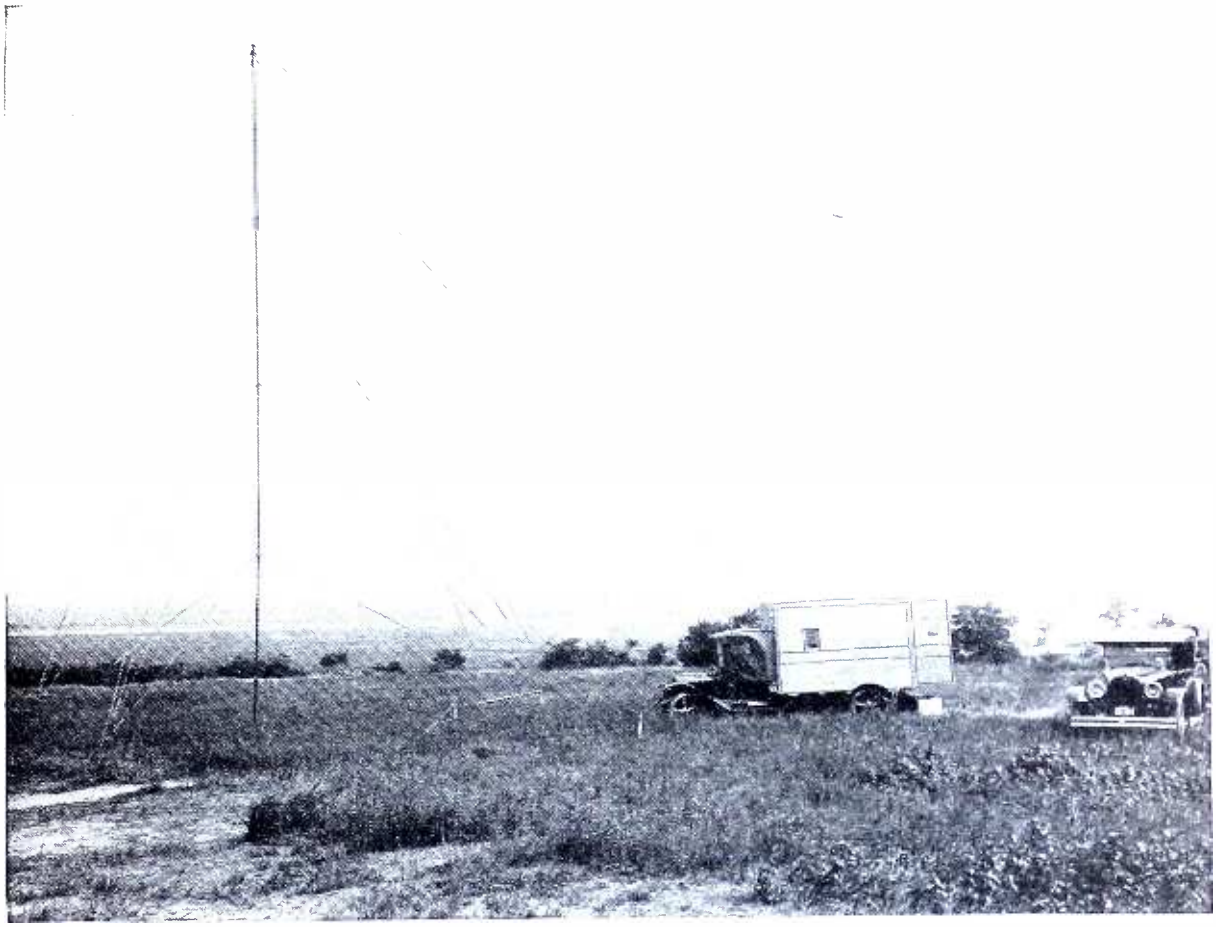
The size and location of dead spots, indicated in the accompanying chart by the closed curves, and the manner in which field strengths decrease in different directions, were disclosed. In regions where the contour lines are close together, the signal intensity is decreasing



A. T. & T. Co.

HOW THE RADIO FIELD STRENGTH AROUND WASHINGTON IS PICTURED

The distortion is less marked around the transmitting station than in New York. The effect of Chesapeake Bay to the north and south is noticeable. At locations five miles away from station WCAP, a difference of one mile makes a difference of two units of field strength. At places 50 miles away, a difference of five miles makes a difference in field strength of only one unit.



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THE "GYPSY" STATION 2XBE

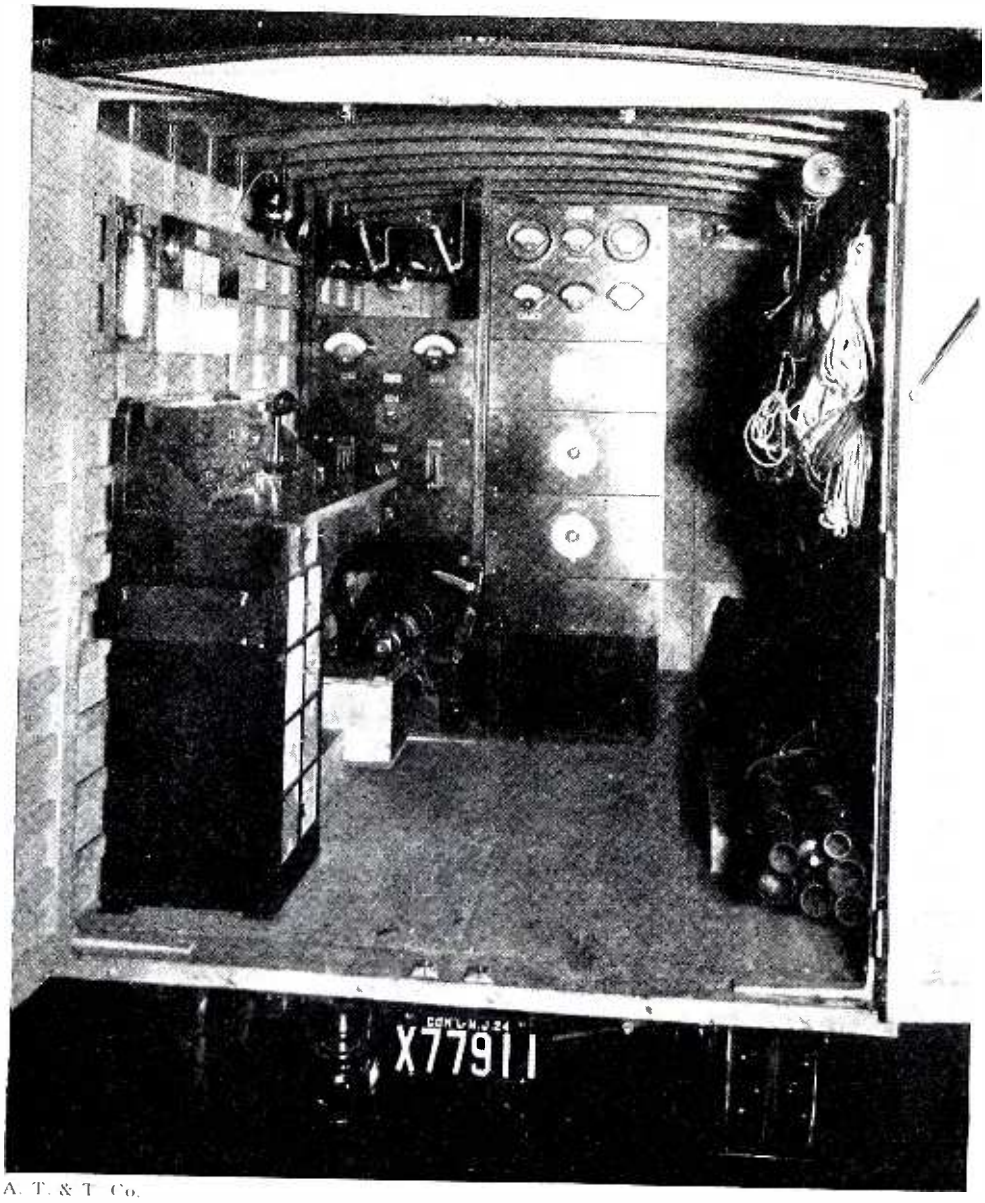
This picture shows the truck that carries the 500-watt transmitter. Alongside it is the portable antenna from which test signals are sent that tell the engineers at the receiving end the quality of the location for transmitting.

rapidly with the increased distance. An inspection of the accompanying chart will also show that at distances close to the broadcasting station one may expect signal intensity to decrease much more rapidly with distance than at great distances away. In this way, the chaotic array of qualitative impressions about radio wave distribution have been replaced by actual quantitative measurements.

Aside from the general interest derived from an examination of the curves, they also make possible some analysis of radio transmission problems.

If the surface of the earth were flat and of uniform electrical characteristics, the decrease in signal intensity, due to the spreading out of the waves and the absorption of the waves by the earth and the atmosphere, might be expressed in simple mathematical form. The many widely varying factors revealed by the great irregularity of the contour lines make it appear that a transmission formula cannot be readily set up to properly account for all of them. However, through charts and data presented in this article the reader can obtain a good picture of how water, dry land, hills, valleys and steel buildings affect radio transmission and gain insight into the allowances which radio engineers must make in their problems. The work of Messrs. Bown and Gillett here being reported disclosed the following salient points:

First: The radio attenuation over different kinds of earth surface vary widely. It is low for sea water and for flat, moist ground. For



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THE INTERIOR OF THE TRUCK

On the right, hanging from the side of the truck, are the wires and guys for the antenna, and below them is the collapsible antenna mast. On the left is the radio-telephone transmitter, the generator and the control panels.

dry ground the attenuation is relatively much greater. In the case of closely built cities filled with steel buildings, the local attenuation may be enormous.

Second: Sudden changes in land elevation and large masses of conducting material cast radio shadows which may be very heavy in extreme cases.

Third: Shadows cause local dead spots; but usually within a relatively short distance beyond the shadow is wiped out by refraction or diffraction.

It can be appropriately pointed out at this point that in the results enumerated above, the diminution of signal intensity results almost entirely by obstructions of various sorts on the surface of the earth and not from changes in atmospheric condition. A fraction of the radiated energy is subtracted from the outgoing waves on account of the variable character of the earth's surface. This energy is transformed into heat and therefore is lost to radio uses. Hence the topographical character of the earth's surface, together with the presence of man-made buildings, are the main factors concerned. Differences in day and night transmission are not outstanding for a resident

or near-resident of New York City; actual geographical location is a point of more importance.

Ship-to-shore tests have shown that the absorbing effect of sea water remains quite constant. The great differences experienced in this case are due to wide differences in atmospheric absorption during the day and night. On some occasions it requires 10,000 times more power to "get through" as well during the worst day as during the best night.

If the decrease in signal power resulted only from the fact that the waves spread out in continuously enlarging hemispheres with no absorption effects operative, then "the inversely as the square of the distance law" would apply. Records show that during the best night conditions the signal power on some occasions seems to follow the inverse square law. Provided no directive effects were present, this might be interpreted as meaning that on these occasions both the water surface and the atmosphere were non-absorbing.

It was early recognized that the best and most comprehensive understanding of radio wave distribution, as far as broadcasting is concerned, would be obtained by making the transmitting station portable as well as the receiving station. Consequently telephone engineers have designed a traveling transmitting station. This has been constructed by the Western Electric Company, using a White truck as the conveyor. The truck is of a special type used extensively in telephone work for pulling cables through underground conduits and through the long chains of supporting rings used for aerial cable suspension.

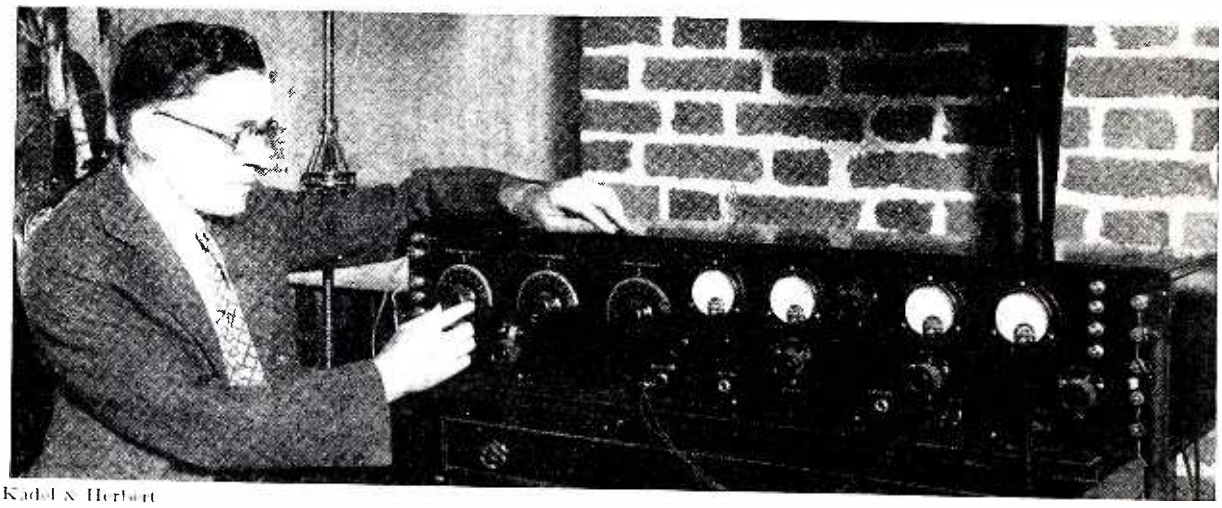
The mobile transmitter is rated at 500 watts output and employs vacuum tubes using a plate potential of 1,500 volts. One of the accompanying photographs shows the interior of the truck with the panels of the transmitting set, and on the left hand the receiving set. Government regulations require that every coastal transmitting station be equipped for listening on 600 meters, the wavelength at which ship distress signals are generally sent out. In operating this portable transmitting station, it is customary to listen continuously on 600 meters, since the messages from the truck are sent out on another wavelength.

This traveling transmitting station is known as 2XBE and undoubtedly many of the radio audience in the past have heard these call letters on the air. If so, they will understand that telephone engineers are on the job seeking to achieve their objective; to eliminate dead spots and to enable each individual in the radio audience to receive broadcast programs under the best possible conditions of clearness and loudness.

It is thinkable that to obtain a more complete picture of radio transmission, signal intensity measurements might be taken in more than one plane. In addition to obtaining contour lines for the earth's surface, lines in planes parallel and perpendicular thereto might give valuable information. In this study the airplane and dirigible might be effectively used. By having a great airship circle over a broadcasting station at varying heights and distances, additional experimental data of great importance would perhaps be made available. If measurements for high altitudes were thus obtained, one might be better able to discuss the existence of the so-called Heaviside layer, that electrically conducting sheet of rarefied air supposed to exist above the earth's surface.

How to Eliminate the "B" Battery

In a near future issue of POPULAR RADIO *will appear a constructional article of widespread value to broadcast listeners, that represents the latest product of the* POPULAR RADIO LABORATORY.



Kadel & Herbert

THE OPERATOR SHOULD KNOW WHAT EACH ADJUSTMENT MEANS
When tuning a more complicated type of receiver, it is essential that the operator knows what happens with each adjustment and just what each one is for; otherwise he cannot obtain the best results.

When You Turn Your Dials

Few broadcast listeners actually know what is going on inside their radio receivers when they "twist the knobs." This article tells them just what happens. An understanding of these details will help *you* to tune in!

By JACQUES AVON

IT is one thing idly to turn a knob on a receiving set and another thing to tune a receiving set in a practical, scientific manner.

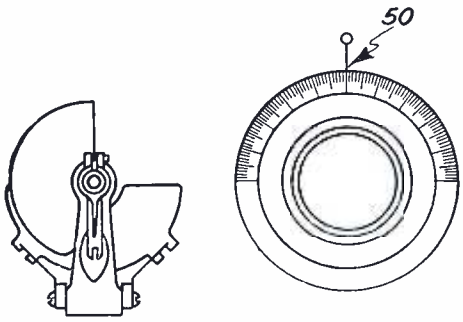
To some radio fans "knobs" are simply wheels to be turned when one wishes to listen to a broadcasting station, and they depend largely upon the "Be-Gosh-and-Be-Gad" principle of bringing about the desired results.

A tuning knob is more than a mere handle. It is a key with which we are enabled to open up the doors of the wavelength channels which we may want to use. Some fans think that the numbers on a dial are placed there to aid their memory. Perhaps they are—but this is not the only function they have.

Before we can hope to tune a radio set the way it should be tuned, it is necessary to understand thoroughly what happens when we do turn a knob. We must know what is going on behind the scenes. Secondly we must know that the knobs are set upon their shafts in such a way that we are informed of the exact position of the instruments (to which they are attached) when a particular portion of the scale is reached.

The first device to consider is, perhaps, the variable condenser, as this is by far the simplest.

Most of us know that a variable condenser is at maximum capacity when all of its plates are interleaved, when the movable plates are entirely sandwiched between the stationary plates. When setting the knob initially on the shaft, the condenser should be brought to maximum capacity as just described.



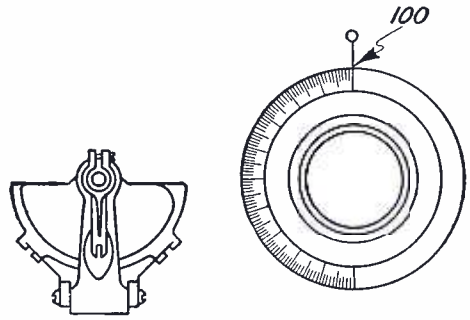
THE DIAL SETTING OF A CONDENSER

FIGURE 1: *The dial and the condenser (at the left of the above diagram) show the relation between a dial setting of 50 and the position of the rotor plates of a variable condenser. In this position they are half-way meshed. At the right the corresponding setting of the rotor plates is shown as fully meshed with a dial setting of 100.*

Then the dial is moved to a point where the 100 mark will be directly opposite the adjusting line marked on the panel. As the knob is turned away from this position down the scale until 50 is reached the condenser plates will be half-way interleaved. But, of course, this does not mean that the condenser is at exactly half capacity. This will depend upon the capacity curve of the particular condenser used. However, if a curve is supplied with the condenser (and some manufacturers are willing to do this) the dial attached to the knob can be calibrated so as to give an accurate indication of the capacity of the condenser, in micro-microfarads, at any point.

The radio fan, who wants to create a professional appearance while he is working over his set in the presence of friends, should never be seen turning his dials around onto the unmarked portion of the dial beyond the 100 mark.

This is ridiculous from the standpoint of the radio expert. When we reach the unmarked edge of the dial we are going through the same cycle of operations that we go through on the marked half, save that in the latter case we have little or no notion as to the relative positions of the plates of the condenser at any particular setting of the dial. As a condenser can be brought from maximum to



MAXIMUM INDUCTANCE

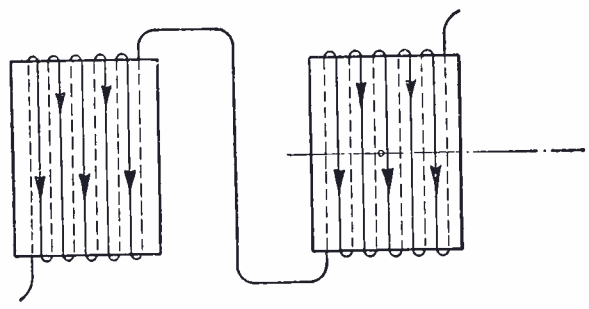


FIGURE 2A: *The two coils of the variometer when turned at 100 on the dial have a maximum inductance.*

INDUCTANCE AT HALF VALUE

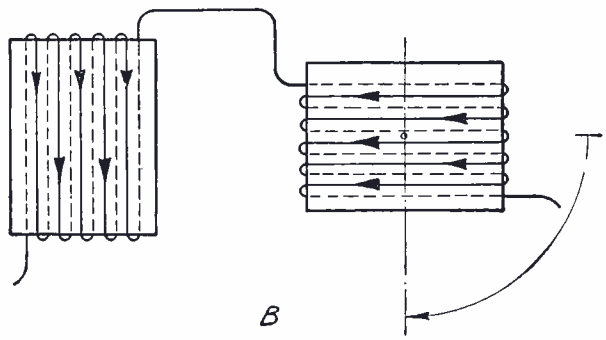


FIGURE 2B: *When the rotating coil is at right angles at a corresponding dial setting of 50, the inductance is a medium value.*

MINIMUM INDUCTANCE

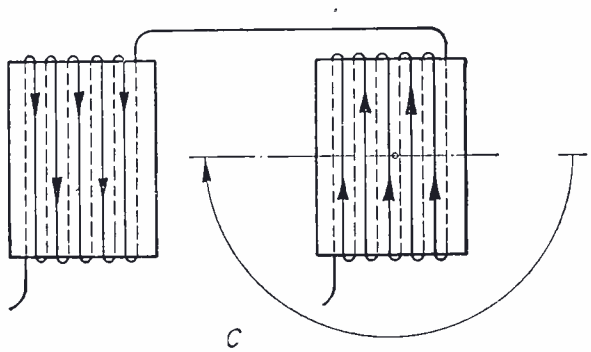
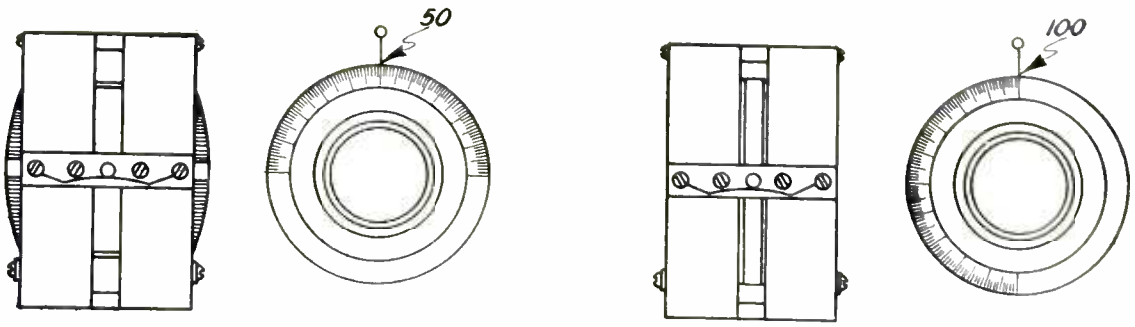


FIGURE 2C: *When the dial setting is at zero, the two coils oppose each other and the inductance is a minimum.*



THE DIAL SETTING OF A VARIOMETER

FIGURE 3: *This diagram shows (at the left) the corresponding settings for the variometer as shown in Figures 2B and 2A respectively.*

minimum capacity within the marked space of the dial, it is unnecessary to go between the 0 and 100 limits on the unmarked portion of the dial.

The second instrument of importance, that is usually controlled by a knob and dial, is the variometer.

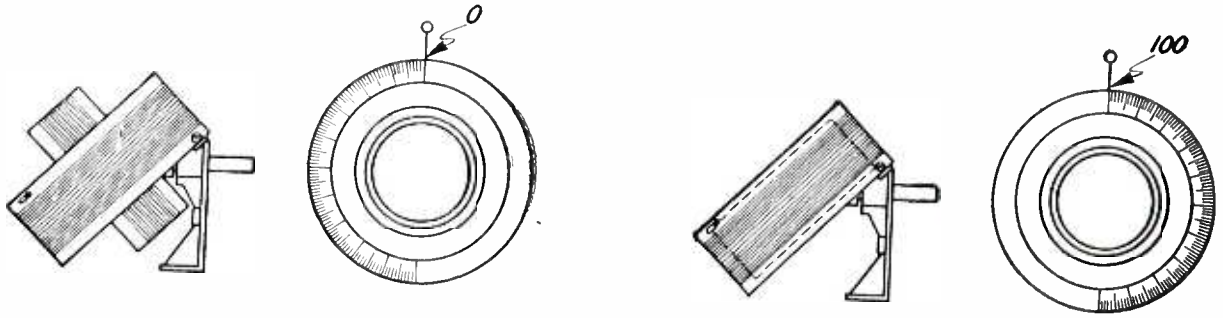
Here we are confronted with a problem essentialy different from that of the condenser, for we are controlling the second property of an electric circuit, inductance.

Inductance is, of course, controlled by several different instruments, but the variometer is one of the most important, for the adjustment obtained by means of this instrument is continuously variable.

The operation of the variometer will be better understood by reference to Figure 2. If we have two coils of wire wound in the same direction maximum inductance will be obtained when they are placed in inductive relation in the position shown at A. If, however, one coil is rotated on its axis until it has passed through 180 degrees corresponding to the 100 mark on the dial, two coils will present little or no inductance, providing they are close enough to each other to bring about an inductive relationship. Any position between these two extremes will result in placing a certain amount of inductance in the circuit.

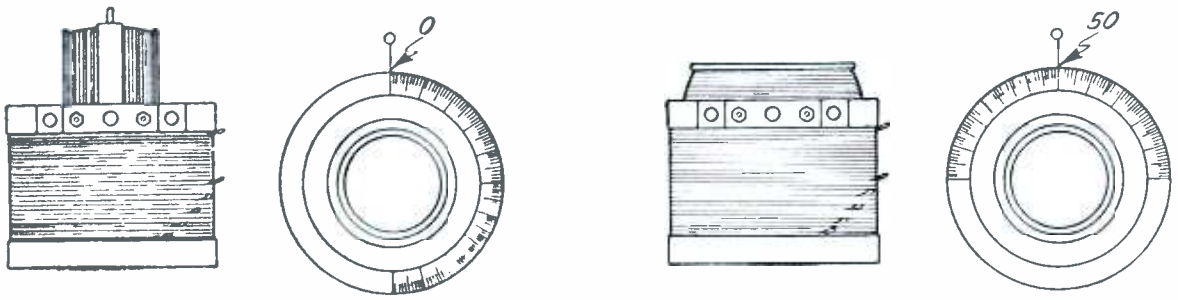
Unlike some of the other instruments used in radio, the variometer may be rotated in either direction with the result that the same increase or decrease in inductive relationship between the coils is obtained.

From the diagram it will be seen that what we actually do when we rotate one of the coils through 180 degrees is to change the direction of the current flowing through it. Hence, if there is exactly the same amount of wire in each coil—the stationary and the movable one



THE DIAL SETTING OF A VARIOCOUPLER

FIGURE 4: *At the left, corresponding to a dial setting of zero, the secondary coil (or tickler) is at right angles to the primary coil that gives minimum coupling. At the right is shown a dial setting of 100 with both coils in inductive relation whereby maximum coupling is obtained. This is true only of the 180 degree variocoupler.*



THE DIAL SETTING IN RELATION TO THE 90 DEGREE VARIOCOUPLER

FIGURE 5: *At the left is shown the position of the rotor for a dial setting of zero; this gives minimum coupling between the two coils. With this type of coupling the maximum inductive relation is obtained when the dial is set at 50. If it were revolved to 100 the minimum coupling would be again obtained.*

—the two coils will theoretically represent no inductance when they are entirely opposed to each other,* while their inductances will be added when the current is flowing through them in the same direction. To set the dial properly, we first turn the variometer to a position of maximum inductance. This can be determined by tracing the coil connections through to see that the current is flowing in one direction. Otherwise one will have to guess which position to set the dial in. When this point is reached, the dial is put on the shaft so that its 100 degree mark will be at the line on the panel. With this arrangement a 50 setting of the dial will represent approximately 50 percent of the total inductance of the coils.

*Actually there will be some slight inductance left, as the coupling never is close enough to produce zero inductance.

STATION	CONDENSER	VARIOMETER	CONDENSER
WDBX	15	19	33
WFBH	26	32	42
KDKA	33	41	48
WAHG	34	43	49
WBZ	37	46	51
WHN	42	52	55
WGY	45	56	58
WOR	49	61	61
WJZ	57	67	70
WEAF	62	72	77
WNYC	67	76	84
KSD	69	78	87

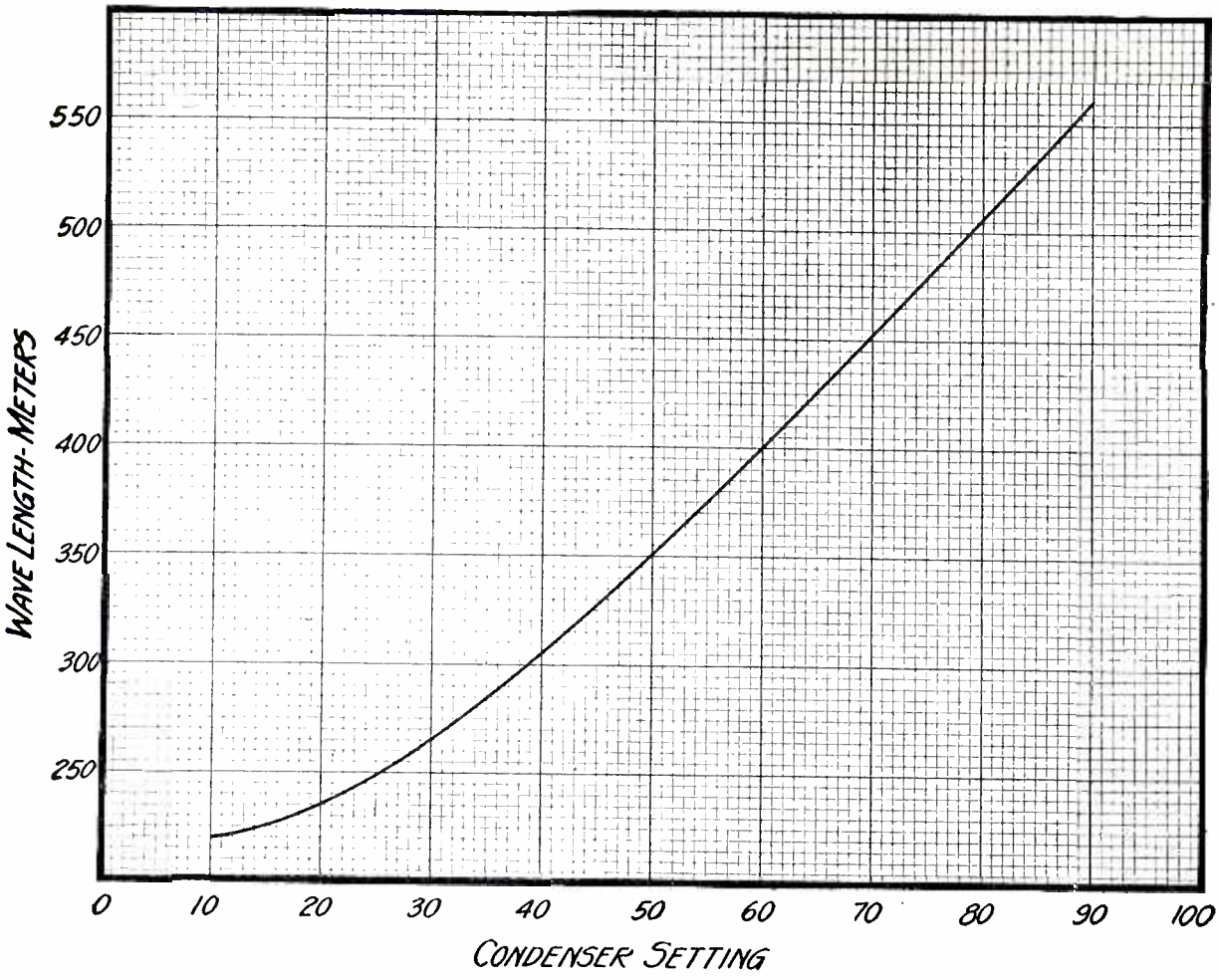
A GOOD TYPE OF TUNING LOG FOR EVERY SET-OWNER TO KEEP

FIGURE 6: *This table shows a sample log for making a record of the settings of the instruments for given stations so that they may be readily found again.*

The 180-degree coupler operates in a fashion similar to that of the ordinary variocoupler. That is, minimum coupling will be obtained when the coils are at right angles to each other. We can understand this relationship when we recall that we get maximum magnetic-coupling between two coils carrying electric currents when their axes are in line with each other. If we place them at right angles to each other the coupling is reduced to a minimum because their electromagnetic fields are at right angles. When the 180-degree variocoupler is brought to the position indicated in Figure 4, the dial is set at zero degrees indicating minimum coupling. From this point there will be a gradual increase in coupling to a maximum as the dial is slowly turned to 100.

The next instrument of importance, that is controlled by the motion of a dial, is the type of variocoupler illustrated in Figure 5.

Here we have an ordinary coil of wire with a rotatable member that carries another coil arranged near it. This variocoupler, although mechanically different from the variocoupler previously described, is closely related to it and operates on the same principle. However, the rotor operates through an angle of only 90 degrees if it is provided with a stop (which it should be, for there



A SAMPLE TUNING CURVE FOR A RECEIVER

FIGURE 7: *This chart shows how a single-control receiver might be charted to enable the setting of the tuning dial for any given wavelength. For instance, the setting for the wavelength of 350 meters, which is shown at the left-hand vertical scale, would correspond to 50 on the condenser dial. A wavelength of 450 meters would correspond to a dial setting of approximately 70. A glance at this chart will reveal the method employed.*

is no practical reason why it should be allowed to turn in a complete circle).

When the rotor is in such position that its sides are horizontal there is maximum inductive coupling between it and the primary coil. With this data available the fan should have no trouble in setting his dial in such a way as to have an approximate idea of the coupling in the circuit when the dial is at any one particular position. The only difference between these two types is that the first type takes one-half revolution of the dial to go from minimum to maximum coupling while the latter type takes only one-quarter revolution.

The matter of knobs, for rheostats, is also important. Too many radio fans have the mistaken idea that no vacuum tube is operating at maximum efficiency unless the filament is at full brightness. Some of them seem to think that a vacuum tube is an electric light. This idea leads to distorted reception, general circuit troubles and a heavy drain on the pocketbook for "A" and "B" batteries and for burned out vacuum tubes. Nor should one attempt to regulate the current passing through the vacuum tube by depending upon the brightness of the filament as an indication. Visual indications of this nature cannot be relied upon, nor can one return to that particular position on the rheostat where best

results are obtained by merely trying to bring the filament to a certain point of incandescence. It is much better to use a small ammeter which will tell how much current the filaments are passing, or a voltmeter which will tell the proper voltage across the filaments.

With so many broadcasting stations in operation, it is difficult to remember the tuning dial settings for each one unless one has an exceptionally good memory. Of course, it is possible to make up a chart like the one shown in Figure 6. Reference to this chart any moment will show just where the station can be found on the tuning apparatus dials. This saves time and trouble, and if the condensers have verniers such an approximate setting will nearly always bring the desired results.

One exceptionally clever method of tuning is that which uses a curve similar to that shown in Figure 7. This result can be obtained by so arranging the constants of the coils and capacities that the two tuning condensers have the same setting for any particular wavelength. Of course, the condensers could be mounted on the same shaft with a single knob, which would bring about the same results. It will be seen, however, that it would be practically impossible to bring about this result unless both the condensers were working in unison in this fashion. It will be a simple matter to use this type of chart with some of the simplified single-control sets that are now coming into general use.

RADIO PLAYS A PART IN A BALLOON RACE

When these two aeronauts set forth from St. Joseph, Mo., on May 1 in the Army balloon S-14, they carried radio receiving sets with them—largely in order to obtain advance information about weather conditions.

The MEN WHO

9th Installment

The Scientist Who Added a "C" Battery to the Receiving Circuit

ONE of the men responsible for the radio successes of the United States Navy was FRITZ LOWENSTEIN. *He studied, especially, the effects of controlling the grid potential by a biasing voltage. One of his inventions is that of adding a "C" battery to the receiving circuit.*

International

An Authority on the Radio Control of Machinery

JOHN HAYS HAMMOND, JR., *son of the distinguished engineer of the same name, has devoted his active life to radio experimentation. In his private laboratory at Gloucester, Mass., he perfected, before the war, devices for the control of unmanned ships, torpedoes and other craft by radio signals. Mr. Hammond is the inventor, also, of the system of preventing radio interference by means of double modulation—a system now in use by the Radio Corporation of America.*

General Electric

The Inventor of the Langmuir Vacuum Pump

DR. IRVING LANGMUIR, *distinguished physicist and research worker in the Schenectady laboratories of the General Electric Company, is known in radio for his work on the space charge inside vacuum tubes and for his perfection of the thoriated filament, which filament has a much greater electron emission than can be obtained with ordinary tungsten wire. Dr. Langmuir is also the inventor of the Langmuir mercury-vapor pump, a device for attaining very high degrees of vacuum in vacuum tubes or other apparatus.*

MADE RADIO

The Creator of the Grimes Inverse Duplex System

DAVID GRIMES *is the inventor of the "inverse" method of employing the reflex principle, of which the well-known "Grimes inverse duplex" circuit is an illustration. By this principle the one of a succession of amplifier tubes which has the smallest radio-frequency load is made to carry the largest audio-frequency load, thus equalizing the work of the tubes.*

The First Scientist to Send Pictures by Radio

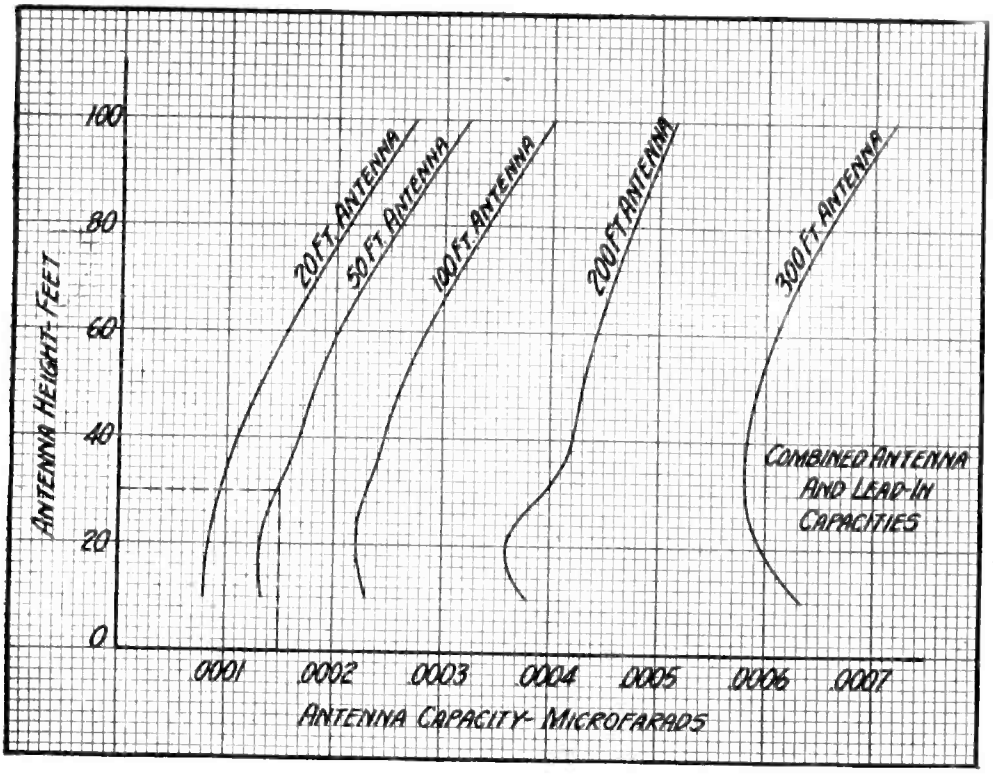
From a photograph made for POPULAR RADIO

IN *inventive circles* C. FRANCIS JENKINS *is known as the man who perfected the first adequate motion-picture projector as well as many other inventions. Turning his attention to radio, Mr. Jenkins devised the first successful apparatus for transmitting pictures by radio. He is now at work on the problem of the radio transmission of motion pictures, a step toward radiovision.*

The Inventor of the Reinartz Receiver

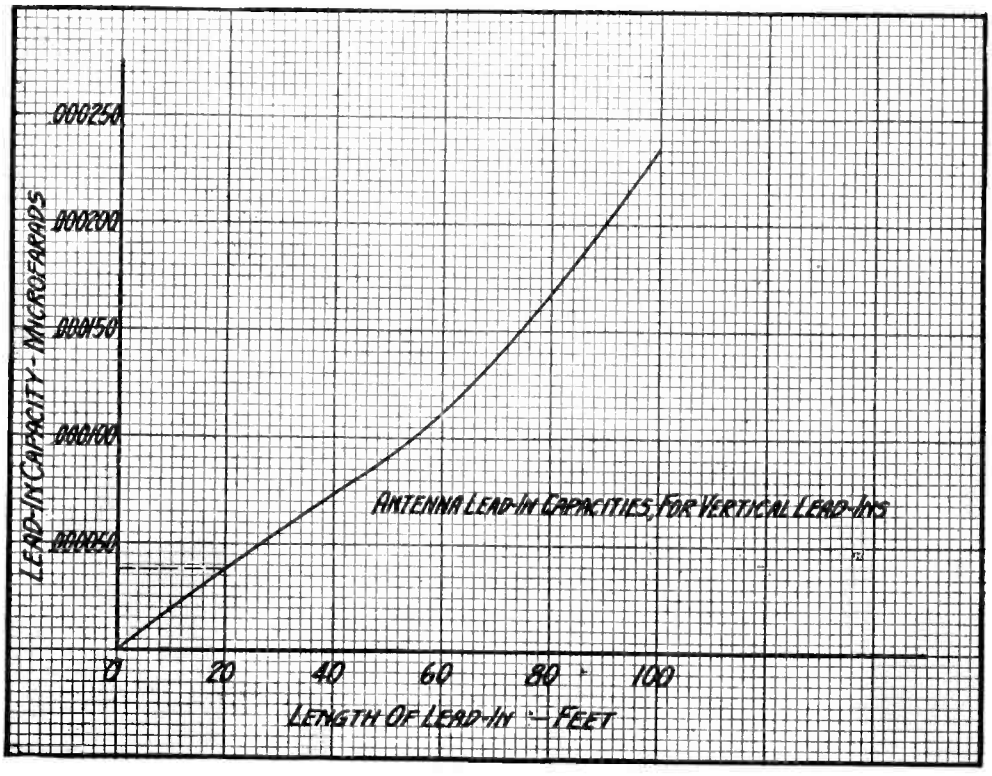
Underwood & Underwood

JOHN L. REINARTZ *is one of the best known of American radio amateurs. His modification of the fundamental Hartley circuit has been built and used by thousands of amateurs. This "Reinartz receiver" is now proving especially successful in work with the new short waves, below one hundred meters in wavelength. Mr. Reinartz is now with the MacMillan expedition in the Arctic.*



FOR DETERMINING THE CAPACITY OF AN ANTENNA

FIGURE 1: *This chart of curves shows the variation of capacity in an antenna with the variation of antenna height and length. The uneven portion of the curves of the 100 foot to 300 foot antenna is due to the capacity of the lead-in wire.*



FOR DETERMINING THE LEAD-IN CAPACITY

FIGURE 2: *The variation in capacity for straight vertical lead-in wires of varying heights is illustrated on this chart.*

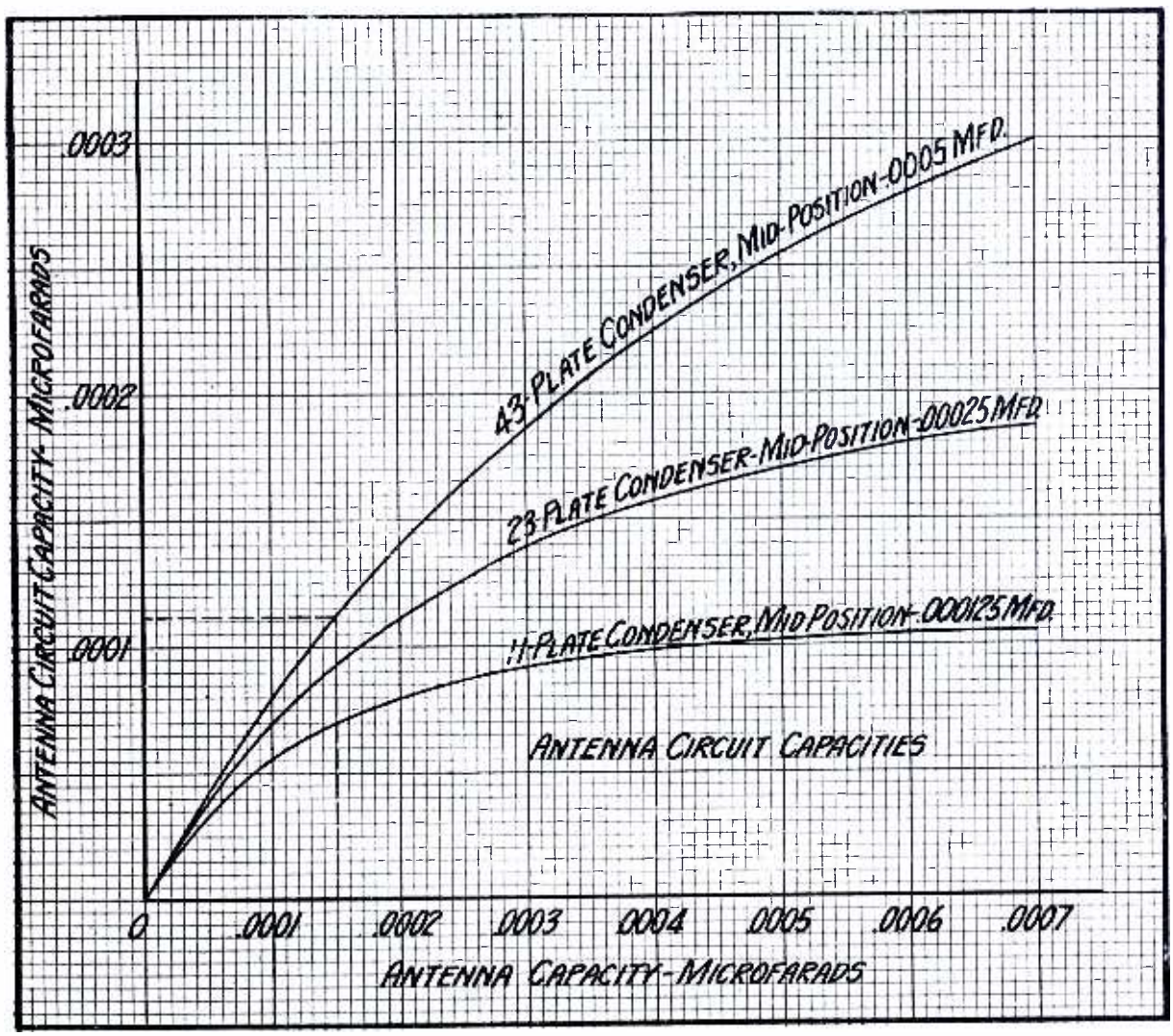
Useful Charts *for* Amateurs

Authoritative information tables for the guidance of experimenters who design or build radio receiving sets

By LIEUT. C. C. TODD, JR., U. S. N.

AS a rule, most amateurs get their hook-ups from friends, or from popular literature on the subject. This information, while good, is as a rule incomplete as far as the individual is concerned, and there are generally a number of points left in doubt when the amateur attempts to apply the information to his particular needs.

The curves accompanying this article have been prepared to furnish the information necessary to amateurs in building radio sets, and at the same time to present this information in the



FOR DETERMINING TOTAL ANTENNA CIRCUIT CAPACITY

FIGURE 3: *This chart shows the average capacity for the combined antenna circuit when using condensers of different sizes. The values are given for the mid position of each of the condensers.*

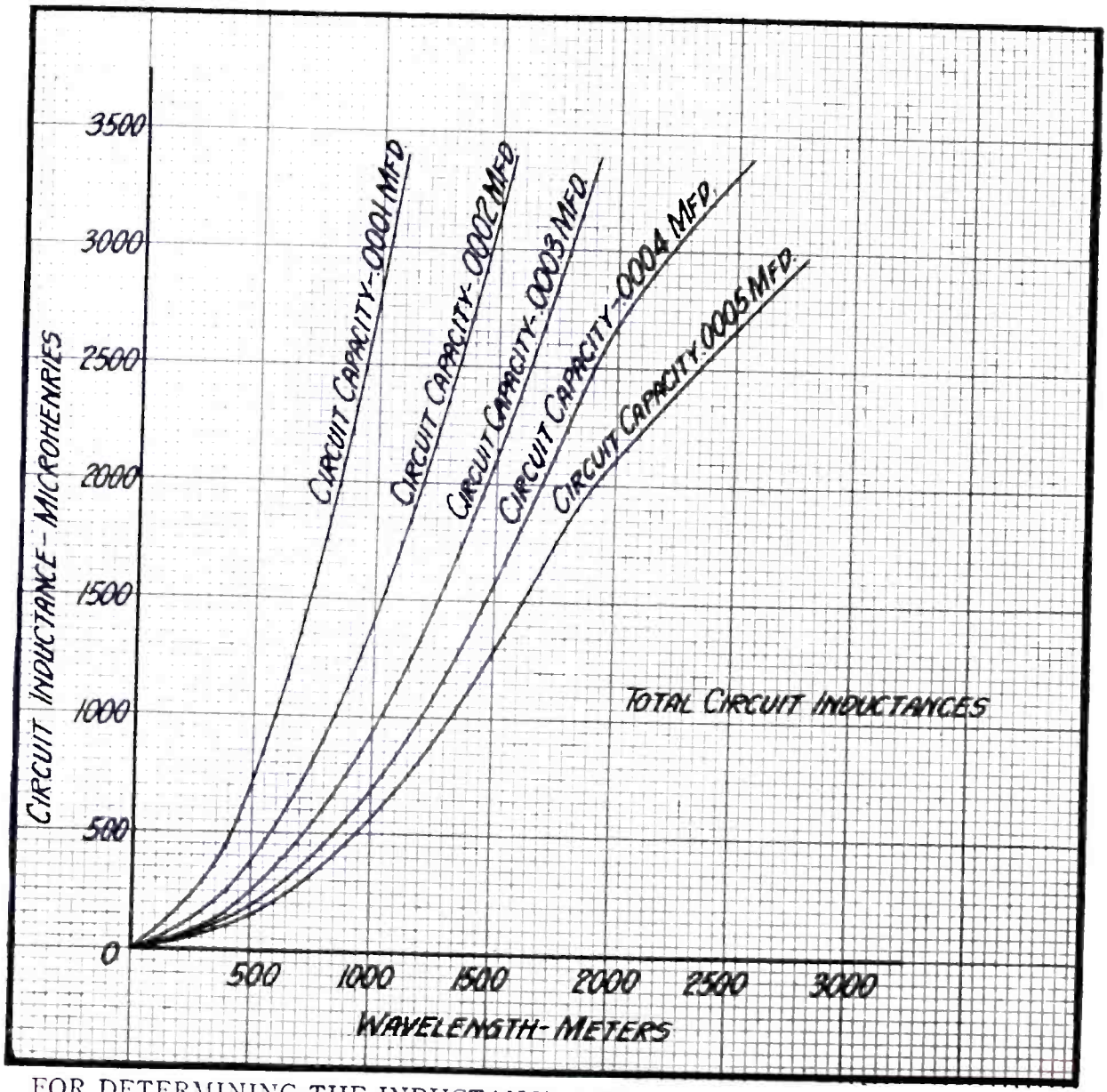
simplest and most convenient form for amateur use.

The curves are based on formulas to be found in the circular of the Bureau of Standards, Number 74 (issue of March, 1918) and on a formula for the inductance of coils which was developed by Dr. L. A. Hazeltine, of Stevens Institute. The curves are not intended to furnish *exact* data, but will furnish information far superior to "guesses," and they will eliminate a large amount of experimental work on the part of the amateur.

Let us work out a typical design to illustrate the use of the curves:

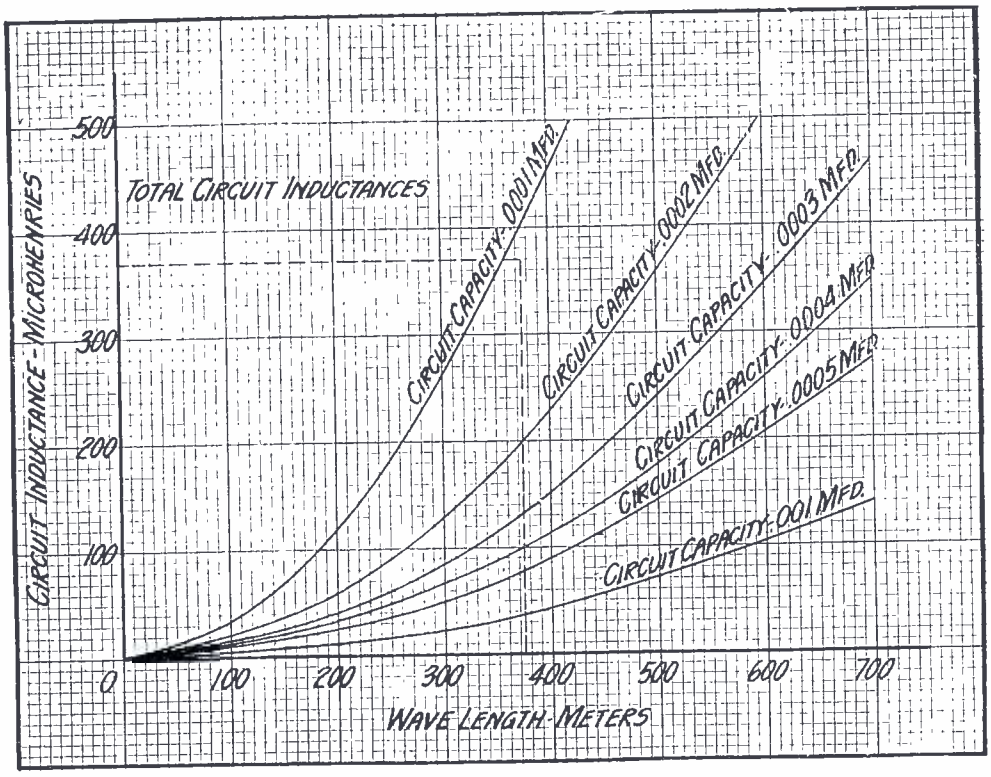
The first consideration, in the design of radio receiving sets, is the space available for the location of the antenna. The single wire (No. 14 B. & S. gauge copper wire) is generally the most satisfactory for amateur use. Let it be assumed that there is available a 50 to 100 foot span, 30 feet high, where an antenna can be strung, and that the lead-in is 30 feet long, practically vertical.

The second consideration is the type of set to be built. A radio set, like any



FOR DETERMINING THE INDUCTANCE AND CAPACITY FOR LONG WAVES

FIGURE 4: *In this chart is shown a series of curves for condensers of various capacity so that the experimenter may choose the proper inductance for his coils to cover a specified wavelength range. (For wavelengths below 500 meters consult Figure 5.)*



FOR DETERMINING INDUCTANCE AND CAPACITY FOR SHORT WAVES

FIGURE 5: *This chart gives the same kind of information as that in Figure 4, except that the wavelength range is lower than shown in the preceding chart and, therefore, a more accurate value of inductance may be determined.*

other piece of apparatus, will work best if designed for a particular duty. It is, therefore, unwise to try to design a receiving set to work over too great a range of wavelengths. It is better to design the coils of a set to a particular band of wavelengths, and to have several sets of coils to cover the entire range of wavelengths in which the amateur is interested. This last feature would lead to the choice of a 3-circuit set, having a primary or antenna inductance coil; a secondary inductance coil, and a plate-circuit or tickler coil. This naturally suggests some form of coil easily wound, small in size, and efficient. The pancake form of coil answers these requirements; consequently pancake coils of 2½-inch inside diameter may be chosen.

The necessary condensers will be one 43-plate variable; one 23-plate variable, and one .001 microfarad fixed condenser; together with the grid leaks and condensers recommended by the manufacturer of the vacuum tubes.

Grid condensers for use with detector tubes are usually about .00025 microfarads. Grid leaks of about 1 or 2 megohms are found best.

The rest of the equipment should be of reliable manufacture.

An examination of Figure 1 shows that for an antenna height of 30 feet and a length of 50 feet, the combined antenna and lead-in capacity will be about .00015 microfarads.

Figure 2 need not be consulted unless the lead-in is longer or shorter than the height of the antenna. If the length of the lead-in differs from the antenna height, the antenna capacity should be corrected by the amount of the lead-in capacity corresponding to this difference. For example: if the length of the lead-in were 10 feet, instead of 30 feet, .00004 microfarads (corresponding to 20 feet in Figure 2) should be subtracted from .00015 microfarads to obtain the antenna capacity.

With the value of .00015 microfarads and the 43-plate condenser curve in

Figure 3 it will be found that the antenna-circuit capacity is equal to about .00011 microfarads.

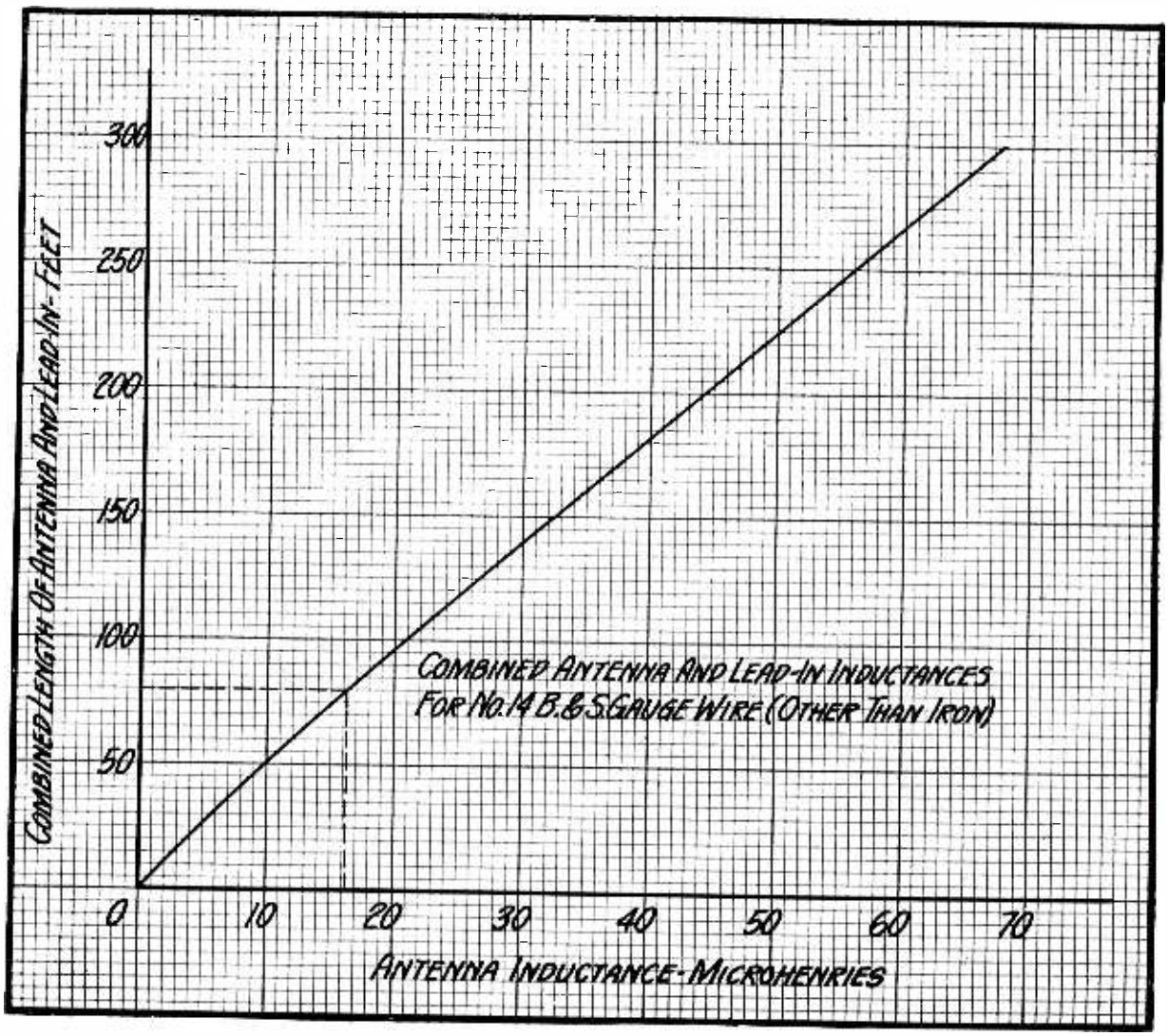
Let it be assumed that it is desired to design the receiving set for an average wavelength of 375 meters. With a wavelength of 375 meters and a circuit capacity of .00011 it is found that (from Figure 5) the primary circuit (antenna circuit) should have an inductance of 370 microhenrys.

Figure 5 should be used for greater wavelengths than covered by Figure 4.

The combined length of the antenna and lead-in is 50 feet plus 30 feet, or 80 feet. From Figure 6 it is found that the antenna inductance is about 16 microhenrys. As a total of 370 microhenrys is required for a wavelength of 375 meters, and it was found that the antenna would furnish 16 microhenrys, the primary inductance coil should be wound for an inductance of 370-16, or 354 microhenrys.

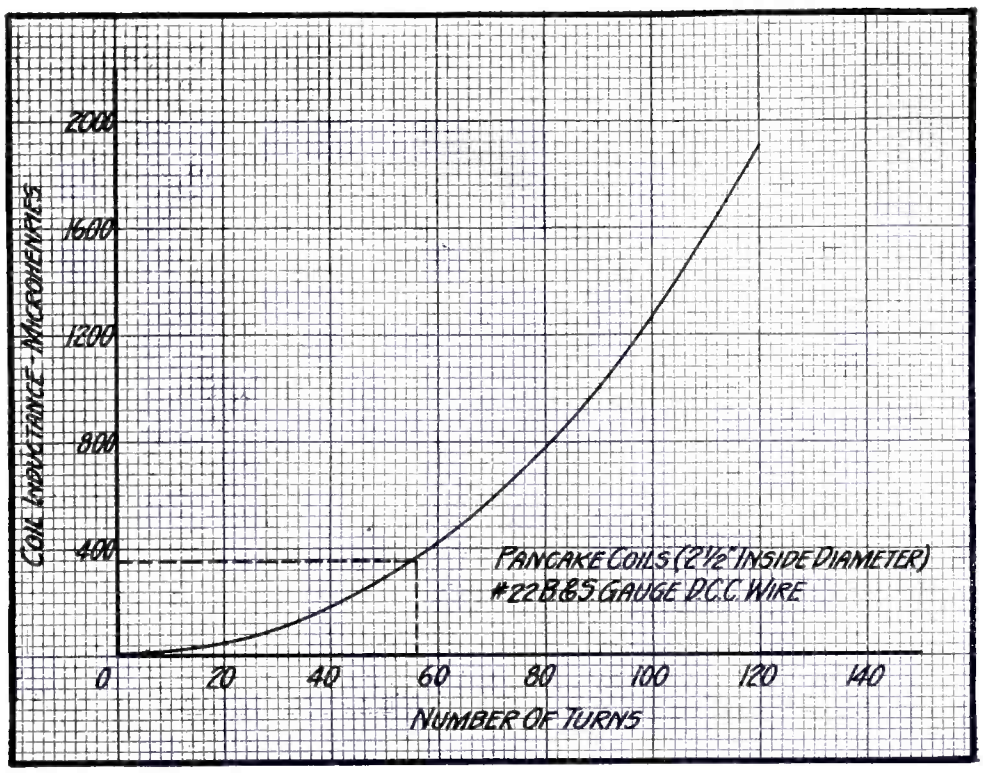
From Figure 7 it is found that a pancake coil of 2½-inch inside diameter and 56 turns will give an inductance of 354 microhenrys.

The secondary circuit is to use a 23-plate variable condenser, the maximum capacity of which is usually about .0005 microfarads. In mid-position the condenser is assumed to have a capacity of .00025 microfarads. The secondary cir-



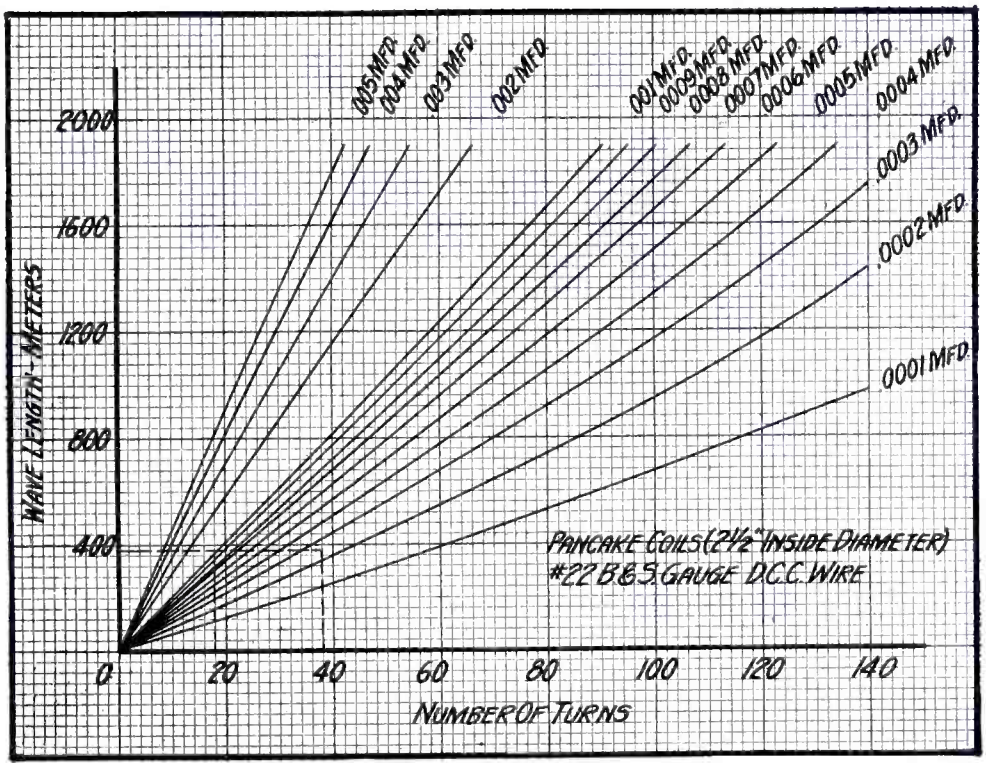
FOR DETERMINING ANTENNA INDUCTANCE

FIGURE 6: *This chart gives the variation of antenna inductance in microhenrys with the combined lengths of the antenna and the lead-in in feet. From it the experimenter may determine the inductance of his antenna system.*



FOR DETERMINING THE INDUCTANCE VALUE OF PANCAKE COILS

FIGURE 7: *This chart gives the inductance value for pancake coils made with No. 22 BCC wire with an inside diameter of 2½ inches. The values are given for coils containing approximately 10 to 120 turns.*



FOR DETERMINING THE COIL AND CONDENSER SIZES FOR VARIOUS WAVELENGTHS

FIGURE 8: *This chart tells the size of coil to use shunted by the proper size condenser for a given wavelength range. It is valuable in determining proper constants for secondary and tickler circuits.*

cuit is to work on 375 meters wavelength, so from Figure 8 with a wavelength of 375 meters and a capacity of .00025 microfarads it is found that a pancake coil of 2½-inch inside diameter with 38 turns is required.

It is decided to use a .001 microfarad fixed condenser as a by-pass condenser around the telephones or the primary of the first-stage amplifying transformer. From Figure 8 with a wavelength of 375 meters and a capacity of .001 microfarads it is found that a pancake coil of 2½-inch inside diameter with 18 turns is required for the plate circuit or tickler coil.

The results of this hypothetical design are as follows:

Antenna length..... 50 feet
Antenna height..... 30 feet
Antenna lead-in..... 30 feet
} *No. 14 B. & S. gauge copper wire*

Antenna capacity..... .00015 microfarads
Antenna inductance.....16 microhenrys
Antenna circuit capacity..... .00011 mfd.
Secondary circuit capacity..... .00025 mfd.
Plate circuit capacity..... .001 mfd.

Primary (Antenna) circuit inductance coil.....56 turns
Secondary circuit inductance coil.....38 turns
Plate-circuit (tickler) inductance coil.....18 turns
} *2½-inch inside diameter pancake coils*

The hook-up to use with this arrangement of coils is shown in Figure 9.

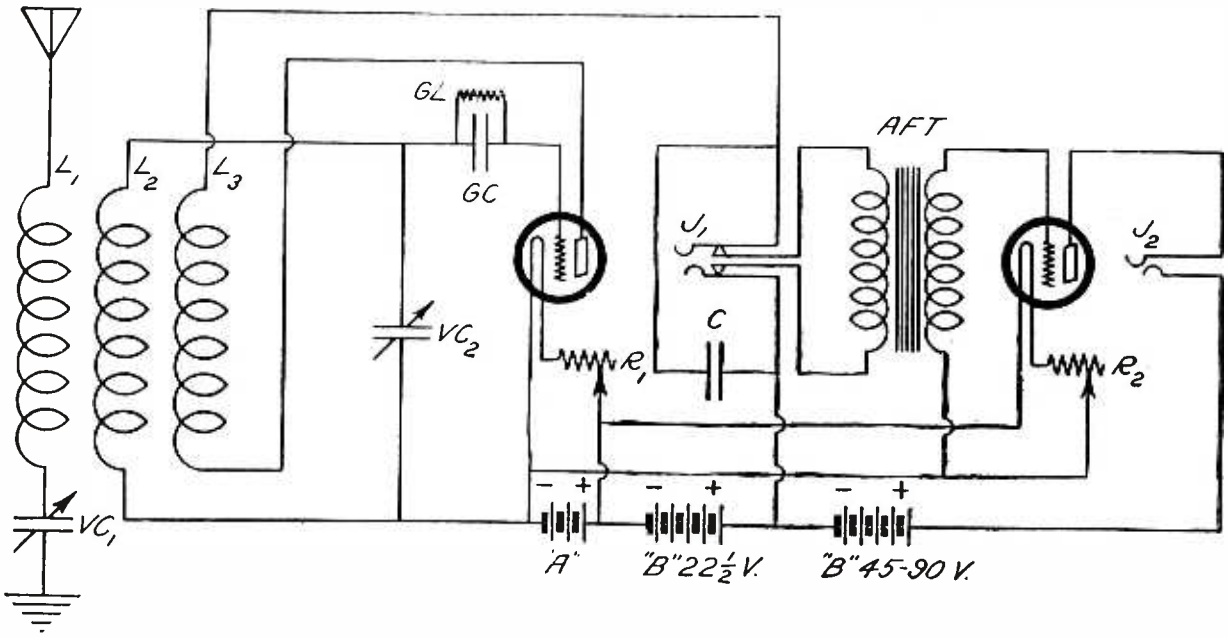
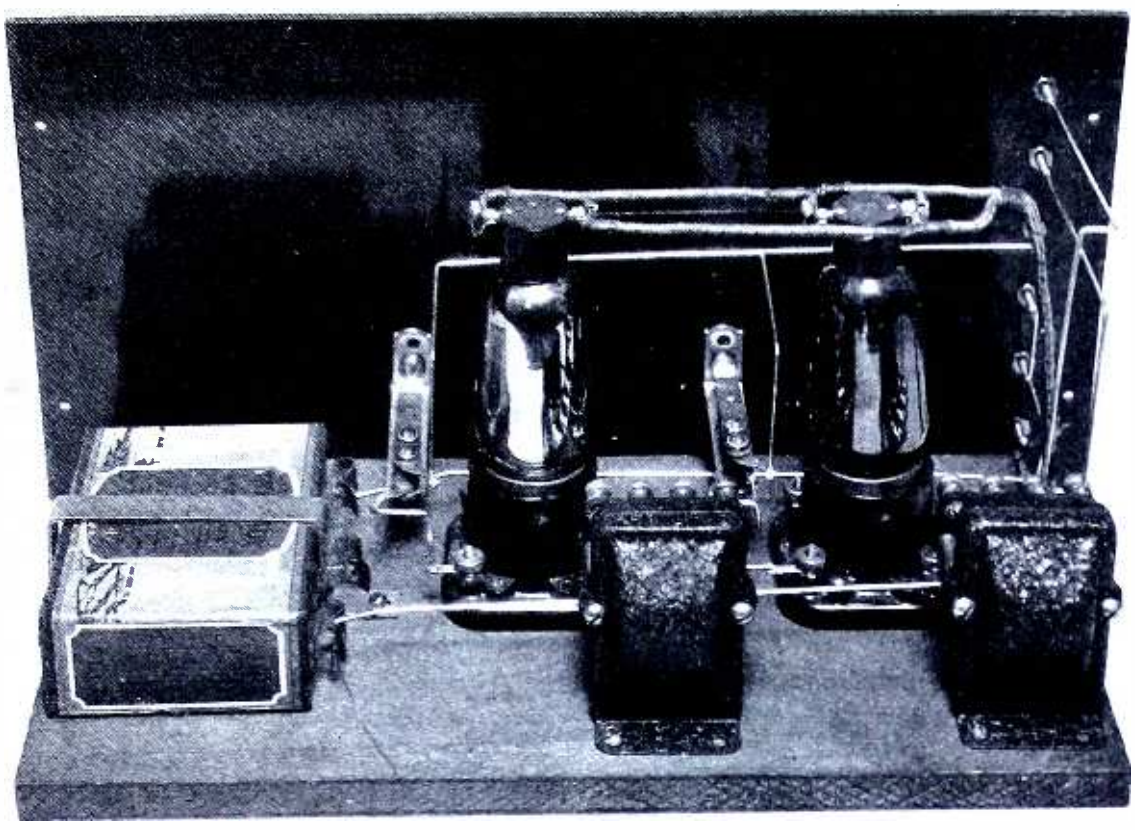


FIGURE 9: *A circuit for a triple-coil receiver with one-stage of radio-frequency amplification.*

What Makes a "Low-loss" Coil?

RADIO *fans and experimenters usually connect the term "low-loss" coil with some sort of multi-layer coil which contains no dielectric supporting material. Some interesting facts that show this is not the case will be presented in an article in the next issue of* POPULAR RADIO—*for October.*



THE REAR VIEW OF THE AMPLIFIER

FIGURE 1: *Study this view in connection with the picture diagram of the hook-up, Figure 2. The location and connecting points of each wire appear clearly and you may determine just how to bend the wires to get the shortest connection with the proper clearance.*

Simple "How-to-Build" Articles for Beginners No. 11

How to build a two-stage audio-frequency amplifier for AC tubes

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $23.00*

HERE ARE THE ITEMS YOU WILL NEED—

A and B—Precise audio-frequency transformers, No. 285;
C and D—Kellogg sockets;
E—Brooklyn Metal Stamping Corp. single-circuit jack;
F—Brooklyn Metal Stamping Corp. double-circuit jack;
G—Hard rubber panel, 7 inches by 14 inches;
H—Hardwood cabinet for 7 by 14 inch panel;
I—Baseboard, 12½ inches by 6½ inches;
6—Eby binding posts.

THE eleventh instrument to be described in this series of simple "how-to-build" articles is a vacuum-tube amplifier that comprises two stages of transformer-coupled amplification for use with the new McCullough AC tubes.

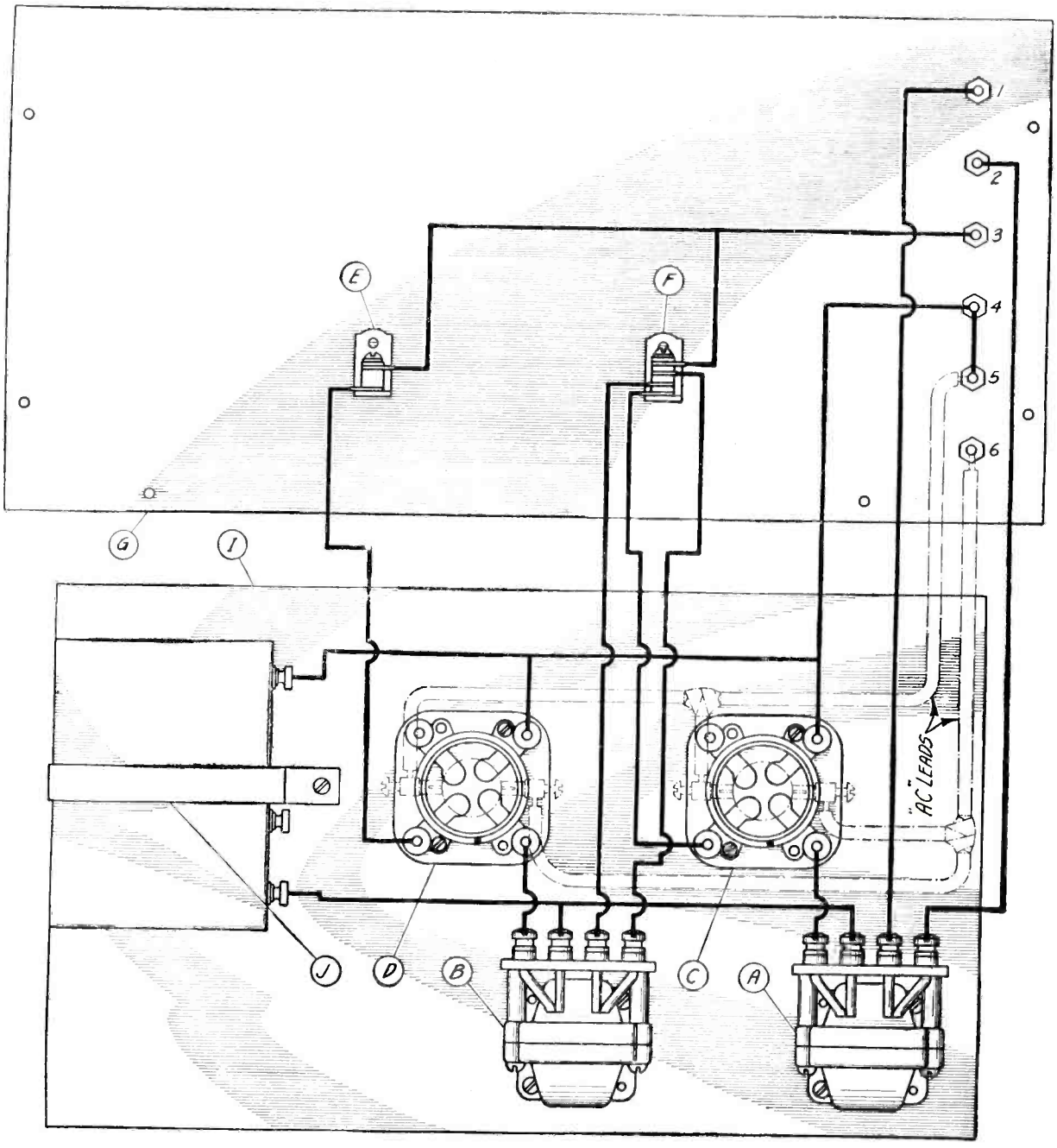
This unit will be found efficient when used with any of the preceding units and

tuners described in this series or wherever a two-stage, audio-frequency amplifier of the usual type is satisfactory.

This particular unit was built in the POPULAR RADIO LABORATORY for the purpose of supplying the beginner with details of an efficient amplifier that utilizes the new AC tubes and for acquainting him with its operation.

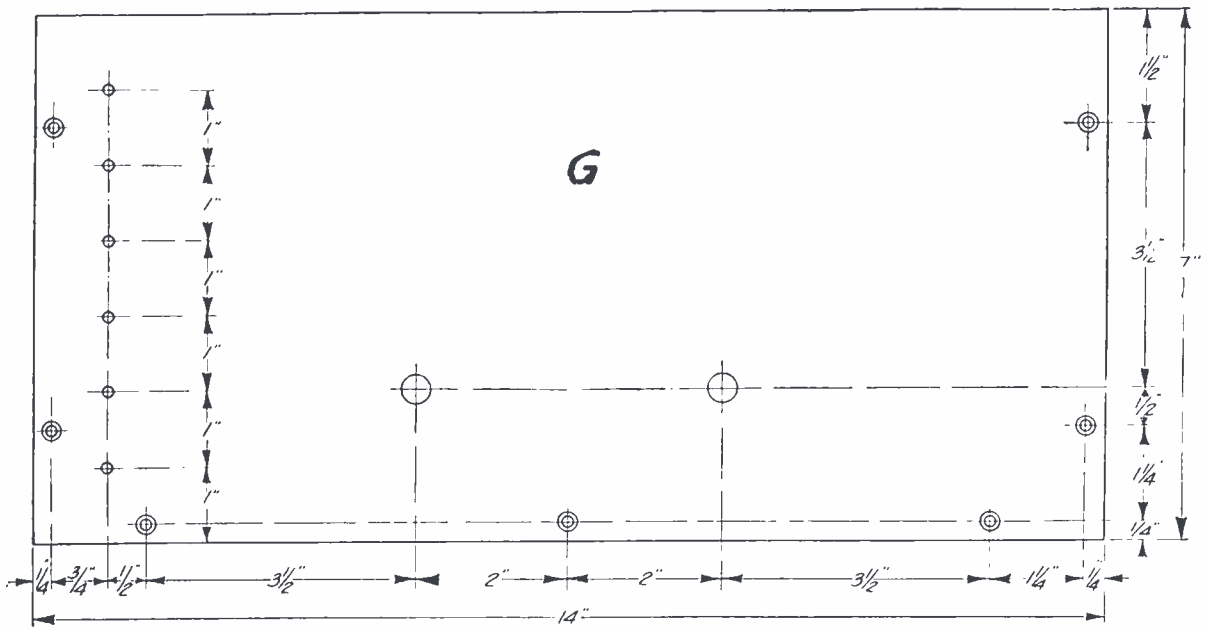
Take the list of parts (given at the beginning of the article) to your radio dealer and ask him to supply you with them.

After you have obtained all of them, find a satisfactory table or bench on which to work and lay out the parts on the baseboard as shown in Figures 1 and 2.



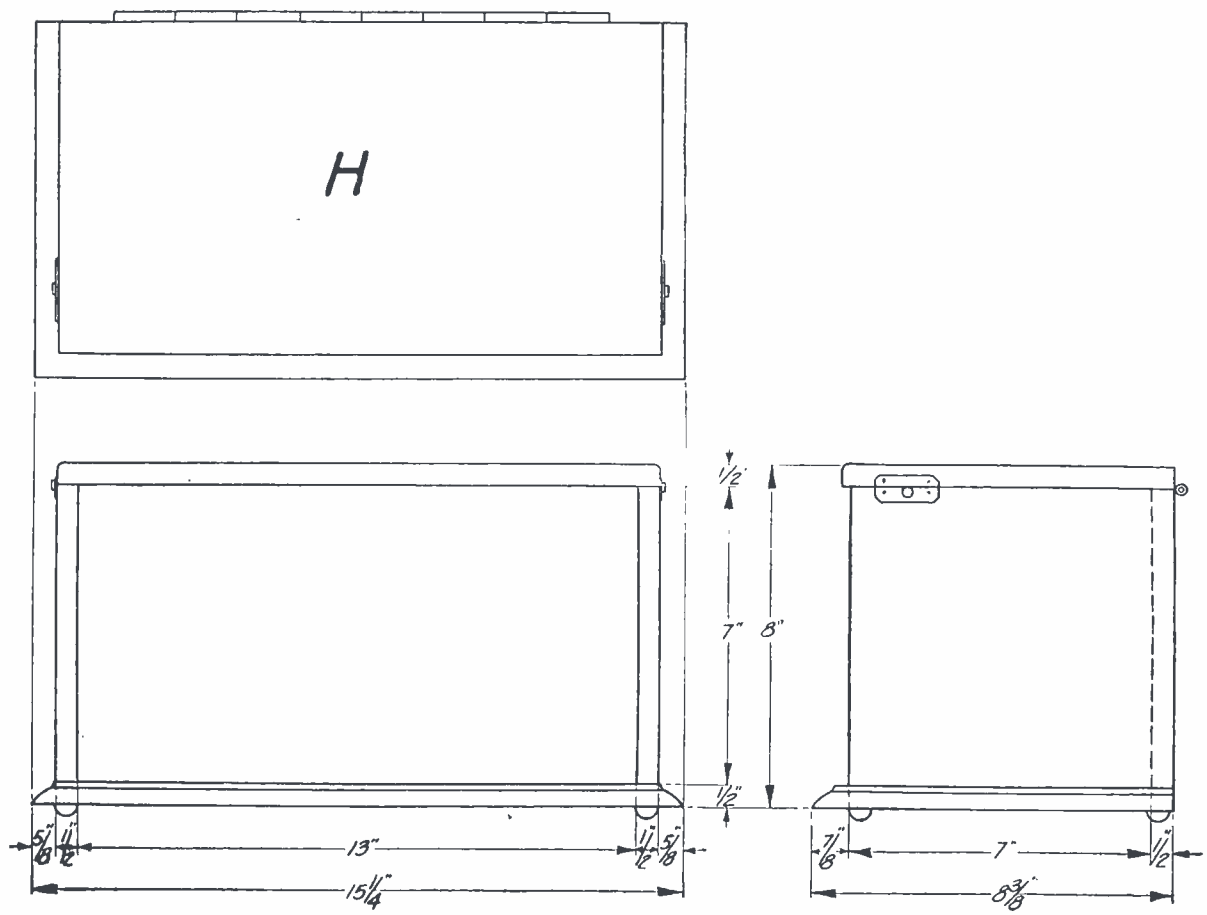
THE "PICTURE DIAGRAM" OF THE HOOK-UP

FIGURE 2: *The illustration shows the exact manner in which the instruments are placed on the panel and baseboard and how the wires run in relation to them. The upper rectangle shows the back of the panel, and the lower one shows the baseboard. All the parts are lettered to correspond with the designations in the text and in the list of parts.*



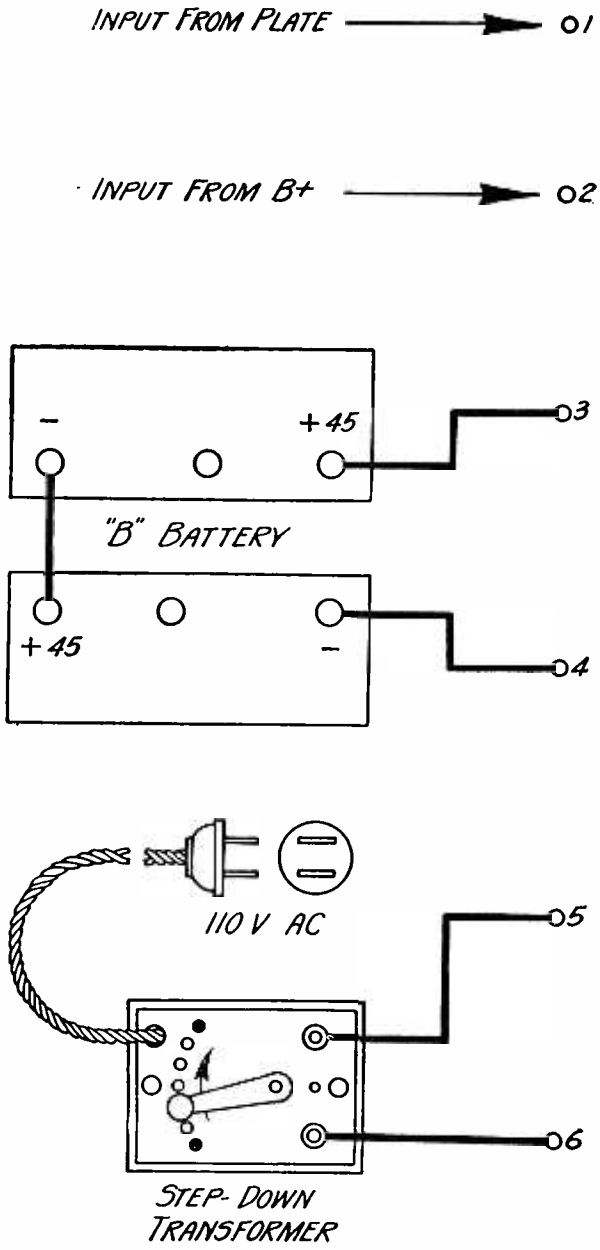
THE PANEL LAYOUT

FIGURE 3: *This drawing gives the dimensions for the front panel and the correct spacing from center to center for the holes that are used to mount the instruments and the binding posts as well as the holes for attaching the panel to the cabinet.*



THE DIMENSIONS FOR THE CABINET

FIGURE 4: *This diagram (which contains the top, front, and side measurements for the walnut cabinet) may be turned over for construction to a competent cabinet maker who can build it from these directions exactly the right size for the panel.*



HOW TO HOOK UP THE BATTERIES AND THE TRANSFORMER

FIGURE 5: *This drawing prevents you from making mistakes in making connections from the batteries and the step-down transformer to the terminals of the amplifier. If you follow these instructions the unit will be hooked up correctly because the binding posts shown in the picture wiring diagram are marked with designating numbers that correspond with the numbers given here.*

The grid post G of the sockets should be located immediately below the G post on the transformer as shown. Only two screws on diagonal corners of the sockets and transformers need be used to fasten them to the baseboard.

The panel should then be laid out and drilled. To minimize the possibility of spoiling the looks of the panel by making scratches in the wrong place, cut out a piece of paper the exact size of the panel. The position for the holes should then be marked on this using the dimensions given in the panel drawing in Figure 3. This is then used as a template by holding it on the panel carefully and punching through it with a sharp instrument of some kind at the required points. The dimensions of the holes have not been given, but the builder may readily determine the size of drill to use by noting the size of the jack nuts and the binding-post screws.

After the panel is drilled it should be fastened to the baseboard with one-inch nickel-plated screws. Flat-head screws should be used and the holes in the panel should be countersunk to make a neat job. The holes which require countersinking have a double ring drawn around them in Figure 3.

The 4.5-volt "C" battery should be fastened to the base with a brass strip bent and fastened with two small wood screws as shown in Figure 1.

This battery will last almost as long in the set as when it is not in use, due to the very light drain on it. It may readily be replaced, when necessary, by removing the brass retaining strip J, and disconnecting the two leads to the battery.

You are now ready to wire the set and should have no difficulty if the picture diagram is carefully followed. All parts are lettered with their designating letters used in the parts required list and this eliminates the possibility of a mistake.

When the wiring has been completed the set should be fastened into a cabinet of the sizes shown in Figure 4.

Figure 5 shows how the batteries and the transformer should be connected to the completed set. Although the binding posts have been placed so as to simplify connections to any of the preceding units described in this series, they also correspond to those used on most standard tuning units. Having the two step-

down transformer leads (corresponding to the usual "A" battery leads) at the left of the panel makes it possible to connect these two to the preceding unit when the latter is also designed to use AC tubes of this type. This minimizes induction from long leads carrying alternating current.

Two flexible leads made of ordinary lamp cord (or similar wire) should be run from the two bottom binding posts to the heater terminals on top of the tubes as shown in Figures 1 and 2. To make these leads readily removable four friction clips of the type designed for these tubes should be soldered to the two leads.

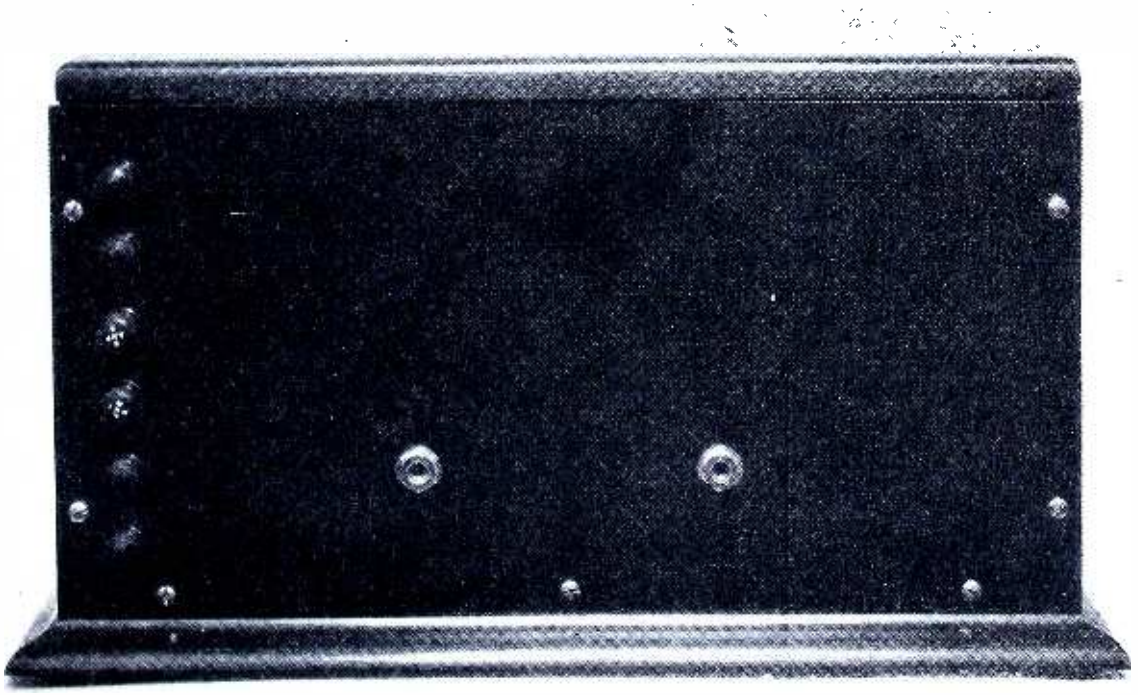
These tubes operate best with from 3.25 to 4 volts on the heater circuit and a small step-down transformer designed for this special use should be employed to supply this current. Care must be taken in obtaining the transformer to be sure it furnishes the proper values of voltage and preferably that it allows considerable variation over this range.

As is also the case with the usual filament type tube the heater coils should be run at as low a voltage as possible consistent with good reproduction and volume, so as to insure long life.

In adjusting the filament circuit make changes slowly as there is a time lag of some ten or fifteen seconds before variations in the applied voltage cause much of a change in the electron emission.

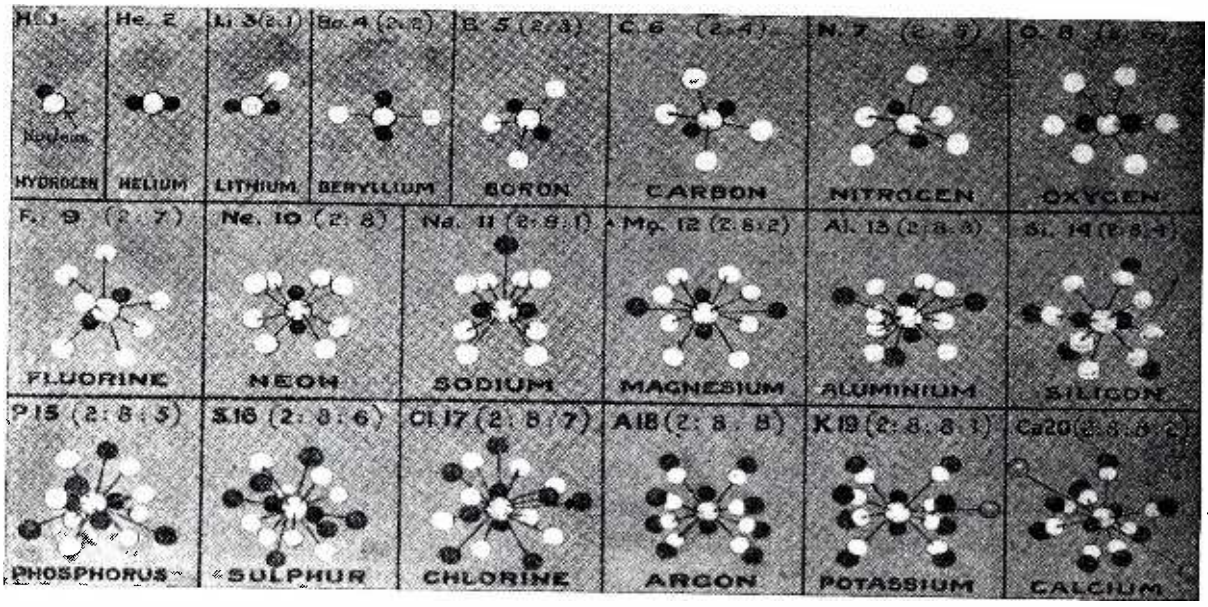
Where this unit is to be used with a tuner already using the AC tubes, care should be taken to see that the same filament lead is connected to the "B" in the tuner as in the amplifier. The fifth post from the top is connected to the "B—" and this post should connect to the post which goes to the filament and "B—" of the preceding unit. This precaution will prevent a short-circuit through the common "B—" connection. Where a separate "B" battery is used for the amplifier no such precautions need be taken.

When this amplifier is properly built and properly connected it will give very satisfactory results on a loudspeaker.



THE PANEL ARRANGEMENT FOR THE AMPLIFIER

FIGURE 6: *This picture shows the front view of the panel installed in the cabinet. The only instruments on the front are the two jacks which connect to the first and second stages of amplification and the row of binding posts at the left.*



THE PROBABLE NUMBER AND ARRANGEMENT OF ELECTRONS IN THE ATOMS OF VARIOUS ELEMENTS

FIGURE 1: *The first model shows an atom of hydrogen, which consists of a positive nucleus and only one electron; the last model shows the calcium atom, which contains a positive nucleus surrounded by twenty electrons.*

The ATOM

ARTICLE No. 2: THE NATURE OF GASES

In this article the author reveals in simple, everyday language some more of the little-known facts about the atom—that little understood particle that plays such an important part in radio—and the laws that govern electrons in the various combinations that make up the various elements.

By SIR WILLIAM BRAGG, K.B.E., D.Sc., F.R.S., M.R.I.

IN the first article it was shown that the behavior of the helium atom, which was expelled by the radium atom at the moment of its disintegration, necessitated a new conception of the structure of an atom.

The helium atom passes *through* the hundreds of thousands of atoms of all sorts which it may meet in its brief career. Starting at the rate of 100,000 miles a second, it travels in a straight line, until its energy is used up in the encounters with the atoms it meets. This and other effects observed in the movement make us believe that each atom is like a minute solar system, in which the sun is replaced by a nucleus charged with positive electricity, surrounded by negatively charged satellites which we call electrons. The positive charge of the atom is invariable: its amount determines the number of electrons which it can attach to itself. A "six-electron" atom, for example, has a nucleus charged with positive electricity equal to six of the standard units of electricity in nature—there is only one standard magnitude. It can attach to itself six electrons, for every electron has one standard unit of the negative electricity which is the antithesis of the positive.

The atom as a whole is electrically neutral. The behavior of the "six-electron" atom is, for all practical purposes, entirely determined by the fact that the nucleus

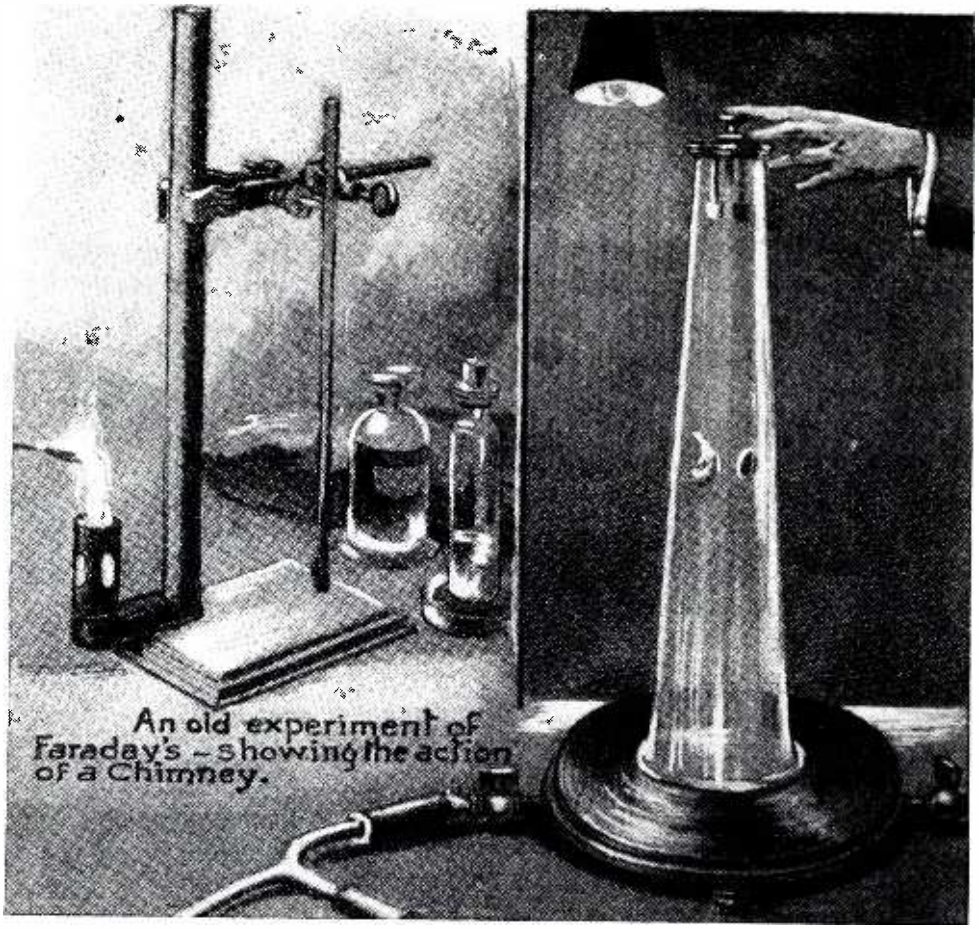
is a "six-electron" nucleus. It is what we call carbon. When the atoms of carbon are arranged in a certain way, they form diamond; a second arrangement gives graphite, and black lead; carbon is the most important constituent of the animal body and of all organic substances, of coal, of fats, oils, petrol and a vast variety of well-known materials. But, though it plays so great a part, all its properties and uses depend on its possessing a six-electron nucleus. A "seven" or a "nine," or any other number gives totally different properties, and, in fact, makes a new substance. The former is nitrogen, and the latter fluorine.

Atoms are found with almost every number of charges on the nucleus, from the "one-electron" atom which we call hydrogen, to the "ninety-two" electron, which is called uranium. Every atom has its name: a name generally given by the discoverer as indicating some special property which it possesses; or it may have been discovered so long ago that the origin of the name is obscure. Most of the names are well known and time-honored, and are not likely to be abandoned. Actually each kind of atom is identified with a certain number, as already explained; so that the number is a perfectly sufficient description. Some of the atoms have not yet been met with; for example, number 43. A few months ago there was great interest in the discovery of number 72; it is generally agreed that it shall be called "hafnium," the name being derived from the old Latin name of Copenhagen, where its existence was proved.

In the first of the figures on the opposite page a set of models is shown (Figure 1). These are to represent, roughly, a probable feature of the arrangement of the electrons in each of the first twenty atoms. Whether the electrons are in movement or not, and what is the character of any movement they possess, is for the present of no importance. The point that is meant to be illustrated is an un-

HOW MOLECULES OF GAS "BOMBARD" A CONTAINER

FIGURE 2: *This drawing shows, by analogy, how a gas expands the silken envelope of a balloon by bombardment; the tiny molecules of gas act on the envelope separately, just as the billiard balls do, in bending the strip outward.*



LABORATORY EXPERIMENTS THAT ILLUSTRATE PHYSICAL LAWS

FIGURES 3 *and* 4: *The figure on the left shows the action of a chimney in guiding the molecule of gas through a tube to the flame. Figure 4 (on the right) illustrates the fact that a feather and a coin, although of different sizes and weights, fall at exactly the same rates of speed in a vacuum.*

doubted arrangement in groups, to some extent concentric about the nucleus. Thus the first, hydrogen, has one electron; the second, helium, has two. These electrons are more closely associated with the nucleus than any of the others that are to be added as we go to higher numbers. The nucleus of lithium can attach three electrons to itself. Two of these are closely associated with the nucleus just like those of helium; the third is further away, and is not to be classed with the first two.

As we go along the line and add one electron after another—the positive charge on the nucleus growing steadily—the new electrons are to be classed with the third electron of lithium. The two inside members are present in all of them; but an outer shell is being formed. This goes on until the number in the new class is eight. After that a third group appears, which grows until it also has eight members; and after that appears a fourth. We need not go further, because the rules of the further formations are of a similar character, and we wish to avoid the complication of detail.

All these facts are illustrated by the models. For instance, aluminum has a "thirteen-electron" nucleus, and the thirteen electrons which it can attach to itself are so arranged that there are two close to the nucleus, eight in the next group, and three in the next.

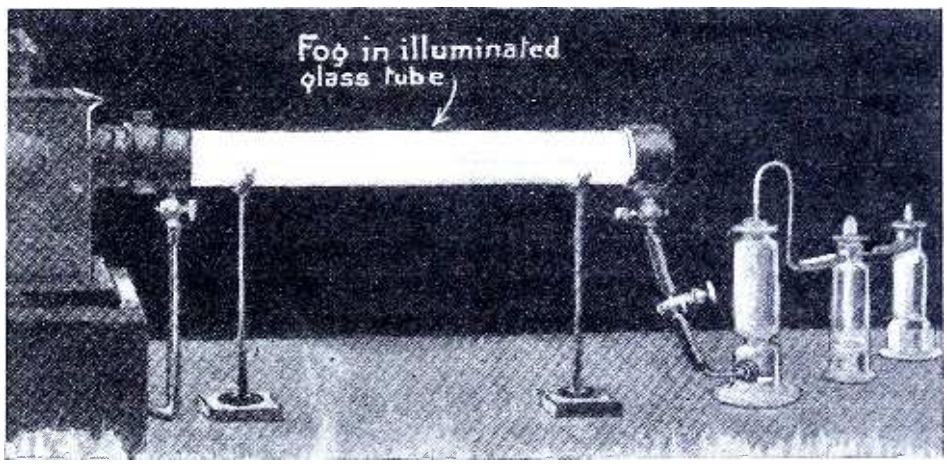
The forces exerted by one atom on another, when the two are brought close together, are very complicated in character, and are imperfectly understood. If more were known, the models might be more exactly constructed. No doubt they de-

pend on the way the atoms are presented to each other, just as—to take a simple example—a magnet can be made to attract another magnet according to the way their poles are brought together. We know that atoms do attach themselves to one another, and that the forces are very different for different members and arrangement of electrons, and depend on that arrangement. For example, fluorine, which has two electrons in the first group and seven in the second, has properties very similar to those of chlorine, which has two in the first, eight in the second, and seven in the third. In both cases the outside group, that which presents itself to the outside world, is an arrangement of seven.

A certain number of the atoms have singularly feeble attractions for any other atoms, whether like or unlike themselves. These are numbers 2, 10, 18, 36, 54, 86. They are, we may say, the "unsociable atoms," because they never combine with others, they take very little part in the affairs of the world. They were, in consequence, overlooked until a few years ago. The late Lord Rayleigh found that, after the oxygen had been removed from a sample of air, and every other known gas which might be contained as a small impurity, the remainder did not, as he expected, exactly resemble the pure nitrogen which he prepared in the usual ways. With the help of Ramsay he proved the existence of a new gas in the air, which was the number eighteen shown in our models. The proportion in the atmosphere is quite considerable. The air in the theater of the Royal Institution weighs about three quarters of a ton; of this about eighteen pounds is composed of the new gas. Such a proportion would easily have been discovered long ago if the new element had been willing to enter into combination with any other. The discoverers named the element "argon," the lazy one, because of its unwillingness to associate itself with other atoms. It is rather, however, unsociable than lazy; its physical movements are as quick as those of any other atoms of the same weight.

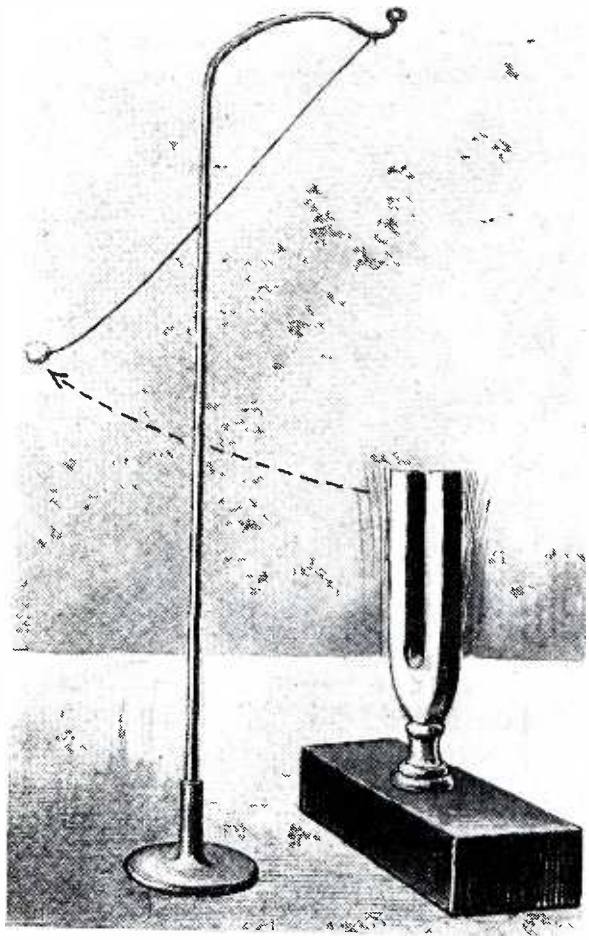
The discovery of argon was quickly followed by the discovery of others like it. The two-electron, helium, was found in certain minerals; its existence in the sun was already known. Neon (10), the "new" gas; krypton (36), the "hidden" gas; xenon (54), the "stranger," and the radium emanation (86) are all very rare.

All these are gases, which is to be expected. Their atoms are in movement, and are each on their own, there being so little tendency to associate. Only when the temperature is greatly reduced do they liquefy, especially those that are light. They are excellent examples of the nature of a gas; of the state in which



AN EXPERIMENT WITH MAN-MADE FOG

FIGURE 5: *A dense fog may be formed in a tube by moisture settling on the innumerable small particles in the air.*



HOW SOUND WAVES ARE PRODUCED

FIGURE 6: *This picture of a laboratory set-up shows how the atoms of a gas are set in motion by contact with vibration; a pith ball is hurled away when it comes in contact with a vibrating tuning fork.*

movement overcomes attraction. There are many other well-known substances which are usually met with as gases, oxygen, hydrogen, nitrogen, and so on. But in these cases we have examples of molecule building which will be considered more carefully later. In each case atoms have combined in pairs; and the pair forms a contented combination, somewhat unwilling to join up with other atoms, and therefore maintaining an independent existence like argon.

The properties of a gas are readily understood if its nature is borne in mind. It is convenient to take the analogy of a billiard table. For these lectures, Messrs. Burroughs and Watts were kind enough to make a special table of small size and having no pockets. A number of balls moving on the table represent the atoms of a gas-like argon; the cushions represent the walls of a containing vessel. The only defect is that the balls, when set moving, soon come to rest, whereas the atoms of the gas are always on the move. But the table and balls may still be used to illustrate the main properties of a gas. The pressure of a gas on its containing vessel is illustrated by the continual bombardment of the cushions by the moving balls; a thin strip forming a false cushion is bent outwards just as a balloon is distended by its gas (Figure 2). If, again, a loose cushion is pushed in, the balls are made to move more quickly. Just so, when the piston is driven into a cylinder, the atoms or molecules of the gas move more quickly. In other words, the gas is heated, as every one has realized who has felt the bicycle pump grow warm with use. If the gas is allowed to expand suddenly, it is chilled; so, if the false cushion is withdrawn, the balls that strike it lose some of their speed. In the same way, the hands are drawn back while catching a ball, so that the ball can be brought to rest. If damp air is allowed to expand suddenly, the chill may produce a fog. The apparatus that is shown in the figure is designed to show the effect (Figure 5). If the air is clean, though damp, the expansion produces a light mist; but if the air of the lecture-room is drawn into the tube, the expansion produces a sample of London fog.

The pressure of the atmosphere is much greater than may naturally be supposed. Its flexibility, due to the independence of the separate atoms, is so great that its massiveness is overlooked. The pressure on the exterior of the human body is more than ten tons. The body would collapse were it not that gases and liquids within are exerting the same pressure outwards, so as to counter the pressure of the air.

Pathé

The Diary of a Radio Fan

By D. R. PATTERSON

Dec. 20.—The papers say you can hear music and bedtime stories with a little box affair connected to telephones on the head, like a telephone operator. Oh, well! Just another fad.

Dec. 22.—Bill Parker says this radio stuff is good. Says he can almost distinguish the words on a set he made himself. Think I'll get one for son Gordon.

Dec. 23.—Hooked up a radio set to clothes lines tonight after Gordon had gone to bed. You have to monkey around with a little curly wire dinkus the clerk told me was a cat's something-or-other. Then you connect the clothes line to a water pipe or something, and a condenser (or was it a crystal?) has to be touched by the curly wire vario-coupler. Maybe I've got it wrong.

Dec. 24.—The darned thing works! Late tonight, after Parker fixed the wires up right and Friend Wife was in bed, I heard a chap saying, in the ear phones: "This is Station BVD broadcasting—" Later on I heard some dots and dashes. It will be great sport for Gordon.

Dec. 26.—Tried all day yesterday to hear something on the radio but had no luck. Son Gordon, who has the modern idea of all children that they can do anything better than their parents, tried it. And purely by luck he got some nice music going. This should be good stuff.

June 4.—Bill Parker says the new idea of vacuum bottles instead of crystals is better, but you have to use storage tanks—or was it storage batteries? Will go over and see what his new idea works like when he gets it going, just so I can tell the young son about it. I have no interest in it myself.

June 10.—Heard some great stuff at Parker's tonight. Must get Gordon a set like Bill's. Son must be kept up-to-date.

July 12.—Tried all evening to hear something on new outfit; phoned a chap who sold it and he showed me where I'd forgotten to put the vacuum tube in place. Stayed up till three A.M. listening to dots and dashes.

July 13.—Must teach Gordon the Morse code so he can read the messages in the air. Dug up a code in the encyclopedia. Copied message I heard like this: "AXGP dnm 64k hsd mnli." Must have been some operator outside the three mile limit. Maybe I didn't get it right myself.

Aug. 29.—Had a lot of trouble on Monday—that is, Gordon did—until Bill Parker discovered it was the washing on the line. Friend Wife will have to hang the washing in the cellar.

Sept. 1.—Parker helped me to put up an aerial wire from chimney to a tree, so it won't interfere with washing any more. Now hear stations in the west but can't get southern ones.

Nov. 5.—Gordon wants to know why he can't work the set himself. Says I oughtn't to want to listen to what Hoppity Rabbit did to Phewie Skunk. I don't like fussing with the darned radio but have to get it running for the sake of the kids.

Jan. 8.—Parker says aerial is in wrong direction. Took it down and put it up on another tree. Now hear southern stations but no westerners.

Jan. 20.—Gordon is now using the old crystal set all himself, while I keep on experimenting with the big one until I get it working right for him. Heard three concerts tonight; got to bed earlier, two A.M. Willing to lose a little sleep for the sake of the children.

Mar. 3.—Got a new book which says a variable condenser is no good. Gave the old set to Gordon.

Mar. 4.—Bought a new set, regenerative variocoupler and variometers. Was telling the boys at the office how to work it, and those big words came in fine. (Memo: find out what those words mean.)

Mar. 15.—Tried for an hour to get a station; gave it up. Put set away in the attic.

Mar. 30.—Saw a good program in the paper tonight which was to be put in the air by station IOU. Some day I may dig up that set and see if it works.

April 24.—Bill Parker has a copy of POPULAR RADIO that shows all the new radio stunts. No wonder my set wouldn't work! Bill showed me where I was wrong, and we stayed up till three A.M. tuning in different stuff.

Apr. 18.—This radio is great dope! Heard sixteen different stations tonight; heard a lecture on shoemaking and one on curing hay fever. Friend wife says you wouldn't go to those lectures in a hall. Isn't that just like a woman?

May 15.—Bought a new book which shows that all my trouble was on account of the aerial. Took it down. Building a set myself on plans in the book.

May 16.—Took the day off to finish set. Got tangled up with the coils of wire and also bust the black panel. Finally hired a young radio enthusiast to finish it for me. Didn't cost much more than a factory built set.

May 17.—Now using new set with bedspring instead of outside aerial. With a loop hung on a miniature "Stop, Look and Listen" sign can hear western and southern stations now, but not very well. No wonder the other set wouldn't work.

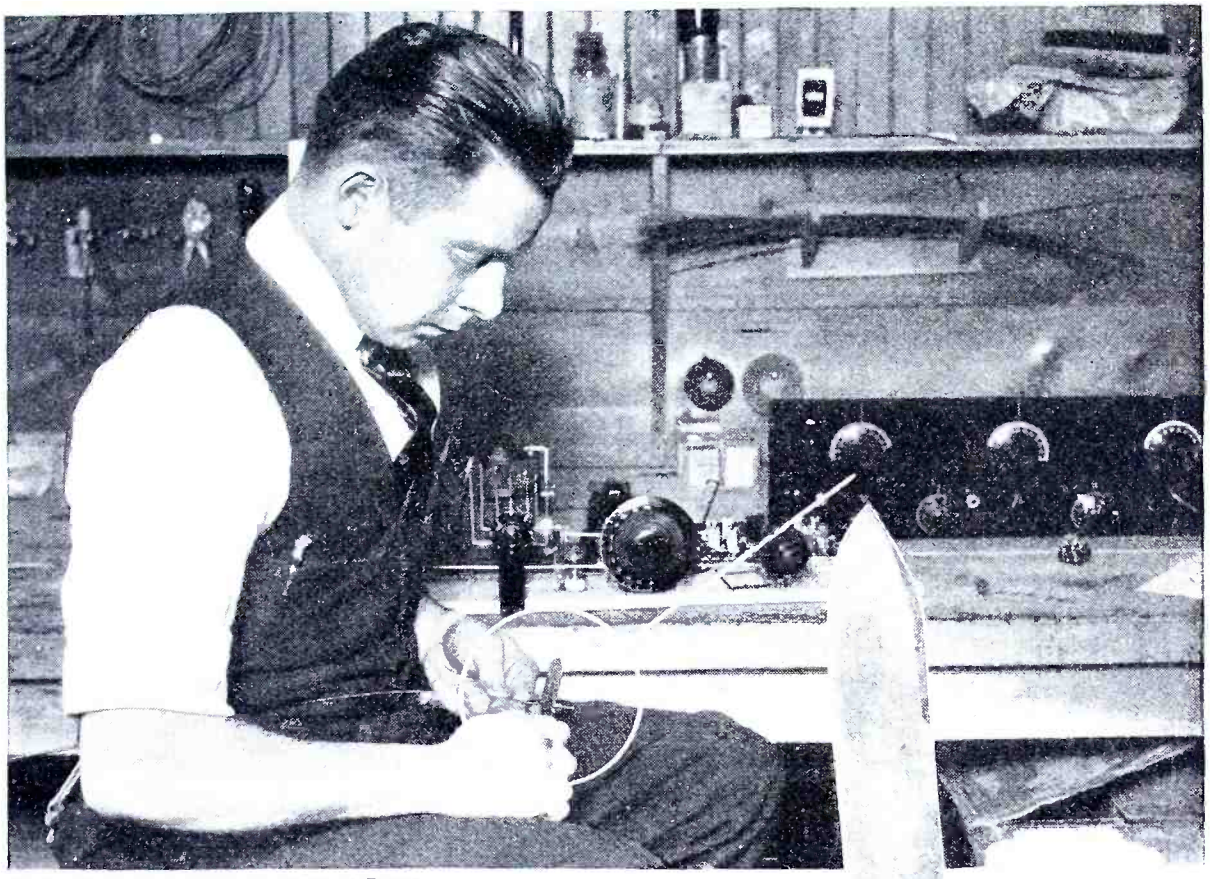
May 20.—This new outfit is too complicated to bother with. Gave it to Gordon and hooked up the old crystal set. No batteries to bother about.

July 25.—Off the radio for life. Had the boss in to hear the thing tonight and couldn't make it work. Boss wonders why I stay off work to monkey with it. After he left, young Gordon tuned in Cuba on his set, just by chance.

Sept. 8.—The reflex is the thing! No more regenerative radio frequency for me. This new book says the sound goes in the vacuum tube and out, then dashes through it a few times more, picking up more sound each trip, with a final run through a crystal. Have to look up the prices of these sets.

Oct. 10.—Friend Wife wants to know why we didn't buy a flivver instead of spending all the cash on radio sets. No interest in science, these women.

Oct. 25.—Too much work getting new set working. Son objects to taking any more sets. I took back his old crystal set and bought him a tricycle. The crystal is the thing for me!



From a photograph made for POPULAR RADIO

THE JACKKNIFE

Useful for making connections

IT is almost impossible to put up a set, install an antenna, and make connections to batteries, without the use of a knife, yet this tool is often overlooked in the radio fan's kit.

For scraping the insulation from wire that is to be used for connections and for cleaning up the ends of wires that are to be soldered, the jackknife is invaluable. It should contain one large "husky" blade and at least one other smaller blade. There are some knives that are also provided with a small screw-driver blade.

The preceding suggestions in this series were SIDE-CUTTING PLIERS, SCREW-DRIVERS, THE HYDROMETER, THE BATTERY-TESTING VOLTMETER *and* THE FILE.

"What Set Shall I Buy?"

4th Installment

For the guidance of readers who want specific and authoritative information concerning the best of the ready-made receivers that are now on the market, this feature will be published monthly until all of the receivers that have passed the tests of the POPULAR RADIO LABORATORY have been included

The Standardyne Receiver

MANUFACTURER'S NAME; Standard Radio Corporation

MODEL; Standardyne

NUMBER OF TUBES; five

TYPE OF TUNING; tuned-radio-frequency with a variable-reactance control that gives the receiver practically a straight line regeneration or tendency toward oscillation curve

TYPE OF DETECTOR; vacuum tube

RANGE ON PHONES; 3,000 miles

RANGE ON LOUDSPEAKER; 3,000 miles

COST, COMPLETE; with cabinet, $60.00; with all accessories, $90.00 to $150.00

ANTENNA RECOMMENDED; antenna about room or outside antenna about 100 feet long

KIND OF TUBES FOR R. F.; UV-199, 201-a, DV-3, DV-2

DETECTOR TUBE; same

AUDIO TUBES; same

TYPE OF "A" BATTERY; 4½ volt dry cells for 199 or similar tubes; 6 volt storage for other tubes

TYPE OF "B" BATTERY; 90 to 100 volt dry or storage "B" Battery

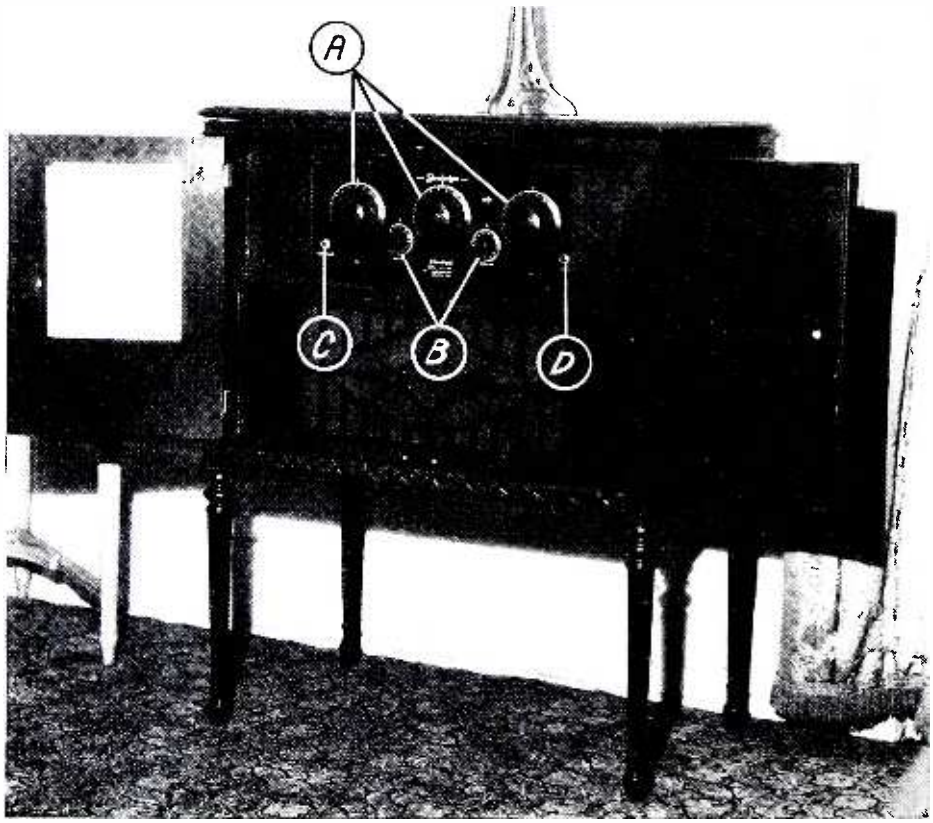
DETECTOR "B" VOLTAGE; 22½ to 45 volts

WAVELENGTH RANGE; 190 to 575 meters

NUMBER OF TUNING CONTROLS; 3 individual variable condensers, detector and audio on one rheostat; radio on another

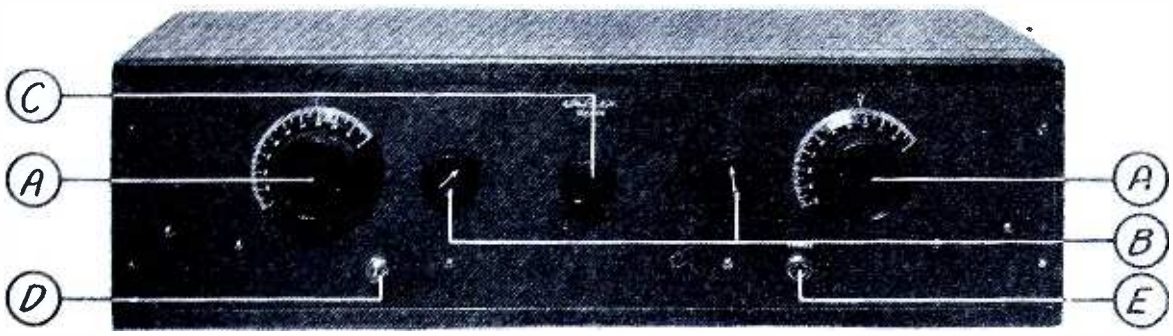
"A" BATTERY CURRENT USED; 3 amperes with dry-cell tubes, 1¼ amperes with 201-a tubes

"B" BATTERY CURRENT USED; 15 to 25 milliamperes, depending on tubes used



THE COMPLETE RECEIVER IN A CABINET

This picture shows the "Standardyne" receiver mounted in a cabinet that contains batteries and loudspeaker. The dials A are the three tuning coils; B are the two rheostats; C and D are the loudspeaker and phone jacks for plugging in.



Trirdyn Receiver

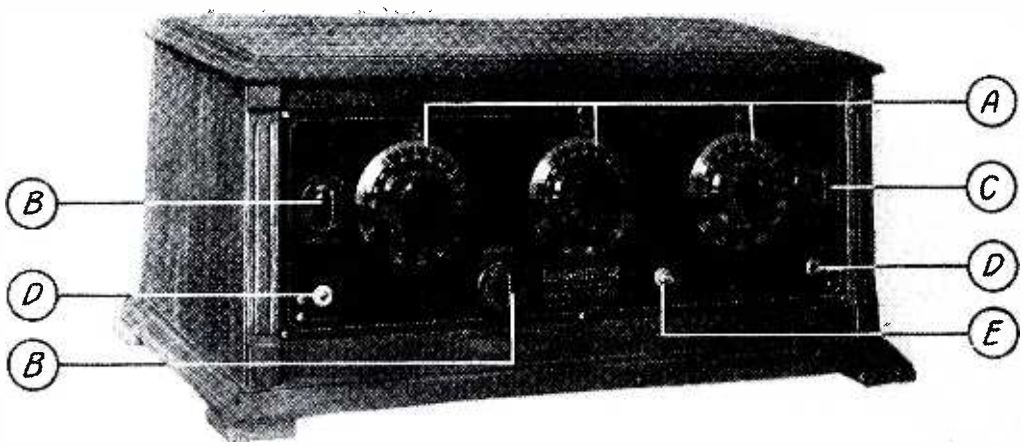
MANUFACTURER'S NAME; Crosley Radio Corp.
MODEL NAME; Trirdyn
NUMBER OF TUBES; three
TYPE OF TUNING; tuned R. F. combined with regenerative detector, and reflex amplification
TYPE OF DETECTOR; vacuum tube
RANGE ON PHONES; 1,000 to 1,500 miles
RANGE ON LOUDSPEAKER; 1,000 to 1,500 miles
COST COMPLETE; $65.00
ANTENNA RECOMMENDED; outdoor
KIND OF TUBES FOR R. F.; UV-201-a, C-301-a, WD-12, C-12, UV-199, or C-299
DETECTOR TUBE; UV-200, C-300, WD-12, C-12, UV-199, or C-299
AUDIO TUBES; UV-201-a, C-301-a, WD-12, C-12, UV-199, or C-299.
TYPE OF "A" BATTERY; to suit tubes
TYPE OF "B" BATTERY; 90 volts
DETECTOR "B" VOLTAGE; 22½ volts
WAVELENGTH RANGE; 180 to 575 meters
NUMBER OF TUNING CONTROLS; two
"A" AND "B" BATTERY CURRENT USED; depends on tubes used

Melco Five Receiver

MANUFACTURER'S NAME; Amsco Products, Inc.
MODEL NAME; Melco five
NUMBER OF TUBES; five
TYPE OF TUNING; variometer-inductance
TYPE OF DETECTOR; vacuum tube
RANGE ON PHONES; coast to coast
RANGE ON LOUDSPEAKER; coast to coast
COST; $165.00 without accessories
ANTENNA RECOMMENDED; 20 to 25 feet indoor or 60 to 75 feet outdoor
KIND OF TUBES FOR R. F.; UV-201-a or C-301-a
DETECTOR TUBE; UV-201-a or C-301-a
AUDIO TUBES; 201-A or 301-A
TYPE OF "A" BATTERY; Exide 100 amperes
TYPE OF "B" BATTERY; Burgess 45-volt
DETECTOR "B" VOLTAGE; 45 volts
WAVELENGTH RANGE; 200 to 600 meters
NUMBER OF TUNING CONTROLS; three
"A" BATTERY CURRENT USED; 1¼ amperes
"B" BATTERY CURRENT USED; 10 to 15 milliamperes

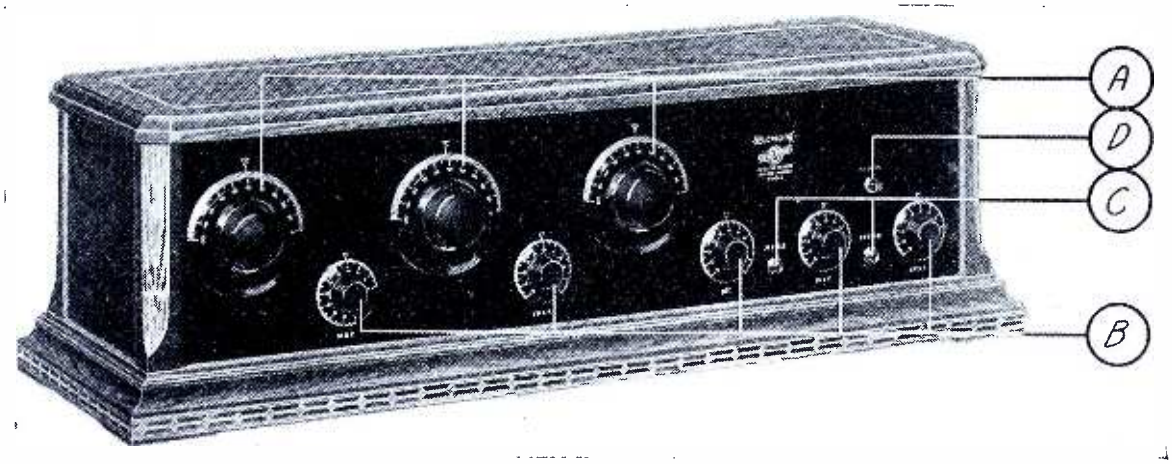
Neutro-Junior Receiver

MANUFACTURER'S NAME; F. A. D. Andrea, Inc.
MODEL NAME; 195-A Neutro-Junior
NUMBER OF TUBES; three
TYPE OF TUNING; neutrodyne
TYPE OF DETECTOR; tube
RANGE ON PHONES; 500 to 1,000 miles
RANGE ON LOUDSPEAKER; up to 500 miles
COST; approximately $110.00
ANTENNA RECOMMENDED; single wire, 60 feet
KIND OF TUBES FOR R. F.; UV-201-a, C-301-a
DETECTOR TUBE; UV-201-a, C-301-a, UV-200, C-300
AUDIO TUBES; UV-201-a, C-301-a
TYPE OF "A" BATTERY; 6 volts
TYPE OF "B" BATTERY; 90 volts
DETECTOR "B" VOLTAGE; 22½ volts
WAVELENGTH RANGE; 200-600 meters
NUMBER OF TUNING CONTROLS; three
"A" BATTERY CURRENT USED; ¾ ampere
"B" BATTERY CURRENT USED; approximately 10 milliamperes



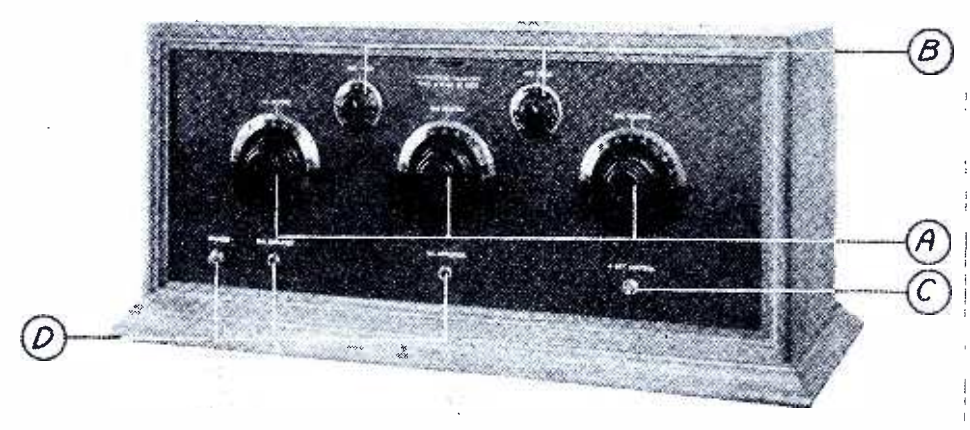
The Logodyne "Big Five"

MANUFACTURER'S NAME; Kodel Radio Corp.
MODEL NAME; Logodyne "Big Five"
NUMBER OF TUBES; five
TYPE OF TUNING; tuned-radio-frequency
TYPE OF DETECTOR; vacuum tube
RANGE ON PHONES; 1,000 miles
RANGE ON LOUDSPEAKER; 1,000 miles
COST, COMPLETE; approximately $125.00
ANTENNA RECOMMENDED; single wire
KIND OF TUBES FOR R. F.; 201-a
DETECTOR AND AUDIO TUBES; 201-a
TYPE OF "A" BATTERY; storage
TYPE OF "B" BATTERY; 90 volt dry cell
DETECTOR "B" VOLTAGE; 22½ to 45 volts
WAVELENGTH RANGE; 200 to 550 meters
NUMBER OF TUNING CONTROLS; three
"A" BATTERY CURRENT USED; 1.25 amperes
"B" BATTERY CURRENT USED; 20 milliamperes



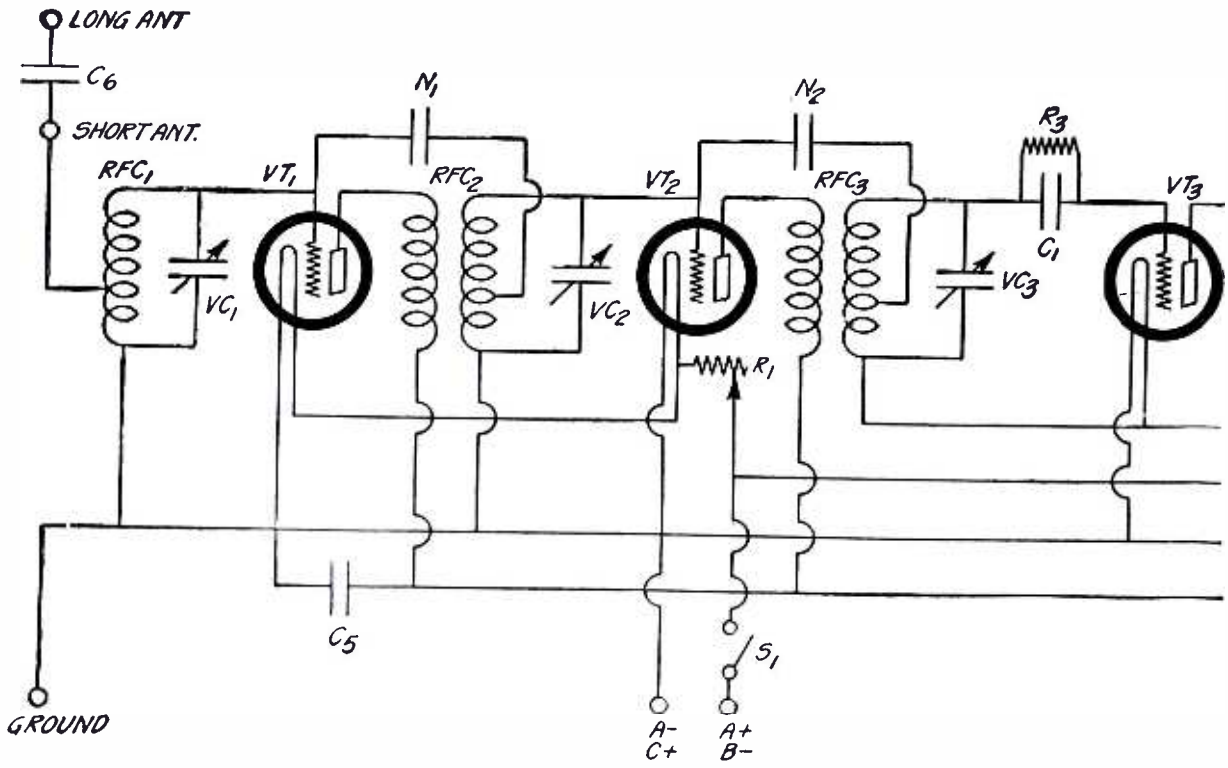
Howard Neutrodyne Receiver

MANUFACTURER'S NAME; Howard Mfg. Co., Inc.
MODEL; models A, B and C
NUMBER OF TUBES; five
TYPE OF TUNING; three dial neutrodyne
TYPE OF DETECTOR; UV-201-a or C-301-a
RANGE ON PHONES; coast to coast
RANGE ON LOUDSPEAKER; coast to coast
COST COMPLETE; $200.00
ANTENNA RECOMMENDED; 50 feet single wire
KIND OF TUBES FOR R. F.; UV-201-a or C-301-a
DETECTOR TUBE; UV-201-a or C-301-a
AUDIO TUBES; UV-201-a or C-301-a
TYPE OF "A" BATTERY; 6-volt storage
TYPE OF "B" BATTERY; 90-volt dry or storage
DETECTOR "B" VOLTAGE; 45 volts
WAVELENGTH RANGE; 200-600 meters
NUMBER OF TUNING CONTROLS; three
"A" BATTERY CURRENT USED; 1¼ ampere
"B" BATTERY CURRENT USED; 12 milliamperes



No. 100 Neutrodyne Receiver

MANUFACTURER'S NAME; Wm. J. Murdock Co.
MODEL NAME; No. 100 Neutrodyne
NUMBER OF TUBES; five
TYPE OF TUNING; 3 dial neutrodyne
TYPE OF DETECTOR; vacuum tube
RANGE ON PHONES; 3,000 miles
RANGE ON LOUDSPEAKER; 1,500 miles
COST; $100.00 with loudspeaker but without batteries or tubes
ANTENNA RECOMMENDED; 60 to 100 feet
KIND OF TUBES FOR R. F.; UV-201-a Radiotrons
DETECTOR TUBE; 201-a Radiotrons
AUDIO TUBES; UV-201-a Radiotrons
TYPE OF "A" BATTERY; storage
TYPE OF "B" BATTERY; regular
DETECTOR "B" VOLTAGE; 22½ volts
WAVELENGTH RANGE; 150 to 650 meters
NUMBER OF TUNING CONTROLS; three
"A" BATTERY CURRENT USED; 1¼ amperes
"B" BATTERY CURRENT USED; 10 to 15 milliamperes



THE WIRING DIAGRAM OF THE COMPLETE RECEIVER

The hook-up for the Freed-Eisemann receiver. The designating letters shown in this diagram are as follows:

RFC 1—Antenna coupling coil;
RFC 2 and RFC 3—Tuned radio-frequency coupling coils, (neutroformer);
VC1, VC2 and VC3—Variable condensers;
VT1, VT2, VT3, VT4 and VT5—UV-201-a or C-301-a vacuum tubes;
C1, C2, C3, C4 and C5—Mica fixed condensers;
R1 and R2—Filament rheostats;
S1—Battery switch;
S2—Amplifier jack switch;
R3—Grid-leak resistance;
J—Loudspeaker or phone jack;
AFT1 and AFT2—Audio-frequency amplifying transformers;
H1 and H2—Neutralizing condensers.

HOW TO GET THE MOST OUT OF

YOUR READY-MADE RECEIVER

No. 8: THE FREED-EISEMANN RECEIVER

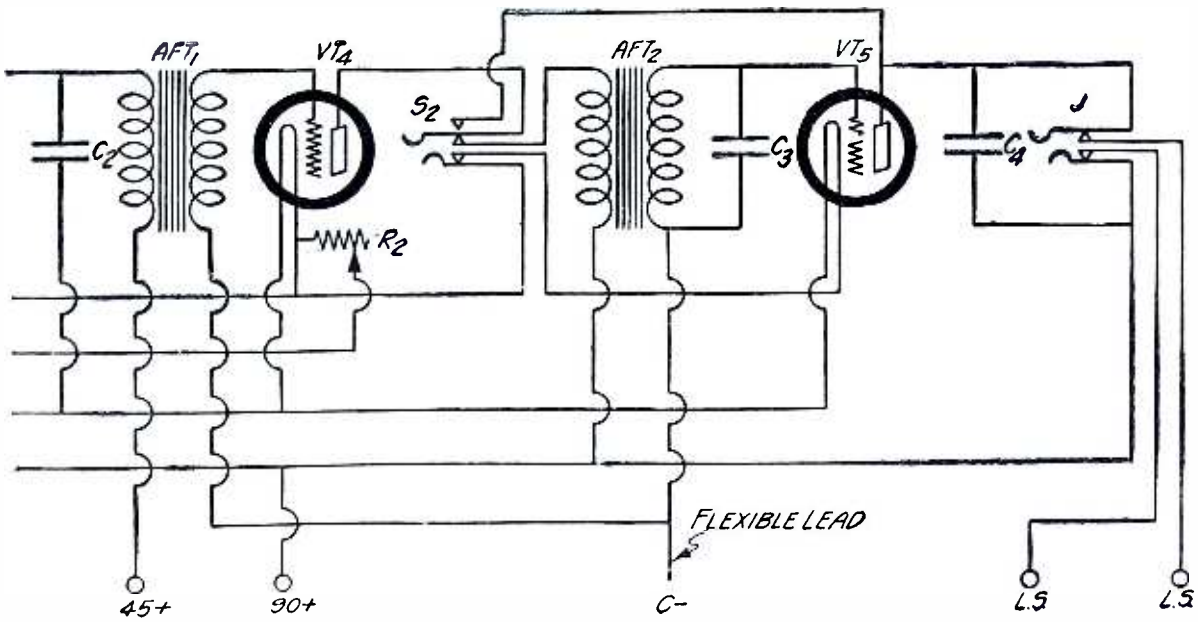
This series of articles explains the theory, operation, equipment and care of standard receiving sets

This series does not indorse the product of any manufacturer or make comparisons between receivers. The sets already described include: No. 1, the Eagle Neutrodyne; No. 2, the Radiola Superheterodyne; No. 3, the Melco Supreme; No. 4, the Crosley Trirdyn; No. 5, the De Forest Reflex; No. 6, the Atwater Kent; No. 7, the Grebe Synchrophase.

By S. GORDON TAYLOR

THE Freed-Eisemann receiver, model NR 20, is of the tuned radio-frequency type and makes use of five vacuum tubes.

The neutrodyne method of preventing oscillation in the radio-frequency amplifier is employed in this set. In view of the fact that two other receivers which employ the neutrodyne principle have already been described in this series of



articles, it will not be necessary to repeat the theory of operation nor to again describe the course of the signal through the receiver and the action of the individual parts.*

Construction of the Receiver

This receiver is designed for home use; it is not designed for use as a portable. The cabinet is of mahogany and is a massive and ornamental affair. The top raises up to permit access to the inside for the purpose of inserting the vacuum tubes and other parts. In addition there is a front door that covers the entire panel. This panel is lowered to permit access to the tuning dials and other panel controls. When the receiver is not in use the front door may be closed, thus concealing all of the tuning controls and at the same time protecting them from dust.

The receiver itself is mounted entirely on the panel and is completely assembled and wired before being placed in the cabinet. The binding posts for connections to the batteries and other parts are mounted on long shafts which extend out through holes provided in the rear wall of the cabinet; connections to these posts are made from the outside rear of the cabinet.

The Antenna and Ground

The antenna for use with this receiver may be anything from a short wire stretched along the picture moulding of one or more rooms, to a regular outdoor antenna up to 100 feet in length. For local reception a short outdoor antenna or even an indoor antenna will give results practically equal to those obtained with the larger outdoor type. For reception from distant stations, however, the longer antenna will be found best. Such an antenna is illustrated in Figure 1.

To find out which is the best ground connection in any particular location, try all that are within convenient reach of the receiver. The cold water pipe is usually best, but hot water pipes, radiators or pumps will in many cases serve equally well. If none of these are available, a pipe driven several feet into fairly moist earth will do, or a coil of copper wire suspended in the water of a well.

The antenna should be well insulated

*Readers who want this information are referred to the articles of this series which appeared in POPULAR RADIO for December 1924 and August 1925.

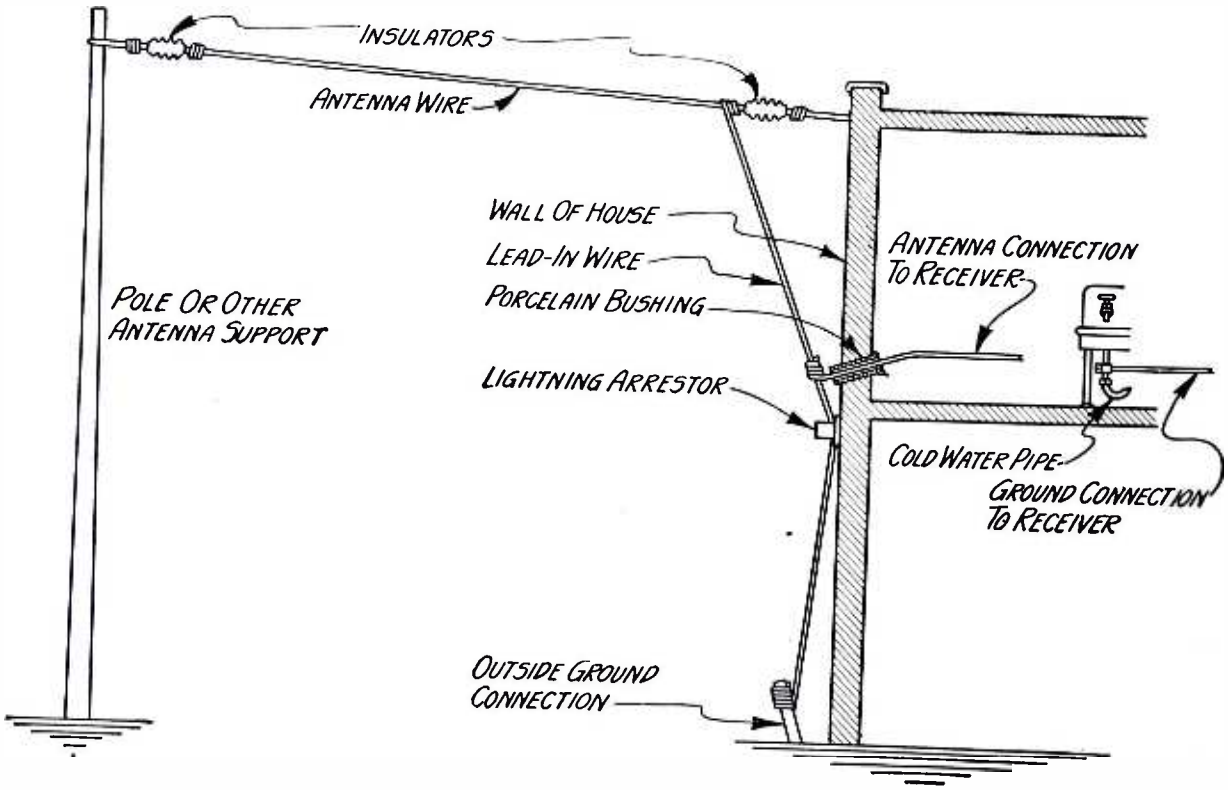
from its supports and the lead-in wire should either be a continuation of the antenna wire or else securely soldered to the antenna wire, to prevent corrosion at the joint. Before making the actual installation of the outdoor antenna it is advisable to make inquiries as to the requirements of the local rules of the fire underwriters. These require the use of a lightning arrester with an outdoor antenna and sometimes require that the arrester be installed on the outside of the house with a ground connection from the arrester to a point outside of the house. These requirements vary in different localities, but in any case the desired information may be obtained from the local fire insurance agents.

The Tubes That Are Used

The Freed-Eisemann receiver is designed for the use of the 201-a type tubes in all five sockets. These may be either UV-201-a, C-301-a or the De Forest DV2. "Soft" detector tubes, such as the UV-200 or the C-300 cannot be used, nor can power amplifier tubes such as the VT2 or 216-a be used. These limitations are due to the fact that the rheostats incorporated in the receiver have insufficient current carrying capacity for these tubes, which require comparatively high filament current.

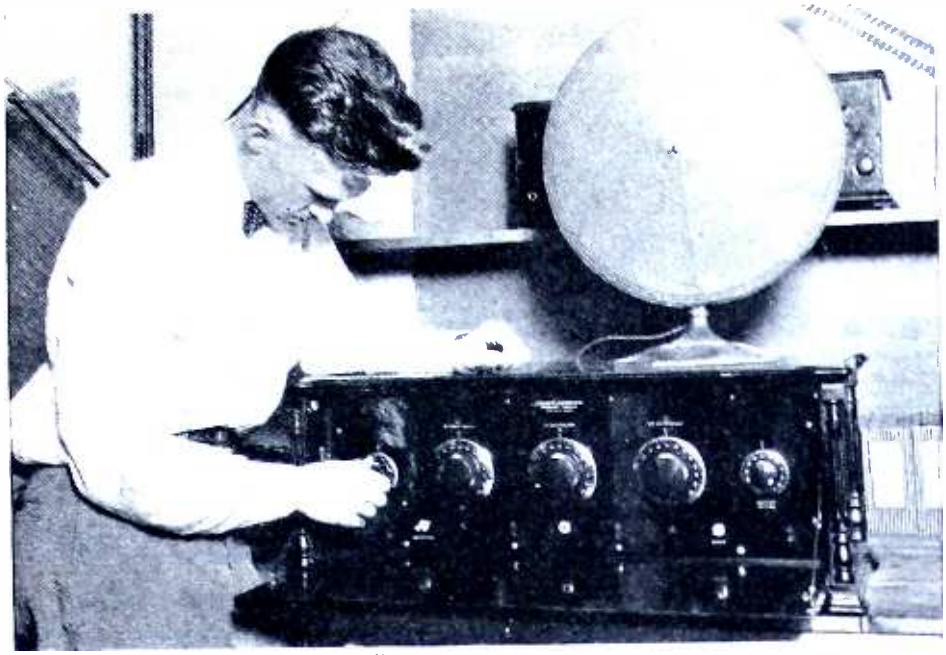
What Batteries to Use

For lighting the filaments of the vacuum tubes, a six volt storage battery is required, preferably with a capacity of not less than 60 ampere hours. The filament current consumption of the receiver is approximately 1¼ amperes an hour when all five tubes are in use. This means that, in theory, with a 60 ampere hour battery the receiver can be operated for close to 50 hours from a single charge of the battery. Actually it is not advisable to keep the battery in use until it is completely discharged, as a total dis-



HOW TO ERECT AND BRING IN YOUR ANTENNA LEAD

FIGURE 1: *This shows how the antenna should be erected and how the lead-in is attached to the antenna and anchored near the window. From the insulator outside the house the lead passes through a porcelain tube or bushing that is set in a hole bored through the window shaft.*



From a photograph made for POPULAR RADIO

THE AUTHOR EXPERIMENTING WITH THE RECEIVER

After the set had been installed in the laboratory it was carefully tested on different types of aerials and different types of loudspeakers to determine the data that has been written up in this article to enable the prospective user to get the most practical benefit from his set.

charge is harmful to the battery. With such a battery the receiver should be used only about 40 hours before recharging the battery; this means that the battery should be recharged every ten days if the receiver is used four hours a day. The advantage of using a battery with higher ampere hour capacity is therefore evident. A 100 ampere hour battery is probably the most practical size.

The storage battery requires little care other than occasional recharging. Every month or two it will be necessary to add a little distilled water to each of the three cells of the battery to keep the level of the electrolyte above the tops of the plates. It is never necessary to add acid.

A check is kept on the state of charge of the battery by means of a hydrometer. This little instrument shows the specific gravity of the electrolyte and therefore indicates the amount of charge in the battery because the specific gravity fluctuates in a known proportion with the charge and discharge of the battery. When the battery is fully charged the hydrometer should read approximately 1,285, and will drop to about 1,150 when the battery is fully discharged. The state of charge should always be kept between maximum and 1,185 for best results and prolonged life of the battery.

To provide the high voltage plate supply "B" batteries are necessary and may be of either the dry-cell or the storage type. The first cost of the former is lower but the storage batteries will be the cheapest in the long run, because instead of throwing them away when they become run down, they can be recharged for a few cents. Thus the life of storage "B" batteries is figured in years rather than weeks or months.

If dry-cell "B" batteries are used they should be either the "large" size or the extra large "heavy duty" type. The "heavy duty" type are more economical as shown in the accompanying tabulation. While their first cost is some higher, their life is much greater.

In any event, the total required "B" battery voltage is 90. In the case of dry-cell batteries this will mean two of the 45 volt blocks while in the case of the storage "B" batteries, which are usually made in 24 volt blocks, four will be

needed. In this latter case the total voltage will be approximately 96, which is close enough.

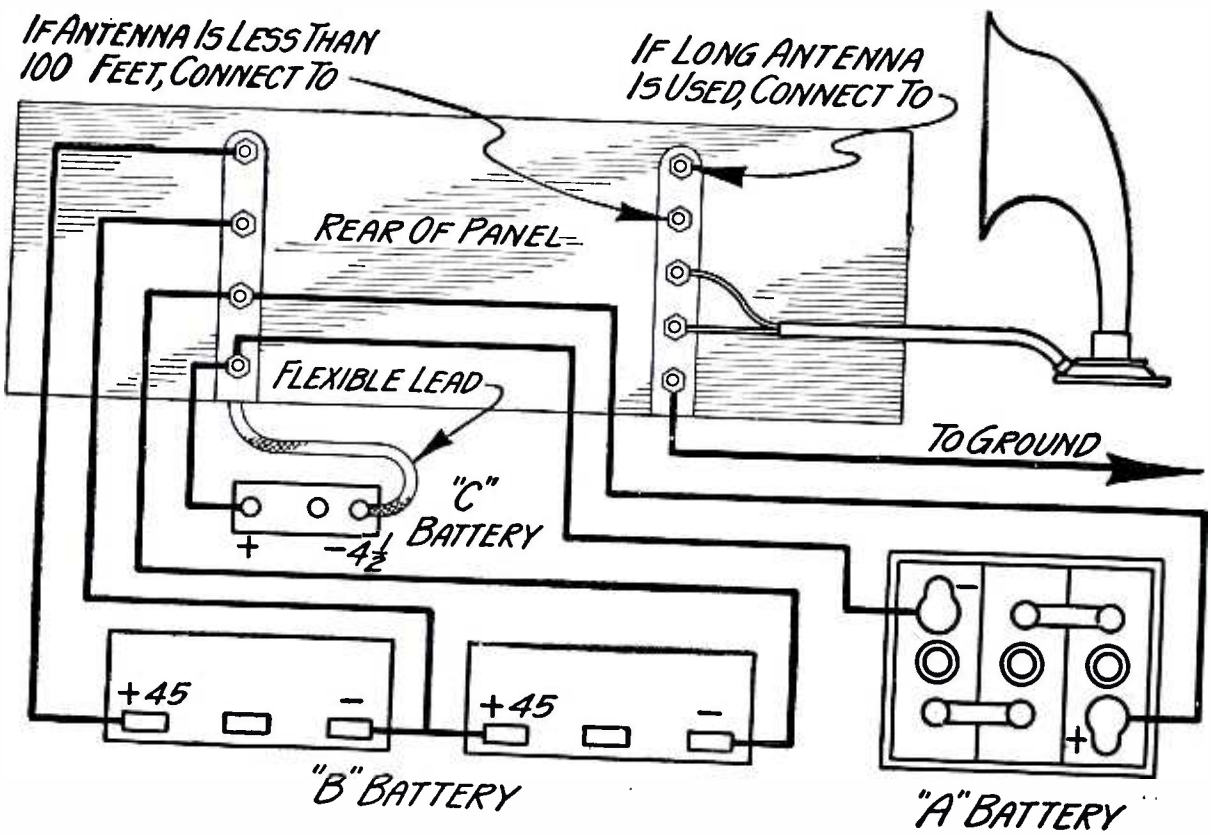
Some owners may wish to equip their receivers with a "B" battery eliminator in place of the "B" batteries. In such a case the eliminator should be purchased with the understanding that the price will be refunded if the eliminator fails to function properly during an actual trial at the home of the purchaser.

Provision is also made for the use of a so called "C" battery. This is a small dry-cell battery of 4½ volts and is used to provide the proper grid bias to the audio amplifier tubes, thus serving two most useful purposes: *First*, by maintaining the tube at the proper bias, which tends to improve tone quality and volume; *Second*, by prolonging the life of the "B" batteries, because the "B" battery current drain is reduced through the action of the "C" battery. The current drain on the "C" battery itself is almost zero and its life is therefore great —usually somewhere in the neighborhood of a year. The economy effected through the use of a "C" battery with the Freed-Eisemann receiver is shown in the accompanying tables.

How to Operate the Receiver

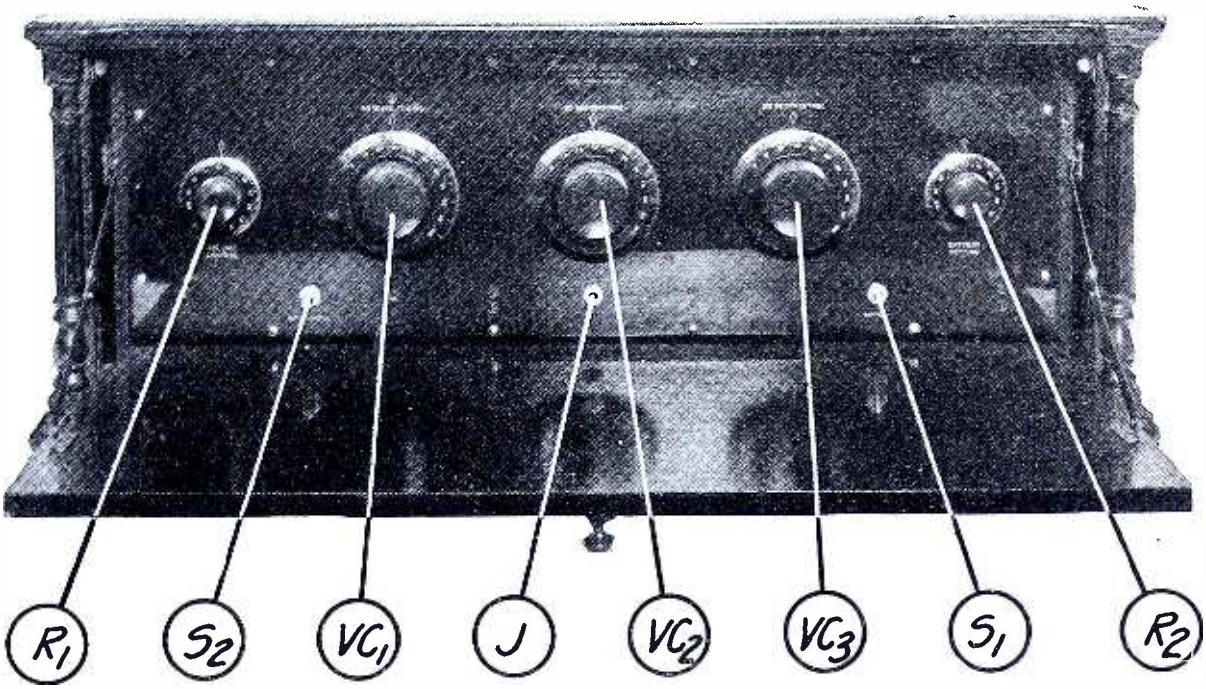
In putting the receiver into operation, connections are first made from the receiver to the antenna, ground, batteries and loudspeaker as shown in Figure 2. Be sure that connections are made exactly as shown, otherwise there will be trouble — especially if the "A" battery connections from the receiver are connected to the "B" battery instead of the "A" battery. The penalty may be one or more tubes ruined.

The filament supply current from the "A" battery is then turned on. This is accomplished by first pulling out the



THE BATTERY HOOK-UP

FIGURE 2: *How to connect the "A," "B" and "C" batteries to the rear of the receiver. Check up before actually using the set to make positive that you have the terminals connected exactly as shown in this diagram; then you will have no trouble with burned out tubes.*



THE PANEL VIEW OF THE RECEIVER

This picture shows the set with the front flap let down as in operation. The three principal controls are VC1, VC2 and VC3 while the rheostats R1 and R2 control the volume and quality.

knob of the battery switch in the lower right hand corner of the panel, and then turning the knobs of the two rheostats in a clockwise direction to about 40 on their dials. Now insert each of the five tubes in the first socket to make sure each lights properly.

The next step is to insert the five tubes in their proper sockets. Place them in their sockets so that the pin on the side of the tube slips down in the slot provided in the side of the socket. Then press down as far as possible and turn tube to the right as far as it will go. Thus it is securely locked in place. The rheostat knobs are then turned up to about 70.

Now the tubes should all light up, provided the knob of the "amplification" switch is pulled out, and all is in readiness to tune in the broadcasting stations. If the "amplification" knob is in only four of the tubes will light. By referring to the chart near the end of this article the approximate settings of the three large dials for a number of broadcasting stations will be found. These readings were made with the receiver shown at the beginning of this article and should correspond very closely with those of any other Freed-Eisemann receiver of this type. At least this is true of the settings of the second and third dials. The setting of the first will vary according to the antenna used.

It is advisable to first try tuning in a local station which is known to be "on the air" at the time. Find its dial settings on the chart, or the dial settings of another station operating on the same or near wavelength. When it is heard readjust each of the three dials until the greatest volume of sound is obtained. This setting will be the proper one for that station. If the station is not heard at all, even after considerable "feeling around" with the dials, it is evidence that something is wrong in the connections to the batteries, or in the tubes, and they should be checked over carefully.

Assuming that the first station has been successfully tuned in, it is well to repeat the operation on a number of stations until the method of tuning becomes familiar. Be sure and keep a record of

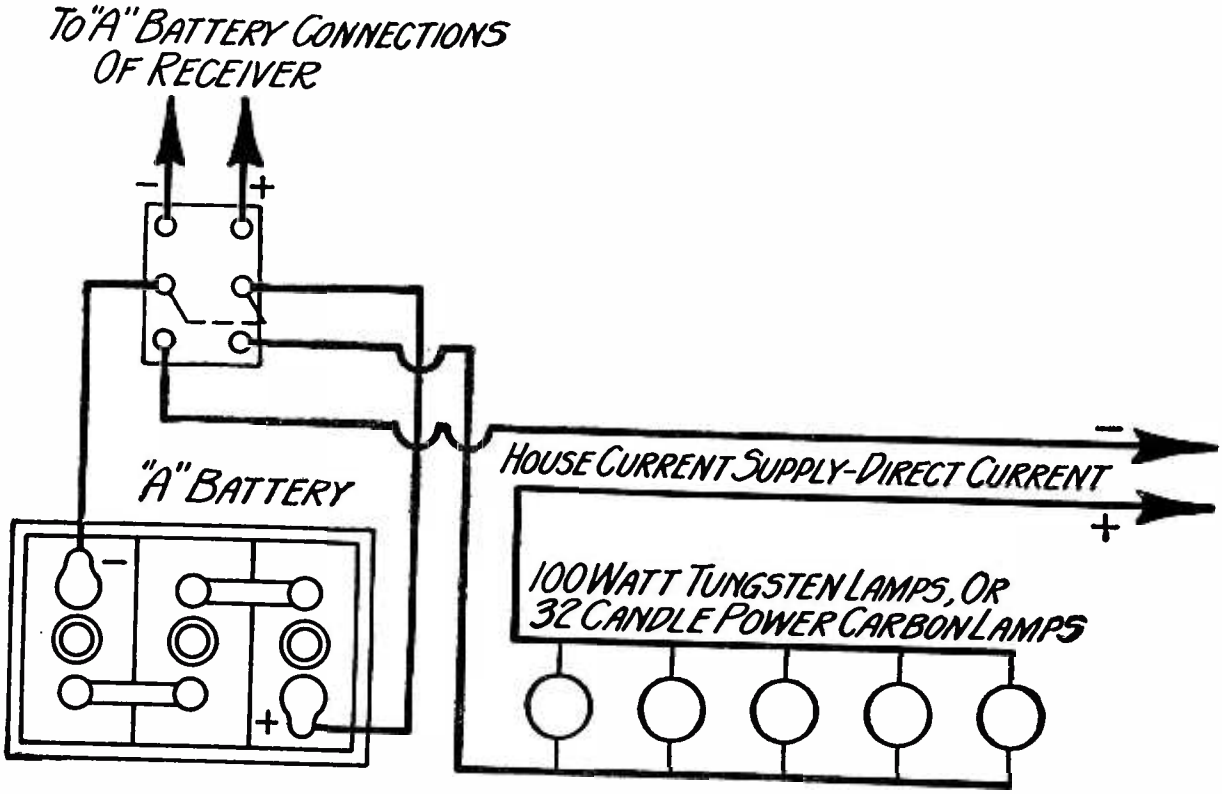
the dial settings at which each station is tuned in so that the same station may be tuned in again if desired, without the necessity for hunting around.

Now for a little investigation of the other controls—and a word or two of advice regarding them.

Under ordinary conditions this receiver will deliver more than ample volume of sound in the case of reception from local stations. If it is operated at full blast on the locals the tone quality will be sacrificed because the average loudspeaker cannot handle such volume satisfactorily, especially if it be operated in a small room with the acoustic qualities of the average room. Secondly too great volume is uncomfortable to the ear of those who may not be used to listening to the receiver.

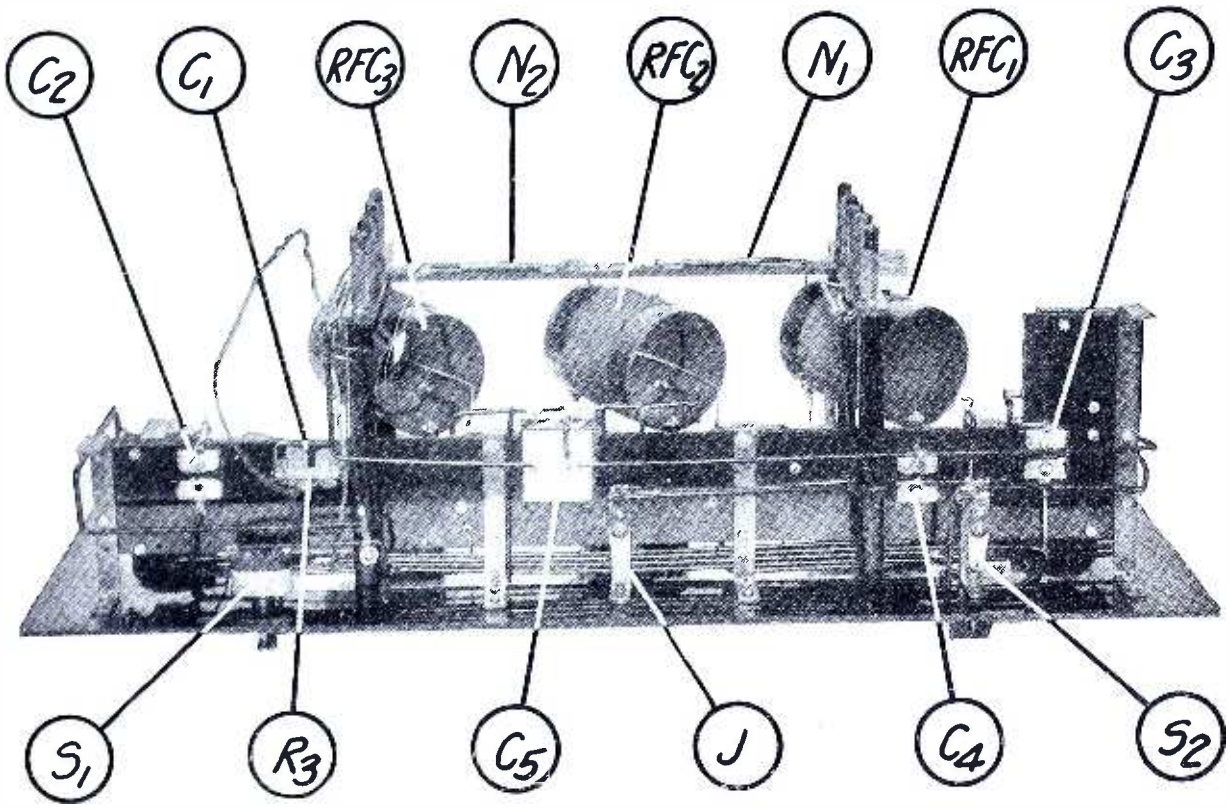
The upkeep cost of the receiver can be greatly reduced by keeping the volume at a point where it is comfortably audible. In the case of local reception this is accomplished by pushing the "amplification" knob all the way in, or by turning the "volume control" dial in an anti-clockwise direction until the volume is reduced to the proper point. By following the former plan the last tube is automatically cut out of the circuit and its filament extinguished. The drain through the rheostat (R2) is thus reduced and this rheostat should be turned back (anti-clockwise) about 20 degrees on its dial. The best plan for ordinary use, however, is to leave the "amplification" knob pulled out and to control the volume by means of the volume control dial. This provides a smooth regulation of volume to just the degree desired and results in just as economical operation so far as "B" battery consumption is concerned—and this is the largest item of upkeep cost—as would result from using the "amplification" knob to reduce the volume.

When the receiver is to be turned off it is necessary only to push in the knob marked "battery." The rheostats may be left in their regular operating position



HOW TO CHARGE THE BATTERIES WITH DIRECT CURRENT

This diagram shows the proper connections for charging the storage "A" battery from 110 volt direct-current lighting lines. If you have alternating current in your home, the battery should be connected as shown in any of the preceding articles of this series.



VIEW OF THE RECEIVER FROM UNDERNEATH

This picture gives the general construction features of the Freed-Eisemann Neutrodyne receiver as viewed from below. The mounting and spacing of the coils are clearly shown as well as the method of supporting the sub-panel.

because the battery switch cuts off the entire receiver from the "A" battery circuit. Also, when the "A" battery is disconnected by means of this switch the "B" batteries are in effect cut off also, as no current can flow from the "B" battery unless the tube filaments are lighted.

The loudspeaker may be connected to a phone plug and plugged into the jack at the center of the lower edge of the panel, or it may be connected without a plug to the two binding posts that are provided for this purpose at the back of the receiver. Results are the same in either case. If desired, the headphones may be plugged into the jack whether or not the loudspeaker is connected at the back of the receiver. This is a convenience as it is sometimes desirable to use headphones in tuning in distant stations. When this is done, however, the "amplification" knob should be pushed all the way in and the "volume control" knob will probably have to be turned back somewhat to reduce the volume to a comfortable degree for use with the headphones.

In any case the two rheostat dials (R1 and R2) should be kept at as low a setting as possible, consistent with good volume.

In this way the lives of both the "B" batteries and the vacuum tube filaments will be greatly prolonged and the "A" battery will give somewhat longer service on a single charge, although this last is not important if the owner has a battery charger.

Another item that effects economy of operation is the little "C" battery.

While this battery is small and lasts for a long time its influence on the entire receiver is marked. It affects tone quality, volume and "B" battery life materially. The accompanying table showing the approximate life of "B" batteries demonstrates the effect of the "C" battery on the economical operation of the receiver. It will be noted that the life

of the "B" batteries increases with increased voltage of the "C" battery; therefore it is most economical to use the full 4½ volts of the "C" battery. On the other hand the best tone quality is frequently obtained with only 1½ or possibly 3 volts of "C" battery. It is further up to the owner to experiment a little to determine whether 1½, 3 or 4½ volts of "C" battery give the most satisfactory results. Indeed the tone quality without any "C" battery at all may prove more desirable than the greater volume and economy obtained when the "C" battery is used.

Selectivity

When an antenna 100 feet in length is used, and is connected to the binding post at the back of the receiver marked "short antenna," it may be found that two stations separated less than 10 meters apart in wavelength will interfere with each other, especially if one is a powerful local station. In that case the antenna should be connected to the "long antenna" binding post. Thus connected, there will be ample selectivity.

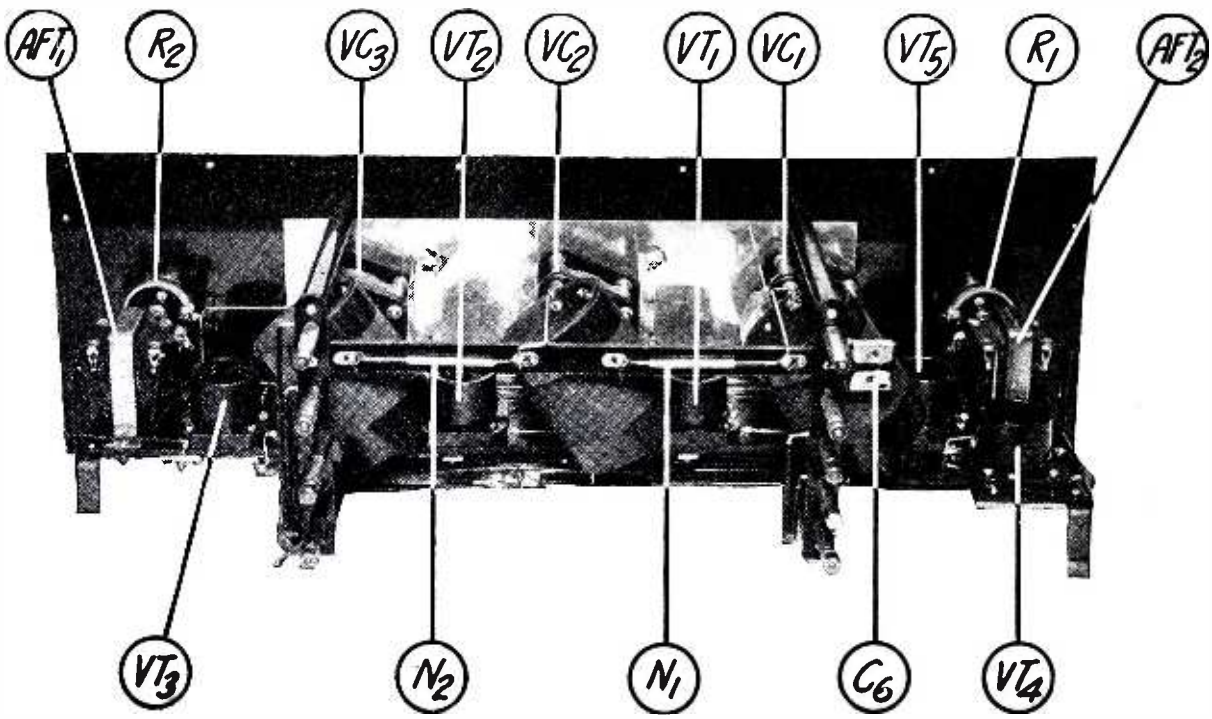
If the antenna be only 60 or 70 feet in length there will probably never be occasion to use the "long antenna" connection. Best results are obtained with the antenna connected to the "short antenna" terminal, provided it is found that selectivity is satisfactory in this case.

Charting the Receiver

Under the head of "How to operate the receiver" it was suggested that a record of the dial settings for each broadcasting station be kept, in order that the same stations may be tuned in again at will without the necessity of hunting around for them.

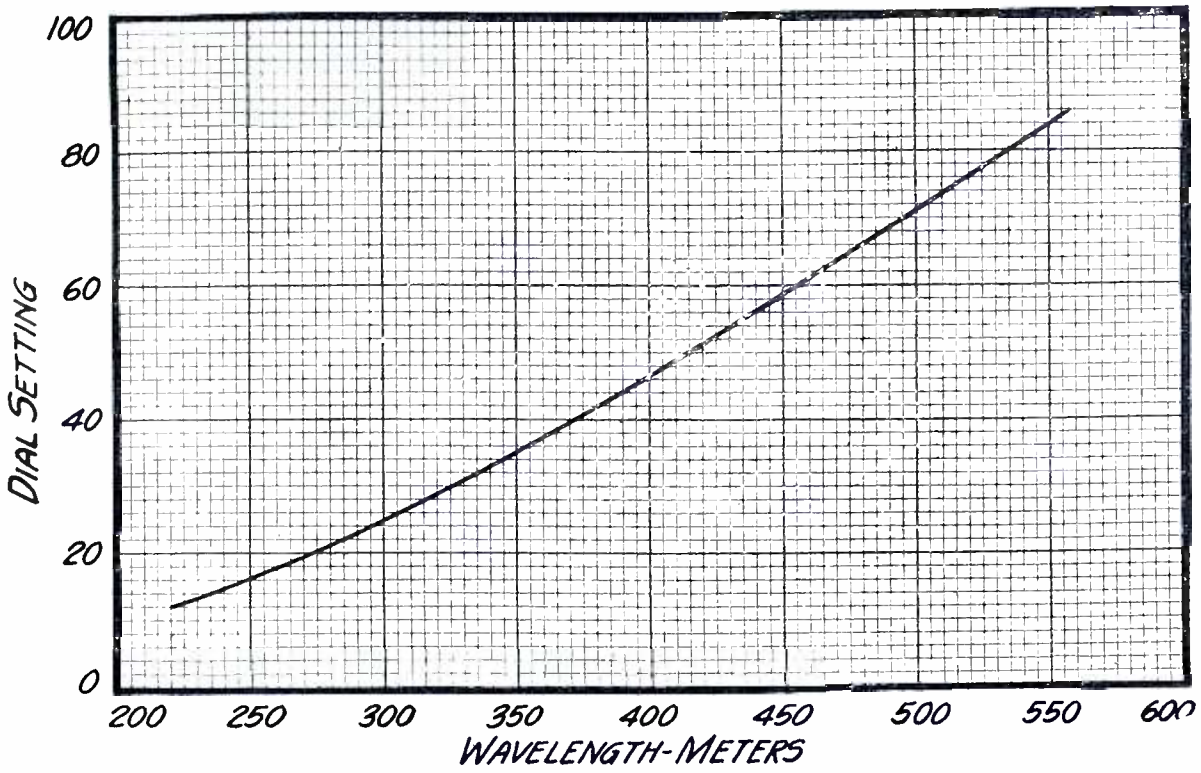
It is well to keep this record in a convenient form so that it constitutes a tuning chart. An approximate chart is shown on page 253. A better form of record, however, is one which lists the actual settings of each of the three dials, as the settings may be different.

It is advisable to jot down the settings



VIEW OF THE SET FROM THE REAR

In this picture the reader may clearly see the method of shielding the three tuning units, VC1, VC2 and VC3 and also the arrangement of the sockets and the transformers, which are mounted directly upon the top of the sub-panel. The designations of the various parts are the same as shown in the other diagrams, in the list of parts and in the text.



A TUNING CHART FOR THE RECEIVER

This gives the approximate setting for the three dials, VC1, VC2 and VC3 for tuning in the various wavelengths used in broadcasting. The first dial setting may be a little higher or a little lower than shown in this curve on account of the varying lengths of antenna that may be used with the receiver; however, the setting given above will be approximate for all three dials.

APPROXIMATE "B" BATTERY LIFE OF THE FREED-EISEMANN NR 20 RECEIVER

AVERAGE HOURS USE PER DAY	"LARGE" BATTERIES			"HEAVY DUTY" BATTERIES		
	2 hours	*3 hours*	*4 hours*	*2 hours*	*3 hours*	*4 hours*
No. "C" battery	68 days	38 days	20 days	147 days	84 days	52 days
1½ volt "C"	81 "	46 "	26 "	164 "	96 "	60 "
3 volt "C"	91 "	52 "	31 "	179 "	107 "	68 "
4½ volt "C"	107 "	63 "	39 "	203 "	123 "	81 "

Measurements made with 90 volts of "B" battery, varying "C" battery voltage from 0 to 4½, "amplification" switch pulled out and both rheostats set at 70.

Same conditions as in Table I except with the "Amplification" switch pushed in.

AVERAGE HOURS USE PER DAY	"LARGE" BATTERIES			"HEAVY DUTY" BATTERIES		
	2 hours	*3 hours*	*4 hours*	*2 hours*	*3 hours*	*4 hours*
No. "C" battery	99 days	59 days	34 days	190 days	114 days	73 days
1½ volt "C"	107 "	63 "	39 "	203 "	123 "	81 "
3 volt "C"	115 "	69 "	43 "	215 "	130 "	88 "
4½ volt "C"	130 "	77 "	51 "	237 "	148 "	100 "

Inasmuch as the cost of "B" battery replacement is practically the entire upkeep cost of the receiver, the above tables will be of interest. The conclusion to be drawn from the tables is: To attain maximum economy, use 4½ volts of "C" battery and keep the "amplification" switch pushed in wherever this will provide sufficient volume. Also, don't start the receiver going early each evening and leave it going until bedtime unless someone is actually listening.

for each station as it is tuned in for the first time. After this has been done for a few evenings a new record should be made listing all the stations that have been recorded in some convenient order. This may take the form of a list arranged alphabetically according to station calls, or it may list the stations in the order of their wavelengths with the highest wavelength stations first. If one is not familiar with the wavelengths of the different stations, or if someone other than the maker of the record will have occasion to use it, the alphabetical arrangement will probably be best; one can easily determine which form is most suitable to his needs.

After this list has been made up it will need to be revised occasionally as new stations are tuned in for the first time, in order that the dial settings of these new stations may be entered in their proper place on the record.

The important item is to note the dial settings for every station received. Otherwise, when it is desired to listen in on the program of one particular station, several minutes may be spent in trying to locate it on the dials. This in itself does not seem a serious matter but every operator of a receiver knows the embarrassment of having to "fish around" in front of company, when one of the guests asks to hear some particular distant station. If the operator can, by referring to his tuning chart, set the dials immediately for the desired station it is much more pleasant for everyone concerned.

United

A UNIQUE USE OF RADIO IN THE BUSINESS OFFICE

Henry Ford maintains the largest private radio system in the country. His station at Dearborn, Mich., is in constant communication with six of his plants and his four lake ships. Communicating in private code, Ford is said to be able to save large sums yearly. In each of his stations are installed electric typewriters which transmit the messages to other reproducing typewriters in the various plants.

Call Letters That Have a Past

By LAWRENCE A. CORRIDON

Call letters that were originally assigned to ships that have met disaster are seldom re-assigned to other ships, in deference to the superstitions of seamen. They are, however, now assigned to broadcasting stations. For example:

KJS, now assigned to the Bible Institute of Los Angeles, was formerly used by the steamer *North Star* in transmitting an important message when on a foggy morning in August, 1919, a call for immediate assistance was sent out by the radio operator of the vessel. Radio played an important rôle in the rescue of all of the 348 persons on board.

WSB, now assigned to the station of the *Atlanta Journal*, was formerly assigned to the steamer *Francis H. Leggett* which foundered off the Oregon coast on September 18, 1914, with 67 persons on board, two of whom were lost. After this wreck the call signal was re-assigned to the steamer *Firwood* which burned off the coast of Peru on December 18, 1919, with 28 persons on board, none of whom were lost.

WHN, now used by the station of Loew's Theatre, New York City, was at one time assigned to the steamer *Hanalei* which was wrecked. It was later used by the steamer *Santa Isabel* which was sold to citizens of Chile. When a vessel is sold to a foreign country, the country to which it is sold assigns its own letters to the vessel's station.

KLZ, Reynolds Radio Co., Denver, Col., was the call of the steamer *Speedwell* in 1920. KLZ and SOS were an important combination of signals on September 29 of that year when the *Speedwell* was caught in a tropical hurricane in the Gulf of Mexico. This storm was so severe that after the distress call and position of the vessel were sent out the engine room became flooded, the dynamo ceased to work and the sea carried away the whole after-deck, taking with it the storage batteries which were necessary to operate the radio station. This catastrophe caused the loss of nine lives, including the captain, mate, and two women passengers, out of 25 persons on board.

KGB, now assigned to the *Tacoma Daily Ledger*, was at one time used by the steam screw *D. N. Luckenbach* which was sunk by a submarine about 100 miles off the French coast on December 27, 1917.

WGR, Federal Telephone Manufacturing Co., Buffalo, N. Y., was used by the passenger steamer *Governor* prior to its assignment to the broadcasting station. The *Governor* was sunk in a collision with the freighter *West Hartland* in April, 1921. Eight lives were lost. No doubt some old-time operators recollect when WGR was heard up and down the Pacific coast.

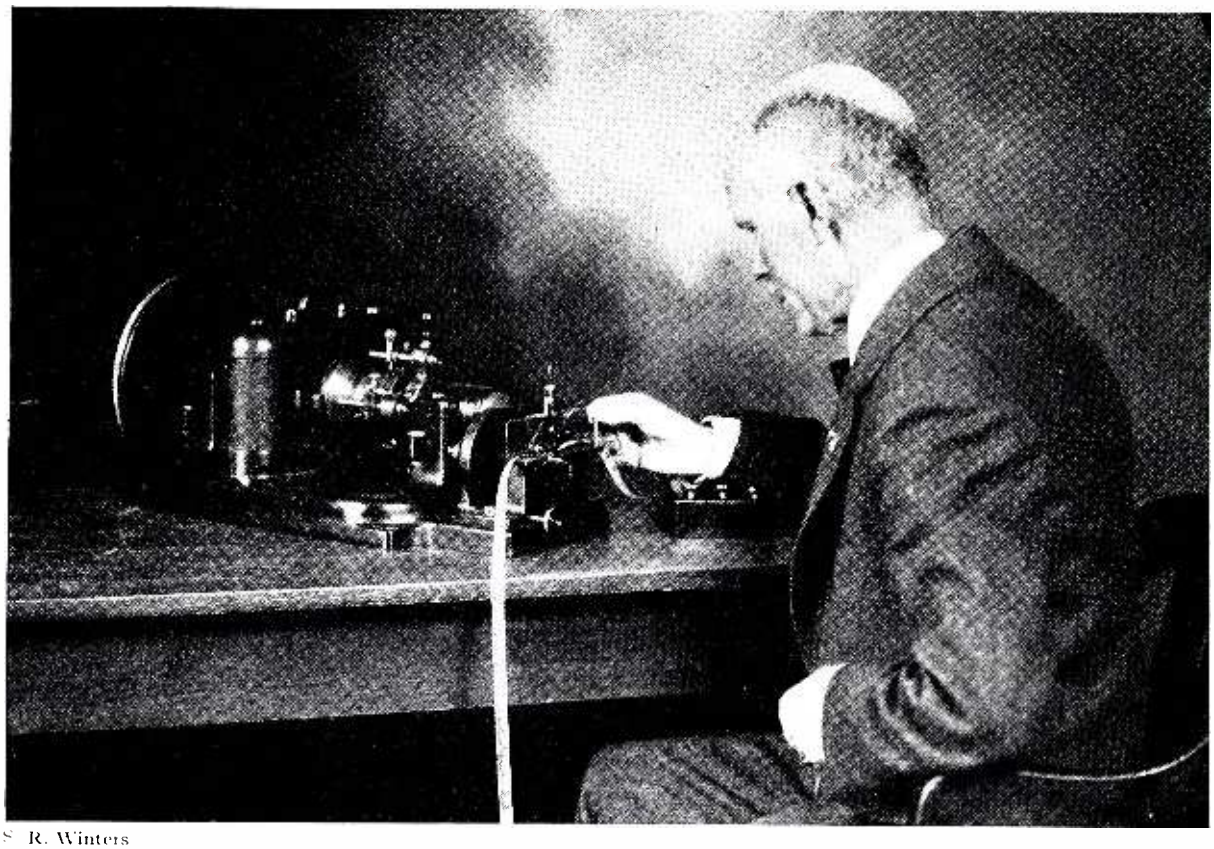
WWJ was once the call of the steamer *Peru;* it is now used by the *Detroit News* station. The *Peru* was transferred to the French flag, causing the cancellation of the call letters of the United States.

KLS, now assigned to the *Oakland Tribune*, was formerly assigned to the steamer *Kermanshah* which was transferred to the Hungarian flag.

KNX, *Los Angeles Evening Express*, was formerly used by the vessel *Susana* which was sold to citizens of Italy.

KOB, New Mexico College of Agriculture and Mechanic Arts, State College, New Mexico, was used by the steamer *Princess Anne* up to the time she stranded on Rockaway Shoals, Long Island, February 6, 1920, with 106 persons on board none of whom were lost. The *Princess* broke in two and the cargo, valued at $500,000, was practically a total loss.

KRE, *Berkeley Gazette*, Berkeley, Cal., was at one time assigned to the steam screw *Florence H.* which was blown up by an internal explosion in Quiberon Bay, France, April 17, 1918, causing the loss of 45 lives out of 77 on board.



S. R. Winters

INVENTIONS BY PUBLIC OFFICIALS MAY BECOME PUBLIC PROPERTY

The value of stock in radio enterprises that are based upon inventions and patents of men who were in the Government's employ are vitally affected by the recent court decision against Major General George O. Squier, whose "wired wireless" patents have been declared public property.

Riding to Riches by Radio

PART II

How much are the radio stocks that you own—or that you are thinking of buying—really worth? On what factors do their values depend? What is their value likely to be? In this series of two articles the author points out some of the points that every investor or prospective investor should consider before he buys.

By RALPH E. RENAUD

THE quickest way is to purchase the offered certificates, take them to your bank and ask how much they will lend you on them. But this is expensive and may subject you to insult. On the surface, at least, the proper examination of radio stocks does not differ from that suitable to any proposed investment. Perhaps the Golden Rule is: Don't believe the salesman. After that the first consideration should be the general financial position of the company. This includes the average earnings over a reasonable period, the progression of earnings in proportion to the outstanding capital, the current asset position, the latest available balance sheet and the relation of the funded debt to the capital stock. Then there is the question of management—how much brains, how much honesty and what sort of reputations are back of the enterprise? Marketability is also a factor in the radio field where changes have been so rapid.

Inventory is an item decidedly worth considering. A company which manufactures more sets than it can sell is to be avoided. These extra sets, above the prevailing market, may be carried as surplus or current assets, but they almost invariably mean loss. The only way to move such current assets is through sales, and in view of the fact that sales failure caused the accumulation the prospect is usually and obviously pretty poor. Perhaps nothing except yesterday's newspaper becomes obsolete more quickly than today's radio set. Even eggs keep better in storage.

When you have settled all these points to your satisfaction and are about to reach down into your pocket, stop one moment more. Consider the patent aspect of the stock. Ask yourself these questions:

1. What patents does the company control or under what patents are they licensed?
2. How basic are these patents?
3. Is the company equipped to conduct scientific research and thus build up its patent structure?
4. Am I about to buy a radio patent infringement suit?

Don't flatter yourself that you will ever be able to answer all these questions definitely or even approximately. The radio experts themselves, the boys who get a hundred dollars a day to contradict each other on the witness stand, can't answer them. The courts thus far have spoken obscurely and with many voices. Candidly, the patent situation is a mess.

But unfortunately for the buyer of radio stocks this patent situation must govern the future of his investment for two reasons. A patent is the most convenient nozzle in the world through which to pour water into a stock. And the patents under which any company operates may turn out any minute to be valueless or void. Nevertheless, in this labyrinth of patent litigation there are certain signposts which may serve to guide the investor toward peace and profit.

For the layman to grasp even the first syllable of the patent crossword puzzle it is necessary to go back a little way for a running start. Before the United States entered the war wireless communication in this country was controlled chiefly by the Marconi Company, a British concern. The Marconi Company, it is claimed, could not give efficient service because of faulty apparatus at both ends. It used the Fleming, or two electrode tube, but required to perfect its service at least two things which it never succeeded in getting—a three electrode vacuum tube, based on De Forest patents then controlled by the American Telephone and Telegraph Company, and the Alexanderson alternator, developed and controlled by the General Electric Company.

When the United States entered the war the government took over the Marconi stations and appealed to all manufacturers to disregard patent rights for the period of the conflict. Under the government guarantee of protection efficient radio apparatus was manufactured and many improvements perfected. All patents were, in effect, scrambled, and to this day they have never been satisfactorily unscrambled.

After the war the British Marconi Company naturally sought to buy the rights to the Alexanderson alternator. Their advances were smiled upon. At this juncture Admiral Bullard stepped in with another patriotic appeal to the General Electric Company not to make it possible for American radio communication to fall wholly into the hand of foreign interests.

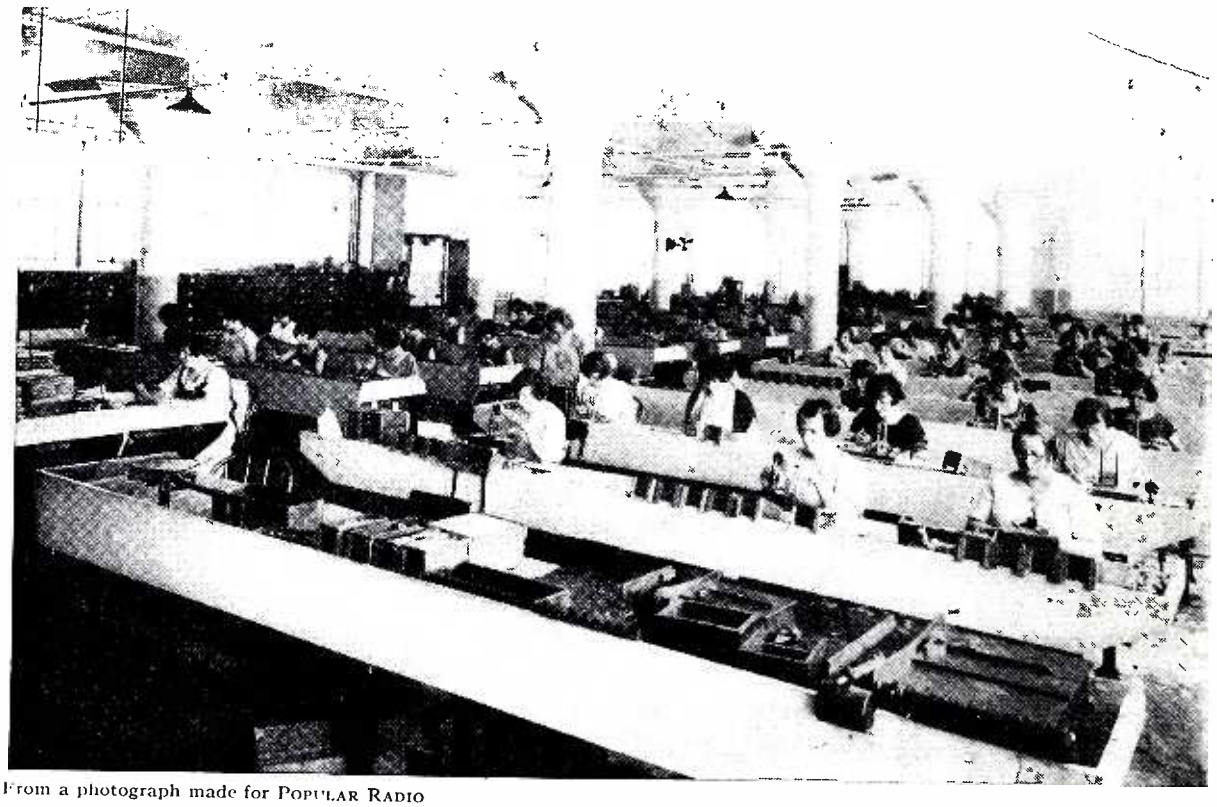
That appeal was the genesis of the Radio Corporation of America, the child of the General Electric. In 1919 all rights and physical assets of the Marconi Wireless Company of America passed to the new corporation, a strictly American organization, which thus started with control of both the Marconi and General Electric patents. Within two years thereafter, in one way or another, it acquired the radio patent rights of the American Telephone and Telegraph, the Wireless Specialty Apparatus, the Federal Telegraph Company, the Western Elec-

tric Company, the United Fruit Company, the Radio Engineering Company of New York, and the Westinghouse Electric and Manufacturing Company which, as far back as 1920, had developed radio receiving sets but couldn't sell them because the Radio Corporation controlled the vacuum tubes.

The chief elements in this combination, of course, are the General Electric, Westinghouse and the American Telephone & Telegraph Co. Agreements of the Radio Corporation with the General Electric run to 1947, with Westinghouse to 1945 and with A. T. & T. only until 1929. Under these agreements the Radio Corporation of America accepts 60 percent of its manufactures exclusively from General Electric and 40 percent from Westinghouse. Through its various connections it is said to control the rights to something like 2,000 patents, among them the highly important Armstrong Regenerator and the Fessenden Heterodyne.

Anyone might think all this consolidation, as in the case of the steel industry, might have tended to clarify and stabilize conditions. Far from it. Despite the fact that the Radio Corporation controls 2,000 patents there are thousands more which it does not control And always there are new ones. At this moment 2,247 radio patents are pending. In addition there are all the government patents, many foreign patents and the German patents seized during the war.

The legal confusion may be gauged by the present anomalous position of the Armstrong regenerative system, a basic circuit used in the bulk of modern sets. Lee De Forest has attacked it repeatedly as an infringement on prior patents of his own. One court has decided for the Radio Corporation. Another court in a different district has held for De Forest. The Court of Appeals has ruled for Radio Corporation and De Forest is attacking on another angle in still a different court.



From a photograph made for POPULAR RADIO

A COMPANY THAT PLAYED A CONSPICUOUS PART ON THE CURB

During the first four months of this year (1925) the stock values of the Dubilier Condenser & Radio Corporation (one room in whose factory is pictured above) fluctuated between 12⅞ and 35¼. Stocks in other companies varied between 2 and 17¾. How may the causes be ascertained—and anticipated?

It will be fully two years before the United States has adjudicated the main patents in dispute. Big issues in the radio industry are at stake. Radio Corporation, for example, is suing Hazeltine on the ground that the neutrodyne is an infringement on the Rice and Hartley patents which are held the pioneer inventions in the field of controlled regeneration. The Alexanderson tuned-radio-frequency is just about to be litigated. In fact, there are now approximately twenty big radio patent suits of which six are of the most vital importance.

The recent decision against Major General George O. Squier, refusing him the fruits of his wired wireless invention, largely because it was perfected through the expenditure of government funds, has also precipitated the fat into the fire with a sickening sizzle. Every radio inventor who was in public service, during the war, and there were many, now fears his patents may have become public property. The Latour patents have also risen to add another element of confusion to the prevailing madhouse atmosphere.

Dr. Marius C. A. Latour, a French scientist, formerly in the employ of the General Electric Company, recently visited us with the glad tidings that there was scarcely a receiving set in use here which did not infringe some of his eighty basic patents. The Radio Corporation thought they had exclusive rights to these, but Professor Latour differed. Finally, after long negotiations, four non-exclusive licenses were issued to the American Telephone and Telegraph Company, the Postal Telegraph Company (purely for wire use), the Radio Corporation and the Freed-Eisemann Company. It now develops that the Hazeltine Corporation has bought control of the Latour corporation and threatens suits against all unlicensed users of the Latour devices.

Obviously those who have really put constructive effort into radio development will use the courts to maintain their rights. A lot of patent claims are bound to blow up in the next two years, and among the

Kadel & Herbert

MILLIONS ARE INVESTED IN RADIO IN THE UNITED STATES

If you want to find out something of the value of the particular stock that you own, bring the stock certificates to a bank—and find out how much the bank will lend you on them. (The above picture was made in the plant of a concern that manufactures radio parts.)

fragments will be many fly-by-nights and pirates who have worked the stock game to the limit. Unhappily, some legitimate enterprises will also suffer.

But let us reason together. It isn't all hopeless. Radio will continue to develop despite the patent confusion and the industrial slump. Safety for the investor seems to lie inevitably with the big fellows, those which have the means to build up a broad patent structure, to defend it, and to prosecute extensive research.

Research, indeed, is the key to the future of radio. Systematic invention, as against empirical experiment, is almost bound to win. It is the laboratory against the work bench. Of course, outsiders will continue to invent, just as Professor Hazeltine did with his amazing mathematical formulas, but even there a scientist was at work. Amateur experiment is interesting, but it is also disorganized and sometimes

incompetent. The cleverest of the amateurs are pretty sure to find their way into somebody's research laboratory.

It is through research that what looks to be the next great step in radio will have been taken.

Now they are talking super-regeneration which enables us to make one tube do the work of three. It is true that no commercial super-regenerative sets have yet been manufactured and sold. But the problem is an engineering one which is bound to be solved. The new thorium filament tubes which use less current because their electronic efficiency is heightened, new methods of more efficiently exhausting these tubes are likewise the result of research. Clearly, the organizations which cannot produce these improvements are going to be left either without anything to sell or will be forced to sell their obsolete produce at a price too low to guarantee profit.

Other factors, too, now dimly moving beind the continuous curtain of time, will influence radio as a business and as an investment. There is, for example, the gradual shaping of public opinion, reflected in Congress, toward the great public utility group of industries. Will it be actively inimical, inclined to regulation, or merely passive? The Radio Corporation, summoned into being, or at least godmothered by one branch of the government, is now being examined as a monopoly in restraint of trade by another branch of the government, the Federal Trade Commission. Is this a symptom? Or is the change in character within the Commission itself and the postponement of the present proceedings the vital symptom?

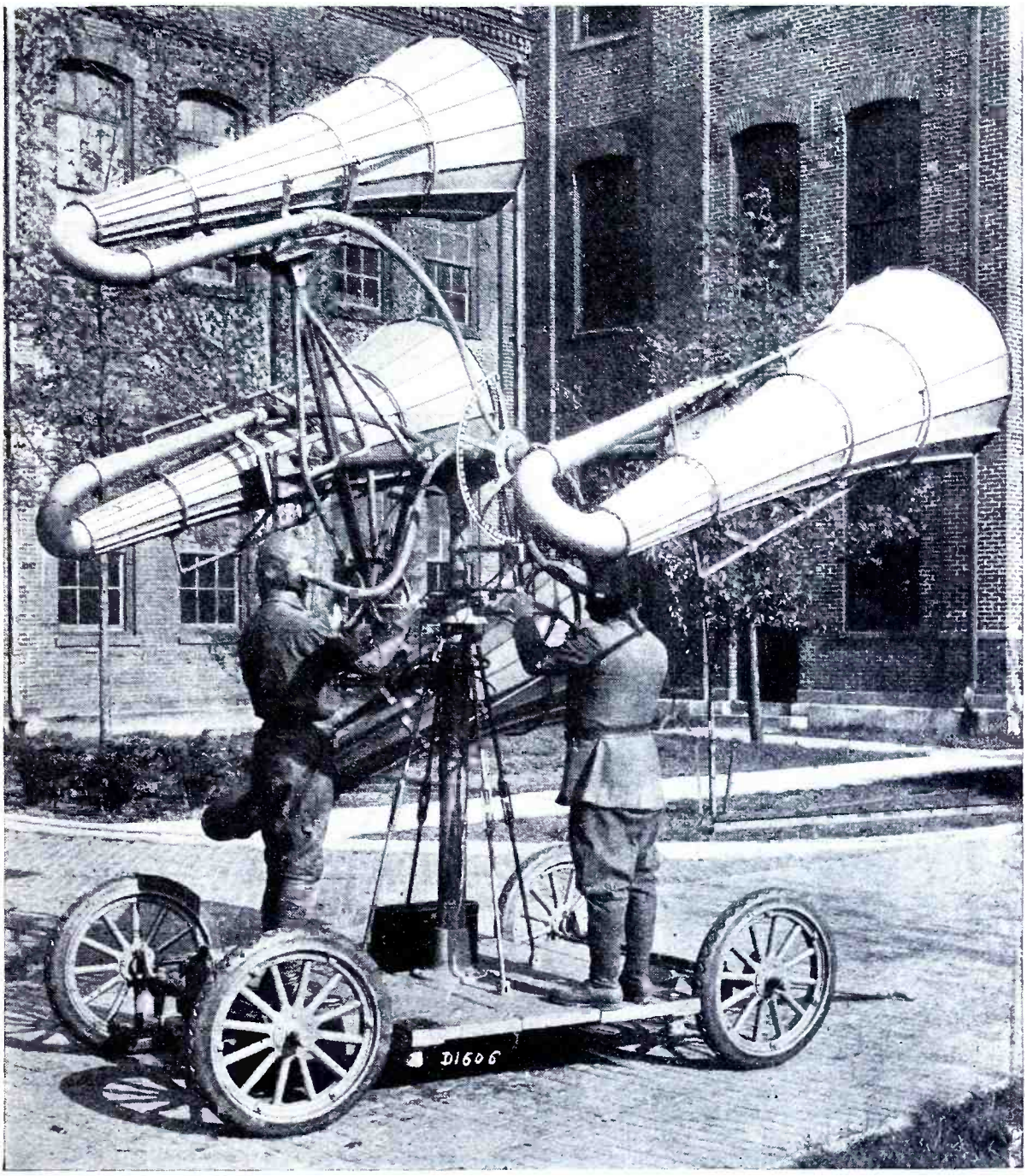
Then there is the matter of radio communication or radio telegraphy. There is no question of competition here. Radio Corporation controls it absolutely so far as private enterprise may, in face of the web of great government stations. A plotted chart showing a curve of radio set sales and another curve of returns from radio communication reveals some interesting trends. The curve for set sales is like the trajectory of a shell; it mounts spectacularly until recent months when the upward angle begins to diminish appreciably. The curve for radio communication, though flatter, doesn't diminish at all. It has remained steadily upward. Where will the two lines be ten years hence? Will they, like Einstein's parallel lines, meet each other at infinity, or will the set sales curve acquire a new energy? Few people realize that already twenty percent of the total telegraphic communication with Europe is handled by radio.

American Telephone and Telegraph is the most powerful agent of communication in the United States today. The agreements between A. T. & T. and Radio Corporation only run until 1929. If the telephone company, with its superb patent structure, ever decides to enter the field of radio, either in communication or set making, present estimates of the industry will have to be revised. Just now A. T. & T. understands telephonic radio transmission perhaps better than any other group and maintains what the public regards as some of the most efficient of the broadcasting stations. As the advance of radio is inextricably interwoven with the improvement and limitation of broadcasting this may or may not be significant.

But enough has been revealed here to show that the purchase of radio stock isn't quite so simple as it is made to seem. I am serenely aware that nothing I have said will check you if you have the bug. But if you have read this far you may at least be able to do a little blooping with the salesman before you sign on the dotted line.

How to Cut Down Interference in Reception

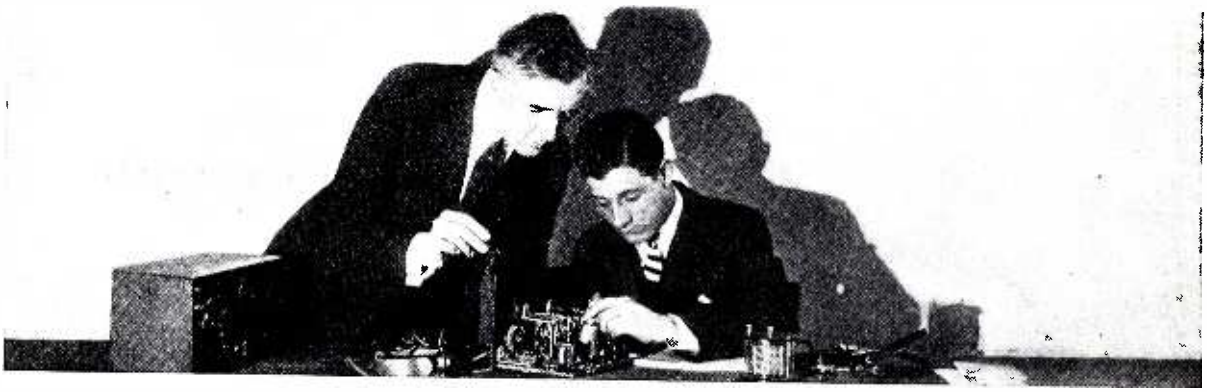
A helpful and essentially practical article on this timely topic will appear in POPULAR RADIO *next month—written by the well-known expert, John V. L. Hogan.*



Ordnance Department, U. S. Army

Listening Horns to Detect Aircraft

The United States Army has developed this ingenious listening device to detect the approach and position of hostile aircraft by means of the noise of the motors. The horns are designed on the so-called "exponential" equation, also used in designing some types of loudspeaker horns. One pair of horns follows the elevation of the sound; the other pair follows the sound around a horizontal circle. One operator controls each pair. The combined setting shows both the direction of the aircraft and its elevation angle. Corrections must be made, however, for the relatively slow speed of sound and for the "drift" caused by wind. The sensitivity of the horns could be increased, no doubt, by attaching microphones and audio-frequency amplifiers instead of the ear tubes.



IN THE EXPERIMENTER'S LABORATORY

Operating a Loop Receiver Near an Outdoor Antenna

MANY radio experimenters who have previously operated sets on the ordinary outdoor antenna have finally built a loop receiver and installed it on their radio table or bench and found that its selectivity is not what they expected. This, in many cases, is due to the fact that when the outdoor antenna lead-in wire runs near the loop antenna it gives too great a pick-up for the ultra-sensitive loop receiver, causing lack of selectivity. A loop receiver should be operated at least fifteen feet distant from the lead-in wire to be of the required selectiveness.

If you want to test out the loop receiver to find its true selectivity, it is always best to curl up the lead-in wire and leave the outdoor antenna ungrounded. In this way its effect of energizing the loop will be negligible and the true directional characteristics of the loop antenna may be employed.

Tubes for Resistance-coupled Amplification

THERE are some new tubes now being placed on the market for use with resistance-coupled amplifiers. These tubes have a higher "mu" and thus will enable the user to obtain greater amplification when used with this type of amplifier. They run in amplification with a ratio of about 20 to 8, which is about two and one-half times that obtained with the standard tubes.

Soldering Connections

WHEN soldering the wires in a receiving set, the experimenter should always be careful to use soldering flux or paste sparingly, wiping off each joint after the connection has been made, to be sure that no superfluous paste or liquid is left on the joint or on the insulation surrounding the joint. This will prevent corrosion of the joint itself and will also prevent leakage across any insulating materials, which might decrease the efficiency of the receiver or transmitter that is being wired up.

When soldering leads to taps on an inductance be sure that the silk or cotton covering on the wire is first scraped back out of the way before the soldering flux or paste is applied. This will prevent the hot flux or paste from running up along the insulation and causing a short-circuited or partly short-circuited turn in the coil.

"Straightline Frequency" Condensers

THE latest development in condensers that seems to overshadow, at present, the "low-loss theme" is "straightline frequency."

Condensers, to date, are constructed so that as the dial setting is varied the capacity will vary proportionately and the area of the meshed plates will vary uniformly. But, it has been determined, that, as the wavelengths of the broadcasting stations are allocated according to frequencies, the old type of condenser normally known as the "straightline-capacity type, crowds the low-wave stations too closely.

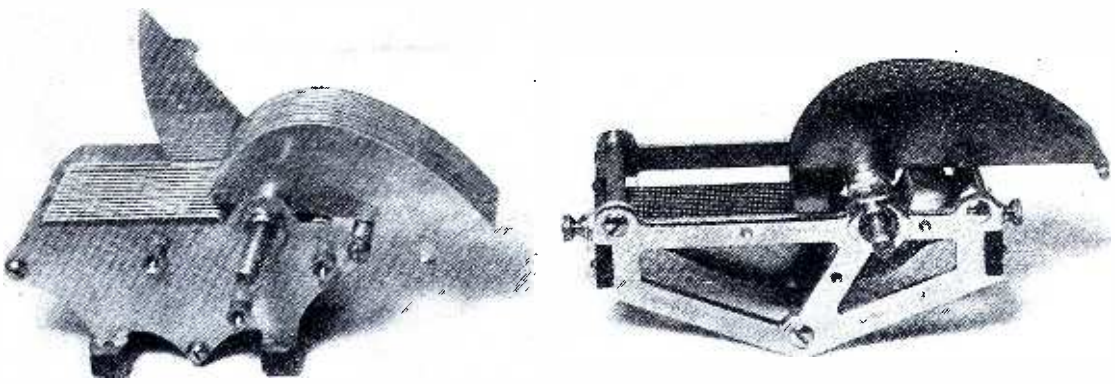
Frequency is figured from the formula

$$f = \frac{1{,}000{,}000}{2\pi\sqrt{LC}} = \frac{159{,}154}{\sqrt{LC}} \quad \ldots\ldots 1$$

where f = frequency in cycles per second, C = capacity in microfarads, and L = inductance in microhenries. In this case we may regard the inductance, L, as unity and therefore not consider it in the formula,

so that $$f = \frac{159{,}154}{\sqrt{C}} \quad \ldots\ldots\ldots 2$$

Therefore, it will be seen that the frequency will vary inversely as the square of the capacity. In a condenser this means that in order to space the frequencies of the stations evenly over the dial the meshed condenser plates must vary as the square of their areas. Thus, if at a frequency of 1,250,000 cycles (240 meters), the included area of all the



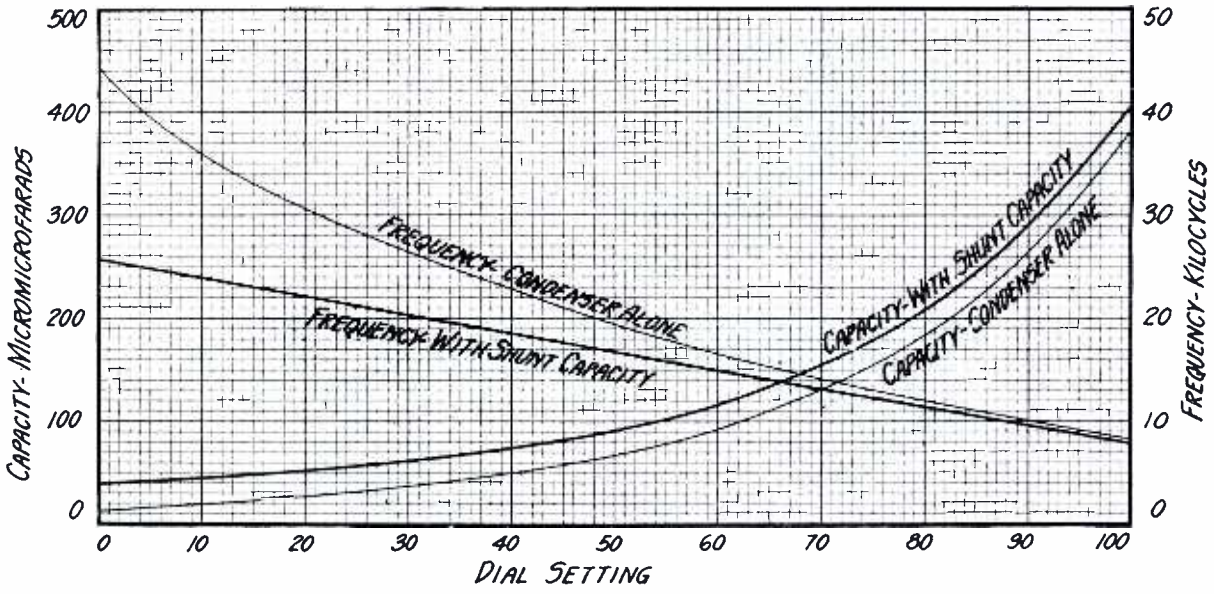
THE ROTOR PLATE DESIGN FOR
STRAIGHTLINE-FREQUENCY CONDENSERS

FIGURE 1: *Here are shown two new types of straightline-frequency variable condensers. The condenser on the left contains also a compensating plate that forms a shunt capacity across the condenser which can be varied. This enables the condenser to be set so that it will give a straight-line-frequency curve with almost any type of tuning coil.*

condenser plates is figured to be 6 square inches, then, at half that frequency, 625,000 cycles (480 meters), the included area of the meshed plates would have to be 36 square inches and so on.

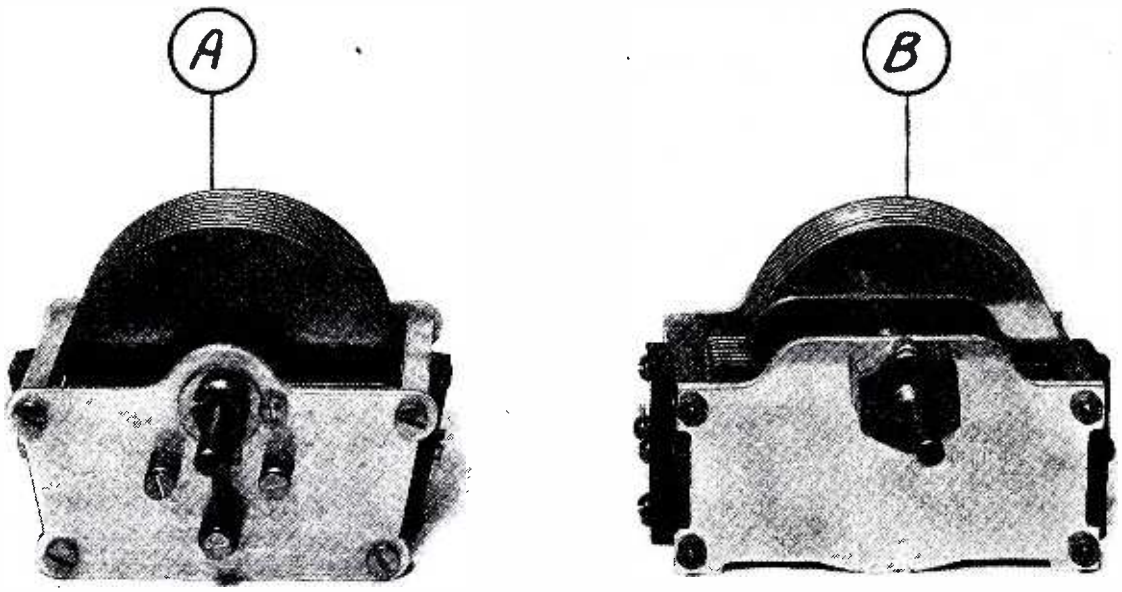
Neglecting all other capacities outside the condenser such as distributed capacity of coils the shape of such a plate would be as shown in Figure 1. The curves for this condenser are shown in Figure 2.

Such a condenser would be just the thing for spacing the frequencies evenly over the dial, but as soon as the condenser is coupled in a radio set to some part of the circuit, then the distributed capacity of the coils connected with it (and even the connections to a slight degree) will affect the capacity of the condenser and likewise the straight-line-frequency characteristic. Laboratory tests and experiments have shown that ordinary coils coupled to the



EVALUATED CONDENSER CHARACTERISTICS IN CHART FORM

FIGURE 2: *These curves show the characteristics of the left-hand condenser shown in Figure 1. The lower capacity curve marked "condenser alone," shows the continuing various values of capacity with dial setting. This gives the frequency curve shown under the heading "frequency-condenser alone." It will be noted that this curve has a slight curve characteristic. To make it a straightline, a shunt capacity must be added as shown in the top capacity curve. This gives the straight-line-frequency curve which is marked on the chart "frequency- with shunt capacity." In this way the condenser with the compensating plate can be adjusted so that it will give a straight-line-frequency characteristic with any type of coil.*



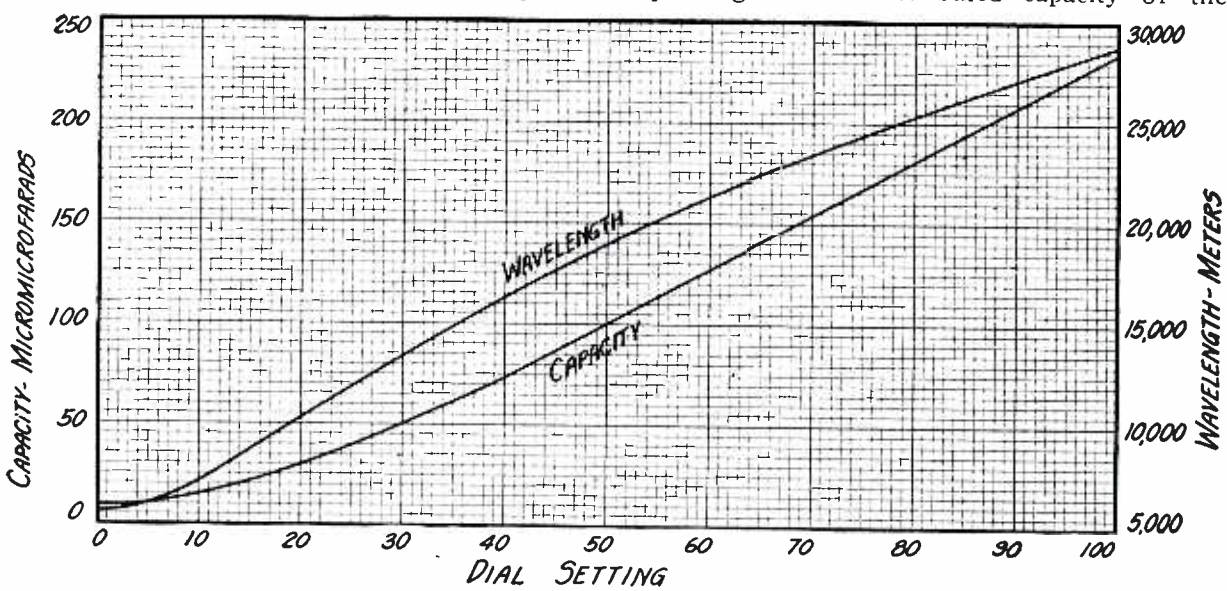
THE TWO PREVIOUS TYPES OF VARIABLE CONDENSERS

FIGURE 3: *The condenser "A" is a straight-line-capacity condenser in which the capacity varies directly as the dial setting. The condenser "B" is a straight-line-wavelength condenser which is supposed to prevent crowding at the lower wavelengths.*

condenser vary up to approximately .000025 microfarads in distributed capacity. Coils with a small number of turns may have .000005 microfarads distributed capacity. One manufacturer of the new type of condenser, in order to offset this effect, adds an extra end plate, which has the appearance of the old time vernier. He has so figured his condenser that when the end plate is fully meshed the resultant readings are absolutely straightline in frequency. This plate can be so adjusted as to compensate for the distributed capacity of the coil in the circuit.

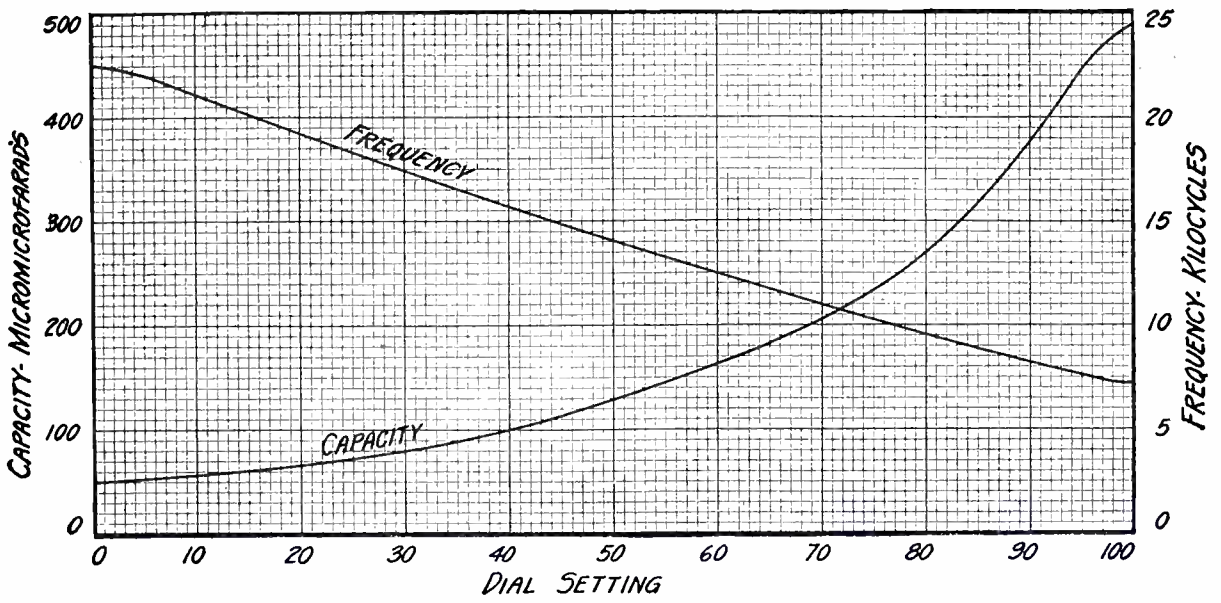
To design a straightline frequency condenser properly a capacity curve for a condenser of the desired capacity should be drawn first, ignoring coil capacities.

Then a second curve should be drawn, deducting a certain amount of capacity corresponding to the distributed capacity of the



WAVELENGTH AND CAPACITY CURVES FOR THE STRAIGHT-LINE-WAVELENGTH CONDENSER

FIGURE 4: *A study of the above capacity curves and its corresponding wavelength shows that this condenser although it does distribute the lower wavelength slightly over the dial, is not as effective as the straight-line-frequency condensers for this purpose.*



IDEAL CHARACTERISTICS FOR THE STRAIGHT-LINE-FREQUENCY VARIABLE CONDENSER

FIGURE 5: *This curve gives the data for the proper capacity settings against dial settings in order to have an ideal straight-line-frequency condenser. The capacity as denoted in the lower curve includes both the capacity of the condenser and the distributed capacity of the coil. To find the correct capacity to be incorporated in the condenser, the distributed capacity of the coil must subtract all along the line.*

coil to be used, say .000025 microfarads, from the first curve.

This will then give the actual capacities of the condenser at various dial settings.

The truth of the whole matter is this; there is really no such thing as a straight line-frequency condenser, except when considered in connection with a particular type and size of coil.

—MORRIS M. SILVER

Single-circuit Receivers

IT is recommended that single-circuit receivers (that is, those circuits in which the input circuit to the tube is also a conductive part of the antenna circuit), should not be used in crowded areas where receivers are located closer than half a mile apart. These simple receivers, if they are of the regenerative type, will cause great disturbance in neighboring sets because they radiate a wave in the same manner that the broadcasting stations do, except that the waves are of smaller intensity.

These simple circuits have been found to be useful in portable sets used in the country or in any place where neighboring receivers are not closer than half a mile or so, but in the city their use should be prohibited by mutual consent of all radio users.

Radiation or So Called "Re-radiation"

THERE seems to be considerable misunderstanding regarding the question of radiation. Many fans seem to be under the impression that a receiver which contains one or more stages of radio frequency amplification cannot radiate. On the other hand, there is another faction which labors under the belief that any receiver which squeals also radiates.

Both of these impressions are wrong.

Many of the receivers which include one or more stages of radio frequency amplification radiate as freely as the "single circuit" type. On the other hand some regenerative receivers which whistle freely when tuned while in an oscillating condition will not radiate.

It is true that any receiver which is capable of oscillation is capable of radiating. However, in some types of receivers this radiation is possible only from the coils of the receiver—not from the antenna—and therefore is effective only a few feet from the receiver.

In the case of the Four-circuit receiver, for instance, a test was recently made to determine its radiation qualities. In the test two other sensitive receivers were used, and two antennas. The Four-circuit receiver was connected up to one antenna and put into regular operation. In the same room a tuned radio frequency receiver loop was set up and also put into operation. When the Four-circuit receiver was made to oscillate, the oscillations were picked up faintly with the other receiver but—and this is important—the oscillation was picked up equally well whether the antenna was connected to the Four-circuit receiver or not.

This proved that the slight radiation no-

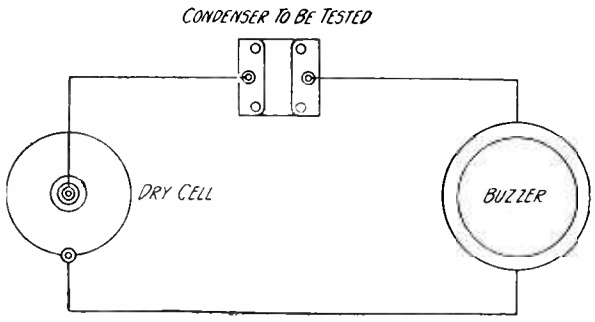


FIGURE 6: *This simple circuit shows the manner of connecting a condenser with dry cell and buzzer for testing of short-circuits.*

ticed was coming from the receiver direct, rather than through the antenna.

Next, the loop receiver was moved into the next room and another test made. This time no radiation could be picked up from the Four-circuit, with or without an antenna.

Finally, a third receiver was connected to an antenna which ran almost parallel with the one connected to the Four-circuit, and about 15 feet distant from the latter. When both receivers were put in operation, absolutely no interference was noticed in the other receiver, although the Four-circuit set was oscillating continuously.

This gave conclusive evidence that the Four-circuit receiver does not radiate, in spite of the fact that it can be made to oscillate, especially on the lower wavelengths.

The fact that a receiver is used with a loop rather than with an outdoor antenna does not prevent it from radiating. Many superheterodynes cause considerable interference to neighboring receivers, even when operated on a loop. But it does not follow that all superheterodynes radiate. Where the first tube is used as a stage of non-oscillating radio frequency amplification there is little danger of radiation. Or a balancing coil arrangement may be used, as in the Pressley Superheterodyne, which will prevent interference to other receivers. The real trouble makers among the superheterodynes are those which have the oscillator coupled directly to the grid circuit of the first tube.

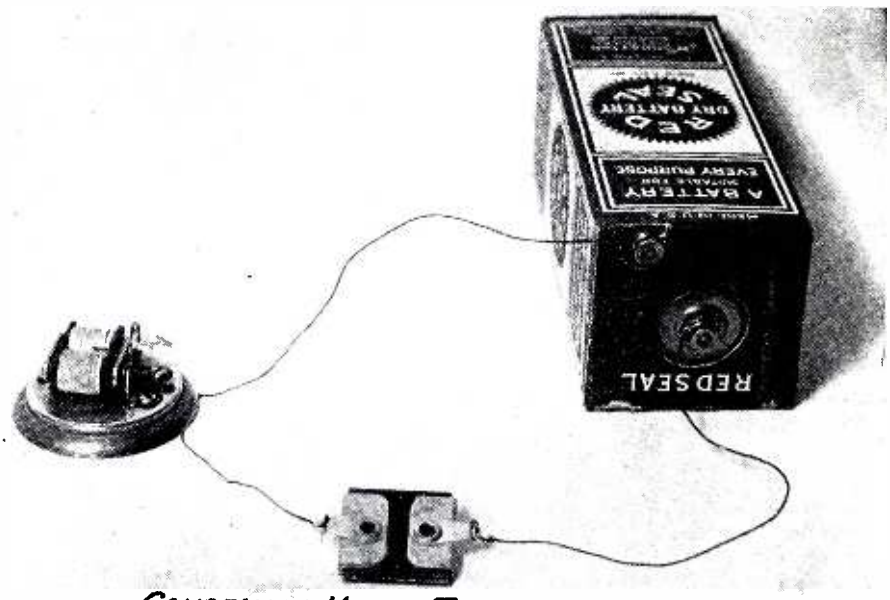
A receiver will not radiate if the first tube does not oscillate, and there is no oscillating circuit coupled to the antenna circuit or the antenna coupler. Moreover, even if the first tube does oscillate, there will be no radiation providing the coupling between the grid circuit of the first tube and the antenna is sufficiently loose. In many regenerative receivers the coupling between antenna and regenerative detector cannot be made sufficiently loose to prevent radiation and at the same time provide satisfactory reception. The Four-circuit receiver works best with extremely loose coupling, the coupling consisting of the single turn which is wound around the stabilizer coil. It is this extremely loose coupling that prevents it from radiating.

—S. GORDON TAYLOR

Shooting Trouble in Condensers

WHEN trouble is encountered in a radio receiver it is frequently desired to test the fixed and variable condensers to make sure they are O. K.

There are two main possibilities of trouble in condensers, *i.e.:* short-circuit between plates and poor internal connections.



HOW THE BUZZER TEST LOOKS

FIGURE 7: *This shows the set-up diagramed in Figure 6 for testing fixed condensers to find out if they are short-circuited or not. If the buzzer operates, the insulation in the condenser is broken down and it is useless.*

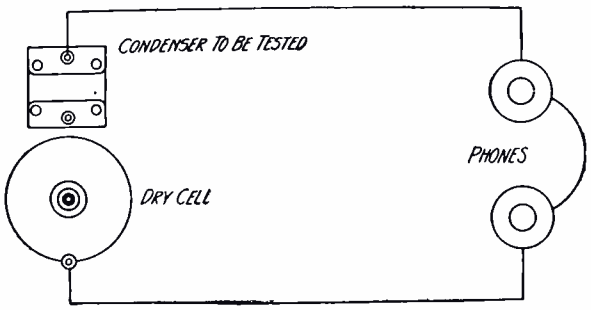


FIGURE 8: *The wiring diagram for testing condensers for leakage.*

The test for a complete short circuit in either fixed or variable condensers is simple. It is necessary only to connect the condenser in series with a battery and buzzer as shown in Figures 6 and 7. If the buzzer operates it is an indication of a complete short. If it does not operate, however, there is no complete short. This test does not show a partial short-circuit. In making such a test the condenser must, of course, be disconnected from the receiver.

There is a single test for both of these defects in the ordinary small condensers used in radio receivers. This test is simple but, nevertheless, some care will have to be exercised to make it effective. When a direct current, as from a 1½ volt battery, is allowed to flow through a circuit in which a series condenser is connected, the current will flow for only a fraction of a second, or until the condenser becomes charged. If phones are in the circuit during that time, the momentary current flow will result in a single audible click in the phones. Even if the circuit is broken and immediately connected again, there will be no further current flow in the circuit. If current does flow it indicates a defective condenser. Such a test circuit is shown in Figure 8.

If a path is provided from one side of the condenser to the other, without the battery in the circuit, there will be another flow of current while the condenser discharges the energy which it has stored up. If the finger is placed across the two ends of the condenser, for instance, this energy will flow through the finger. Or if the phones are connected directly across the condenser the energy will flow through the phones, resulting in another audible click. This is a sure sign of a good condenser.

Perhaps the surest way to make this test, to avoid any undesirable leakage path, is shown in Figure 9. Connect one phone tip to the negative side of a dry-cell and hold the other phone tip against one end of the condenser with the fingers (being sure that the fingers do not touch the other end of the condenser). Now tap this other end of the condenser against the positive pole of the battery. At the first tap there should be a comparatively faint click. At the second tap there should be no click because the condenser was charged at the first contact. Now touch this end of the condenser to the negative pole of the battery. In effect this connects the phones across the condenser, allowing the charge to leak off through the phones, making another click.

To sum up: a condenser is short circuited if a click is heard every time the battery circuit is connected, provided the circuit is disconnected and reconnected rapidly. The current is then not stored up in the condenser but flows right through. If no click is heard at all, there is a poor connection inside the condenser which does not permit the current to flow into the condenser, and therefore the condenser can neither charge nor discharge. Due care must be exercised in all cases to prevent any leakage path across the condenser while it is charged, such, for instance, as holding the finger across both ends of the condenser during the test. If this is done the condenser will discharge as quickly as it is charged and the effectiveness of the test will be spoiled.

—S. GORDON TAYLOR

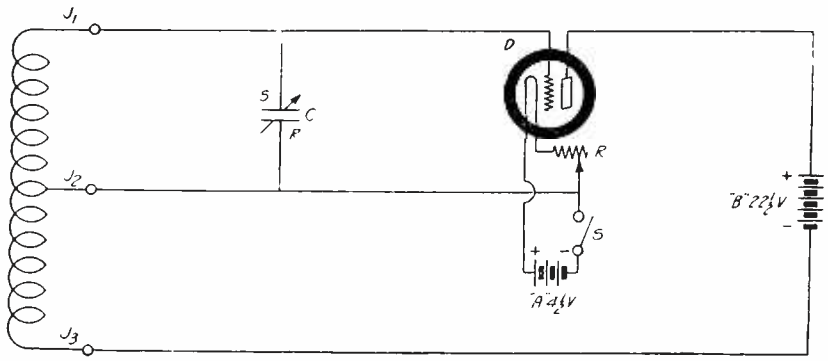
An Oscillating Wavemeter

THE PARTS USED IN THE OSCILLATING WAVEMETER—

A—4½ volt "C" battery, Eveready type No. 771;

B—Small size 22½ volt "B" battery, Eveready type No. 763;

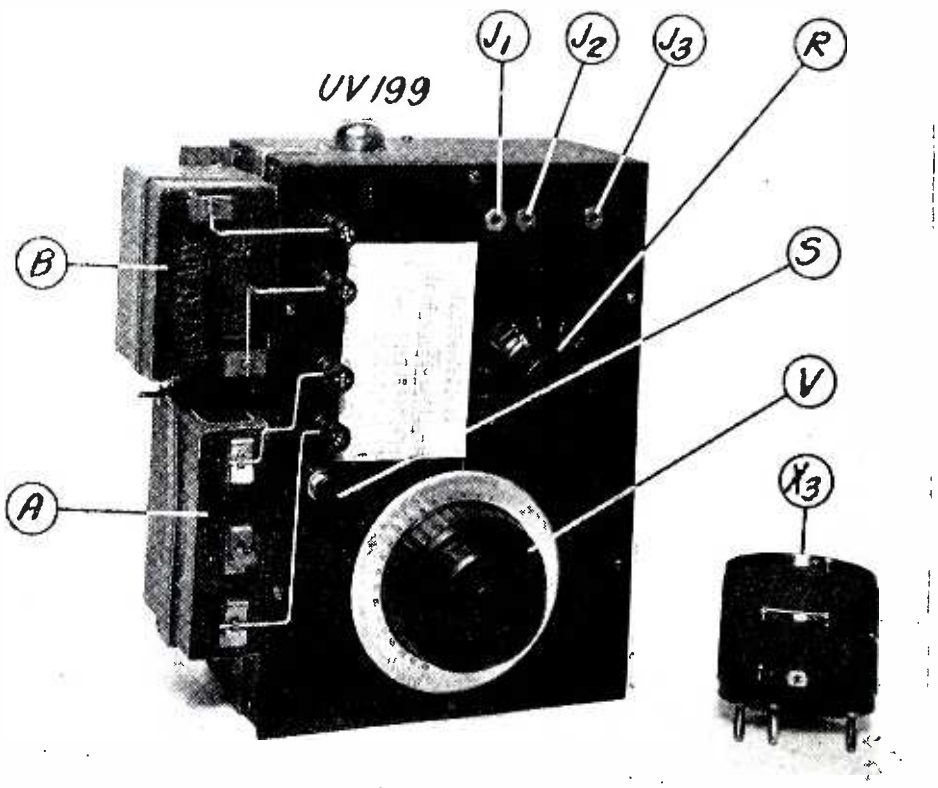
FIGURE 9: *The author is here shown using a set-up diagramed in Figure 8 for testing the ordinary fixed condenser for leakage. If more than one click is heard the condenser is defective.*



THE WIRING DIAGRAM FOR THE NEW OSCILLATING WAVEMETER

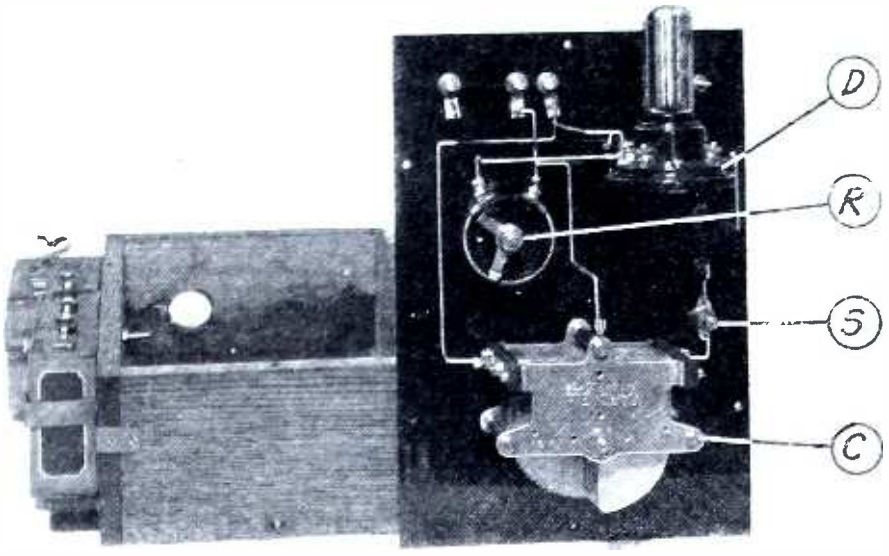
FIGURE 10: *This diagram gives the hook-up for the wavemeter. All the symbols for the coils, condensers and other instruments bear designating letters which are used in the list of parts and throughout the text and illustrations.*

C—Cardwell .0005 mfd. variable condenser, 21 plate;
D—Na-ald No. 499 socket for UV-199 tube, equipped with Na-ald panel mounting No. 460;
J1, J2 and J3—General Radio coil mounting jacks, No. 274J;
P—12 General Radio coil contact plugs, type 274P (3 used with each coil).
R—General Instrument 30 ohm rheostat;
S—Benjamin Battery switch;
V—Accuratune vernier dial, 4 inch diameter;
X1—General radio inductance coil No. 277A, without plugs;
X2—General radio inductance coil No. 277B, without plugs;
X3—General radio inductance coil No. 277C, without plugs;
X4—General radio inductance coil No. 277E, without plugs;
1 composition panel, 7 inches by 10 inches;
4 Eby binding posts;



THE FRONT VIEW OF THE OSCILLATING WAVEMETER AND ONE OF THE COILS

FIGURE 11: *This picture gives an idea of how the wavemeter looks when viewed from the front. As all the parts and accessories are marked with designating letters, the prospective operator will have no trouble in locating the various controls as they are explained in the text. In operation any one of the four coils may be used by plugging into the three jacks, J1, J2 and J3.*



THE INSIDE VIEW OF THE OSCILLATING WAVEMETER

FIGURE 12: *This gives the general arrangement of the instrument fastened to the panel and shows how the two batteries are attached to the cabinet. It also shows the hole which is made in the top of the cabinet for inserting the vacuum tube.*

Lumber, screws, strap brass—18 inches by ½ inch by 3/32 inch.

ONE of the most important pieces of equipment that a radio experimenter can have is an oscillator wavemeter such as the one to be described below. This instrument serves not only as an accurate and precise reading wavemeter, but also as a standard for measuring capacities, inductance and other details.

In making your own coils, this instrument enables you to tell the exact waveband the coil will cover; it also enables you to measure the capacity of small fixed condensers, the maximum capacity of variable condensers and your antenna capacity.

With it it is possible to tell in an instant the wavelength of a broadcasting station to which your receiver is tuned.

This article is confined to the construction and operating directions for the oscillator used as a wavemeter; in a later issue more data will be given on the use of this instrument for measuring condenser capacities and coils.

The circuit used in the oscillator is a modification of the Hartley Circuit; it is shown in Figure 10.

The coils are fixed and are connected into the circuit by a plug arrangement which provides a simple and satisfactory way of changing coils for different wavebands.

The construction of the oscillator is clear from the illustrations. It will be noted that the coil, tube and "B" battery are placed well away from the dial for the purpose of eliminating body capacity. It is for the same reason that the variable condenser is shunted across only one half of the coil rather than across the entire coil.

Four coils are used, and they cover the wavebands as follows:

X1—33 to 100 meters
X2—65 to 206 meters
X3—127 to 398 meters
X4—194 to 602 meters

As will be noticed this set of four coils covers all of the broadcast band and also the amateur 150-200 and 75-85 and 37-42 meter bands.

It is best to use only the upper part of the oscillator dial—from 30 to 180 if accurate readings are desired.

It is extremely important that no changes be made in the oscillator after it is once calibrated, otherwise recalibration will be necessary. Even the position of the batteries in relation to the oscillator must remain fixed. It is for that reason that the batteries are attached directly to the case of the oscillator, as shown in Figure 2. Variations in rheostat setting or battery voltage will, however, have little effect on the dial setting, and as a rule the use of a different tube of the same type as the one used when the oscillator is calibrated will not materially affect the calibration. It is well to always use the same tube, thus eliminating any possible chance of variation from the calibration.

There are several ways of calibrating the oscillator. The first and best way is to calibrate it by means of a standard oscillator—if the use of one can be obtained. The next best plan is to listen in on the standard frequency signals sent out from the Bureau of Standards in Washington. These are sent out on the 5th and 20th of every month, beginning at 10 P.M. Each evening a band of frequencies is covered. One evening, for instance, the band from 545 meters down to

200 meters is covered; the next transmission night the band from 200 to 100 meters is covered. The schedule of transmissions may be obtained from the *Radio Bulletin* issued monthly by the Government Printing Office; it may be purchased for five cents a copy.

The third and most usual method of calibrating the oscillator is to use the wavelengths of broadcasting stations.

To do this a number of broadcasting stations, ranging from the lower to the upper wavelengths, are tuned in on any type of ordinary receiver. When a station has been tuned in the oscillator is placed about three feet from the receiver, the oscillator tube is lighted and the dial rotated until the familiar heterodyne whistle is heard as the oscillator is tuned to resonance with the receiver (and therefore also with the transmitter of the broadcasting station). As the wavelength of the broadcasting station is approached on the oscillator dial the whistle will first be high pitched. As the dial is turned further the whistle will become lower until it is no longer audible. At this point the oscillator is in exact resonance with the broadcasting station. If the dial is turned too far the note once more rises, an indication that the dial has been turned too far.

When the oscillator has been tuned to resonance in this manner make a note of the reading of its dial, together with the wavelength of the broadcasting station. Now repeat this operation on different stations, obtaining a goodly number of calibration points.

The method of calibrating the smaller coils by the harmonics of the higher wavelengths will be explained in a later issue.

To make up the calibration "curve" or chart, a piece of cross-section paper will be helpful, preferably the style with 20 lines to the inch, both vertical and horizontal, dividing each square inch into 400 small squares. The size of the ruled form should be not less than 6½ inches by 9½ inches. This is a standard size which can be obtained at most draughtsmen's supply stores.

The left hand margin of the sheet is marked off to correspond with the dial, the bottom line being marked 30 and the top line 180, if the above size paper is used. Every tenth line is marked, the tenth from the bottom marked 40, the twentieth 50, and so on. This applies in cases where a 180 degree dial is used on the oscillator. If a 100 degree dial is used the bottom line may be marked 0, the tenth line 10, and so on.

The bottom margin is marked with wavelengths. Where the coil being calibrated is one which covers the broadcasting waveband the left-hand line is marked 200 and the right-hand line 600. Then every vertical line represents 2 meters and every tenth line is marked accordingly.

To spot the calibration points, find the intersection of the dial setting and the wavelength. For instance, the eightieth line from the left represents 360 meters. If a reading has been taken on a 360 meter station the eightieth line is followed up to where it intersects the horizontal line corresponding with the oscillator dial setting for that station. At this intersection a dot is made, and all of the other calibration points are marked in the same way. After they are all marked in, connect them together with a line and the "curve" will be completed. Such a set of curves is shown in Figure 5.

The method of using the oscillator and the "curve" is simple. Suppose a broadcasting station is tuned in on a receiver (not necessarily the same receiver used in obtaining

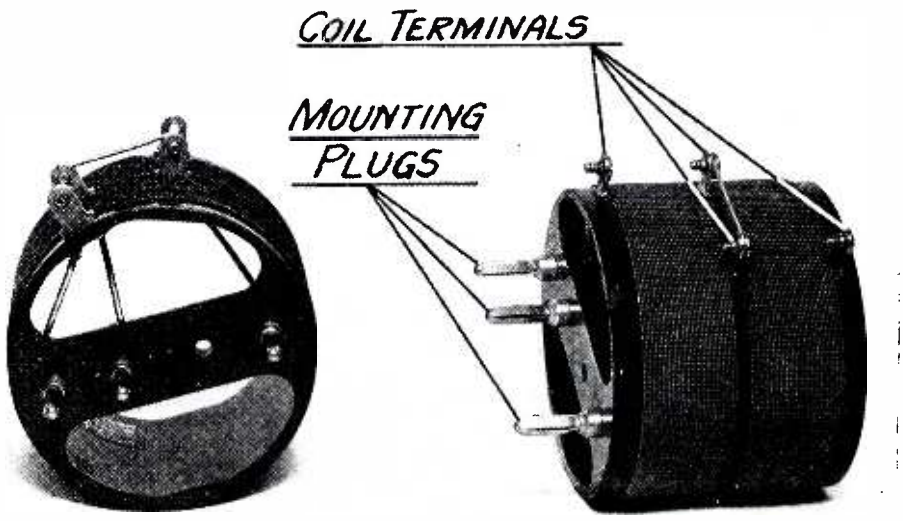
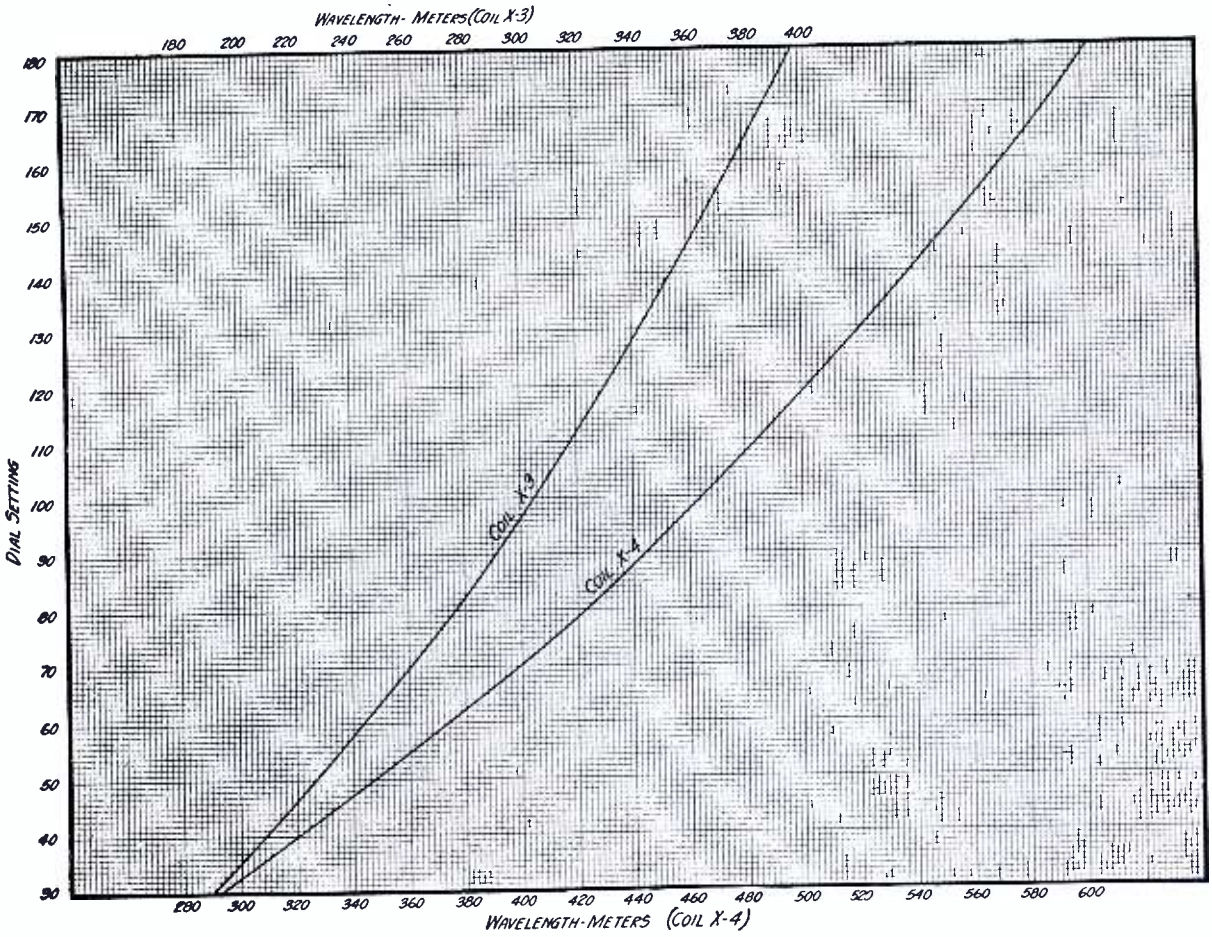


FIGURE 13: *Two of the coils and the method of mounting plugs on the cross strip provided on the coil form. Four holes will be found in the cross strip but only three of them are used. In the left-hand picture, the first plug on the left is connected to the front end of the coil; the second one is connected to the center tap and the third right-hand plug is connected to the rear end of the coil. The two inner coil terminals are connected together with a piece of wire as shown.*



A SAMPLE TUNING CHART

FIGURE 14: *This diagram shows how two tuning curves were made for coils, X4 and X3. This is the kind of chart which the author tells how to make in the text of his article. With one of these charts and the oscillator described, the experimenter is able to tell the wavelength of any incoming signal that he picks up with his receiver.*

the calibration points) and it is desired to know what station it is, or what the wavelength is. The oscillator is turned on and its dial rotated very slowly until the whistle is heard. The dial setting of the oscillator is noted. Referring to the "curve" the horizontal line representing this dial setting is followed across until it intersects the "curve." The vertical line nearest this point of intersection represents the desired wavelength.

The cabinet shown in the illustration can be easily made. Its inside dimensions are 6 inches by 9 inches by 3½ inches deep. A small shelf is mounted on one side for the batteries and a piece of strap brass is bent to fit the batteries and is screwed on to the side of the cabinet. A threaded rod is provided at the center of the brass bracket to tighten it against the batteries, holding them securely in place.

—S. GORDON TAYLOR

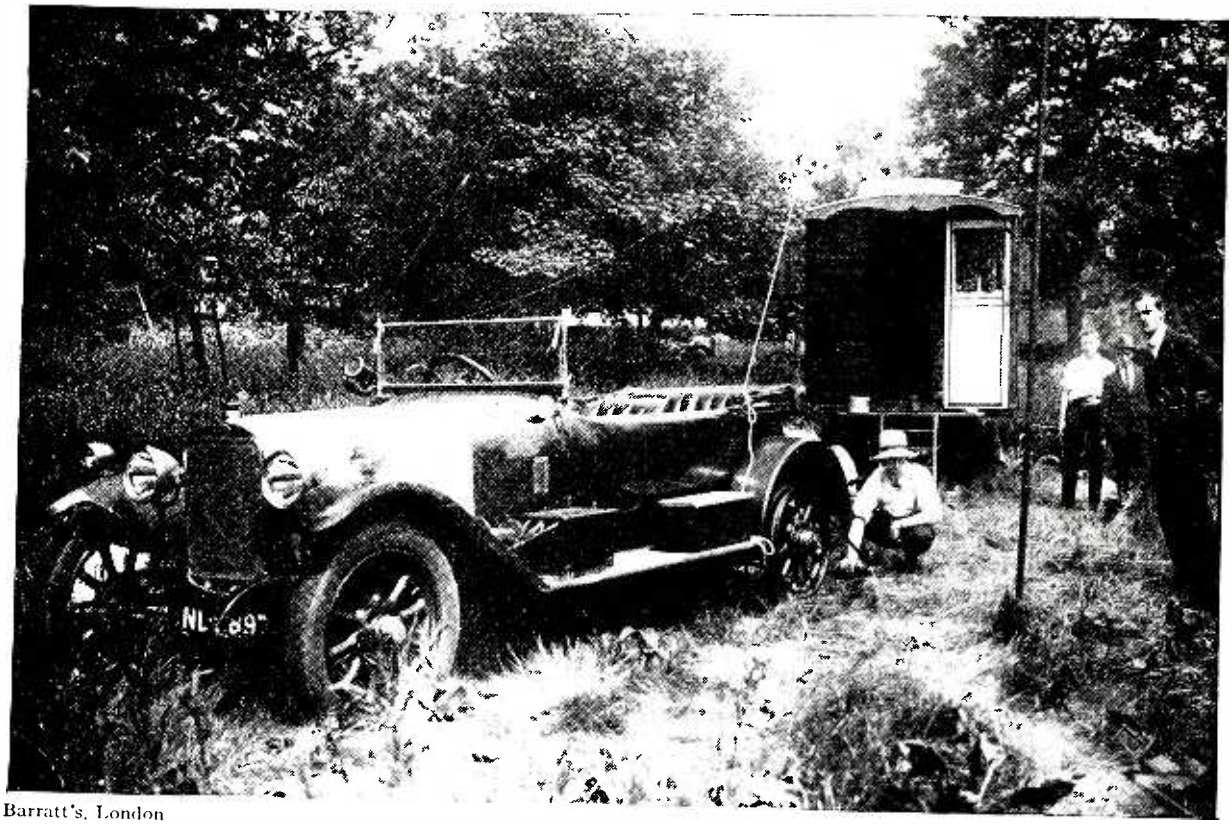
A Power Tube in the Last Stage of Audio

IT is often advisable to use a power tube, such as the VT-2 or the 216-a tube, in the last stage of audio-frequency amplification. This will usually help considerably in getting better quality from the receiver, especially if the receiver uses radio-frequency amplification ahead of the detector.

If a power tube is used, be sure that the last rheostat has sufficient current carrying capacity for the tube you use. If it has not, it should be changed and the proper rheostat installed. In the case of Amperite filament adjusters, the ordinary type No. 1-a (which is used with the 201-a type tubes) should be taken out and an Amperite No. 1 substituted. This latter type will accommodate the so-called power tube.

"How to Compare Losses in Condensers"

Useful information—based on laboratory experiments—that every radio amateur should have, will appear in POPULAR RADIO *for next month.*



Barratt's, London

AN ENGLISH "RADIO CARAVAN" THAT COMMUNICATED WITH AMERICA

An enterprising and inventive English radio experimenter recently succeeded in communicating with amateurs across the Atlantic by using a transmitting equipment which obtained its power from the rear wheel of his motor car. The rear end of the car was belted to a high voltage generator which supplied the current to the plates of the vacuum tubes employed.

The BROADCAST LISTENER

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

By RAYMOND FRANCIS YATES

Why German Programs in America?

THE artful publicity department of the Radio Corporation of America probably thought it was dropping a great big bombshell when it announced that the German broadcasting station was going to export its programs to America and that they were going to be rebroadcast here. The announcement was received coolly in our department, however, for, while we anticipate the day when the entertainment of the nations of the world will mix and blend in the great amphitheater of the ether, we are, for the time being at least, perfectly satisfied with the American-made product. This decision is not the result of a patriotism so intolerant that it cannot condone the thought of music from the Deutschland. As a matter of fact, there is a place in this big heart of ours for the worst-sounding, beer-drinking German band that ever inflated its red cheeks. Our argument is, "Ladies and Gentlemen of the radiophone audience," that the exchange of foreign programs can be nothing but an amusing experiment made to order for the publicity departments of the various corporations concerned. As a diversion for a night or two, it receives our very official O.K., but technical radio is not ready to extend this into a lasting performance of a really meritorious nature.

* * *

Something Novel on a Program

WHEN our field department wired us from Cincinnati that the Crosley station had installed a new feature, we were all aflutter. Any studio manager who is caught doing a little thinking in an effort to inject fresh blood into the fast

hardening veins of the art, will find the full power of this department squarely behind him. We don't care if it is the simple trick of permitting a pig to squeal into the microphone; as long as a pig has never squealed into a microphone before (and we really don't know why pigs have never been permitted to squeal into microphones), we shall be back of the pig-squealing movement heart and soul. The trouble with radio (or one of the troubles at least) is that studio managers are not experimentally inclined. When KDKA broadcast its first program, it set down a pattern that has been followed ever since.

WLW is using a novel method to present the daily news, and while it may not be very exciting as excitement is measured in these days of petting parties and uncovered feminine knees, it is pretty good for so young and yet so mossy a thing as radio broadcasting. WLW mixes news items with music, reading a piece of news and then playing an appropriate (or as near appropriate as possible) selection. Although the brief wire of our Cincinnati attache does not so state, we presume when a news item concerning the K.O. of a pugilist is read, that the orchestra lapses into the plaintive strains of "I Dreamt I Dwelt in Marble Halls." This may be a little far-fetched, but it is the best example we can think of at this time.

* * *

The "Invisible Guest"

Long years ago, when we were annoying the readers of the New York *Herald-Tribune* with clumsy paragraphs very similar to the present run, Mrs. Marie Hemstreet contributed a little poem that we liked a great deal because it pleasantly expressed sentiments of our own concerning the constant reference made by announcers to the "invisible guests." One is very uncomfortably reminded of a spiritual seance because that is really the only place you would expect friends in the proto-plasmic realm. Mrs. Hemstreet objects with poetry:

There is one thing I hate to be called,
Against it I boldly protest;
It gives me a shiver,
A chill on the liver,
To be hailed as "invisible guest."

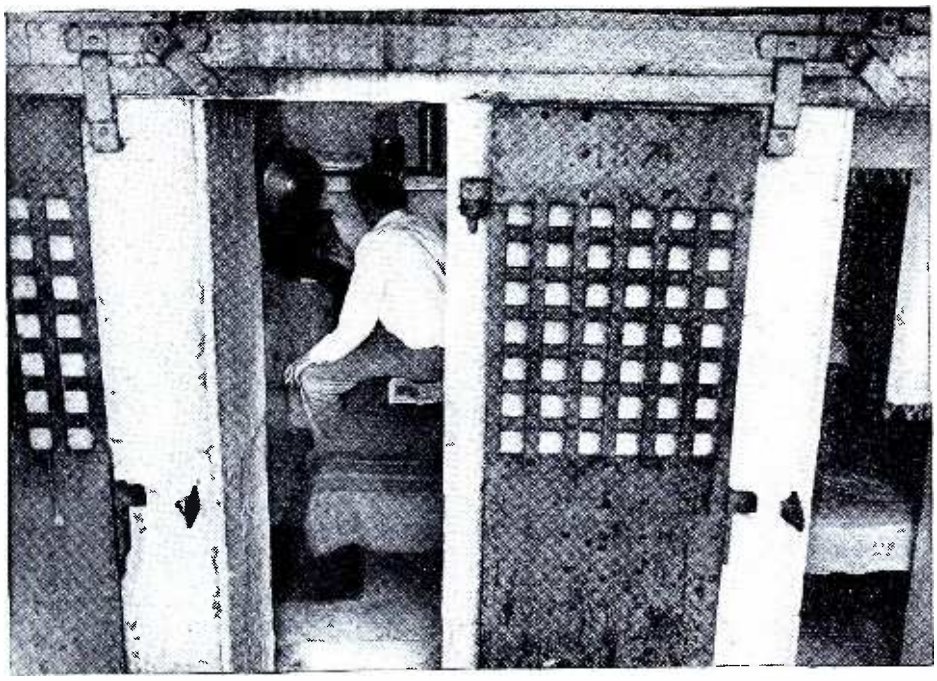
It's hard to imagine the ether,
As crawling with bodiless hosts,
But it gives me the creeps,
When a voice from the deeps,
Seeks to claim me as one of the ghosts.

When you call me "dear friend" or
"dear fan,"
I'll tune in with fervor and zest.
But somehow I quiver,
And cannot but shiver,
When hailed as "invisible guest."

* * *

This Month's Cake Is Awarded

Continuing our practice of including one little puff of simon-pure praise each month, we wish to lay a wreath at the door of the Eveready Entertainers. The nice thing about



Kadel & Herbert

HOW A STATE'S PRISON INMATE EVADES THE LONELINESS OF CELL LIFE

Radio is a magic fluid that seeps into every crevice of human life—even through prison walls. Here is a Sing Sing prisoner manipulating a curious radio set built by himself.

the Eveready Entertainers is the delightfully reckless way in which they abuse the most sacred traditons of the art, for the habitual listener of WEAR, WSAI, WEEI, WJAR, WOC and WEAF must feel with us that Eveready entertainment is unusually good to the point of being actually satisfying. It seems that a perfectly appalling amount of thought and painstaking effort has been put into the construction of these weekly events. They should be a great inspiration to the hundreds of studio directors with heads filled with ground-up corn cobs.

* * *

A Real Nut Comedian on the Air

WHILE we are at it, we may as well add another dash of parsley to this unpalatable dish of arid hokum. We wish, in this case, to extol Harry Richman, who is perhaps the most outlandishly foolish man on the air. To say that he is the most outlandishly foolish man on the air is saying a pretty large mouthful, too, when we stop to think things over. Yet with all of his downright foolishment, he is a powerfully funny man, and the weak old thing that runs this department has been a subscriber of his since the second night he came to the air through WHN—yes, it's a little over a year ago now.

It takes a good man to be so foolish that he is funny. Most of the super-nutty comedians are just foolish without being funny, which is a most pathetic status. While Harry Richman unloads many scuttles of utter craziness, one finds in much of it kernels of real subtle humor. To say that one was dining with a big rubber man from the Turkish Baths or that one went to the theater with a large collar man from Great Neck or that the evening was spent with a big locksmith man from Key West is, to our way of thinking, a pretty steamy line of talk. All of which goes to show how easily a man like Richman can take on customers like us.

* * *

Talky Announcers

SOME day when we are under a little less social pressure, we are going to look up the WEAF, WJZ, WJY, KDKA, WMAQ and WFI programs of a year back and publish them with the programs of the present time. This would be, perhaps, the most effective way of saying that radio is hog-tied to the hitching posts of broadcast tradition and that the majority of our impresarios and *entrepreneurs* are at the very end of their wits. If you changed the date on any one of these program cards, it would be just about all you would have to do to bring them right up to the minute as the classiest and newest means of cooking up a batch of entertainment for the yokels "out there."

With the precious few announcers that we have who know how to carry on an intelligent, connected conversation free from "ands" and "buts," we often wonder if the bare announcement of the station, the number and the artist would not be the wisest course to

F. M. Delano, Paris

THE ALUMINUM LOUDSPEAKER SPEAKS

This gigantic loudspeaker, which was set up on the grounds of the Leipsig Fair in Germany, consumed approximately one horse-power of electric current, which was sufficient to send the sound waves scurrying over the entire exhibition. This loudspeaker operates with a thin aluminum ribbon pulled taut between the poles of a powerful electromagnet.

follow. Surely that would be better than listening to a long line of grammatical goulash, which, after all, is simply designed to say, "This is station BXW, Buffalo, N. Y. John Jones will play 'Home Sweet Home' on the harmonica."

It is certainly amusing to hear some of the patter that is offered as intelligent comment by talky announcers. There is one chap in New York (we'd hate to mention his name because he took us out to lunch one day, poor devil; we're pretty decent after all, aren't we?) who offers the rarest bit of irrelevant matter that you would care to listen to every time he approaches the microphone. He is perhaps the most capable oratorical kaleidoscope that has ever faced a microphone. The photographic rhapsody of a Pathé news reel is an example of unblemished harmony when compared to the thoughts commented upon by this young man in the course of a single minute. Metaphysics, baseball, music, pancakes, flowers, race horses, subways and hardware are some of the subjects that you might find in any one of the little rhetorical grab-bags that he injects into the program at the end of each studio feature.

We don't mind being announced at in the conventional manner by men like Milton Cross (WJZ) or Thomas Cowan (WNYC), but we are awfully sensitive to the intellectual white wash peddled by the average young man who, by some dirty trick of fate, has found himself in a radio studio.

And that's that!

Underwood & Underwood

A BROADCAST ARTIST WINS A FORTUNE

So gentle and soothing was the jazz symphony music played by Paul Ash that a kind-hearted old lady of Olathe, Kansas, remembered him to the extent of $66,500 in her will. This is the first case on record where a man has been rewarded in the will of one of his radio listeners.

Five Pointers for Reducing Static

1: NEARBY signals, when we have the advantage of a relatively high signal level as compared with the static level, are fairly free from static. Good reception is therefore assured from nearby broadcasting stations, especially today when many of the broadcasters have gone to higher powers so as to insure proper reception of programs under all conditions.

2: THE most effective way of reducing static is to select a powerful radio signal—which usually means a local station. Ordinarily, there will be no static interference in the first place; but if the background is scratchy and blurred as the result of intense static, the output volume of the set can be cut down until the background noises are reduced to the vanishing point. Obviously, the signal volume is also reduced, but if it is sufficiently powerful to begin with, there is ample opportunity for reducing it and still have left sufficient volume at the end.

3: WHEN static interference is excessively troublesome, the amplification should be cut down to one stage. In the event that static interference is overwhelmingly troublesome (such as with an approaching thunderstorm) it is still possible to listen to sufficiently powerful signals by means of the head-set, without amplification of any kind.

4: LOUDSPEAKER reproduction often may be improved in summertime reception by bridging a small fixed condenser across the loudspeaker terminals. The capacity of such a condenser obviously must vary from one type of loudspeaker to another, but a little experimentation with several sizes of small fixed condensers must soon disclose the proper value for a loudspeaker.

5: IT is hardly necessary to go to the trouble of installing a shorter antenna for summertime operation, although the radio listener will obtain interesting results by trying out various kinds of antennas. After all, the only result of a short antenna or an indoor antenna is that the amount of energy intercepted is noticeably less than with a full-sized antenna; hence the static level falls and with it falls the signal level. If the static level is below the signal level to begin with, this matter of dropping the initial values to lower levels must bring the low static down below the threshold of audibility. At best it is an illusion, though to some it is highly pleasing.

—DR. ALFRED N. GOLDSMITH

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.*

AERIALS

Super-Sensitive Omni-Directional aerial; Portable Globe Aerial Co.

AUDIO-FREQUENCY TRANSFORMERS

Pacent audioformers; Pacent Electric Co., Inc.
Peerless Twin-audio; Peerless Radio Corp.
Precise audio-frequency transformer; Precise Mfg. Co.
Precise push-pull transformers; Precise Mfg. Co.
"Hegehog" audio-frequency transformer, Premier Electric Co.
"Receptrad" audio-frequency transformer; Radio Receptor Co.
Reliable audio-frequency transformer; Reliable Parts Mfg. Co.
"Rhamstine" audio-frequency transformer; J. Thomas Rhamstine.
"Rubicon" audio-frequency transformer; Rubicon Co.
Duplex (push-pull) transformer; Rubicon Co.

BATTERIES

Prest-O-Lite batteries; Prest-O-Lite Co., Inc.
Jumbo battery; Primary Mfg. Corp.
"Rebat" rechargeable wet "B" batteries; Radio Rebat Co.

BATTERY CHARGERS AND RECTIFIERS

"Rhamstine" "B" rectifier; J. Thomas Rhamstine.
Battery chargers; P. C. Rumbold

CRYSTAL DETECTORS

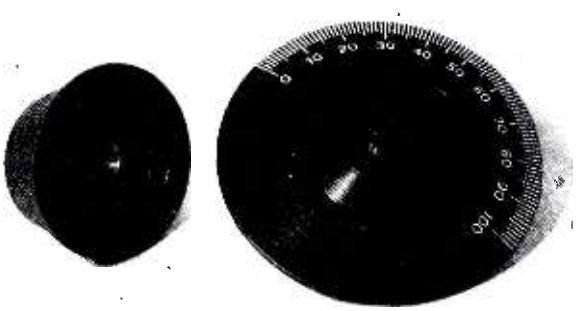
Oscillaformer; Oscillaformer Co.
Detector stand; Pacent Electric Co., Inc.
"Death Valley" crystal; Pacific Radio Specialty Co.
"Death Valley" permatect; Pacific Radio Specialty Co.
De-Tec-Tone crystal detector; Pyramid Products Co.
Big Pyramid crystal; Pyramid Products Co.
Goldwhisker; Rep Radio Co.
Roll-O crystal; Roll-O Crystal Co.
R-U-F semi-fixed detector; R-U-F Products Co.
R-U-F rough wonder crystal; R-U-F Products Co.
Rusonite fixed detector; Rusonite Products Corp.

DIALS

Ultra-vernier tuning control; Phoenix Radio Corp.
"Hemco" dials; Geo. Richards & Co., Inc.

GRID-LEAKS AND RESISTANCES

Cartridge resistances; Pacent Electric Co., Inc.
Grid-leak and condenser; Pfanstiehl Co.
Nonoise variable grid-lead; Radio Foundation, Inc.



A dial made in two parts that is self-centered.

THE DIAL WITHOUT A SET-SCREW

Name of instrument: Knob and dial.

Description: This knob and dial unit is made in two pieces and is attached to the shaft of a tuning instrument by means of a threaded chuck. The dial itself is placed over the shaft in the right position and then the small knob is screwed up tight causing the chuck to pinch on the shaft, thus making a secure and self-centered fit.

Usage: As a dial for tuning a radio-frequency circuit.

Outstanding features: Neat appearance. Clear vision of the numerals. Self-centering. No set-screws. No wobbling.

Maker: Waterbury Button Co.

HEADPHONES

"Pacent" headsets; Pacent Electric Co., Inc.
"Perfectone" phone; Perfectone Radio Corp.
"Randolph" special headphone; Randolph Radio Corp.
"Royalfone" headset; Royal Electrical Laboratories.

JACKS

Pacent jacks; Pacent Electric Co., Inc.

KITS

Ultradyne kit; Phoenix Radio Corp.
Pink-A-Tone superheterodyne kit; Pinkerton Radio Corp.
"Vir Bren" kit; Radio Instrument Co.
"Raven" superheterodyne kit; Raven Radio, Inc.
"Rubicon" kit; Rubicon Co.

LIGHTNING ARRESTERS

Anchor lightning arrester; Radio Receptor Co.

LOOPS

"Pathe" Curtentenna; Pathe Phonograph & Radio Corp.
"Pollard" loop; Pollard Bros.
Collapsible loop aerial; Radio Association of America
Duo-Spiral folding loop; Radio Units, Inc.
"Hemco" loop aerial; Geo. Rchards & Co., Inc.
"Ritter" loop aerial; Ritter Radio Corp.

An automatic switch that prevents short-circuits.

A BATTERY CIRCUIT BREAKER

Name of instrument: Circuit breaker.
Description: A protective switch enclosed in a neat metal container for mounting near the storage battery of a receiving set, to protect the battery and the set against short-circuits. The breaker may be set in operation by pressing one of the small buttons. The other one if pressed will release the switch and open the circuit. If a short-circuit occurs the switch automatically opens and stays open until it is reset by the operator. The mechanism may be set to open at a load of three or four times that drawn by the filaments of the vacuum tubes in the receiver.
Usage: As a protective switch against short-circuits in a radio installation.
Outstanding features: Absolute protection. Small size. Ease of setting.
Maker: Precise Mfg. Corp.

A low capacity is obtained between terminals.

AN EFFICIENT VACUUM-TUBE SOCKET

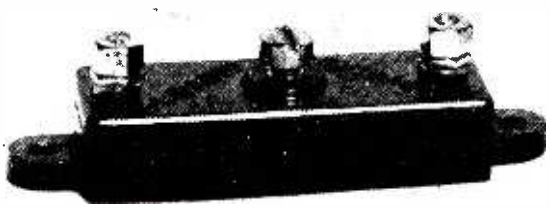
Name of instrument: Vacuum-tube socket.
Description: This instrument is about as simple as it is possible for it to be. The contact pieces are attached to the skeleton insulator base by screws which can be used for fastening connecting wires. The contact, however, is also brought out in a single piece which is available for soldering. The tubular support for the vacuum tube contains a unique flap for applying pressure on the side of the tube and thus holding it secure in the socket. The four eyelets are installed in the base for mounting.
Usage: As a holder for vacuum tubes in a receiving set.
Outstanding features: Light weight. Good contact. Low capacity between terminals. High insulation. Neat appearance.
Maker: Leich Electric Co.

LOUDSPEAKERS

"O'Neil" audiphone; O'Neil Mfg. Co.
"Pathe" loudspeaker; Pathe Phonograph & Radio Corp.
"Perfectone" loudspeaker; Perfectone Radio Corp.
"Radiola" loudspeaker; Radio Corporation of America
Radio Vase; Radio Vase Co.
American Bell loudspeaker; Randolph Radio Corp.
"Thorola" loudspeaker; Reichmann Co.
"Thorophone" loudspeaker; Reichmann Co.
"Remo" Trumpet; Remo Corporation
"Remola" recreator; Remo Corp.
"Royalfone" loudspeaker; Royal Electrical Laboratories

MISCELLANEOUS ACCESSORIES

Radio wall map; Ozarka, Inc.
Peerless Twin-audio amplifier; Peerless Radio Corp.
"Nodust" cleaner; Peiffer & Co.
"PRSH" A. C. leads; Pittsburgh Radio Supply House
Standard adjustable aerial base; Pomona Hardware Co.
Panel engraving machine; H. P. Preis & Co.
"Precise" No. 1,600 protector (circuit breaker); Precise Mfg. Corp.
Filtoformer; Precise Mfg. Co.
Coil plug receptacle; Pacent Electric Co., Inc.
Jack name plates; Pacent Electric Co., Inc.
Quinby radio frames; Quinby Radio Frame Corp.
"Radeco" safety fuses; Radio Equipment Co.



A small condenser provided with an adjusting screw that is a great aid in neutralizing a receiver.

A SMALL ADJUSTABLE CONDENSER

Name of instrument: Small variable condenser.
Description: The two plates which form part of this condenser are mounted inside of the neat bakelite container directly on the two screw terminals shown and also serve as binding-post terminals. The adjustable screw in the center when turned in a clockwise direction depresses one of the plates, thus decreasing the distance between them and increasing the capacity.
Usage: In any part of an electric circuit where a very small variable condenser is necessary.
Outstanding features: Small size. Electrical efficiency. Exactness of manufacture. Ease of adjustment. Neat appearance.
Maker: X-L Radio Laboratories.

Run-a-Radio"; Radio Appliance Co., Inc.
Tiny-Turn vernier control; Radio Units, Inc.
"Rajah" snap terminals; Rajah Auto Supply Co.
Rajah" radiator ground; Rajah Auto Supply Co.
Goldschisken; Rep Radio Co.

PANELS

Panelyte radio panels; Panelyte Board Co., Inc.
Insuline radio panels; Radio Panel & Parts Corp.

PHONE PLUGS

Plugs; Pacent Electric Co., Inc.
Poly plug; Polymet Mfg. Corp.

PHONOGRAPH ATTACHMENTS

Phonograph attachment; Perfectone Radio Corp.
"Thorola" phonograph attachment; Reichmann Co.
"Rhamstine" victophone; J. Thomas Rhamstine.
"Rhamstine" needlephone; J. Thomas Rhamstine.
"Royalfone" unit; Royal Electrical Laboratories.

POTENTIOMETERS

No. 88 potentiometer; Pacent Electric Co., Inc.
"Premier" potentiometers, Premier Electric Co.

POWER AMPLIFIERS

"Radiola" balanced amplifier (push-pull); Radio Corporation of America.

RADIO CABINETS

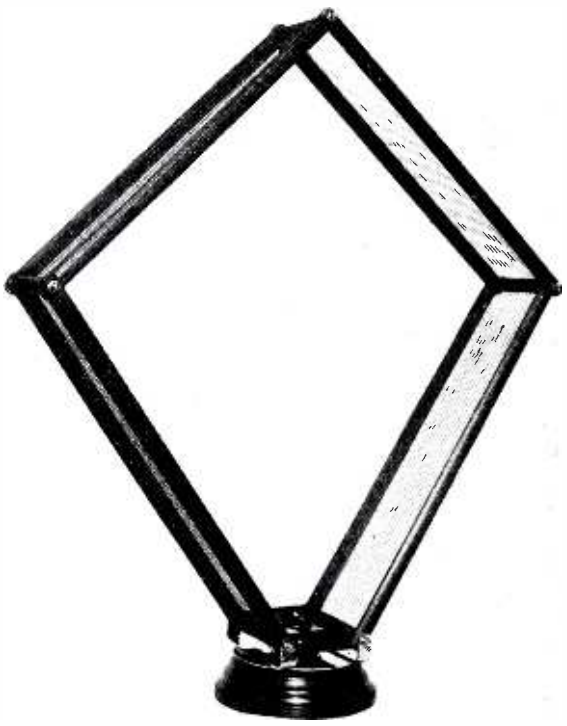
"Campbell" radio cabinet; Perkins-Campbell Co.
Radio cabinets (desk style); Peters Electric Cabinet Co.
"Robbins" radio desk; Robbins Woodworking Co.

RADIO FREQUENCY TRANSFORMERS

Ultraformer; Phoenix Radio Corp.
Pink-A-Tone transformer; Pinkerton Radio Corp.
Super-multiformer; Precise Mfg. Co.
Precision radio-frequency transformer; Precision Coil Co., Inc.
"Vir Bren" radio-frequency transformers; Radio Instrument Co.
"Vir Bren" input transformer; Radio Instrument Co.
"Reliable" radio-frequency transformer; Reliable Parts Mfg. Co.
Intermediate-frequency transformer; Reliable Radio Mfg. Co.
Intermediate-frequency transformer; Remler Radio Mfg. Co.
"Rubicon" radio-frequency transformer; Rubicon Co.
Tuned stage transformer; Remler Radio Mfg. Co.

RECEIVING SETS

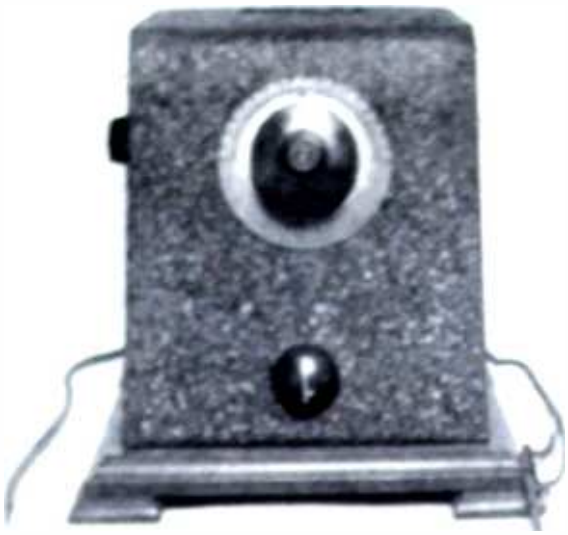
"Operadio" receiver; Operadio Corp.
Low-wave receiving set (for amateurs); Ott Radio, Inc.
"Ozarka" portable receiver; Ozarka, Inc.
"Ozarka" 4-tube set; Ozarka, Inc.
"Minute Man" receiving set; Pathe Phonograph & Radio Corp.



This loop is jointed in five places, which permits folding into a very compact unit.

A COLLAPSIBLE LOOP

Name of instrument: Loop antenna.
Description: A portable loop with a unique folding feature. The wooden strips which support the five slotted insulator rods are hinged so that they may be folded up. The two upper sections thus may be inverted and the two lower sections may be closed up vertically, reducing the over-all dimensions to a small space for packing. The wires, however, remain taut in any position of the outer frame. The loop itself may be revolved on a fixed base.
Usage: As a pick-up device for a radio-frequency receiver.
Outstanding features: Portability. Neat workmanship. Good appearance. Variable inductance. Directional efficiency.
Maker: Aalco Radio Laboratories, Inc.



CONDUCTED BY DR. E. E. FREE

The Ether and the Soul

SIR OLIVER LODGE is one of the world's most competent and sensible scientific investigators. He is also, as newspaper readers well know, one of the few scientific men who have accepted the beliefs of the spiritualists. He not only admits a *possibility* that there exist non-material forces and actions and even beings, but he believes all these things to be *facts*. He has devoted much work to the field of psychic research. He is convinced that human personalities survive after the dissolution which we call death.

Unusual interest attaches, therefore, to a recent radio address made by Sir Oliver from 2LO, in London, in which he suggests that the mysterious ether, about which there has been so much argument, may be the seat of psychic forces and entities as well as the medium for the transmission of radio waves and of light.*

It is possible, Sir Oliver thinks, that life may be connected much more intimately and permanently with the ether than with matter. The ether has "perfect properties." No energy is lost when light (for example) traverses it. Matter, on the other hand, is liable to deterioration. Energy is lost in it and by it. Matter becomes the seat of the mysterious forces which we call life. Matter becomes "animated." The question arises, can ether be animated too?

All force, Sir Oliver continued, is exerted through the ether. It is the medium of such life attributes as mind and memory. These attributes belong to the part of the universe which is unseen. If they have contacts with physical things at all, those contacts are presumably through the ether. Our material bodies are transient. They wear out. Mind, too may need a vehicle, one that is independent of the body and of matter. The present connection of life with matter is probably, Sir Oliver thinks, neither permanent nor direct. The real medium of the life force is ether.

Undeniably these speculations are interesting. Sir Oliver always contrives to be that. Whether, in the present state of knowledge, they get us much farther in the progress of thinking, is another question. The ether itself is, admittedly, utterly mysterious. The life-force or soul or whatever you want to call it is equally mysterious. It does not seem so very useful, therefore, to equate the two mysteries.

Still, most people demand to be allowed to think about the soul. They might as well think about an etheric soul as any other kind. No one can say that they are wrong—or right.

*The address was the last of a series of seven broadcast by Sir Oliver under the title "Ether and Reality." It was delivered on March 31, 1925, and was reported in the London press and in *Nature* (London), vol. 115, page 505 (April 4, 1925). In another address in Christ Church, London, on March 12, 1925, Sir Oliver expressed somewhat the same ideas. This address is reported in the *Chemical News* (London), vol. 130, page 199 (March 27, 1925).

New Antenna System Reduces Static

AN ingenious application of two loop antennas to the problems of directive reception and of static reduction has been perfected by Mr. H. T. Friis of the Bell Telephone Laboratories and was described by him recently before the Institute of Radio Engineers, in New York City.*

The device consists of a long structure, like the movable part of a rotating drawbridge. It rotatess, too, just as the drawbridge does, but on wheels at the two ends instead of on a central pivot. At the two ends of the structure are the two loops, the length of the "bridge" being such that these loops are distant from each other just 1/12 of the wavelength that is to be received. For example, for receiving a 600-meter wave, the length of the bridge between the two loops is 50 meters, approximately 150 feet.

*Mr. Friis' paper was presented before the Institute of Radio Engineers on May 6, 1925. It was reported in the Radio Section of the New York Herald-Tribune on May 10, 1925. The facts given here are taken from a statement issued by the Bell Telephone Laboratories, Inc., New York City.

The operation of the apparatus depends on the fact that radio waves need time to move through space. If one end of the bridge is pointed directly toward the transmitting station the loop at that end of the bridge will receive the wave first. The loop at the other end of the bridge receives the wave a little later. If the two loops are 1/12 wavelength apart this will mean that the received wave in the second loop will be 1/12 later in phase than the wave in the first loop. Expressed in the usual fashion, this means that the second wave will be 30 degrees out of phase with the first.

The next step is to shift this phase difference still further by means of a phase-changer attached to the receiver. It is shifted, in fact, 150 degrees, which makes it just 180 degrees out. This means that the wave coming from that direction will actuate the two loops in exactly opposite fashion. They will cancel each other. Nothing will be heard in the receiver.

But consider a wave coming from the opposite direction. This wave will encounter the two loops in the reverse order. The 30-degree phase lag will apply in the reverse direction to the 150-degree phase difference produced by the phase changer. Accordingly, the net, or resultant, difference in phase between the two loops will be 120 degrees, instead of 180 degrees. This means, as any electrical engineer will tell you, that the signal strength is not canceled. In fact, it is left unimpaired. The two loops function as though they were a single loop or any other satisfactory type of antenna.

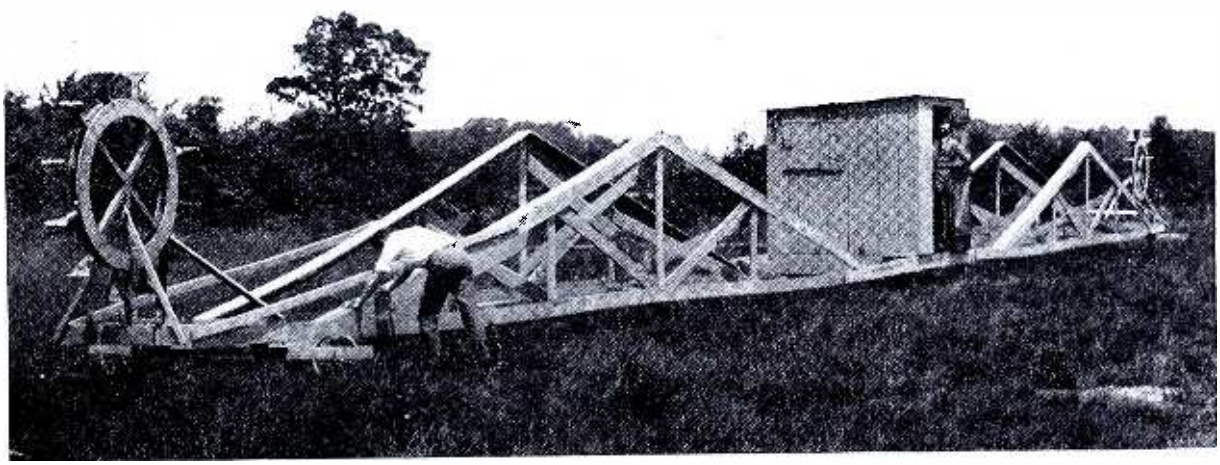
The net effect is, then, that signals coming toward one end of the bridge are received perfectly, while signals approaching toward the other end of the bridge are not received at all. This gives us a directional antenna which will receive from any direction lying in one semicircle and not at all from any direction lying in the opposite semicircle. The ordinary directional loops are much less effective than this, since they receive reasonably well from any direction except those within a narrow angle nearly perpendicular to the plane of the loop.

This is why Mr. Friis' device is so effective in reducing static. Most of the static is directional. If the bridge is pointed in any direction in the semicircle opposite to the direction of the static, the static will be canceled out and will not be heard. Any desired signal coming from the proper semicircle will be heard unimpaired. In the actual set-up used by Mr. Friis a superheterodyne receiver was employed, and the precise tuning of this receiver enabled a still further reduction of the static.

The chief disadvantage of the apparatus is the length, cost and cumbersomeness of the movable bridge carrying the two loops. But doubtless this can be reduced. One thinks, for example, of a pair of very light loops mounted on the two ends of a long pole or a duralumin girder and balanced on the top of a tall vertical pole, like the weathercock on a steeple.

Earth Conductivity Affects Inclination of Radio Wave

Most of the modern theories of radio transmission assume that one component of the wave arriving at a distant receiving station has reached there by some path high up in the air, as, for example, along the supposed Heaviside Layer. If this be true this component of the wave ought to arrive at the receiver with a downward inclination, its wave-front being not quite perpendicular to the surface of the ground. A mechanical analogy is



Bell Telephone Laboratories

A NEW ANTENNA SYSTEM FOR DIRECTIVE RECEPTION

This rotating bridge, having loop antennas at both of its ends, has been built by Mr. H. T. Friis to obtain more complete directive reception as well as to reduce static. The system receives signals from any direction in one semicircle, but from no direction in the opposite semicircle.

Dr. R. L. Smith-Rose

MEASURING ELECTRIC FIELDS

This straight-wire antenna, or "Hertzian rod," was used by Dr. Smith-Rose to determine the direction of the electric field of an arriving radio wave.

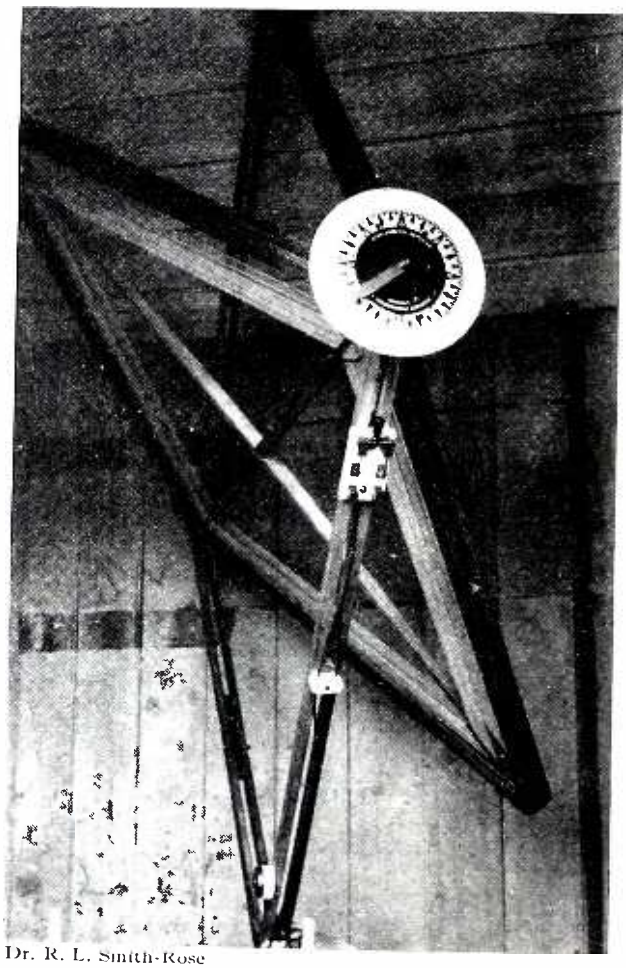
the artillery shell which is fired at a high angle of elevation, reaches the higher levels of the atmosphere during its flight, and finally arrives at its target along a downward-pointing path as though it were falling obliquely from the clouds.

The well-known English radio engineers, Dr. Smith-Rose and Mr. Barfield, have now attempted to verify this theory by a direct test of the inclination of the wavefront arriving at a receiving station.* This proved to be impossible practically because of the relatively high conductivity of the earth's surface. For a perfectly-conducting earth the electric force is always vertical and the magnetic force always horizontal regardless of the real inclination of the wavefront of the arriving wave.

Experimental tests of the actual conductivity of the earth at a number of localities in England showed values between 6×10^8 and 4.7×10^9 electrostatic units. The higher of these values is equivalent, roughly, to 800 ohms resistance per cubic inch of soil. The measurements were made at radio frequencies, by observing the forward tilt of waves from a nearby transmitter.

These conductivities are relatively high for materials of the insulator class and this is ascribed to the fact that the soil and rocks of England are prevailingly moist. This suggests a possible research for radio engineers who happen to be located in some of the American desert regions. In large parts of California, Nevada, Arizona and other western states the soil is almost waterless. Its conductivity is probably far lower than the values found by Dr. Smith-Rose and Mr. Barfield in England. The repetition of these experiments in some such locality might yield very useful information about the actual paths of radio waves close to the earth.

The research is not to be recommended, however, to the amateur or to any one except a well-trained and experienced radio engineer. The necessary technique involves the determi-



Dr. R. L. Smith-Rose

THE TILTING LOOP

This device determined the direction of the magnetic field of the arriving wave. The intensity of the signal varied with the position of the loop relative to the wave.

*"On the Determination of the Direction of the Forces in Wireless Waves at the Earth's Surface," by R. L. Smith-Rose, Ph.D., and R. H. Barfield, *Proceedings of the Royal Society* (London), Series A, vol. 107, pages 587-601 (March 2, 1925).

Dr. R. L. Smith Rose

THE COMPLETE APPARATUS FOR MEASURING WAVE INCLINATION

This portable apparatus, being operated by Dr. Smith-Rose, combines the Hertzian rod and the tilting magnetic loop shown on the preceding page. Measurements with this apparatus led to a determination of the prevailing electrical conductivity of the soil in England.

nation of the direction of the electrostatic field by a Hertzian rod—practically a straight, single-wire antenna the inclination of which can be varied—and the exploring of the electromagnetic field by means of a tilting loop. Both of these pieces of apparatus will work usefully only in the hands of experts, who know exactly what they are about.

Surface Films as Radio Detectors

WHATEVER be the secret of the detecting action of a crystal, it is reasonably certain that this action is accomplished within a thin film, possibly some scores of atoms deep, on the surface of the crystal. The main body of the crystal serves merely to support this surface film. It has no more to do with the detecting action than the main structure of a house has to do with the paint on its roof.

Why not make use, then, of a mere film of crystal material, of lead sulphide (which is the same as galena) or of silver sulphide or of something else? That this can be done with considerable success is claimed by Mr. James Strachan,* whose work on various phases of crystal detection is already familiar to readers of this department.

Mr. Strachan reports, for example, that a piece of lead, a piece of silver or a piece of copper may be exposed to moist sulphuretted hydrogen gas (which is the gas of rotten eggs) and will acquire a thin film of the respective sulphide, which film is then quite efficient as a detector. It works best, he reports, when used with an applied potential. Similar effects may be obtained with oxide films on copper or brass. The mere tarnish which forms naturally in the air on brass articles and which consists, usually, of mixed oxides and sulphides of copper and zinc, will serve quite well for radio detection.

These film detectors are worthy of more attention from experimenters than they seem to have had hitherto.

*"Some Interesting Experiments with Single-Point Detectors," by James Strachan. *Wireless World* (London), vol. 15, pages 200-202 (November 12, 1924).

How to Repair a Broken Lead Wire

A HINT of real value for those who experiment with vacuum tubes is contained in a recent note by Mr. D. A. Wells of the University of Cincinnati.* When one of the fine wires that enters through the glass of an experimental tube is broken off outside the glass, as is all too frequently the case, it is usually believed necessary to throw the tube away. Soldering a new wire to the tiny projecting point of metal is ordinarily a hopeless task.

Mr. Wells uses, he reports, a contact consisting of a drop of metallic mercury. First he cleans the broken, projecting point of the wire with a drop of nitric acid. Then he places a

*"Method of Repairing Broken-off Lead-in Wires," by D. A. Wells, *Journal of the Optical Society of America* (Menasha, Wis.), vol. 10, pages 615-616 (May, 1925).

drop of mercury on it. Next he dips the end of a clean copper wire into this mercury. The copper wire must be held in place mechanically by a strip of tape around the tube or in some other way. Electrically, the mercury contact is good enough. Many a damaged experimental tube can be saved in this way, thus avoiding the blowing and pumping of a new tube.

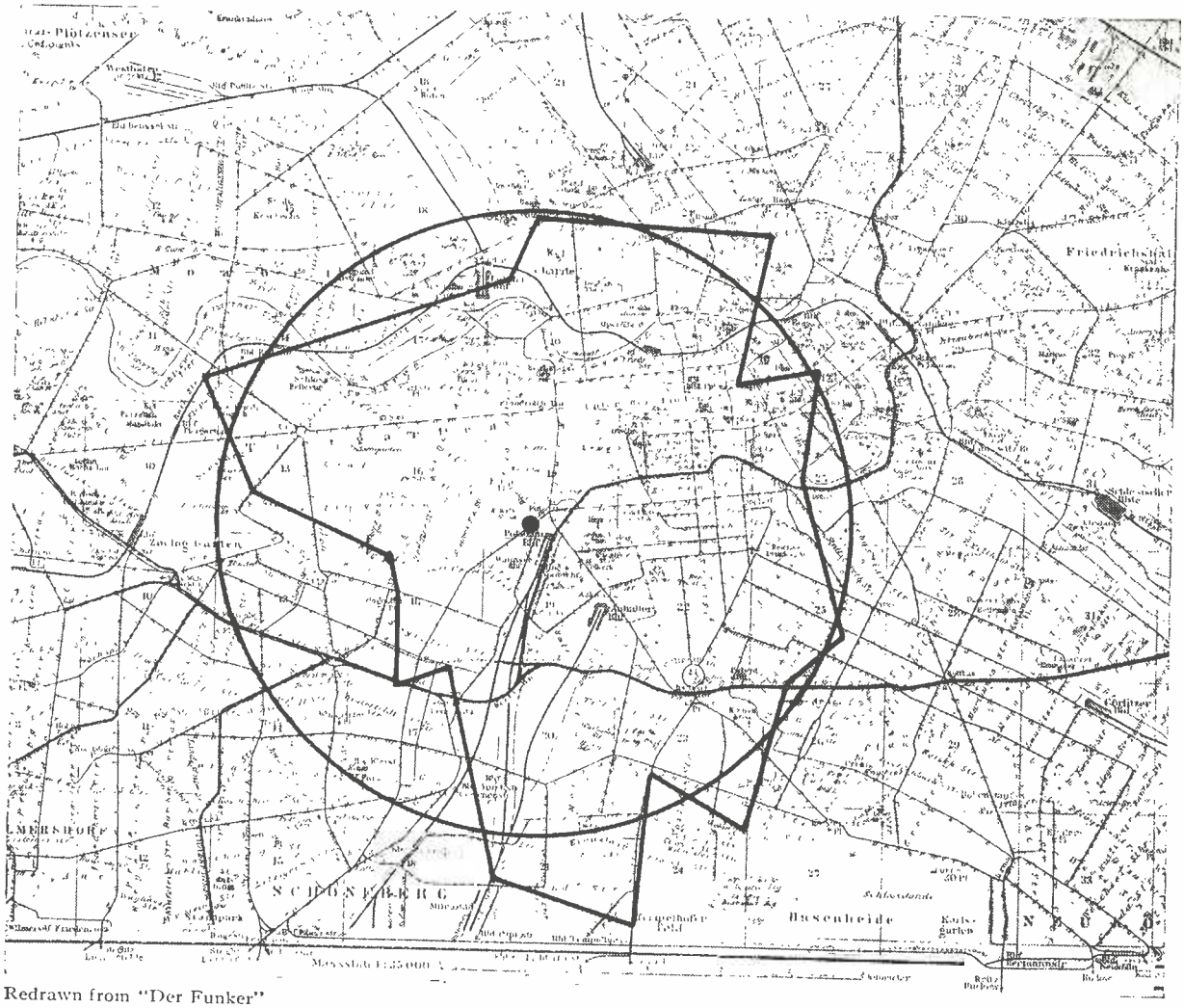
Radio Wave Absorption by Berlin Houses

Over a year ago the engineers of WEAF made a series of measurements of the strength of signals from their station at numerous points on and near Manhattan Island and prepared a map showing in most interesting fashion just how the signals were affected by the two rivers and by the blocks of tall steel buildings in the downtown and the Forty-second Street districts of the city. A similar investigation has now been made by Postal Councillor M. Bäumler, of the German Government Telegraph Service, for the cities of Berlin and Hamburg.*

As was expected, Herr Bäumler found determinable irregularities in the strength of the fields in different directions from the transmitter. Perhaps the most interesting feature disclosed by the map of Berlin is the fact that transmission was better over the famous Tiergarten park than in directions where the city is closely built up. Buildings are evidently more absorptive than trees, at least under the conditions of these tests.

As was the case in New York, no actual "dead spots" were found. We hear less of these supposed dead spots nowadays in the United States, but London is going through an epidemic of them. The London broadcast-

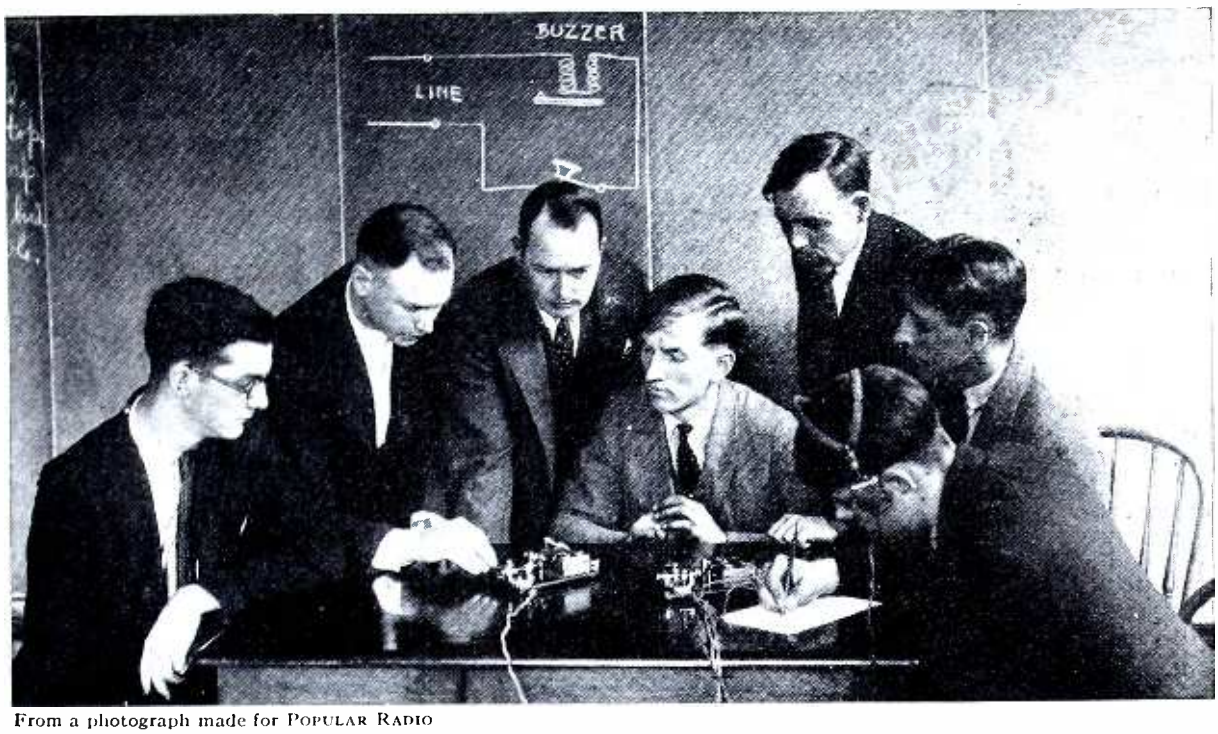
*The results are reported in "Elektrische Nachrichten-Technik," vol. 1, part 5, published by the Wiedemannsche Buchhandlung, Berlin, and are abstracted (in German) in *Der Funker* (Berlin), vol. 4, pages 17-19 (February, 1925).



Redrawn from "Der Funker"

HOW THE CITY OF BERLIN AFFECTED RADIO WAVES

The black dot at the center shows the location of the transmitter at Voxhaus. The circle indicates a uniform distance from this transmitter. The other line connects points at which the same signal strength was found. Note that the transmission is good toward the westnorthwest, over the great park marked "Tiergarten."



From a photograph made for POPULAR RADIO

HOW DEAF STUDENTS CAN LEARN TELEGRAPHY

The "touch receiver" invented by Mr. Jakosky and his associates is worn by the man at the right. Mr. Jakosky himself is at the key. At his left are Dr. McConnell, of the Bureau of Mines, and Mr. Ingel of the Western Pennsylvania School for the Deaf. The type of receiver designed for reception by the finger tips may be seen on the table.

ing station, 2LO, was moved recently to a new location. Since then there has been much complaint that the southeastern portion of the city is so shielded that the programs cannot be received.

Long Waves Also for MacMillan

THE MacMillan Arctic Expedition, which sailed recently for its winter vigil in the north, was originally designed to be equipped only with short-wave radio, the experiences of the last expedition having convinced the officials of the American Radio Relay League that the best results would be attained with waves shorter than one hundred meters.

But this is not to be. The United States Navy is contributing to the expedition some airplanes and equipment together with fliers to operate them. The Navy insisted that the expedition carry regulation long-wave radio apparatus, it being the Government opinion that these more usual wavelengths were more surely dependable than the newer short ones.

And so, if newspaper reports are to be trusted, the expedition will be equipped with both short-wave and long-wave transmitters and receivers. Assuming that space for both is available, this is an admirable outcome. The expedition should come back with much data pertinent to the controversy between advocates of short waves and low power and advocates of long waves and high power.

Receiving Radio Code by Touch

AMONG professions lately made available to deaf persons is, curiously enough, the profession of telegraph operator. This has been done by the perfection of a code receiver which operates by touch instead of by hearing. The device can be applied to radio code as well as to the Morse code of land telegraph lines. There is no reason, therefore, why deaf persons cannot now enjoy code conversations by radio or even, it may be possible, seek employment as commercial radio operators.

The new touch receiver has been devised by Mr. J. J. Jakosky, well-known radio engineer of the United States Bureau of Mines, in cooperation with Dr. W. J. McConnell, a surgeon of the Bureau of Mines, and Mr. Truman L. Ingle, Principal in the Western Pennsylvania School for the Deaf.* Two forms have been perfected; one operating through the finger tips, the other by means of a small plate held against the temple, as the telephone receivers worn by switchboard operators are held against the ear.

In both cases the line is actuated with ordinary 60-cycle alternating current. Attached to the "sounder" or receiving device on this

*"Telegraphy for the Deaf," by J. J. Jakosky, W. J. McConnell and Truman L. Ingle, a pamphlet printed by the Class in Printing at The Western Pennsylvania School for the Deaf, Englewood, Pittsburgh, Penna., 1925. 7 pages.

line is a vibrating armature designed to respond by vigorous vibration to this 60-cycle current. In the finger-tip apparatus this armature is attached to a small metal plate against which the fingers are placed. In the head-band form of the apparatus a similar metal plate presses against the skin of the temple.

Pressing the key at the sending end of the line sends the alternating current into the receiver, sets the vibrating plate into motion and makes the quivering of this plate perceptible to the deaf "listener" at the receiving end. Dots and dashes are distinguishable by length, just as in the usual audible receivers. Weak impulses from long lines are fed into relays and converted into the alternating-current local signal, just as telegraph signals are now reinforced by using direct-current relays. Radio signals may be converted and made sensible to touch in the same way.

Two Important Experiments on the Ether and Relativity

THE famous Einstein theory was developed, you remember, partly from a remarkable experiment known as the Michelson-Morley experiment. This experiment had for its object the detection of any possible motion of the earth with relation to the ether, this being ascribable, of course, to the motion of the earth in its orbit or to its rotation on its axis.

The experiment failed. No drift of ether through or past the earth was detected. There were three possible explanations: (1) that there is no ether, (2) that an ether exists but moves with the earth, (3) that the motion of the earth relative to the ether is exactly compensated by a contraction of matter in this direction, just as a wind blowing against a gas-filled balloon will cause it to contract a little in the direction of the wind pressure. The Einstein theory is consistent with either the first explanation or the third.

Two recent experimenters have carried out tests essentially analogous to the famous Michelson-Morley one. The results were announced at the recent meeting of the National Academy of Sciences in Washington and constitute some of the most important scientific data that we are likely to acquire this year.

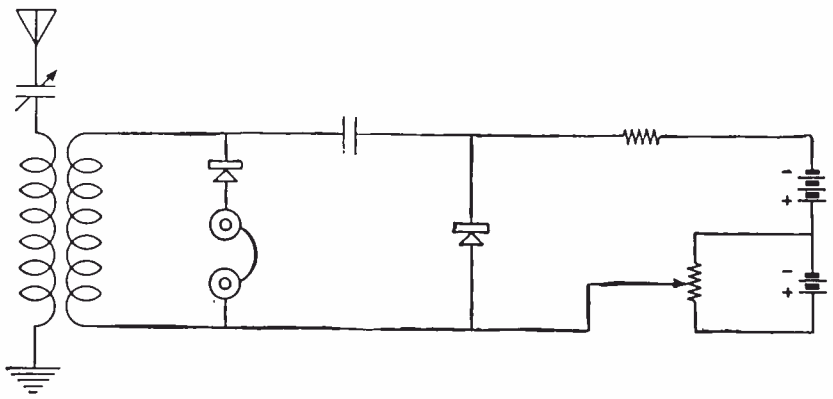
One of the experiments was devised by the same Professor Albert A. Michelson who helped conduct the original Michelson-Morley experiment. In a field some ten miles west of Chicago, Professor Michelson built a square of iron pipe approximately one mile on a side. He pumped most of the air out of this pipe so that accidental variations of the temperature or pressure of the air inside the pipe would not affect the experiment. Then he sent two light rays around the square of pipe; one ray in one direction, the other in the opposite direction.

Meanwhile the earth was revolving, carrying the pipe square with it. The light ray that moved in one direction through the pipe was moving, on the average, with the rotation of the earth. The ray in the opposite direction was moving against the earth's motion. Accordingly any "ether drift" should cause one ray to complete the circuit a trifle faster than the other one.

A long series of very exact measurements was carried out. No ether drift was detected. The result agrees, therefore, with that of the earlier Michelson-Morley experiment and is consistent with the Einstein theory of relativity.*

The other experiment was carried out by Professor Dayton C. Miller, of the Case School of Applied Science, of Cleveland. He too repeated an experiment essentially similar to the Michelson-Morley experiment, but he did it on top of Mt. Wilson, in California, where the great astronomical observatory is situated. His results are absolutely contrary to those of Professor Michelson. He finds a drift of the

*The results were announced tentatively at a lecture in Chicago on January 8, 1925, this lecture being since printed in the *University Record*, University of Chicago, vol. 11, pages 136-153 (April, 1925). Details of the results are given in "The Effect of the Earth's Rotation on the Velocity of Light," by A. A. Michelson, Henry G. Gale and Fred Pearson, *Astrophysical Journal* (Chicago), vol. 61, pages 137-145 (April, 1925).



LOSSEV'S OSCILLATING CRYSTAL USED AS AN AMPLIFIER

When the voltage drop across the oscillating crystal is adjusted to exactly the right value the crystal can operate as a "negative resistance," thus causing some amplification of the signal heard in the telephones connected to the detecting crystal.

Robert H. Moulton

AMERICA'S GREATEST EXPERT ON ETHER WAVES

Professor Albert A. Michelson completed recently the most accurate measurement ever made of the speed of light. His experiment on ether-drift is described in the text. In addition, Professor Michelson has done much other important work with light rays, including the perfection of the interferometer method of measuring the sizes of the stars.

earth relative to the ether equaling approximately ten kilometers per second. More significant still, this drift varies in amount in just the way it should at different times of the day and the year, corresponding with the changing direction of motion of the particular point on the earth where the experiment was conducted.†

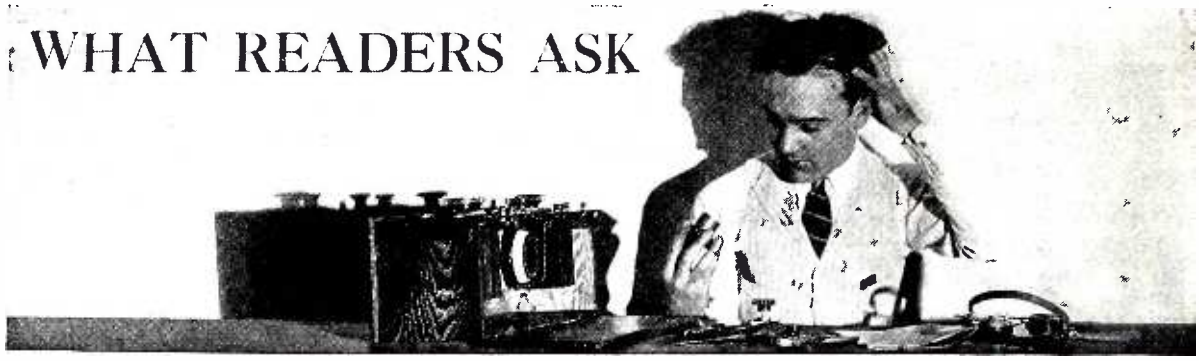
This leaves us confronting a sharp contradiction between two experiments which should have come out the same. It is too soon to say that the Einstein theory is disproved or even that it is notably shaken. That theory is supported in any event, by a vast amount of other evidence. But neither is it possible to say that the real existence of an ether is disapproved. If Professor Miller's results stand the tests of criticism and repetition they will furnsh strong evidence for the reality of an ether through which our earth sails along like a bullet through the air.

In the report referred to Dr. Slosson makes the interesting suggestion that the difference between the results of Professor Michelson at Chicago and those of Professor Miller at Mt. Wilson may be due to the greater altitude of the latter station. Close to the earth's surface the ether may be dragged along, he thinks, by the motion of the ground. Higher up this dragging effect may be less complete.

†Professor Miller's data have not yet been published in detail. They were reported orally to the National Academy of Sciences, in session at Washington, D. C., on April 28, 1925. Brief accounts by Dr. E. E. Slosson, of Science Service, appear in *Science* (Lancaster, Pa.) vol. 61, number 1584, (May 8, 1925) and number 1586 (May 15, 1925).

¶ *In* POPULAR RADIO *for October, "How to Build the New Single Control Superheterodyne Receiver"—the latest development of J. L. McLaughlin in the* POPULAR RADIO LABORATORY.

WHAT READERS ASK



CONDUCTED BY LAURENCE M. COCKADAY

IN justice to our regular subscribers a nominal fee of fifty cents 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.

The Browning-Drake Receiver

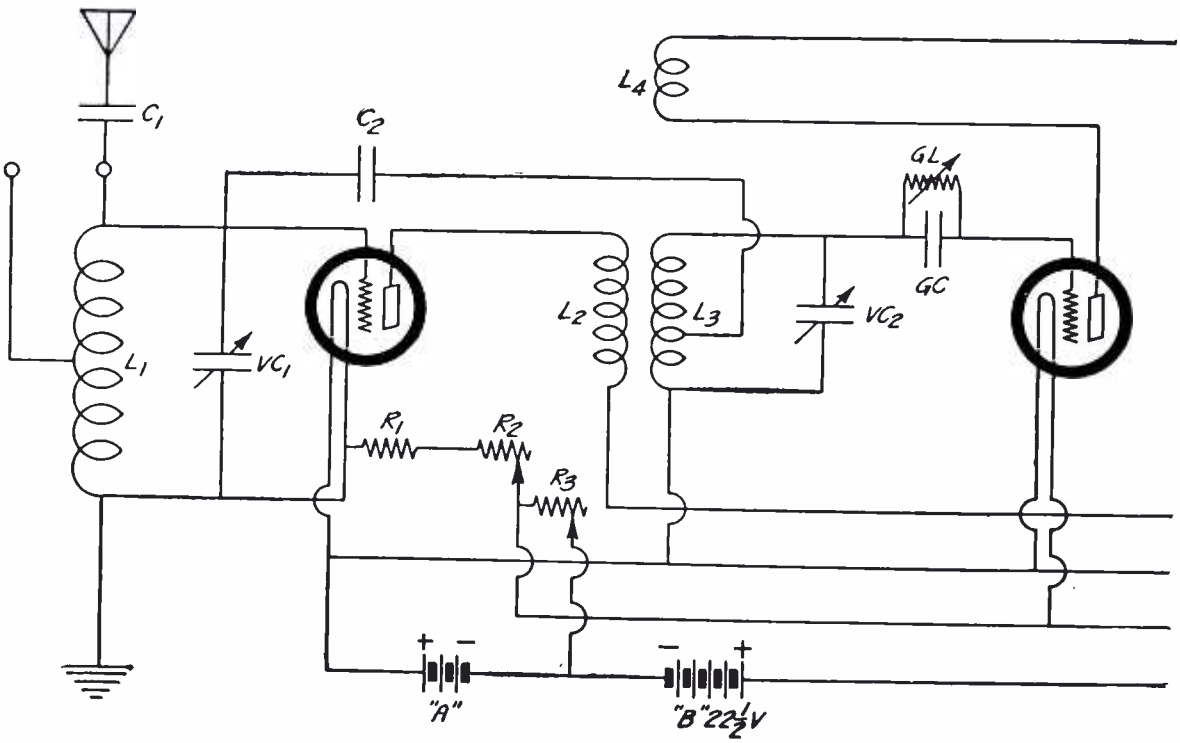
QUESTION: Will you kindly give me the proper circuit for wiring up the Browning-Drake receiver?

R. E. WILLIAMS

ANSWER: In Figure 1 you will find the circuit for this receiver. The parts you will need for this set are the following:

L1, L2, L3 and L4—inductances which comprise part of the National Regenaformer kit;
VC1 and VC2—variable condensers, .00035 mfd. and .0005 mfd. respectively which also comprise part of the above mentioned kit;
C1—mica fixed condenser, .0001 mfd.;
C2—Rathbun three-plate vernier condenser;
C3—mica fixed condenser, .001 mfd.;
C4—bypass condenser, 1 mfd.;
R1—fixed resistance, 25 ohms;
R2—filament rheostat, 20 ohms;
R3—filament rheostat, 10 ohms;
GC—grid condenser, .00025 mfd.;
GL—variable grid-leak;
J1—double-circuit jack;
J2—single-circuit jack, filament-lighting type;
AFT1 and AFT2—audio-frequency amplifying transformers.

Three standard sockets should be used for the last three tubes and one 199 type of socket for the first two. The first tube may be either a C-299 or a UV-199 tube—this is the reason for the extra resistance, R1. The three other tubes should be either UV-201-a or C-301-a tubes.



All the tuning is done with the two condensers, VC1 and VC2 while regeneration is controlled by revolving the small knob which is connected to the tickler coil, L4.

Condenser Capacity

QUESTION: I have recently constructed a 5-tube receiver with two stages of tuned radio-frequency amplification but find that the entire broadcasting waveband lies between 5 and 60 on the dials. The tuned circuits consist of coils taken from an old neutrodyne receiver shunted by variable condensers of .0005 mfd. capacity (23 plate). The broadcasting stations come so close together on the dials, especially the lower wave stations, that it is almost impossible to separate them. I understand that this situation can be remedied either by using smaller capacity variable condensers or by removing some of the turns from the coils. Which would you advise?

MILTON GLASSBURG

ANSWER: Either of the plans you suggest may be followed. However, the better plan would be to leave the coils as they are and replace the variable condensers. If you use .00035 mfd. condenser (17 plate) the broadcast band will be spread out to cover approximately from 5 to 90 degrees on your dials. Roughly speaking, you are now using only about 55 percent of the capacity of your condensers. Therefore by using condensers of lower maximum capacity you discard the unused portion of your present condensers, in this way making practically the entire dial range useful.

Difficulty would be encountered in removing turns from the coils because the turn ratio between the primary and secondary coils is carefully proportioned to prevent oscillation. If turns were removed from the secondary windings (which are tuned by the variable condensers) this ratio would be changed and you would find difficulty in controlling oscillation in the radio-frequency amplifier.

Voltmeter for Storage Battery Testing

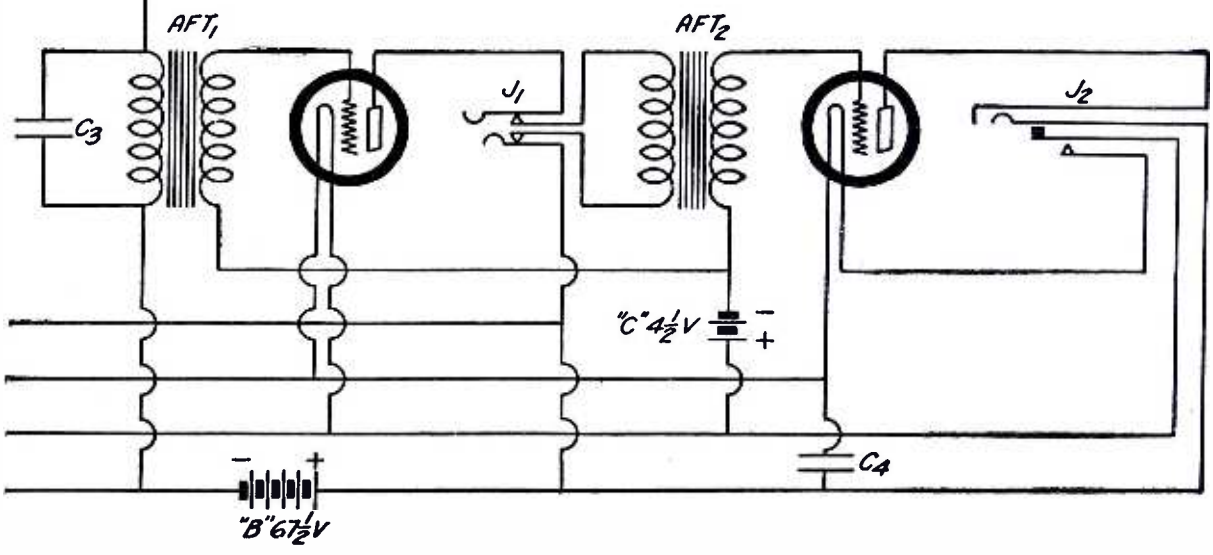
QUESTION: My storage battery is located in a cabinet and must be removed from the cabinet whenever I test it with the hydrometer. Could I install a meter on the radio set which would tell the condition of the storage battery and thus save moving the battery around?

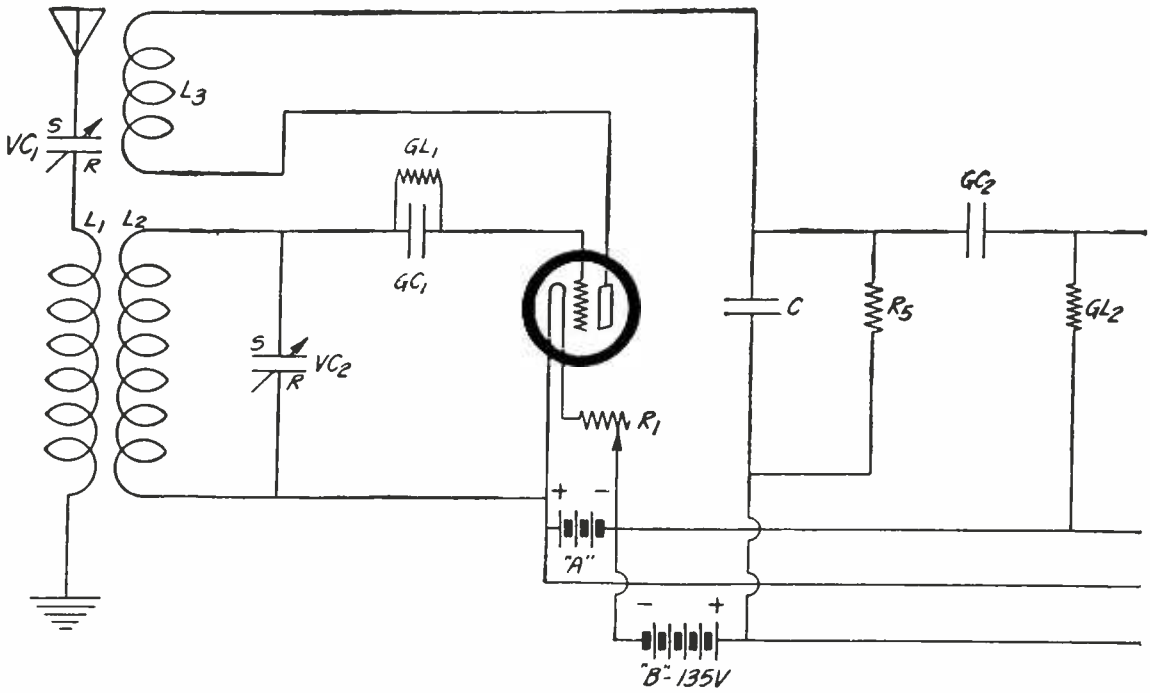
B. MONTGOMERY

ANSWER: A small panel mounting voltmeter with a range of from 7 to 10 volts will give a good indication of the condition of your storage battery. The meter should be connected across the "A" battery terminals of your set and readings should be taken with the tubes in the set burning. The ordinary 6 volt acid type of battery should read about 6.6 volts when first charged and it should be recharged when the voltmeter reading falls off to 5.4 volts.

THE BROWNING-DRAKE CIRCUIT

FIGURE 1: *This popular circuit consists of one stage of neutralized tuned radio-frequency, a regenerative detector circuit and the customary two stages of audio-frequency amplification.*





A Novel Audio-frequency Amplifier Added to the Three-circuit Honeycomb Set

QUESTION: I want to add two stages of resistance-coupled amplification and one stage of transformer-coupled amplification to my single-tube regenerative receiver which consists of three honeycomb coils and two condensers. I want to use the transformer-coupled stage last. Will you show me how to do it?

RALPH HAHN

ANSWER: The circuit diagram for this addition to your receiver is shown in Figure 2. The coils L1, L2 and L3 comprise the triple coil set which you already have. The other parts that are necessary are given in the following list:

VC1 and VC2—variable condensers, .0005 mfd.;
C—bypass condenser, .006 mfd.;
GC2 and GC3—grid condensers, .006 mfd.;
R5, R6 and GL3—coupling resistances, ¼ megohm;
GL2—coupling resistances, ½ megohm;
GC1—grid condenser, .00025 mfd.;
GL1—grid-leak, 2 megohms;
R1, R2, R3 and R4—filament rheostats;
J—single-circuit jack;
AFT—audio-frequency amplifier transformer.

Use any make of standard hard vacuum tubes throughout. The tuning is accomplished with the two condensers, VC1 and VC2 and the coupling is varied by moving coil L1 away from coil L2. The radiation is controlled by moving coil L3 closer to or farther away from coil L2.

New McCullough AC Tube and Regeneration

QUESTION: Is the new McCullough AC tube adaptable to a regenerative circuit?

PATRICK L. NEWSAND

ANSWER: Yes; satisfactory result has been obtained with the new AC tube in various regenerative circuits. However, caution must be exercised to keep the detector tube from an oscillating condition because the moment the detector tube oscillates the AC hum will immediately become apparent.

AC Tubes on Direct Current

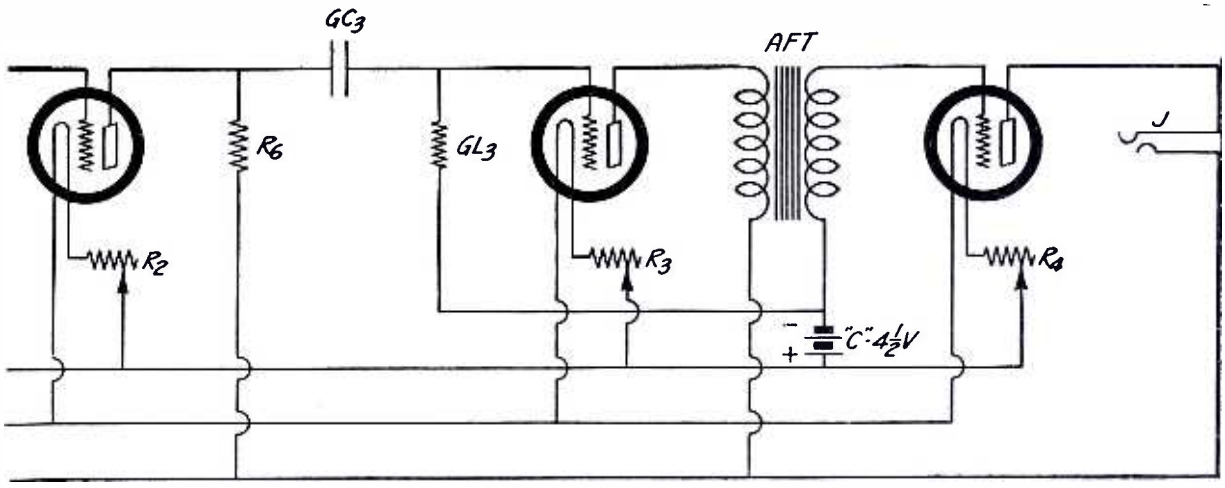
QUESTION: I have direct instead of alternating current in my house but would like to use the new McCullough AC tube instead of the usual "A" battery. I have a five-tube radio-frequency set. Can this be done?

HARRY H. NORTINGTON

ANSWER: These tubes may be used on direct as well as alternating current. The applied voltage must be between 3.25 and 4 volts for best operation, however. This means that the 110 DC must be reduced to this value. In an alternating current circuit this may be done economically with a transformer, but this device cannot be used with direct current. To reduce the voltage applied, a series resistance, capable of carrying in this case approximately five amperes, must be used. This is poor

A HONEYCOMB CIRCUIT WITH COMBINATION AMPLIFIER

FIGURE 2: *The amplifier added to this honeycomb circuit consists of two stages of resistance-coupled and one stage of transformer-coupled audio-frequency amplification. It is different in that the transformer-coupled stage is placed last.*



economy as only about 4 percent of the energy is used in the tube; the rest is dissipated in the resistance. This load will correspond roughly to that of a flatiron.

The easiest way to make a resistance is to fasten five porcelain sockets to a board and connect all of them in parallel. One wire, connecting all the terminals on one side, should go to the plug and another wire connecting the remaining terminals on the other side should go to the "A" battery terminal on the set. The second plug terminal should go to the other "A" battery post. (For details of the connections for the filaments see page 511 of the June 1925 issue.) Four 100-watt lamps (or a combination giving the equivalent) should be inserted in the first four sockets. Lamps varying from 25 to 100 watts should be inserted in the last to get the proper resistance. Use the lowest possible wattage consistent with good reception.

What Size Rheostat?

QUESTION: With rheostats of so many different resistances on the market, how am I to determine which to use with the different tubes? In one receiver I constructed recently I used a 20-ohm rheostat to control the filaments of five 201-a tubes, as I understood this to be the proper resistance to use with this type of tube. However, upon putting the set into operation the rheostat became very hot and in a short time burned out. Why was this, and what type of rheostat should I have used in this case?

HERMAN SCHWENK

ANSWER: A 20-ohm rheostat is suitable for a single 201-a tube or even for two such tubes. However, when several tube filaments are operated in parallel through one rheostat the current passing through the rheostat is the sum of the current requirements of the several tubes. In the case of five 201-a tubes the total current drain is about 1¼ amperes and the average 20 ohm rheostat has a current carrying capacity of only ½ ampere. It is therefore evident that the rheostat was heavily overloaded in the case you mention.

Following are the rheostat resistances required for various types of tubes:

1—201-a tube. 20 ohms;
2—201-a tubes in parallel, 20 ohms;
3 or 4—201-a tubes in parallel, 6 ohms;
5 to 8—201-a tubes in parallel, 2 ohms;
1—UV-200 tube, 6 ohms;
1—199 tube, 50 ohms;
2—199 tubes in parallel, 30 ohms;
3 to 5—199 tubes in parallel, 20 ohms;
6 to 8—199 tubes in parallel, 6 ohms.

When two or more tubes are used in parallel and operate through a single rheostat less resistance is required than when only a single tube is drawing through the rheostat. Fortunately, it is also true that the lower resistance rheostats have a greater current carrying capacity than those of higher resistance. Therefore, the low resistance rheostats are suitable for several tubes in parallel, not only in resistance but also in their current carrying capacity.

The Oscillating Receiver

QUESTION: At irregular intervals my receiving set squeals to such an extent that reception is almost entirely blotted out. These noises, I have been told, are

caused by other receiving sets in my vicinity. I would like to know if there is any attachment which could be applied to my set that would filter out these squeals?

A. B. CLAYTON

ANSWER: There is no such device for eliminating the squeals caused by your neighbors. Each operator of a receiving set should see that his own set never oscillates as he owes that much to the general radio public. The scheme for elimination of oscillation is to tune in the signal first and then increase regeneration to strengthen the signal.

One Stage Neutralized Radio-frequency, Crystal Detector and One Stage of Audio

QUESTION: I have a single-tube receiver which is regenerative that employs a variometer with a fixed condenser in the antenna circuit. I would like to add one stage of radio to this receiver, a crystal detector and one stage of audio, so that it will operate a loudspeaker. The one stage of radio I would like to have neutralized like in a neutrodyne.

T. F. BAER

ANSWER: In Figure 3 we have drawn a hook-up for the final design of your receiver. The parts you will need in rebuilding this set, including the ones you already have, are the following:

VAR—variometer;
RFT—neutrodyne coupling unit;
C1—mica fixed condenser, .00015 mfd.;
C2—neutradon condenser;
R1 and R2—filament rheostats, 20 ohms;
J—single-circuit jack;
DET—crystal detector;
AFT—audio-frequency amplifying transformer.

All the tuning of this receiver is done with the variometer, VAR. The neutradon condenser, C2, should be adjusted by placing a small piece of paper over one of the filament terminals of the first tube and inserting it in the socket so that it will not light. Then, the condenser, C2, is adjusted until the signals are reduced to as low a value as possible. When this is done the receiver is neutralized and the first tube cannot oscillate or cause radiation. The crystal detector will have to be adjusted for suitable sensitivity before this can be done, however.

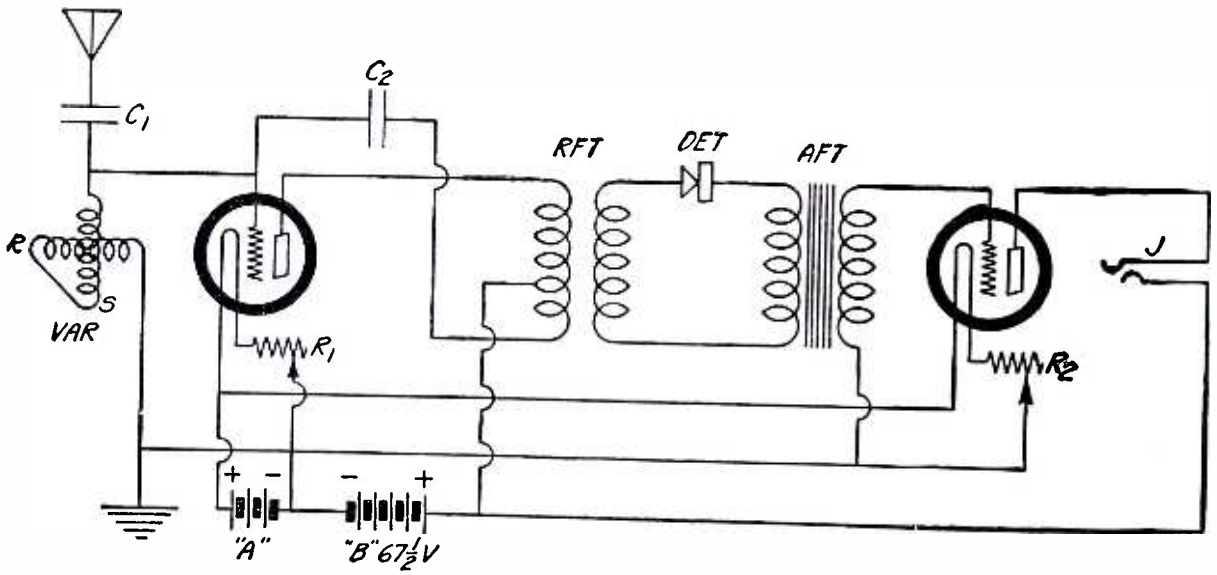
Use two C-301-a or UV-201-a or any other standard make of ¼ ampere hard tube for this set.

How to Eliminate Microphonic Noises

QUESTION: To what are microphonic noises due and how can they be eliminated?

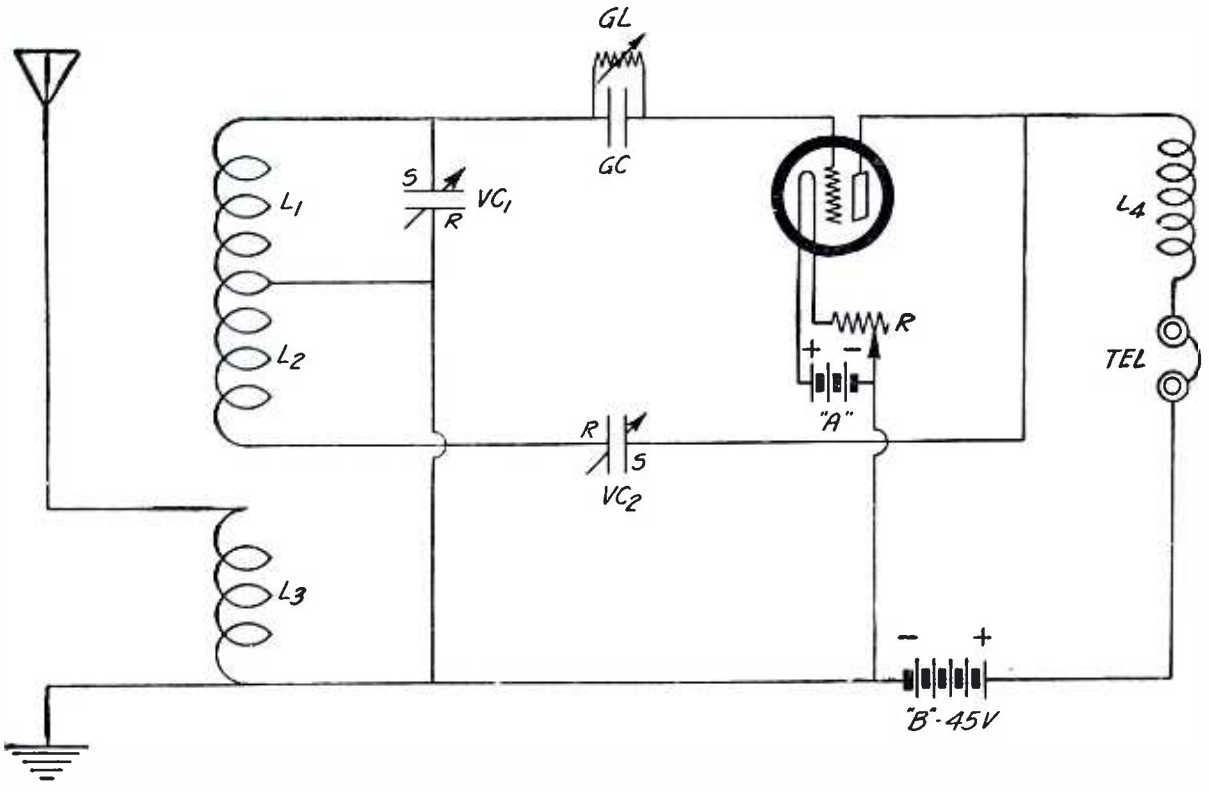
JOHN GILLIES

ANSWER: Microphonic noises are sometimes due to vibrating elements in a tube. This condition is sometimes overcome by putting in a non-microphonic cushion socket, or by putting rubber cushions under the four corners of the receiver.



A SENSITIVE TWO-TUBE CIRCUIT

FIGURE 3: *This diagram shows how to change a single tube regenerative circuit over to a non-radiating set. The stage of audio-frequency amplification requires one additional tube.*



A CIRCUIT FOR THE SHORT WAVES

FIGURE 4: *The single tube circuit in this diagram is satisfactory for the experimenter who is bent upon receiving the short-wave C.W. stations. The number of such stations is steadily increasing.*

A Novel Short-wave Regenerative Receiver

QUESTION: Please give me a diagram showing a form of short-wave receiver that employs a condenser for controlling regeneration. I want to use this receiver for C.W. signals.

LAURENCE TAIT

ANSWER: In Figure 4 you will find a circuit diagram for a regenerative receiver employing one tube. The parts you will need for this set are the following:

L1 and L2—single-layer solenoid coils tapped in the center;
L3—single-layer solenoid coil;
L4—single-layer solenoid coil;
VC1 and VC2—variable condensers, .00025 mfd.;
GC—grid condenser, .00025 mfd.;
GL—variable grid-leak;
R—rheostat, 20 ohms;
TEL—telephones.

Coils L1, L2 and L3 are wound with about No. 22 wire spaced the thickness of one wire on a tube 3½ inches in diameter. Coil L1 consists of 10 turns of wire; L2 consists of 6 turns of wire; L3 consists of 4 turns of wire and L4 consists of 150 turns of wire wound on a one inch tube.

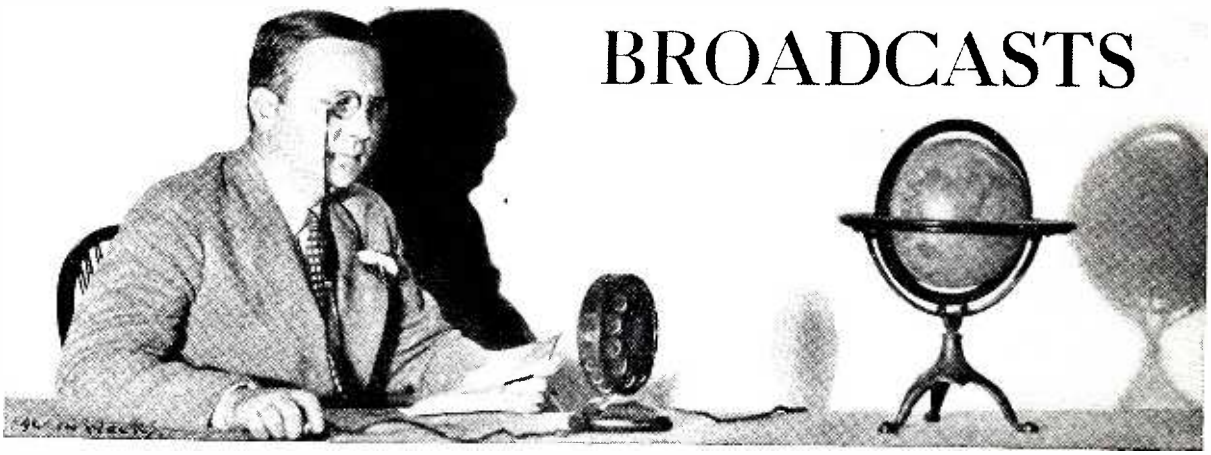
All the tuning is done with VC1 as far as wavelength is concerned and regeneration is controlled with condenser VC2. Coils L1, L2 and L3 may be experimented with for increasing or decreasing the wavelength range of this type of receiver.

The Principle of Modulation

QUESTION: What is meant by "modulation?" I have often heard the word but it seems never to be explained in a popular way.

A. ANIERO

ANSWER: When the announcer talks into the microphone the carbon granules which compose part of the microphone vibrate in accordance with the voice frequency. This vibration in turn varies the resistance of the circuit of the microphone and causes rapid changes in the amplitude of the carrier-wave current. This variation then comes into our receiving set as the announcer's voice. The change of amplitude that takes place in the carrier wave is called "modulation."



BROADCASTS

CONDUCTED BY J. ANDREW WHITE

IN this department the Dean of Broadcasters—whose voice is known to millions of broadcast listeners—records items of interest and value to all radio fans everywhere.

Stopping Bad Radio Manners by Injunction

KEEP it clean has been the one thing broadcast station directors have been very particular about from the beginning. It is gratifying to see how ably the courts supported this policy in reviewing one of the first and one of the most important slips, a series of so-called "health talks" which waved themselves off the antenna of WFBH on the roof of the Hotel Majestic, in New York. An injunction was granted the hotel people to "pull the switch" on programs which do not measure up to the reputation of refinement the hotel enjoys. The case developed, incidentally, that the health talker had been convicted ten years ago on a charge of maintaining a nuisance, which seems to remove any chance of an alibi on the part of the radio concern which leased the space. Personally, I am not familiar with any previous dereliction of duty as flagrant as this; it is customary to require manuscript copies of talks in advance; and this is as it should be.

* * *

Yes, but Who Wants to Listen in on Lawmakers?

WHEN the question of broadcasting the proceedings of both houses of Parliament came up in England recently, the Prime Minister advised setting up a committee to report on the matter. Whereupon spokesmen for the British public at large facetiously suggested a plebecite to determine whether listeners themselves favored an additional burden of tedious political speeches. Which is somewhat like our own situation; the supply of oratory in the halls of Congress seems still to be far in excess of the demand for its propagation.

* * *

A Radio Net Spreads Over Soviet Russia

THE Soviet is figuring on erecting nine new radio stations to enable the distant Siberian peasant to get advice on his farming problems direct from the agricultural colleges in European Russia. The latest inventory discloses the fact that there are forty-three transmitters and 282 receivers scattered throughout the territory of the Soviet Union; fifty new receiving stations are to be built. Incidentally, sets and parts manufacture has been turned over to a State syndicate.

* * *

How to Check Up on Wavelengths

IF it interests you to scratch on your dials the place where definite wavelengths are to be heard, rather than work with a station log and arbitrary numerals, you may listen in twice a month to radio signals of definitely announced frequencies transmitted by the Bureau of Standards from Washington and California. All the dope on how to receive and utilize this service is given in Bureau of Standards Letter Circular No. 92. It's free. Write to the Bureau of Standards, Washington, D. C.

* * *

"Radio Sport" as Played by Fritzie

THEY call broadcasting "radio sport" in Germany, which in itself is just about as interesting as the fact that in two years as many subscribers have been gained for the ether-wave variety as have lined up for the Government's wire telephone in forty years. Radioing started out as a state monopoly, but the advocates of unrestricted development whose main argument was the growth of radio in the United States, did succeed in getting across a compromise and all wavelengths up to 800 meters are released by permit to broadcasting companies. But the Government holds majority control and title to the apparatus. There are now nine of these companies operating the same number of stations; also a total of five sub-stations, with three more to come. Every

listener must have a post office permit, which costs two marks a month, local postmen taking care of the collections from the 714,352 registered subscribers. The latest move is to hop up the power from 1,500 watts to 8,000 and 10,000 watts and inject more variety in programs which have had a preponderance of intellectual and educational features.

* * *

A New Record in Sales of Radio Apparatus

EIGHT million dollars is the estimated total value of America's exports of radio apparatus when the year shall have come to an end. Very close to half that amount was shipped abroad in the first five months of the year, the total for the period and the monthly average showing respective increases of 123 percent and 130 percent, on which basis all existing records should be broken.

* * *

Radio Waves 2,200 Feet Below the Earth

ANY question remaining that radio waves penetrate to great depths into the earth seems to be pretty well answered by the success of Meade W. Powel, an amateur of Warren, Ariz., in picking up a distant naval station while 2,200 feet below the earth's surface. He had no success with bare copper wire nor with a loop, but when he tied 100 feet of lead-covered No. 14 copper wire cable strung along the mine gallery midway between the roof and the floor, NPL, 400 miles distant, came in on a three-tube regenerative outfit, although a five-tube radio frequency set wouldn't percolate at all. Maybe it was freak reception, but the experiment is interesting because no means has yet been devised for two-way communication of a continuous order in the interest of saving lives and keeping in touch with entombed miners when a disaster takes place. The main problem, of course, is to overcome the rapid deterioration due to dampness, which breaks down insulation.

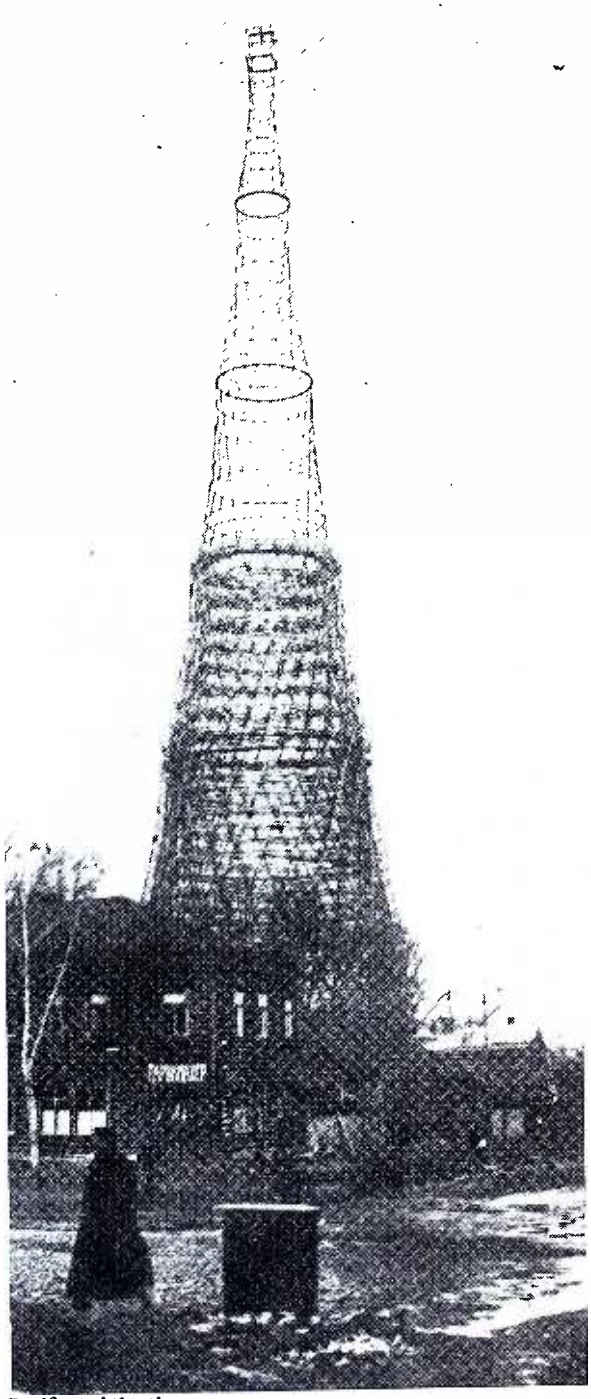
* * *

The Broadcasting Stations of the World

EVERYBODY knows that the United States leads in the number of stations transmitting news and entertainment, in fact that we have more stations than all the other forty-one countries added together, and there are those who think that this is not an unmixed blessing. But it is surprising to learn that Canada holds second place with eighty-three stations; then Russia, with forty-three; and Cuba fourth with thirty-eight stations. Great Britain and Mexico are tied for fifth place with twenty each. France and Germany, eighteen apiece, share sixth place. Then comes Australia with sixteen, and Argentina with thirteen. From this figure downward the numbers decrease rapidly, six small nations bringing up the rear, each with a single broadcaster.

Linking the Telephone to Radio

IN Hawaii they are planning to use a radio system between several central exchanges of a local telephone company. Central will be called in the usual way from any phone, and if the call is for one of the other islands the voice



Pacific & Atlantic

WHERE THE "RED PROPAGANDA" COMES FROM

The famous antenna tower of Shablovka at Moscow, which the Soviet Government of Russia has made the center of its broadcasting activities.

will hop across the water on a wavelength between 66 and 70 meters and be connected up at the other end with the phone of the subscriber in the usual manner. Experimentally, this has been done often; there doesn't seem to be any reason why such communication cannot be maintained commercially. We will find out, anyhow, because they are alive in Honolulu; I recall that one of the earliest of the automatic calling disc telephones there worked itself out to familiar practicality.

* * *

What the Broadcasting of Advertising is Doing to One Station

In the city of Durban in South Africa the listeners won't stand for advertisements mixed up in the programs. They went on strike recently when advertising appeared along with the entertainment and made known their wishes very effectively by refusing to pay the license fee which is required of set owners. Initially, the audience was 500 persons; now there are only 200 licensees, and it looks as if the station will have to run at a heavy loss. In an effort to recoup, the directors of the station agreed to leave off mentioning advertisers on the air but to publish them in official programs, distribution of which immediately went into a slump. The scheme was then tried of selling programs only to those who gave their full name and address on special blanks. This idea was successful only in increasing the ire of the listeners, and at last reports the sale of programs had fallen almost to zero.

What the Austrian Fan Likes Best

Those straw vote things, as to listeners' program preferences, of which we have had a plentiful sufficiency, have now invaded Austria where broadcasting is a tender infant not yet a full year in existence. The publication which conducted the feature required the first three choices to indicate positive interest. And the Viennese picked them in this order: concerts, time signals and financial talks! Education nosed out humor, operas beat out plays, daily news was preferred to dance music—a lot of things cropped up that seemed hard to reconcile with America's radio sophistication, notably that the tailenders included sports and sermons. But there are some 50,000 receiving sets in the country under a license system with the individual paying a fee of from 15,000 to 30,000 crowns a year for the privilege of tuning-in, so the Austrians must like what they have been getting since last October.

* * *

What Will the Author and Composer Make Out of Radio?

Atlantic City saw the first annual convention of the Radio Manufacturers Association recently and a major topic of discussion was the adjustment of differences which have arisen between station owners and the American Society of Composers, Authors and Publishers; a committee was apopinted with a view toward reconciliation of these differences. Although little known to the public, this clash of inter-

F. M. Delanc

RADIO RECEPTION AT A MILE A MINUTE

J. L. Menars, the well-known French amateur, recently experimented with this portable set on a French sleeping car, hooking it up to the train lighting system and using the heating pipe as a ground. He picked up stations in England, France, Spain, Germany and Wales, while traveling 60 miles an hour.

Pacific & Atlantic

SOUND WAVES THAT ARE HEARD BY THE HANDS

Unique experiments are being made by Dr. Robert H. Gault, professor of psychology at Northwestern University, in conveying language to the deaf by means of telephone receivers that are held in the palms of the hands; the vibrations enable the subjects to "hear" words spoken into the transmitter.

ests, which has been active for several years, presents one of the most absorbing problems in broadcasting ethics with which the industry has been confronted. The station owners are practically united in agreeing that suitable reward and compensation is due the men who write the nation's songs; but they can't see the point of accepting license contracts which run for one year only and leaving the future wide open for charging whatever fee the traffic will bear. Already, the Society is guilty of charging one station a certain price and insisting that, for the same privileges, another station pay a great deal higher royalty figure. The figure seems to vary from $250 a year to ten times that amount, and the most recent demands run even higher. So far as I know, no broadcasting station in the country is making money today; how many will continue in existence under an additional financial burden, the size of which cannot even be anticipated, is a pretty question. It is a question that rightfully belongs to the public, the listeners, whose entertainment must predominate in the forthcoming attempt to place the interest of the broadcasters and the music publishers on a working basis.

* * *

Broadcast Programs on a Wire Spool

SOMEWHAT closer at hand is the day—or perhaps better, the night—when the radio fan will be able to hear programs broadcast while he is asleep. And hear them as often as he wants, repeated by what, in Germany, is known as the talking wire. The idea is, that you set the recording instrument, attached to the radio receiver, and speech, music, and all other sounds are permanently retained on thin steel wire running between two spools, tonal differentiations being registered through the reactions of a small electromagnet. Eighteen years of laboratory research are said to be behind the achievement of this apparatus, which is accredited to Dr. Kurt Stille, but from the incomplete advance reports it looks as if the device is merely a modification of the machine invented some years ago by Waldemar Poulsen, a Danish scientist, who produced an electromagnetic recorder that was simplicity itself and certainly worked well, but struck the snag of too high cost when an attempt was made to introduce it commercially. If the price is right this time, the market is wide enough. Yes, I want one, too!

* * *

The Don Is Stirred by Radio Waves

WHILE Spanish playwrights and composers have been seeking relief from unauthorized broadcasting of their works, public interest in radio throughout Spain has been stirred up by

the addition of two stations in Balboa, duplicating the situation in the vicinity of Madrid, where another pair serves. Power three times as great as the earlier ones, incidentally, has been provided for the station just completed at Seville.

* * *

The Irish Still Squabbling Over Their One Proposed Station

THE Irish haven't gotten around to it yet. Over a year ago the Dail disposed of legal difficulties and called for plans for a broadcasting station that would be the Free State's very own. The optimists who bought their sets a year ago are becoming a bit fretful, but the Dail has not acted on the plan nor considered it in any way.

* * *

Locating Air Vessels by Radio Compass

WHETHER or not the radio compass is of value to airships while aloft is the latest problem the Navy has undertaken to solve. The dirigible *Shenandoah*, engaged in a game of hide and seek with the battleship *Texas*, is the interesting form given to the test. The ship being given 100 miles start at sea upon a course unknown to the airmen, the only means of spotting the vessel will be the radio compass employed while the *Texas* is using its radio apparatus. In like fashion, when the *Shenandoah* transmits, it will enable the *Texas* to locate the big balloon and steer clear.

* * *

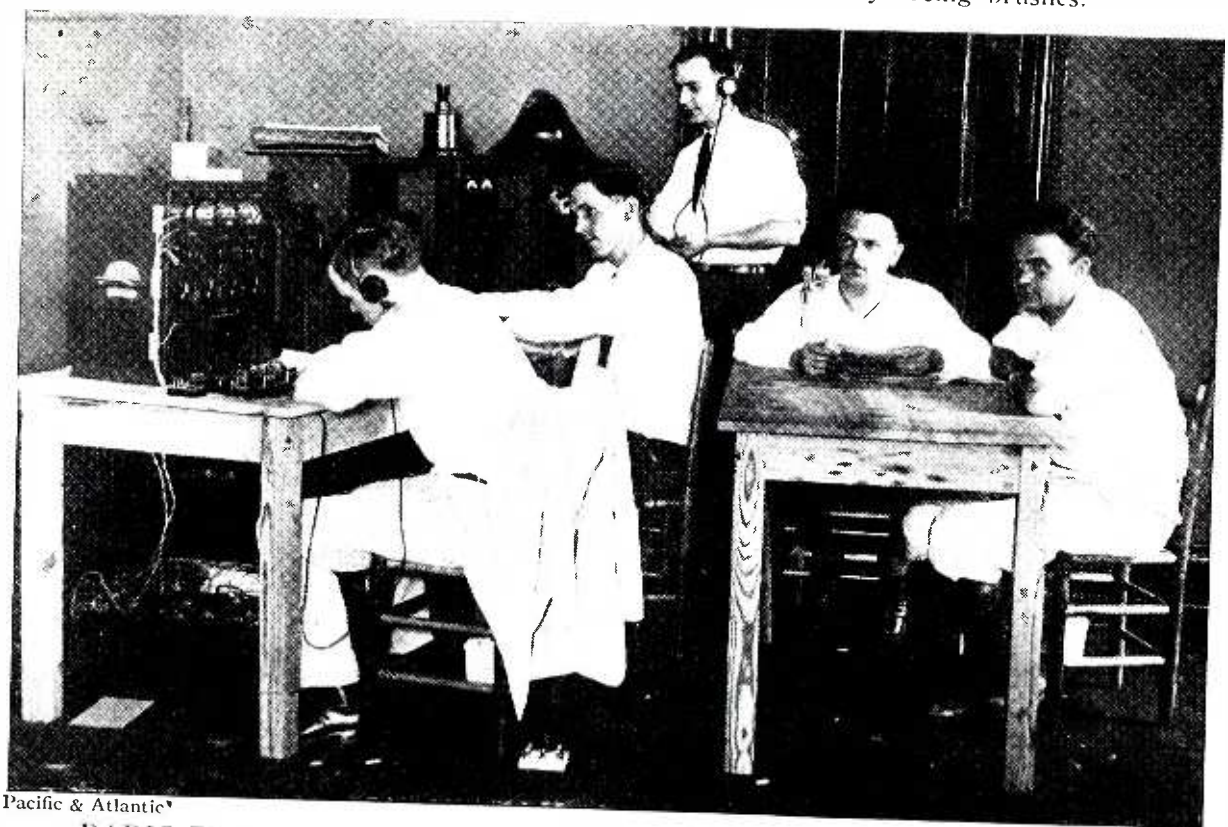
What Programs Do the Farmers Want?

THE farmer is to get what he wants in the way of programs. Questionnaires are to be placed in the hands of 850,000 tillers of the soil as part of the program for conducting a survey by the National Farm Radio Council in cooperation with thirty farm magazines. Previous radio surveys have confined themselves to determination of the number and nature of the receiving sets in the rural sections; this one will deal exclusively with preferences in program material.

* * *

One Public Service Engineer Kills "Anticipated Static"

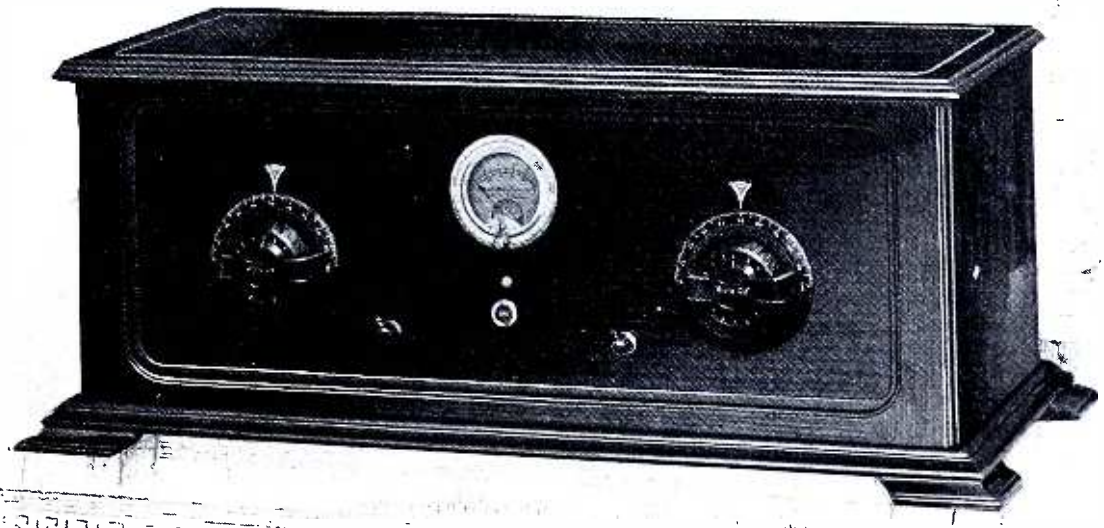
COMPLAINTS by residents of Orange, N. J., that "artificial static" was mutilating broadcast programs to the point of distorted whisperings, resulted in the declaration by the chief engineer of the municipal lighting plant that radio is no longer a novelty but a necessity, and forthwith an order was given for installation of choke coils to overcome the annoyance caused by arcing brushes.



Pacific & Atlantic

RADIO PLAYS A PART IN THE "EVOLUTION TRIAL" IN TENNESSEE

For the first time in the history of American jurisprudence, the proceedings of a criminal trial were broadcast from a courtroom when John T. Scopes, a teacher of Dayton, was prosecuted for teaching scientific theories of evolution. Station WGN of Chicago broadcast the event.



Now—
The Jewett Receiver

Again Jewett leads the way to new and better radio reception.

First the Superspeaker—Now the Jewett Receiver.

Different—Yes, fundamentally so in design—Even more startlingly so in performance.

Distortion, squeals, whistles and other self-made noises—entirely eliminated—by a new and exclusive method of audio amplification. Top efficiency insured at all points on the dial from 150 to 600 meters.

Music as it is actually played—the human voice in its natural tones.

And with it all—the Jewett Receiver is beautiful—the richest, handsomest receiver you have ever seen.

The Receiver that meets and exceeds your fondest hopes for radio reception

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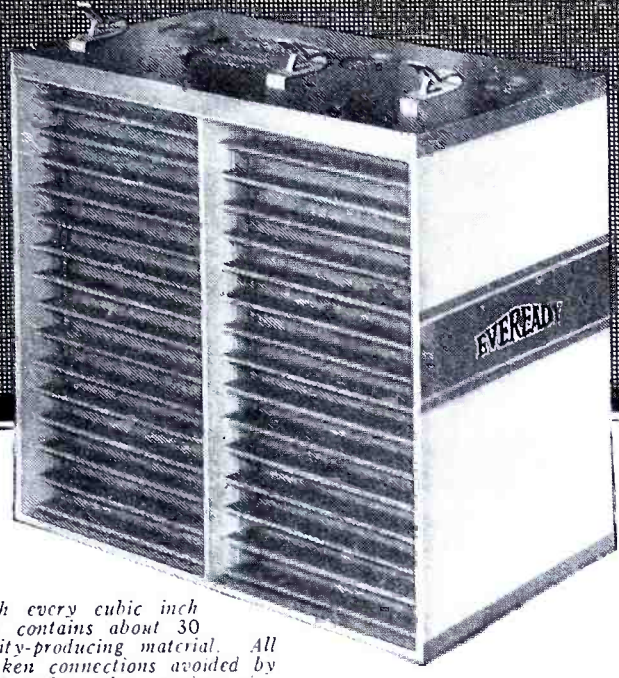
Radically different!



It's all battery. With every cubic inch packed to capacity, it contains about 30 per cent more electricity-producing material. All chance of loose or broken connections avoided by contact of full area of carbon plate against zinc plate. The scientifically correct construction.

ever made in "B" Batteries

On 6-tube sets, 24 mil drain, it lasts 41% longer.

On 8-tube sets, 30 mil drain, it lasts 52% longer.

The new Layerbilt principle is such an enormous stride forward in radio battery economy that we will bring out new sizes and numbers in this Layerbilt form as fast as new machinery is installed. For the present, only the extra-large 45-volt size will be available.

Buy this new Eveready Layerbilt No. 486 for heavy drain service. It far exceeds the performance for which Eveready Radio Batteries always have been famous and is, we believe, by far the most economical source of "B" current obtainable.

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EVERY TUESDAY *at* 8 P. M.
(Eastern Standard Time)
Beginning September 29th, 9 P. M.
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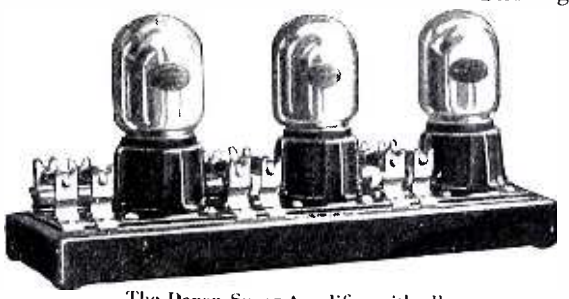
For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—

WEAF	New York	WSAI	Cincinnati
WJAR	Providence	WWJ	Detroit
WEEI	Boston	WCCO	Minneapolis, St. Paul
WFI	Philadelphia		
WGR	Buffalo	WOC	Davenport
WCAE	Pittsburgh		

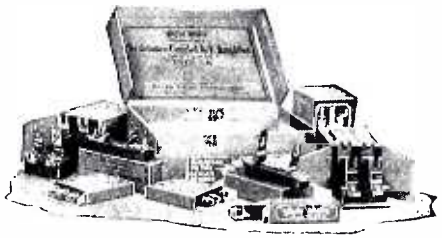
EVEREADY
Radio Batteries
-they last longer

THE BIG LITTLE

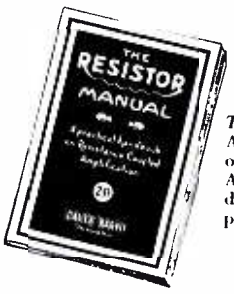
The biggest of all the little things—THE DAVEN GRID LEAK



The Daven Super Amplifier with all labor of assembly eliminated $15.00



The Daven 3-Tube Amplifier Kit, complete except for sockets and tubes $9.00



The Resistor Manual A practical handbook on Resistance Coupled Amplification. At your dealer's 25c. By mail postpaid 35c.

THE discriminating owner of a radio set demands three things: (1) Volume on the weakest signal, (2) Tone quality that makes criticism impossible and excuses or qualifications unnecessary, (3) Both volume and freedom from distortion.

The last is today's problem. We can get volume. We can get quality. There is only one way to get both. Eliminate the distortion from which no circuit employing transformer coupled audio amplification is free. If a transformer will not amplify over-tones and under-tones alike at all frequencies, do away with the transformer. We must get rid of rushing, blowing, frying noises.

The Daven Radio Corporation have made this possible in their development of Resistance Coupled Amplifiers. If you will couple up Daven precision-built resistances and mountings under the direction of Daven engineers, you will know radio at its best.

DAVEN PRODUCTS ARE SOLD

"The Sine
DAVEN RADIO
Resistor
NEWARK Reg. U. S.

USE THIS FREE COUPON D 925

DAVEN RADIO CORPORATION
158-160 Summit Street, Newark, New Jersey

Please send me the following on Resistance Coupled Amplification: —
Check one.

☐ Resistor Manual. 25c is enclosed.
☐ Complete catalogue (free).

Name .....

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For dealers: Send your letterhead or card, or this coupon and we will have our nearest distributor communicate with you.

THINGS OF RADIO

The DAVEN LEAKANDENSER—the combination grid leak and grid condenser

Daven bulletins are the A. B. C. of resistance coupled amplification. Write for bulletin on the Daven "big little thing" in which you are most interested, or get the Resistor Manual, a practical handbook for radio designers and builders.

Dealers who do not handle the Manual are invited to send for free sample.

WE are able to announce two new Daven products at this time. The Daven Leakandenser is a combination of a grid leak of Daven permanent constancy of value, and a grid condenser of fixed capacity, correct for all makes of detector tubes. It is mounted in a new snap fastener that does not permit it to shake out. Precision-built, simple, effective, sturdy and very handsome. Price $1.00 each.

The new Daven High MU Tube increases the amplification of the Daven Super Amplifier to equal or exceed that obtainable with transformers. 6 volt, ¼ ampere—$4.00 each.

The Daven Power Tube Type MU-6 for the last, or output stage—$5.00 each.

ONLY BY GOOD DEALERS

of Merit"
CORPORATION
Specialists
Pat. Off. NEW JERSEY

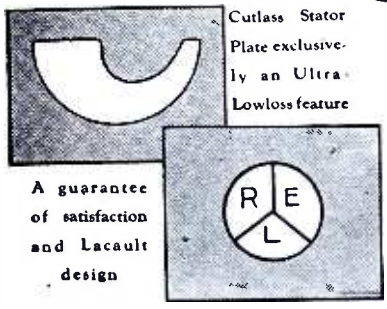
Clip Mounting No. 50—for single Resistor, Grid Leak or Ballast - - - - - $.35 each

Resisto-Coupler No. 42—The first and most popular resistance coupling unit. With condenser - - $1.50

Daven Ballast Resistors for use with amplifying tubes in place of rheostats. Four types, without mounting. $.75 each

The new Daven Tube MU 20 recommended for use with the Daven Super Amplifiers.

Quick, positive tuning



Cutlass Stator Plate exclusively an Ultra-Lowloss feature

A guarantee of satisfaction and Lacault design

SPEED—ability to turn directly to any station, to tune-in instantly and get your station without interference from broadcasting on similar wavelengths—is the outstanding feature of the Ultra-Lowloss Condenser.

With one station of known wavelength located on the dial, all others can be found instantly. Special design of Cutlass stator plates distributes stations evenly over the dial—each degree on a 100 degree dial represents approximately 3½ meters difference in wavelengths.

In addition, losses common in other condensers are reduced in the Ultra-Lowloss to a minimum by use of only one small strip of insulation, by the small amount of high resistance metal in the field and frame, and by a special monobloc mounting of fixed and movable plates. Designed by R. E. Lacault, E. E., originator of the famous Ultradyne receiver and Ultra-Vernier tuning controls.

ULTRA-VERNIER TUNING CONTROL

Simplifies radio tuning. Pencil record a station on the dial—thereafter, simply turn the finder to your pencil mark and you get that station instantly. Easy—quick to mount. Eliminates fumbling, guessing. A single vernier control, gear ratio 20 to 1. Furnished clockwise or anti-clockwise in gold or silver finish.

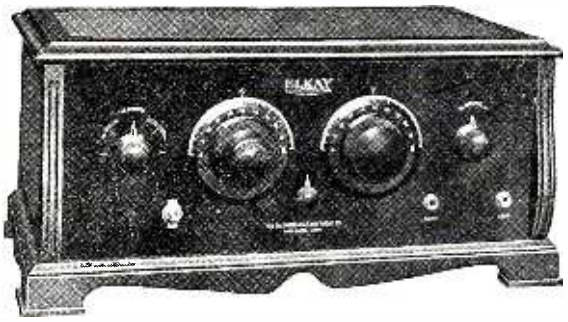
SILVER, $2.50 GOLD, $3.50

At your dealer's; otherwise send purchase price and you will be supplied postpaid.

ULTRA-LOWLOSS CONDENSER

PHENIX RADIO CORPORATION **116 E. 25th Street, New York City**

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Announcing the NEW $80 Five Tube

ELKAY

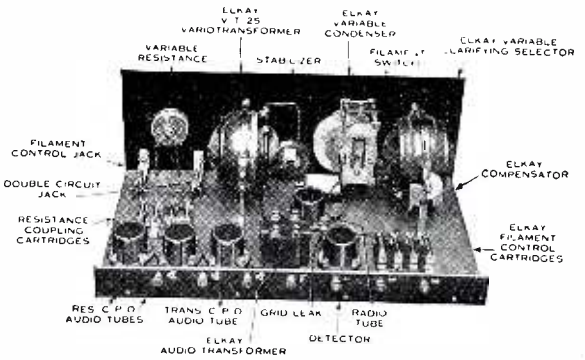
SUPER-SELECTOR

A GENUINE triumph! Combined resistance and transformer coupling; hence marvelous clarity of tone. Control of selectivity—**a distinct departure, an ELKAY invention**—of extreme importance to those close to B. C. centers.

Complete control of oscillation. R. F. device that permits the same smooth operation on the low wave lengths as on the high. Exceptionally handsome cabinet work.

Also built for 4 tubes at $70.00. Write for folder. Amateur set builders, write for profitable kit offer on ELKAY sets.

TO THE TRADE—Write for **exclusive territory** today, while still available.



The Langbein-Kaufman Radio Company

511 Chapel St., Dept. P

New Haven, Conn.

An L-K Product

TUNERS ELKAY SETS, KITS

Wonderful Volume with Clearness AMPL-TONE

$3.00

Phonograph makers have spent years perfecting the acoustic properties of their phonographs. Use an AMPL-TONE Unit and make a real Loud Speaker in an instant or use it in your horn and get better results.

After all, speakers are as good as their unit We make a real unit at a real price. Money gladly returned if you are not entirely satisfied.

The UNION FABRIC CO.
DERBY, CONN.

Makers of the Excellent French AMPL-TONE Headset

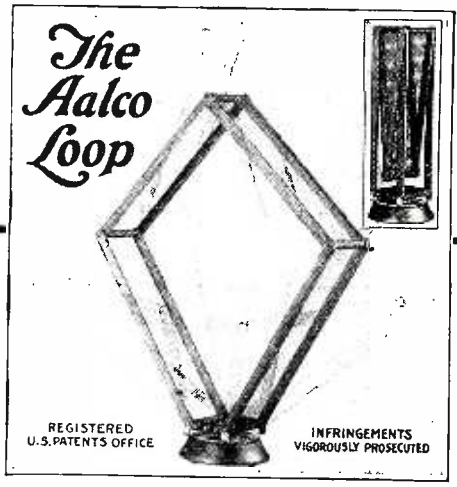
Please send me an AMPL-TONE Unit for which I enclose $3.00

Name .....

Address .....

State .....

The Aalco Loop



GUARANTEED FOR LIFE!

Folds to any position—Wires always taut

The newest addition to the line of quality Radio Accessories. Made of the highest grade materials throughout in a new and masterly design. Specifications: Length, 24 inches, Normal Ht., 30 inches. Wavelength range 120 to 600 meters.

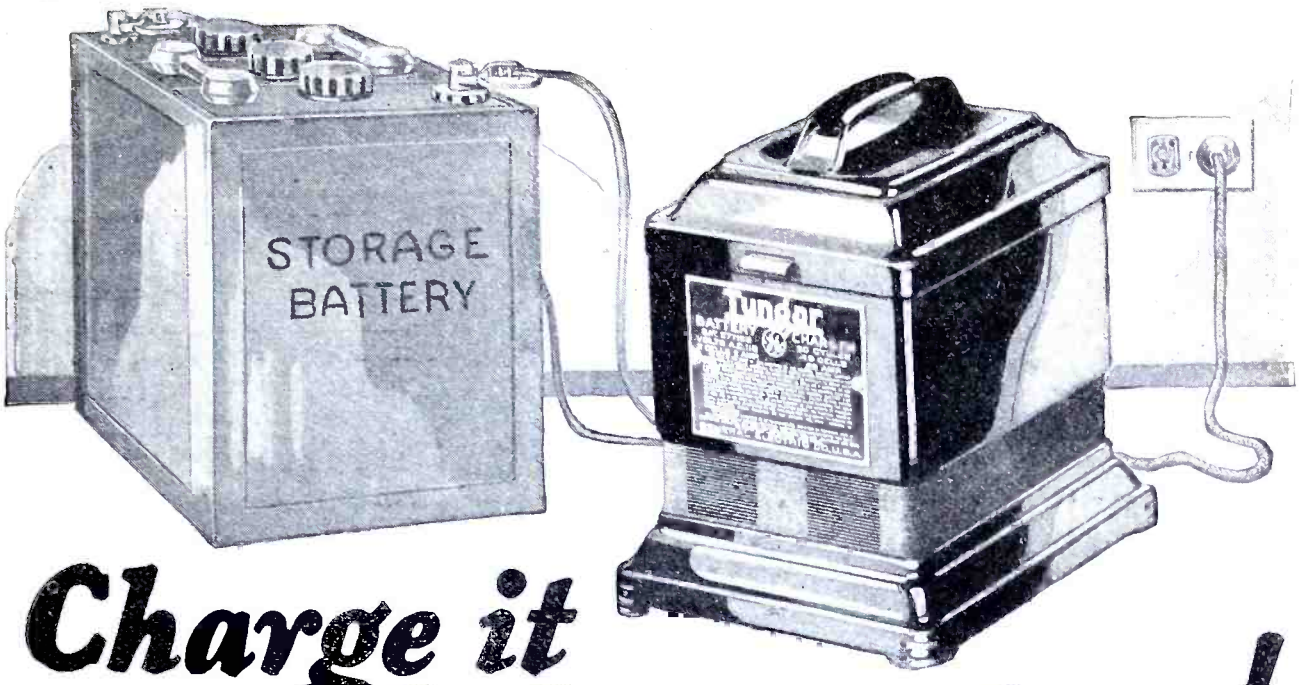
The "AALCO"

Is different both in appearance and operation. You will find that this new loop adds to the performance of your set. If your Dealer cannot supply you send money order, and we will ship direct.

JOBBERS: *Write for our proposition*

AALCO RADIO LABS.

6336 Cottage Grove Avenue **CHICAGO**



Charge it while you sleep!

Last thing at night—concert over—time to lock up. Radio battery low? Just clip on the Tungar, and plug it in. Or if you connect up the Tungar permanently, *just throw a switch.* Charge the battery while you sleep.

The Tungar is simple—makes no disturbing noise. And the low cost of Tungar recharging cuts battery upkeep to next to nothing. It means top notch performance—clear, full-volumed reception—*all the time!*

The Tungar is a G-E product developed in the great Research Laboratories of General Electric.

The new Tungar charges radio "A" and "B" batteries, and auto batteries.

Two ampere size (East of the Rockies) . . . $18.00

60 cycles—110 volts

Tungar

REG. U.S. PAT. OFF.

BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Division
General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Give Me a FIBROC-BAKELITE PANEL—*Every Time!*

Believe me, when I sink good hard earned cash in efficient parts I am not going to skimp when it comes to a panel. Give me the best every time—a panel that I can drill and cut without chipping or feathering—a panel that engraves cleanly and with a finish that will make my set show up like a million—that's a FIBROC-BAKELITE panel and I know for I've tried 'em all. And for winding coils, Fibroc tubes rate just as high as the panels—you just can't beat them.

Fibroc-Bakelite Features

High dielectric strength assuring lowest dielectric losses. Great tensile strength. Will not warp, crack, chip, feather or cold flow. Easily worked. Readily engraved. In black, high polish or mat finish; mahogany, circassian walnut or natural finish. Standard sizes each packed in individual envelope.

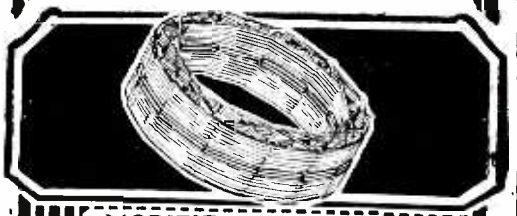
All Good Radio Dealers Have or Can Get FIBROC-BAKELITE PANELS

Fibroc Insulation Co

257 Lincoln Ave.

Valparaiso, Indiana

A-P COILS



MODIFIED LORENZE

EFFICIENT RADIO COILS
Require

A Specialized Organization for Economical Production

We make Coils only. Our entire resources are devoted to Radio Coils.

For that reason we are able to render Radio Set Manufacturers an unequaled coil service.

Regardless of your own facilities you will undoubtedly find this service profitable to you. Ask us for estimates and samples.

ACME PRODUCTS CO

107 W. Canton St. Boston, Mass.

PROFESSIONAL SET BUILDERS!

and dealers who build sets

WE will shortly begin a series of newspaper advertisements, featuring the work of individuals and dealers who builds sets using Cardwell Condensers.

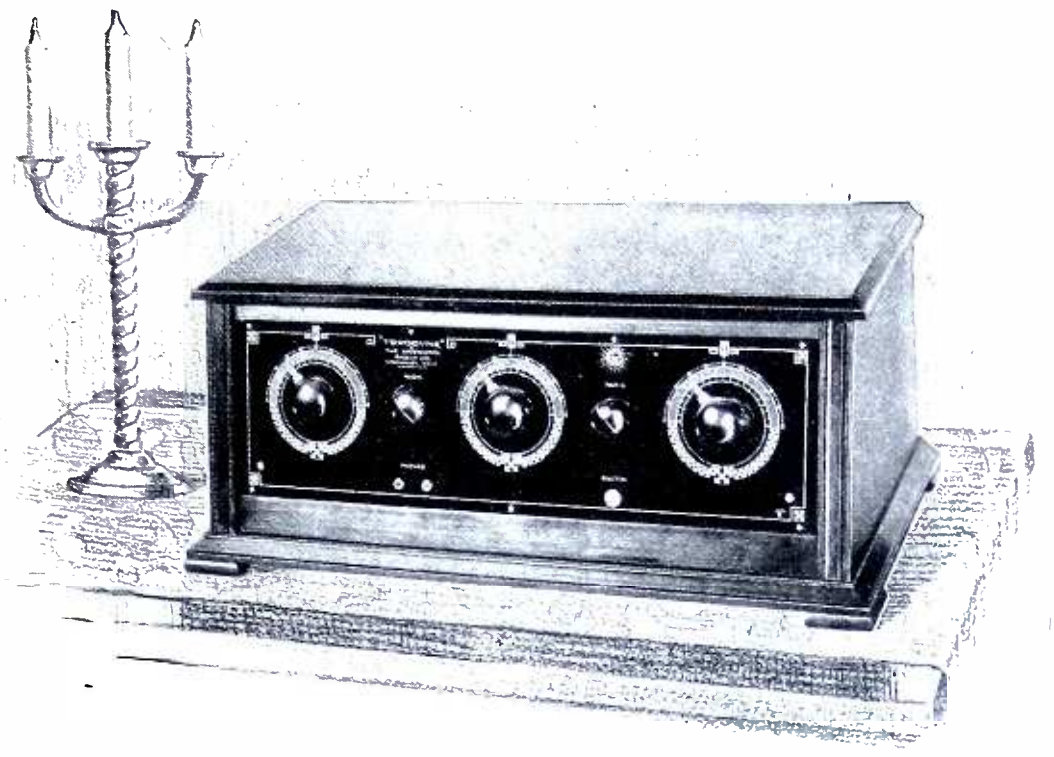
If you build to specification or from original design, it will be to your interest to communicate with us immediately.

Ask for details of plan. Be sure to give name of your jobber.

ALLEN D. CARDWELL MANUFACTURING CORP.

81 Prospect Street, Brooklyn, N. Y.

TORODYNE
Toroidal Receiver



A New and Better Receiver

The TORODYNE is the newest AINSWORTH Receiver. It is one of the few really new developments of the season. Be sure to see it before placing your order.

What is the TORODYNE?

The TORODYNE is a five-tube, tuned radio frequency receiver employing Toroidal (doughnut-type) transformers. The entire arrangement is one of beauty, simplicity and refinement.

Why is it Better?

Largely through the use of Toroidal transformers, which give it:

1. *Greater Selectivity* due to the fact that these coils do not pick up outside interference. Only the signal to which the set is tuned can be picked up.
2. *More Volume* by eliminating coupling. Greater amplification is thus secured without oscillations.
3. *Distance.* The greater amplification brings in distant stations with more volume, which naturally increases the range.
4. *Superior Tone Quality* is secured through the elimination of distortion and foreign noises by preventing stray feed-backs.

Appearance

The TORODYNE has a refined beauty that makes it very attractive. The panel is engraved in silver by a patented process. Pointers on Bakelite knobs, operate over a scale engraved on the panel. The cabinet is Adam brown mahogany.

Simplicity

Very easy to tune and logable. A silver engraved sub panel on the inside leaves only the three condensers and five tube sockets visible. All terminals are correctly marked to insure correct connections. Ample space is provided in the cabinet for the necessary "B" and "C" batteries.

The TORODYNE will give greater satisfaction than any other set in its class. Ask your dealer for a demonstration. You will be sold on it immediately.

PRICE (without accessories) $100.00

The Ainsworth Radio Company
308 Main Street **Cincinnati, Ohio**

$25

The SAAL Soft SPEAKER

YOU need no longer object to loud speakers because of their harshness. Hear the Saal Soft Speaker at your dealer's.

The Saal has no blare, no blast, no metallic ring. It is not a trumpet. It is a faithful reproducer of radio programs. *It combines volume with a velvet tone.* It removes the objection to loud speakers.

The Saal is properly constructed for the accurate reproduction of sound. It is not straight-necked like a trumpet. The goose-neck is curved like a saxophone, the most melodious of all instruments. From the reproducing unit to the edge of the bell is one unbroken taper—one even, unbroken enlargement of sound. The neck is of aluminum, a porous and non-vibrant metal with no tinny ring. The bell is of genuine Bakelite, the most perfect and resonant of all radio materials. There is no wood, no tin, no composition. It has nothing to warp, crack or deteriorate. It will last indefinitely.

The basis of Saal volume with tone quality is the reproducing unit described to the left. In appearance the Saal, with its large black bell, black stippled throat and graceful lines, is the aristocrat of horns. Also furnished with a brown bell and gold or silver stippled throat at $5 extra.

SAAL Jr.

The same in every respect as the Saal Soft Speaker except it is smaller. Measures 18½ inches instead of 21½ inches in height.

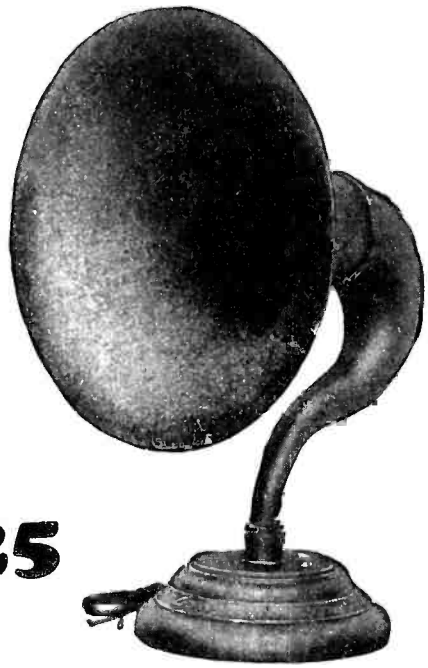
$20

The Saal Soft Speaker Unit is of the floating armature type exclusive with the most expensive reproducers. It automatically maintains its tone with any volume, and cannot be harmed by the loudest receiver. It will not break down with the longest or most constant use. All metal construction—no rubber gaskets. Used as standard equipment by many leading manufacturers of fine radio receivers in built-in reproducers.

SAAL Soft SPEAKER

VOLUME WITH TONE QUALITY

***Manufactured and guaranteed by* H. G. SAAL COMPANY, 1800 Montrose Ave., Chicago, Ill.**



$25

TRIMM Concert reproduces all the tones, from high of violin to low of organ, with perfect fidelity. Easily accessible adjustment permits control of tone and volume. Volconite horn eliminates scratchy overtones and noises.

TRIMM
Superior Reproducers

HEADSETS	
Professional	$5.50
Dependable	4.40
PHONODAPTERS	
Giant Unit	$10.00
Little Wonder	4.50
SPEAKERS	
Home Speaker	$10.00
Entertainer	17.50
Cabinette	17.50
Concert	25.00
Chello	30.00

TRIMM
RADIO MANUFACTURING COMPANY
24 So. Clinton St.
CHICAGO
U.S.A.
MEMBER RMA

NEW—

A single control tuning element for two-control sets!

With a vernier that allows a variation between the two circuits of fifteen points on a 100 point dial!

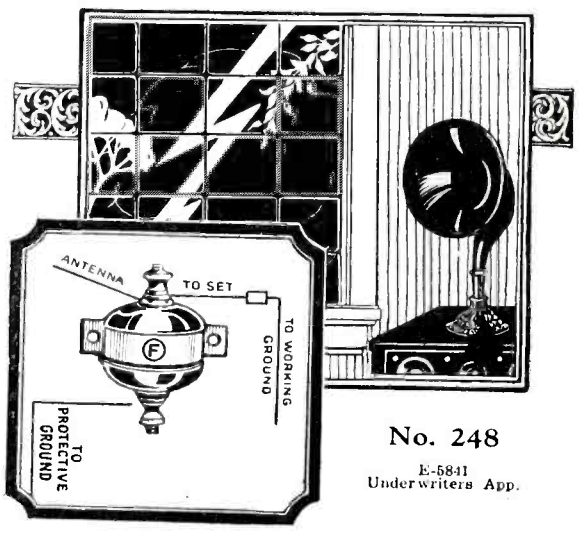
Can be easily applied to

SUPERHETRODYNES
BROWNING-DRAKE
ROBERTS
HARKNESS

or any set employing two tuning controls.

Details on request

HANSCOM RADIO DEVICES
Woonsocket Rhode Island



No. 248
E-5841
Underwriters App.

"Little Joe"
Lightning Arrester

Especially designed for Radio Work. Made of Porcelain, small, neat rugged and serviceable. Can be suspended on antenna or fastened to wall.

Ask Your Dealer

M'f'd by CIRCLE F MFG. CO.
Trenton, New Jersey

NAVY MODEL C-10 Super-Heterodyne

The Highest Class Receiver in the World

Wave length range 50-600 meters with removable Coils.
Panel Dimensions 28 3/16 in. x 8 in. x 1/4 in.
Only two major tuning adjustments.
Total amplification almost 2,000,000 times.

A high powered 10-tube Broadcast Receiver capable of receiving over 3,000 miles under favorable conditions, and having a degree of selectivity far in advance of others.

We believe the Navy Model C-10 represents final superiority over any receiver now being manufactured or even contemplated for broadcast reception.

Attractive illustrated literature gladly mailed upon request. Write direct to

NORDEN-HAUCK, INC.
Engineers
1617 Chestnut Street, Philadelphia, Penna.

For any Circuit

Prompt shipment can be made on tested, standard apparatus of the following manufacture:

E. I. S., Inc.
General Radio
Willard
Benjamin Electric
Allen Cardwell
Dubilier — Formica
Western — Magnavox
Jewell — Amer Tran
Western Electric
Radio Corporation
Music Master — Acme
Cutler Hammer — Frost
Federal — Kellogg

Chart your Radio EXPLOITS!

GET this marvelous new help for radio explorers—a beautiful Air Map, printed in three colors, every station clearly marked and Time zones outlined! Size, 28 x 34 inches. There's no limit to the amusing ways you can use

COLLIER'S NEW RADIO MAP of the U. S. and CANADA

With its help you can find *instantly* how far away any station is. If you use a directional aerial, you can point the loop exactly toward the station you want. Also outlines the radio districts, and gives an alphabetical list of *all* stations and their operators.

Thousands already sold. Get yours *today!* At your news stand or radio dealer's, only 25 cents—or just mail us a quarter.

P. F. Collier & Son Company
244 Park Avenue, New York City

Enclosed please find twenty-five cents for your new Radio Map of U. S. and Canada.

Name .....

Address .....

3424-RMC-M

"Take No Chances—Use Como"
COMO DUPLEX

The World's Standard Push Pull Transformer

PRICE $12.50 per pair
For maximum volume without distortion

What Prominent Writers on Radio Subjects say About Como.

Lewis B. Hagerman, Technical Editor, *Chicago Post:* "Actual Tests show this transformer to be far superior to any others of similar makes."

R. J. Robbins, *New York Sun:* "After consideration of several well-known makes of push pull transformers which are available 'COMO DUPLEX' was selected as most satisfactory."

C. White, *Radio World:* "'COMO DUPLEX' is infinitely superior — most other push pull transformers seem to be ordinary transformers with a center tap brought out as a makeshift."

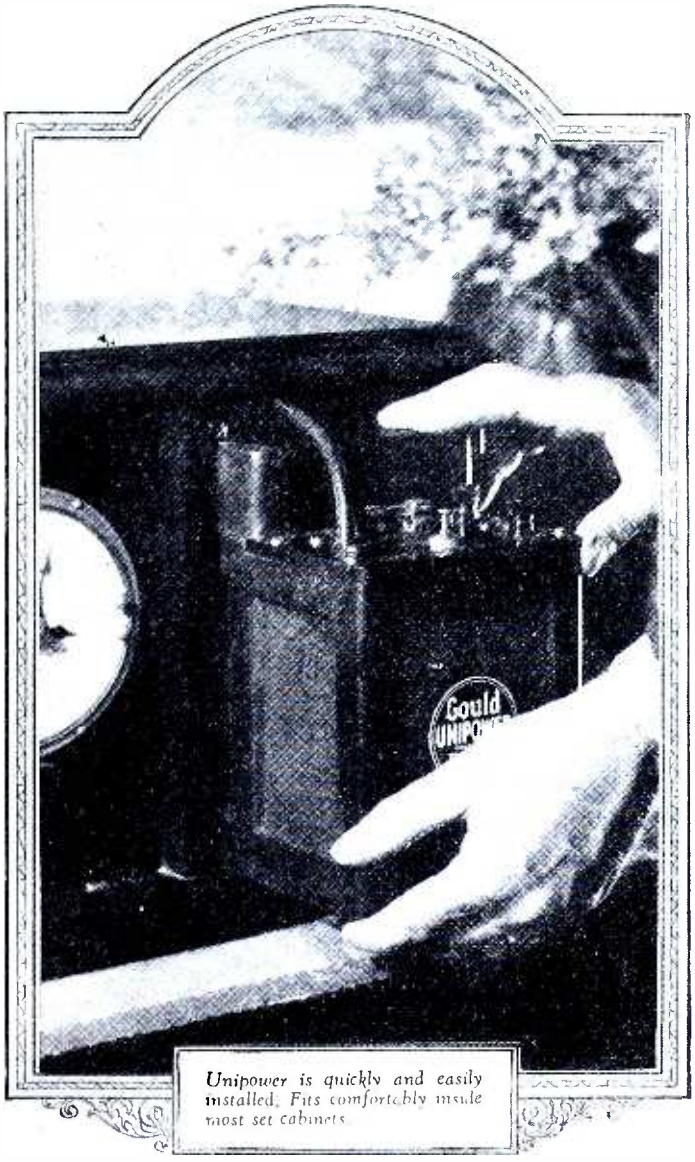
E. P. Gordon, *Open Road:* "A system of audio-amplification which is becoming increasingly popular. Its use .... will give surprising results in both quality and volume, and is thoroughly recommended by this department."

NEED WE SAY MORE?

COMO APPARATUS COMPANY
Manchester, New Hampshire
For Sale at Leading Dealers

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

UNIPOWER—*the latest sensation* in Radio!



Unipower is quickly and easily installed. Fits comfortably inside most set cabinets

NO longer is it necessary for you to put up with the cost and inconvenience of operating your set on dry "A" batteries—or the bother of charging a storage battery every week or so! No longer need your "A" batteries fail when you want them most. And that today is the most frequent cause of poor radio reception.

You can now equip your set with Unipower and have the thrill of *continuous, unfailing* "A" power always of the highest quality and refinement, always at full voltage.

What Unipower Is

Unipower is a single compact "A" power unit that fits *inside* most radio cabinets. It takes the place of separate storage battery and charging units.

Unipower comes to you completely wired and assembled—all you have to do is connect two wires to your set and plug in on your house current.

A unique feature of Unipower is the master-control switch that governs the operation of your entire set. When the switch is *ON*, Unipower feeds your set rich, quiet power, with neither hum nor noise. When the switch is *OFF*, Unipower *automatically* replenishes itself from your house current.

Until you use Unipower, you will never know how easily, perfectly and economically your set can be operated. Never again will you go back to dry cells—or bother with a storage battery and charger.

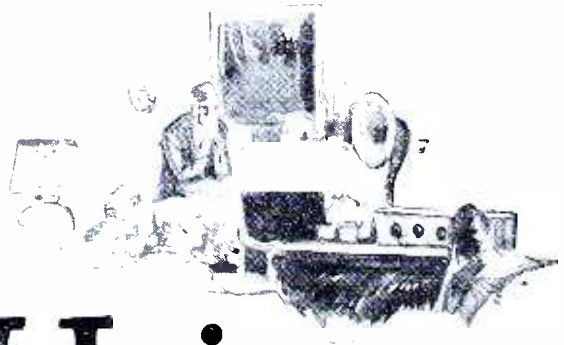
The nearest radio dealer can supply you with Unipower.

GOULD STORAGE BATTERY CO., Inc.
250 Park Avenue New York

The first cost is the last!

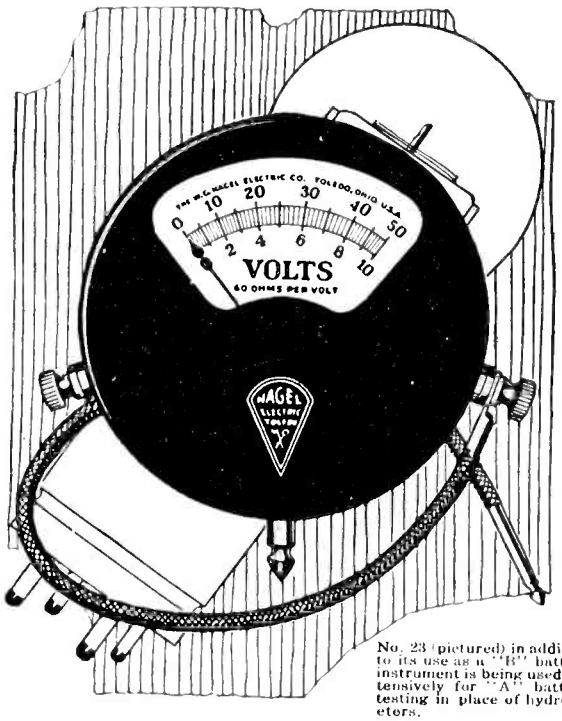
Unipower's initial cost is moderate—and the first cost is the last. Unipower has no tubes, bulbs, lamps or working parts that require frequent or expensive replacement. Unipower is equipped with an exclusive Balkite charger of special design.

Unipower operates from alternating current, 110-125 V-60 cycle. It is supplied in two types. The 4 Volt type is for sets using U V 199 tubes or equivalent and retails for $35.00. The 6 Volt type is for sets using U V 201-A tubes or equivalent and retails for $40.00. West of the Rockies, prices are slightly higher.



Unipower

Off when its on ~ On when its off



No. 23 (pictured) in addition to its use as a "B" battery instrument is being used extensively for "A" battery testing in place of hydrometers.

Test accurately and safely

There's no substitute for high resistance in a voltmeter for testing radio batteries, tube voltage, or experimental work. 60 Ohms per volt is the Nagel standard, assuring accurate readings and safety against battery drainage under touch contact or continuous service. See your dealer or write The W. G. Nagel Electric Co., 513 Hamilton Street, Toledo, Ohio.

If you own a "Super-Het" you can test your "A" and "B" batteries with one instrument—the Nagel No. 62 Voltammeter.

NAGEL

Manufacturers of

DRY CELL TESTERS · AMMETERS
HIGH-RESISTANCE VOLTMETERS
and VOLTAMMETERS · BAKELITE
HOT MOULDED INSULATIONS

Premier

"Blue Ribbon"

Battery Cable

insures the right hook-up

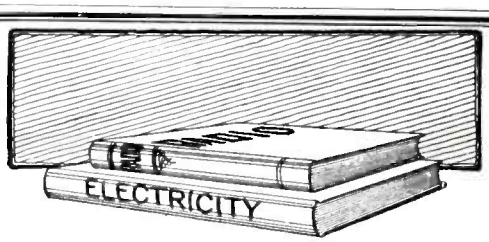
Get a PREMIER 5-Wire Battery Cable. Keeps wires neatly concealed, untangled and out of the way. Five different colored wires insure proper battery and set connections. With a flip of your finger you can unhook "A" battery and hook on charger.

In attractive carton, $1.00

At your dealer's—or write

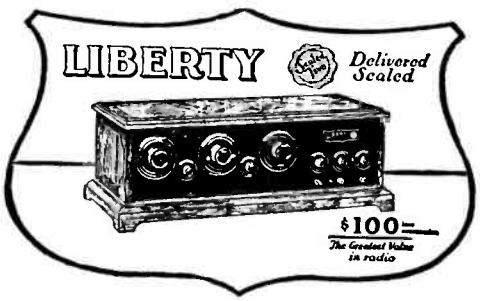
CRESCENT BRAID CO., Inc.
Providence, R. I.

Makers of Premier "Blue Ribbon" Extension Cords, Premier, Jr. Extension Cords and Phone Cords for headsets and loud speakers.



Knowledge of
Radio is not required to obtain perfect results with the

LIBERTY Sealed Five



Manufactured by

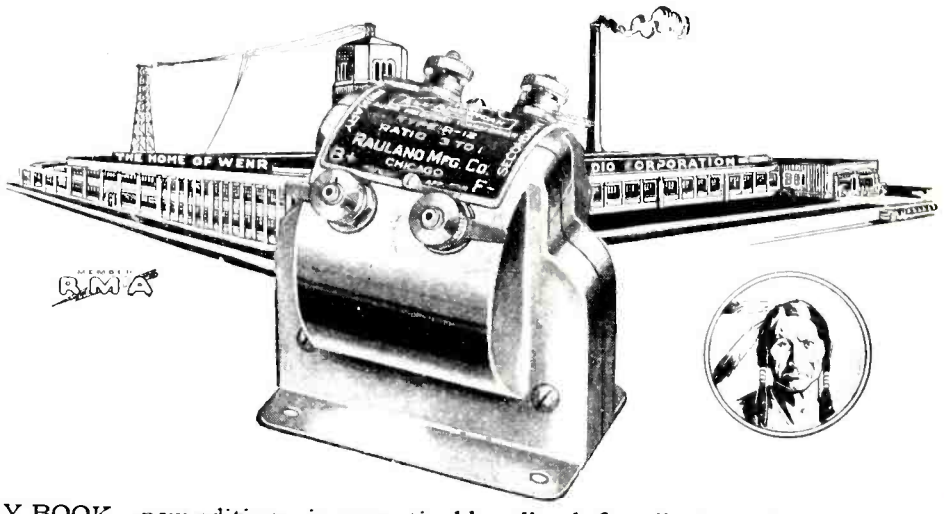
LIBERTY

TRANSFORMER CO., INC.

123 North Sangamon St., CHICAGO, ILL.

Back of Each Instrument

The assurance of reliable operation, which you have always felt when buying an ALL-AMERICAN Transformer, is now increased by a knowledge that it is the product of one of the largest and most completely equipped factories in America devoted exclusively to radio products.



The RADIO KEY BOOK—new edition—is a practical handbook for all who wish to enjoy modern radio at its best. Send 10 cents—coin or stamps—for the KEY BOOK.

ALL-AMERICAN RADIO CORP., E. N. RAULAND, Pres., 4211 Belmont Ave., Chicago

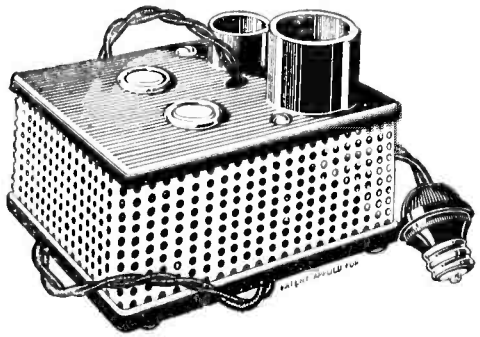
ALL-AMERICAN

Largest Selling Transformers in the World

Insure Your Tubes

BY CONSISTENT USE OF

$7.50 BURTON & ROGERS TUBE FLASHER Brings Back Bad Tubes



Developed by an organization of long experience in the manufacture of electrical instruments.

CORRECT ENGINEERING
UTMOST SIMPLICITY OF OPERATION

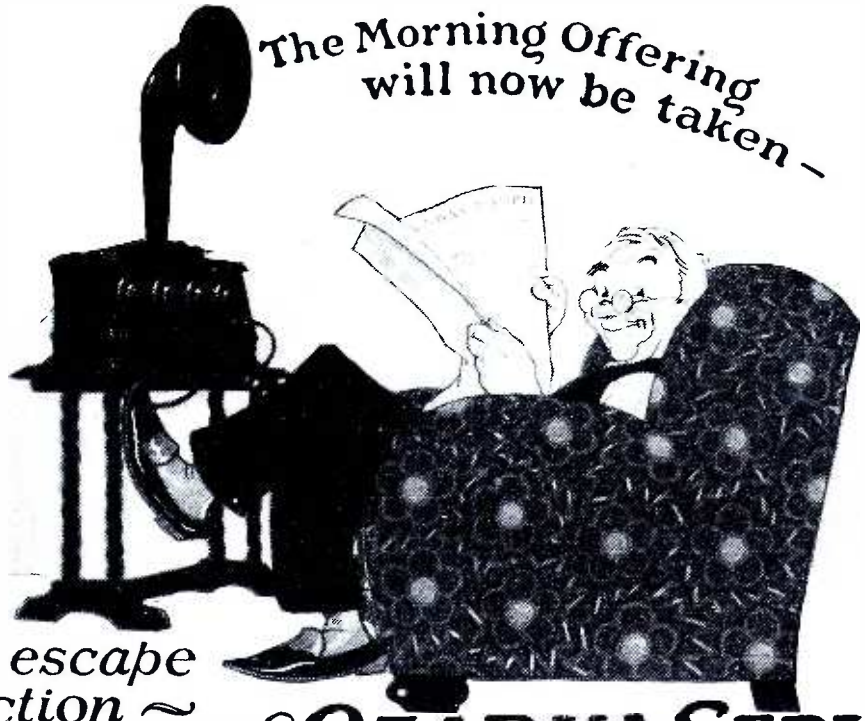
One model for D.C. or A.C.—Any number of cycles

Filament does not cool for an instant during flashing.—Results will exceed your expectations.—Cannot be burned out.—Fully guaranteed.—For tubes with thoriated filaments: types 201-A and 199 only.

Send for pamphlet "Save A Life"

BURTON & ROGERS MFG. COMPANY
755 Boylston Street, Boston, Mass.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



You may escape the collection ~ but not the need of OZARKA SERVICE

THE satisfaction you receive from your radio depends not on what it does once in a while—but night after night and month after month. Whether you grin or cuss depends on the service behind your radio.

Ozarka radio instruments are *only* sold by trained factory representatives, men who not only specialize in radio but sell and service Ozarkas only. 3,100 of these men, trained directly under Ozarka engineers constitute a service force, unequalled elsewhere in radio today.

When you buy a radio you'll compare appearance, tone, volume and selectivity by having various instruments set up in your own home but—that isn't enough—compare the service behind each one.

Any Ozarka factory representative will set up an Ozarka in your home—he will not even operate it himself, but will depend for his sale on what you yourself do. If you, by your own operating, do not bring in the distance, the volume and tone, you expect a radio to give, then you do not buy the Ozarka. If you do buy it, you can rest assured, no matter what happens, a competent service man is at your call at all times. No Ozarka representative can sell Ozarka Instruments without giving Ozarka service. You are entitled to such service—demand it!

That is why our book, "Ozarka Instruments No. 200," describing all models of Ozarka should be of particular interest to you. This book and the name of the Ozarka representative near you, will be sent immediately at your request. Please give name of your county.

We Have Openings for More Ozarka Factory Representatives

OZARKA Incorporated, is now entering its 4th year. From a beginning with one engineer, one stenographer, one salesman—our present president, the Ozarka organization has grown to over 3100 people. There must be some good reason for this growth.

Ozarka instruments have made good—they have more than met competition. Ozarka representatives have made good not only because Ozarka instruments were right, but because they have been willing to learn what Ozarka engineers were willing and capable to teach them—Ozarka unusual salesmanship and Ozarka service.

Radio offers a wonderful opportunity to men who are willing to start at the bottom and build. You need not know salesmanship, but will you learn what we will gladly teach you? You may not know radio, but we can and will teach you if you will do your part. With such knowledge and willingness to work, it doesn't seem possible that you cannot make good. Sign the coupon below, don't fail to give the name of your county. Better still write a letter, tell us about yourself and attach coupon. If interested in our salesman's plan ask for "Ozarka Plan No. 100."

OZARKA
117 Austin and La Salle Streets
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.

Name.....

Address..... City.....

County ..... State.....

YOU'LL KNOW THE MAN BY THIS BUTTON!

INCORPORATED
117 Austin and La Salle Streets
Chicago, Illinois

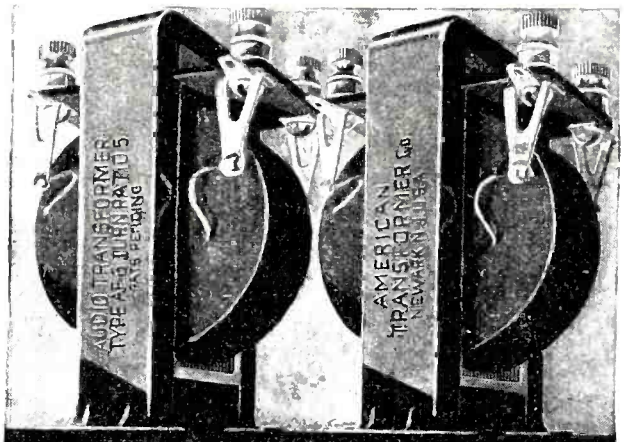
Gentlemen: I am greatly interested in the FREE BOOK "The Ozarka Plan" whereby I can sell your radio Instruments.

Name.....

Address ..... City .....

County..... State .....

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



A PIONEER LEADER

AmerTrans continue from month to month as one of the *best* selling audio transformers.

There is ample volume, and the "tone-keen" characteristic of AmerTrans furnishes a pleasant, distinct reception value—most appreciated by the critical listener. In fact, there is no more efficient and permanent working part in any set than a pair of AmerTrans.

Buy AmerTrans by the Pair!

from an

Authorized AmerTran Dealer

They are made in two types, one quality—AF6, ratio 5:1 and AF7, ratio 3½:1. Price either model, $7.00.

AMERICAN TRANSFORMER COMPANY

175 Emmet St., Newark, N. J.

"Transformer builders for over 24 years"

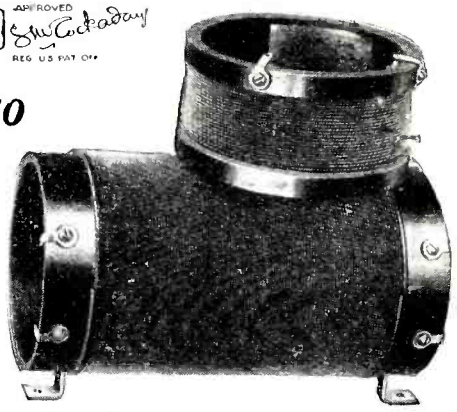
AMERTRAN

TRADE MARK REG. U.S. PAT. OFF.

New and Improved

APPROVED Cockaday PRODUCTS — L. M. Cockaday — REG. U.S. PAT. OFF.

$5.50



Authorized Cockaday Coil!

No more loose winding—special new feature holds coil windings fast. Built throughout of moulded hard rubber, not affected by atmospheric conditions. Wound with No. 18 D. S. C. copper wire.

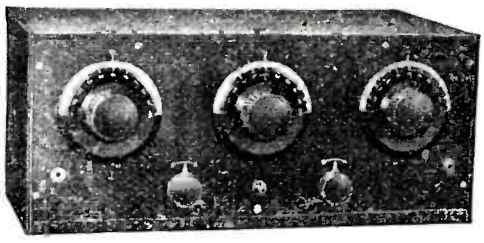
The only coil specified by L. M. Cockaday in his New Four Circuit Tuner with Resistance Coupled Amplification because it meets all his specifications. Described in October POPULAR RADIO as Cockaday Precision Coil. Hundreds have substituted this quality coil for those of inferior make and are amazed at the improved reception, selectivity and general D X results.

At your dealers, otherwise send purchase price and you will be supplied postpaid

In Canada $7.75. Canadian Distributor, Perkins, Ltd. Montreal—Toronto—Winnipeg

PRECISION COIL CO., Inc.

209-B Centre St., New York City



Model SR 5

Radio at its best

With the Simplex SR 5 Receiver you get pure tone and full volume. A good distance getter. Extremely selective. Very simple to operate. Handsome hand-rubbed mahogany cabinet. Dust-proof; wiring and coils concealed beneath sub-base.

SIMPLEX SR5 $57

The great popularity of Simplex products has caused our name to be widely copied. Be sure you get the genuine products made by the original manufacturers of Simplex Radio products.

If your dealer cannot supply you, write direct.

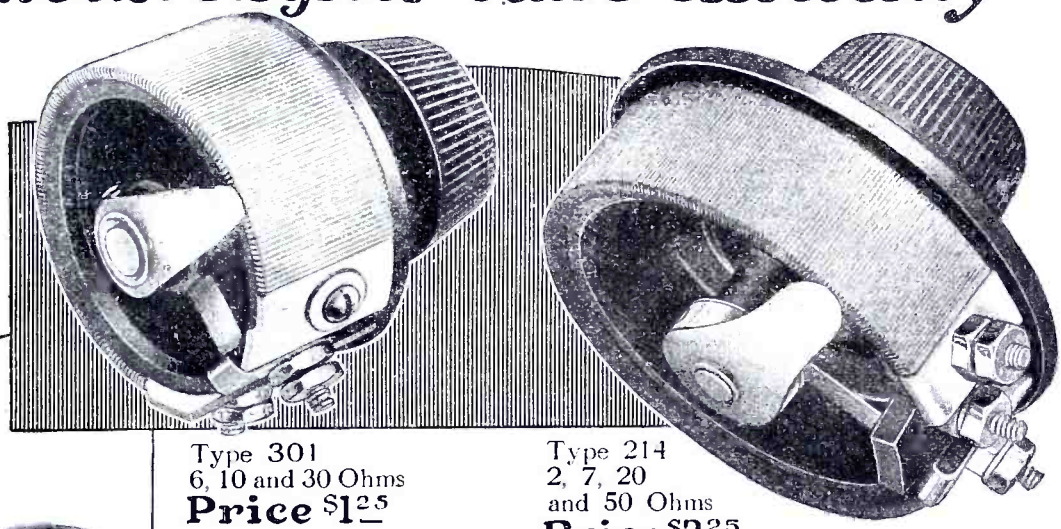
SIMPLEX RADIO COMPANY

Main and Rector Sts.

Manayunk, Phila., Pa.

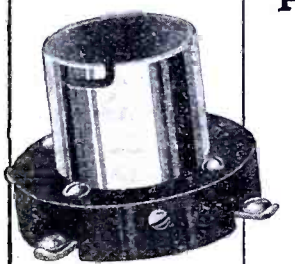
GENERAL RADIO

Rheostats and Sockets mean higher tube efficiency



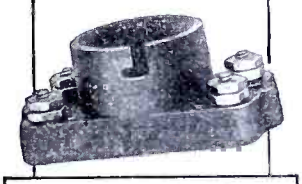
Type 301
6, 10 and 30 Ohms
Price $1.25

Type 214
2, 7, 20
and 50 Ohms
Price $2.25



Type 156

For all standard base tubes. A positive wiping contact is made to the side of the tube prongs by double spring terminals. These terminals hold the tube firmly and prevent vibrations. Price **$1.00**



Type 299

For UV-199 Tubes. This socket is a particularly high-grade socket of moulded bakelite. Contact is made to tube prongs by phosphor bronze terminals with double leaf blades. Price **50c.**

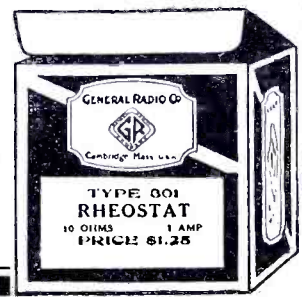
General Radio Rheostats Are Smooth Running and Uniform

THERE is only one way to operate tubes at their peak of efficiency—*by the use of properly designed rheostats and sockets.* In building your set, remember that vacuum tubes are important factors in successful radio reception, and require rheostats which provide a gradual and uniform resistance control over the filament.

General Radio Rheostats are smooth running, uniform, and capable of very minute variations. Many of the well-known manufacturers of receiving sets have chosen General Radio Rheostats and Sockets as standard equipment because of their high efficiency in tube operation. Why not use them in the next set you build, and get more out of your tubes?

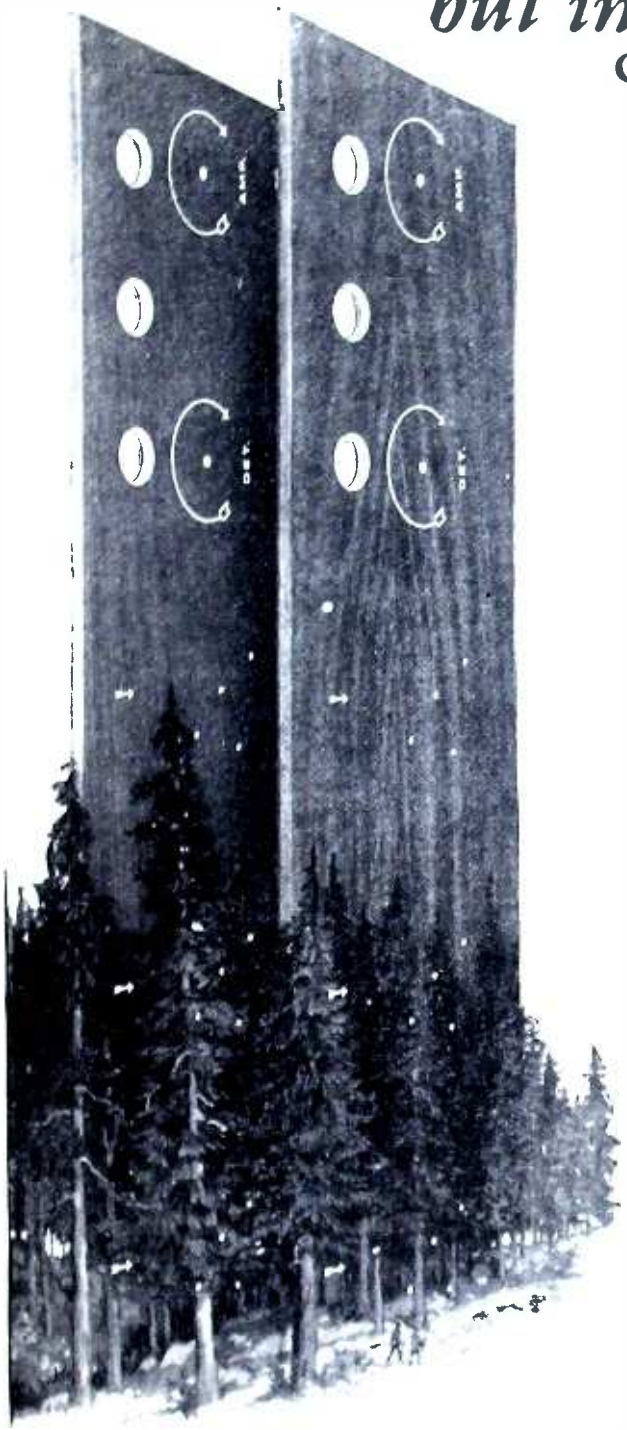
Sold at all good radio stores
Write for New Radio Catalog 920

The red cartons with the General Radio label are your unfailing assurance of satisfaction.



GENERAL RADIO Co.
Cambridge, Mass.

It's mahogany to the eye-
but in fact it's Bakelite



So perfectly is the grain and color of mahogany and walnut reproduced in these Bakelite Radio Panels, that the eye cannot distinguish them from the natural woods.

By using a Bakelite Panel that matches the wood in the cabinet, your finished set will be far more handsome than if a plain panel is used.

Rigid and strong, Bakelite Panels support the weight of heavy instruments without sagging. They will not compress, or cold-flow, under pressure of binding screws. Because of their resistance to extremes of heat, cold and moisture, they will not warp nor split. These properties and their insulation value, color and finish are permanent.

Be sure to ask your dealer to show you these wood finish Bakelite Panels — obtainable under any of the following trade-names:

FORMICA CELORON Dilecto
Spaulding Fibroc Micarta

A Bakelite Panel on a set is an indication that the manufacturer has used the best.

Write for Booklet 28

BAKELITE CORPORATION
247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street

Visit our booth at the Chicago and New York Radio Shows

Bakelite is an exclusive trade mark and can be used only on products made from materials manufactured by the Bakelite Corporation. It is the only material which may bear this famous mark of excellence.

BAKELITE

REG. U.S. PAT. OFF.

BAKELITE is the registered trade mark for the phenol resin product manufactured under patents owned by the Bakelite Corporation.

THE MATERIAL OF A THOUSAND USES

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

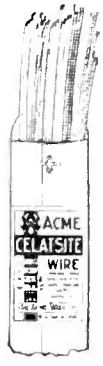
ACME WIRE RADIO PRODUCTS

The New CELATSITE

Flexible stranded wire for "point to point" and sub-panel wiring—latest method of wiring sets. 5 colors, black, yellow, green, red and brown, one for each circuit.

The Original Celatsite Wire

Celatsite is a tinned copper bus bar wire with a *non-inflammable* "spaghetti" insulation in five colors. Supplied in 30-inch lengths.



Flexible Varnished "Spaghetti"

A perfect insulation tube for all danger points in set wiring. Costs little more and is worth a lot more than the cheaper substitutes offered. Black, yellow, red, green, brown; for wires No. 10 to No. 18. 30-inch lengths.

Enameled Antenna (Stranded)

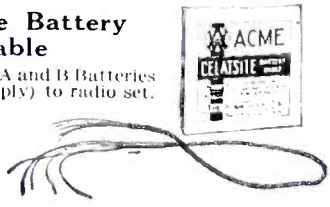
The best outdoor antenna you can put up. 7 strands of enameled copper wire; maximum surface for reception. Enameling prevents corrosion and consequent weak signals. 100, 150 or 200 foot coils, boxed.

Loop Antenna Wire

You can make a good loop with Acme wire made of 65 strands fine copper wire, green silk covered. Flexible; non-stretching, neat.

Celatsite Battery Cable

For connecting A and B Batteries (or current supply) to radio set. Silk braid covering 5 flexible Celatsite wires—5 feet long—a different color for each terminal. Prevents messy wiring and "blown" tubes.



Send for Folder

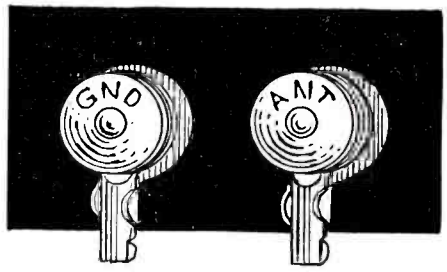
THE ACME WIRE COMPANY

Dept. P New Haven, Conn.

Also makers of fine enameled magnet wire and coil windings for Audio Transformers, Battery chargers, "B" Battery Eliminators.

The Nu-Way Snap Terminal

Makes a Perfect Binding Post



The Stud with the lettered guard is fastened to the set the same as the regular binding post.

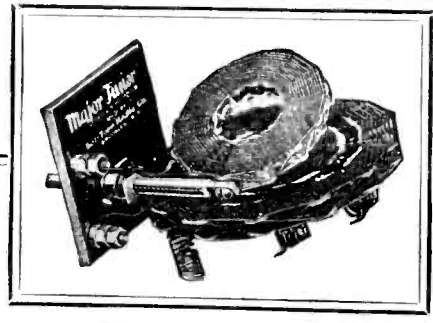
The Connector, to which the wire is fastened (by closing down the lug) is marked the same as the guard. Simply snap it to the Stud.

The Bronze Spring in the Connector compresses the Connector and Stud together, making a perfect contact.

With the Multi-Connector more than one wire can be attached to the same place as when making phone or battery connections.

THE HATHEWAY MFG. CO.

Bridgeport, Conn. Radio Division



Have you met

Major Tuner

Reg. U. S. Pat. Office.

MAJOR TUNER will end those "interference blues." A set built with the MAJOR TUNER gets only one station at a time—the one you want to get and no other.

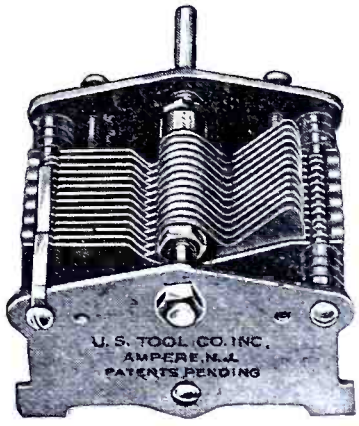
MAJOR TUNER is the most advanced form of three circuit Low-Loss tuner. It is packed with complete picture wiring diagrams and full instructions.

(If your dealer cannot supply you, write us.) **$4**

BEL-TONE RADIO CO.

161 Jamaica Ave., Brooklyn, N. Y.

ANNOUNCING
New Models of
U.S.TOOL CONDENSERS



THE new models U. S. Tool Condensers embody the latest refinements made possible by the combined skill of our large staff of engineers.

U. S. Tool Condensers have always been **good** condensers. The new models are **better** condensers. When the **best** condensers are made, U. S. Tool will make them.

Model 8

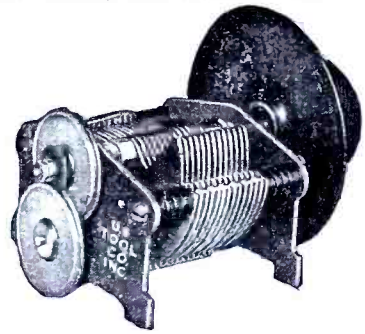
An efficient condenser made with new and patented one-piece stator, guaranteed to give sharp tuning at the lower broadcasting wave lengths

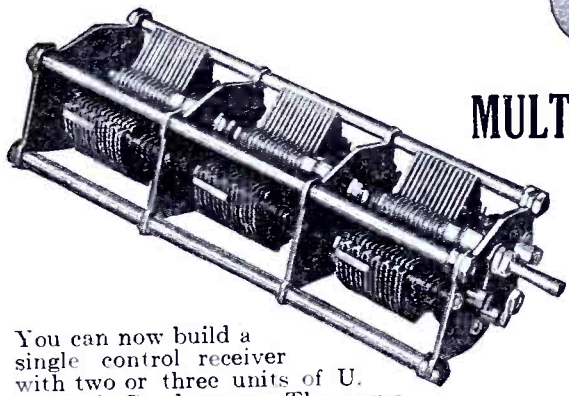
Capacity.	Max. .00025,	Min. .0000076.		$2.70
	Max. .00030,	Min. .000008.		2.85
	Max. .00035,	Min. .0000086.		2.95
	Max. .00050,	Min. .000011.		3.75

Model 9

Same as Model 8, but with Vernier and Kurz-Kasch Dial.

Capacity,	Max. .00025,	Min. .0000076,		$3.75
	Max. .00030,	Min. .000008.		3.85
	Max. .00035,	Min. .0000086,		4.10
	Max. .00050,	Min. .000011,		4.75





MULTIPLE CONDENSER

For Single Control Receivers

You can now build a single control receiver with two or three units of U. S. Tool Condensers. The same efficiency, but greater simplicity. One dial enables any novice to tune in stations at will.

Made under Hogan Pat. No. 1,014,002 Jan. 9, 1912

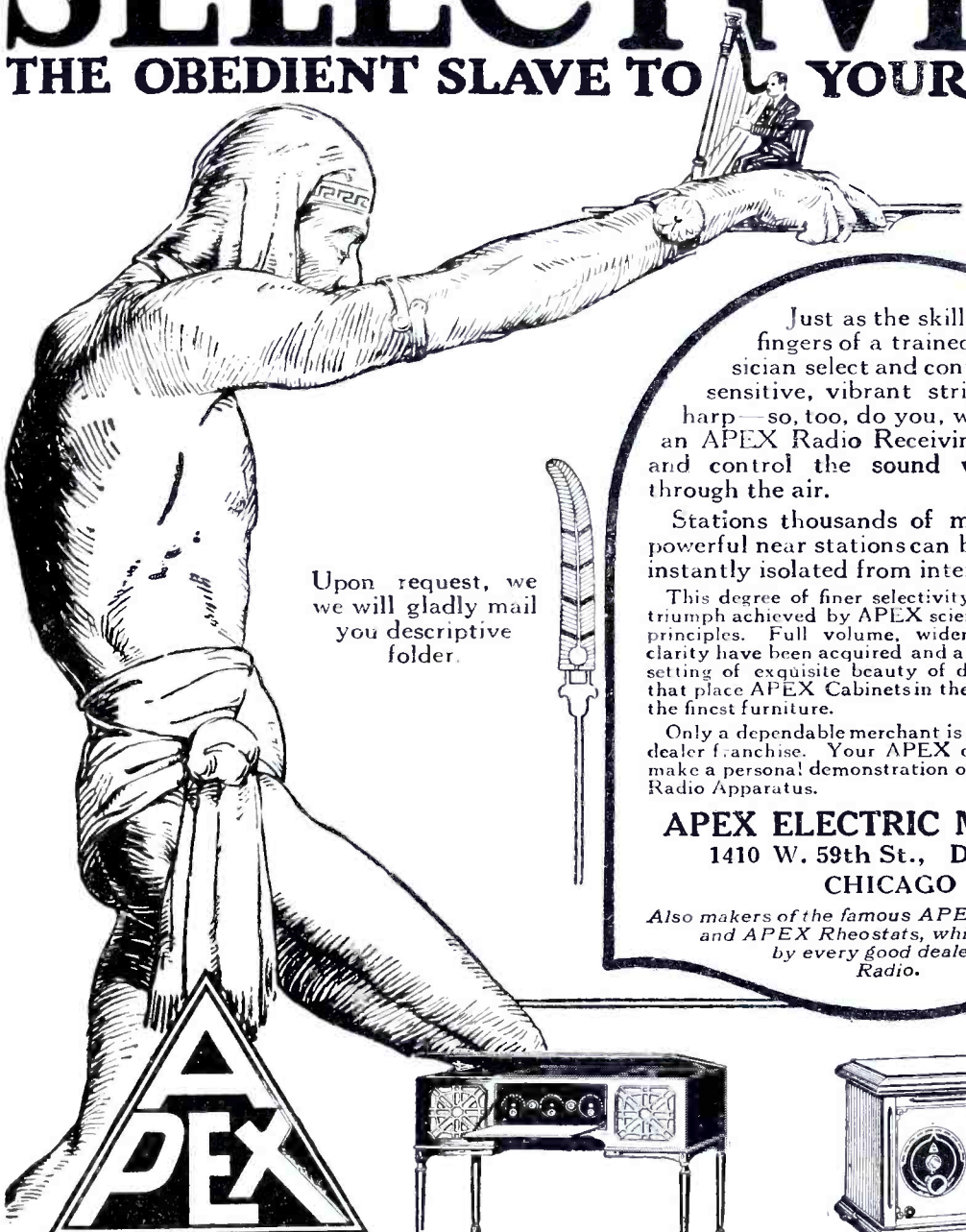
SEE THESE NEW MODELS AT YOUR DEALER'S

Write for Booklet

U.S.TOOL CO.,INC. AMPERE, N.J.

SELECTIVITY

THE OBEDIENT SLAVE TO YOUR DESIRES



Upon request, we we will gladly mail you descriptive folder.

Just as the skillful fingers of a trained musician select and control the sensitive, vibrant strings of a harp—so, too, do you, who operate an APEX Radio Receiving Set, select and control the sound waves wafted through the air.

Stations thousands of miles away, or powerful near stations can be entirely and instantly isolated from interference.

This degree of finer selectivity is not the only triumph achieved by APEX scientific engineering principles. Full volume, wider range, greater clarity have been acquired and are enthroned in a setting of exquisite beauty of design and finish that place APEX Cabinets in the highest ranks of the finest furniture.

Only a dependable merchant is given the APEX dealer franchise. Your APEX dealer will gladly make a personal demonstration of APEX Quality Radio Apparatus.

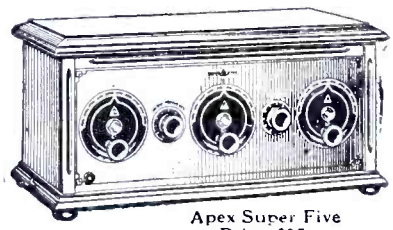
APEX ELECTRIC MFG. CO.
1410 W. 59th St., Dept. 902
CHICAGO

Also makers of the famous APEX Vernier Dials and APEX Rheostats, which are sold by every good dealer in Radio.

APEX

Quality Radio Apparatus

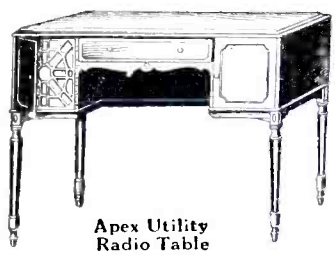
Apex Baby Grand Console Price $225



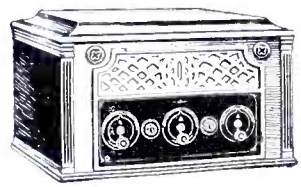
Apex Super Five Price $95 without accessories

Apex Console Entertainer Price $27.50

Apex Entertainer Price $22.50



Apex Utility Radio Table Price $75

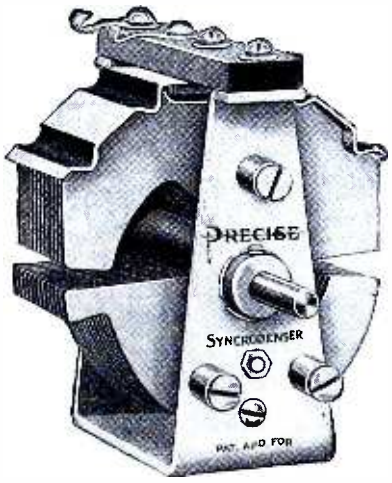


Apex De Luxe Price $135

Prices West of Rockies slightly higher. Canadian prices approximately 40% higher

EVERY PRECISE INSTRUMENT IS A LABORATORY PRODUCT

Announcing
Two New Precise Instruments



PRICES
.00035 Cap. $4.00
.0005 Cap. $4.50

The Syncrodenser

Like a pure straight-line frequency condenser, the Syncrodenser spaces the lower wavelength stations evenly over the first half of the dial from 0 to 50. It does not, however, start at that point to crowd the higher wavelength stations together over the last half of the dial, from 50 to 100.

This is because the Syncrodenser is a scientific combination of straight-line frequency, where it is vital, with straight-line capacity where that is superior.

The practical manner in which the Syncrodenser actually separates stations over this entire broadcast waveband marks a new era in condenser design.

Unusual design and great strength permit the Syncrodenser to be mounted on panel or subpanel in any conceivable position.

Made in two styles. The 750 type has extremely high minimum to maximum capacity ratio for use where a great frequency range is desired. The 750L is designed to cover the same frequency range as the average condenser of approximate capacity using the same coil.

No. 480 Super-size Audio Transformer

The need for faithful reproduction of all forms of broadcasting caused this Precise super-size audio transformer to be designed. It reproduces with absolute fidelity the true richness of the original creation as broadcasted, with magnificent amplification. The core and windings are unusually large and designed to withstand great overload. Compactly housed to permit subpanel mounting.

The other audio transformers in the complete Precise line are the original No. 285 (4½ to 1) at $5. Eclipse (2½ to 1) at $4. Comet (3½ to 1) $3.25. Push Pull No. 800-801 $11 per pair. The Precise Super-Multiformer is four matched radio frequency transformers in one unit, $20. Precise Filtoformer radio frequency choke coil and bypass condenser with inductance of 200 millihenries and .006 m.f.d. is $4.50.

Made in two ratios, 5 to 1 and 2½ to 1
Price for either ratio, $7.50

BRANCHES
105 Park Ave., East Orange, N. J.
53 W. Jackson Blvd., Chicago, Ill.
821 Market St., San Francisco, Cal.
454 Builder's Exchange, Minneapolis, Minn.

CANADIAN DISTRIBUTORS
Perkins Electric Ltd.
Toronto, Montreal, Winnipeg

PRECISE MANUFACTURING CORPORATION
ROCHESTER, N. Y.

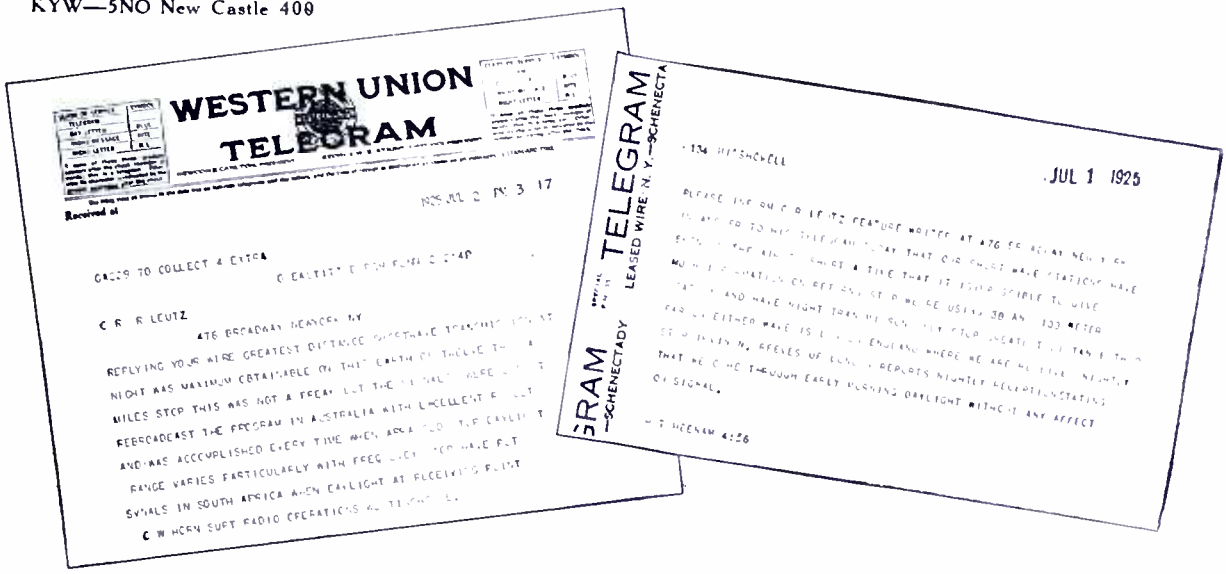
All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

UNIVERSAL PLIO-6

The Only Set That Tunes All Wave Lengths Within Distance Range

35 To 3600 METERS

3AR Melbourne 480—WGY 109—2FL Sydney 770—WKAQ San Juan 360—2BL Sydney 350—PCFF Amsterdam 2000 Karachi — Bombay — KOP — WGY 1660—6KW Tuinucu 340—Bankok—NSF Hilversum 1050—WLW—KDKA 64 KYW—5NO New Castle 400



WOC—CYL Mexico City 510—2FC Sydney 1100—KFI—PA5 Amsterdam 1050—Vienna—Colombo—WWJ—WCX Lakehurst 80—ICE Rome 470—5PY Plymouth 330—Voxhaus 430 — CNRC Calgary 440 — Madras — Stuttgart 437 BAV Brussels 1100—6FL Sheffield 303—WGY 38—PCGG Hague 1050—Otchiski—KGW—CFAC 430—CHXC Ottawa—EBX Cartagena—NAA 2500—PCMM Ymuiden 1050—SBR Brussels 262—KHJ—LOX Palermo 375—OXE Lyngby 2400—KOA—2SB Sydney—OKP Kbely 1150—2BE Belfast 435—KGO—YN Lyons 470—1 Nice 360—FL Eiffel Tower 2600—PTT Paris 450—5XX Chelmsford 1600—LOZ Monte Grande 425—2LS Leeds 346—5MA Adelaide 850—2LO London 365—PWX Havana 400—RAS Vladivostok—WMBF—CJCM Mont Joli—LOR Buenos Aires 400—LP Berlin 2370—VTR Rangoon

3LO Melbourne 1720

6BM Bournemouth 385

5WA Cardiff 350

PRG Prague 1800

2ZY Manchester 375

HB2 Lausanne 850

JJC Funabashi

JSB Chemulpo

3FL Melbourne 400

6VL Liverpool 318

HBI Geneva 1100

KDKA 64

POZ Berlin 2800

2EH Edinburgh 325

5IT Birmingham 475

Munich 485

Leipzig 452

2BD Aberdeen 495

THE NEW UNIVERSAL PLIO-6

Six tube, 2 Stages Non-Regenerative Tuned Radio Frequency Amplification, Detector and 3 Stages Distortionless Radio Amplification. Receiving range from 1,000 to 12,000 miles depending upon location, station transmitting, wave-length received and other variable factors

FULL DETAILS NOW AVAILABLE FROM MANUFACTURERS

GOLDEN-LEUTZ INC.

476 BROADWAY :-: NEW YORK CITY

Manufactured under Hogan Patent 1,014,002 - Other Patents Pending

CABLES "EXPERINFO" NEW YORK

"How I Located My Trouble"

A Massachusetts radio enthusiast tells of a happy discovery that finally solved his difficulties.

"I COULDN'T figure out what was wrong with my radio set," states a Fitchburg business man whose experience is interesting because it shows how one simple little adjustment will sometimes make such an amazing improvement in results.

"I had erected my antenna in just the right way, had connected up my different parts with the greatest care, had added improvements that were designed to bring my apparatus to the highest possible perfection," he continues.

"I spent a good many hours talking over my problems with dealers and experts. I followed one suggestion after another. But still the same old trouble!"

Do You Have This Trouble?

"In spite of all my efforts, when I wanted to hear some particularly interesting broadcasting program, other stations kept breaking in; I found difficulty in getting long distance points; and intermittent squeals, whistles and howls would persist, no matter how I tuned or adjusted my dials.

"I was pretty nearly convinced I'd have to get some high-priced installation man to come out to my home and set me right, when purely by chance I happened to pick up a copy of POPULAR RADIO—and thumbing through its pages I found the very answer to my problems!

"There in black and white, diagrammed and explained, was a simple, practical suggestion that turned the trick for me."

The One Best Way to Get Results

Many other radio enthusiasts, too, who want to get the **most** out of their sets have found in POPULAR RADIO many an idea and practical suggestion that has made a world of difference in their enjoyment of this fascinating pastime, and saved them hours of experiment and costly error.

If you don't already **subscribe** to POPULAR RADIO (with which is combined The Wireless Age), don't miss this opportunity of getting the magazine regularly at your permanent address.

Your Questions Answered *FREE!*

Then, too, as a regular subscriber, any questions you wish to ask of the Technical Editor will be answered **free of charge.** This is one of the most valuable features of POPULAR RADIO's service, and is the same service for which non-subscribers pay 50 cents for each question asked, and they say it's worth many times what they pay. *Yet you can get this same added service absolutely free.*

The Coupon Entitles You to This Service

Simply fill out and mail the attached coupon today and your subscription will start with the very next issue. If you have some problem to put up to our Technical Editor now, send in your question with the coupon and he will be glad to straighten you out. This is a privilege to which all subscribers are entitled, and we want you to take full advantage of it.

But do not delay sending in your subscription. Get POPULAR RADIO now, and don't risk missing any of the helpful and practical suggestions that are coming in future issues.

POPULAR RADIO, Dept. 98A,
627 West 43d Street, New York City.

Please put me down for a year's subscription to POPULAR RADIO, beginning with the October issue. I am enclosing $3.00 in full payment which also entitles me to free use of your Question and Answer Department for a full year.

Name.....

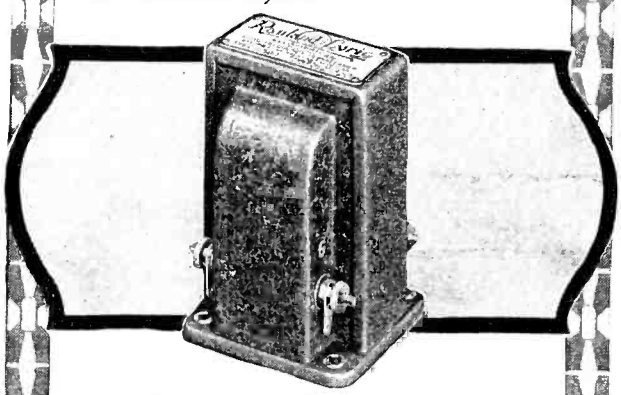
Address.....

.....

(No extra for Canada. Foreign countries 25 cents postage extra.)

Nocturne

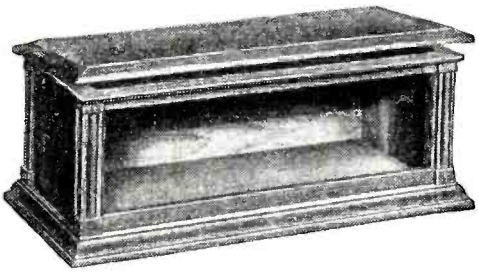
Miracle of science — this flight of music through the air! Into your home it comes, from hundreds of miles away. It speaks a universal language, straight to your heart. And not less a miracle is that magic building up of tonal power —still preserving every mood of the artist—until the room is filled. This is the supreme achievement of Rauland-Lyric.



Rauland-Lyric is a laboratory-grade audio transformer designed especially for music lovers. The price is nine dollars. Descriptive circular with amplification curve will be mailed on request. All-American Radio Corporation, 4201 Belmont Ave., Chicago.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER
The Choice of Noted Music Critics

Our MARVEL Cabinet



Made to take 14 sizes of panels

This is only one of our 1925-26 models. You ought to see the other models including **B Battery** types, also Loud Speaker types.

Free circular mailed on request. All sold at factory to user prices.

UTILITY CABINET CO.
Waukesha, Wis.
'Phone 721

Developed by R. E. Lacault

R E L

what's **new** *in radio?*

-no panel
-no dials
-built-in
-loudspeaker

6 tubes-Completely Wired-$135

ULTRADYNE
MODEL L-3

Out Sept. 10th - Write for details

PHENIX RADIO CORP.
116 EAST 25 STREET N. Y. C.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

PRE-SEASON REDUCTIONS

30 Days Only

Before the regular Fall Season begins you may subscribe for your favorite magazines at greatly reduced rates.

POPULAR RADIO Two annual subscriptions $5.00

Additional one year gift subscriptions only $2.50

*Judge *Popular Radio $8.00 Reg. For **$5.50**	*Cosmopolitan *Good Housekeeping Popular Radio $9.00 Reg. For **$7.75**	Film Fun *Judge *Popular Radio $10.00 Reg. For **$7.25**
Pictorial Review Modern Priscilla Popular Radio $6.50 Reg. For **$5.25**	McCall's Popular Radio $4.00 Reg. For **$3.50**	*Judge *Film Fun *Wit of the World $10.00 Reg. For **$7.00**
Today's Housewife McCall's Popular Radio $4.50 Reg. For **$3.90**	*American Magazine *Woman's Home Companion Popular Radio $7.00 Reg. For **$5.75**	Success Popular Radio $5.50 Reg. For **$4.00**

* Combinations starred (*) must go to one address.

Now before the publishing business is in the full swing of the annual Fall rush, is the time to send in your subscriptions and save money on your magazine purchases for the entire year.

This page represents an opportunity for you to secure your entire season's reading at a substantial cash saving over regular rates. The special combinations above and the representative list at the side should cover all the magazines you are accustomed to read. But if any of your favorites are missing, let us quote prices. You will find our rates as low or lower than you can get anywhere else.

As most of these combinations can be sent to different addresses, you will find that your friends and neighbors will be glad to have you forward their order with your own that they may take advantage of these very low prices.

If your subscriptions for any of these magazines have not yet expired, your present order will be entered as an extension.

So fill out the coupon below and mail it promptly. Magazine prices change so rapidly that these rates cannot be guaranteed for more than thirty days.

POPULAR RADIO

627 West 43d Street, New York City, N. Y.

Date..... 192

POPULAR RADIO, Dept. 92,
627 West 43d Street,
New York City, N. Y.

Enclosed remittance of $..... .... is payment in full for the magazines ordered on the attached list.

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MAKE any selection you wish from the following list, to be sent to different addresses if desired. Remit only the amount shown in the right-hand column, *if more than one magazine is ordered.* All quotations cover twelve issues to the year unless otherwise specified. POPULAR RADIO may be added to any combination of right-hand figures at $2.50 for each yearly subscription.

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McCall's Magazine	"	1.00	"	1.00
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Radio	"	2.50	"	2.00
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American Boy	reg.	$2.00	for	$2.00
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*These magazines do not club but may be added to any combination at the price shown.

Now You Can Test and Renew Tubes!

—tell their exact condition
—reactivate them to full efficiency
—match them in the set, uniformly

It is now possible to know the exact condition of your tubes, and to renew the worn-out filaments. All of which requires but a few moments of your time.

Sterling Tube Reactivator

This device will reactivate the filaments of UV-201A, C-301A, UV-199 and C-299 vacuum tubes, so that you are able to use your tubes long after they have given the usual amount of service. The process may be repeated time after time. An exclusive feature of the Sterling Reactivator is that it includes a filament emission meter which **shows instantly whether the tube needs reactivation** and tells exactly **how efficient the tube is after treatment.** Tubes can be maintained at high efficiency and matched in the set. This reactivator will pay for itself in a very few months.

Price (50-60 cycle) $12.50 (25-40 cycle) $14.00

Sterling Tube Tester

In less than half a minute you can test the plate current of a tube and find the defective tube, or tubes if any, in your set. A convenient chart furnished with the instruments tells at a glance whether a tube is good, fair or poor. This tester is also helpful to locate transformer, wiring and socket troubles. **Price $8.50**

See a good dealer or write us direct

The Complete Sterling Radio Line

Pocket Meters and Panel Meters

"A" and "B" Battery Chargers

Tube Testers

Tube Reactivators

Rheostats

Microcondensers

Audio and Radio Frequency Transformers

Sterling Radio Equipment

THE STERLING MANUFACTURING COMPANY

2831-53 Prospect Ave. Cleveland, Ohio

Electrical Manufacturers since 1906

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Why

Set Manufacturers are Standardizing on D X L Condensers—the New Single End Plate Model C

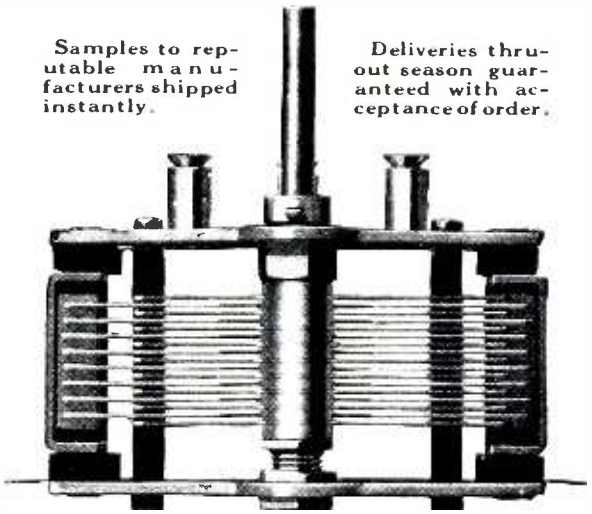
When the engineers of many set manufacturers from all parts of the country specify D X L Condensers for the new Sets—when they select D X L from the hundreds offered them—it means they are satisfied with the sound, sensible principles of design upon which D X L Condensers are built.

Light, yet sturdy and rigid—Simple, yet a marvel of precise workmanship—Instant admiration is won for Model C—just one end plate yet any engineer will vouch for its absolute rigidity.

Like all D X L Straight Line Condensers Model C is guaranteed to run true to specifications and careful workmanship in every single shipment. Buy D X L with perfect confidence.

Samples to reputable manufacturers shipped instantly.

Deliveries thruout season guaranteed with acceptance of order.



Individual Set Builders

D X L Condensers will make your set perform at maximum. Ideal for low wave lengths. Details and prices on request.

TRADE DXL MARK

RADIO CORPORATION

5767 Stanton Ave., Detroit, Mich.

Another Achievement!

$5.00 per set

PRECISION R. F. COUPLING UNIT

May be used as a transformer for coupling two tubes in a circuit as a radio frequency amplifier. Designed for present broadcast range in conjunction with a standard .0005 mfd. variable condenser. The coupler consists of a compact primary winding to be connected to plate circuit of one tube and a split secondary winding, half on each side of the primary, to be shunted with the tuning condenser and connected in grid circuit of following tube.

Air wound type, the most efficient coil winding, special design prevents windings becoming loose at any time.

The design is such that an amplifier built with this apparatus makes possible extremely sharp tuning with maximum signal strength and stability of operation.

Made by the makers of the famous Cockaday Coil.

At your dealers, otherwise send purchase price, and you will be supplied postpaid

Precision Coil Company, Inc.

209-B Centre St., New York City

Steinite LOW LOSS Interference Eliminator

What Every Radio Owner Needs

Tested and approved by the Popular Radio Laboratory

Over 36,000 Sold First 6 Weeks. Now you can select stations at will, cut out interference and undesired stations—tune in loud and clear. **Wonderful results with tube or crystal sets** of any make using any kind of aerial except loop antenna.

Reduces Static

$1 Postpaid

Amazing satisfaction. Better reception guaranteed or your money cheerfully refunded.

Select Stations At Will

Put this interference eliminator on your set—that's the test—no tools—attached in two minutes to aerial. Doesn't disturb present log. Directions easy to follow. No additional tubes or batteries. Two big banks testify to our reliability. Order today—dollar bill will do—we take the risk—money back if you say so.

STEINITE LABORATORIES

Manufacturers

134 Radio Building, ATCHISON, KANSAS

Write for complete radio literature—it's FREE. Steinite sharp tuning summer sets. Most beautiful and least expensive radio sets in America.

Jobbers—Dealers: Write today for full description and prices Steinite nationally known popular price radio sets, interference eliminator, and long distance crystals.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

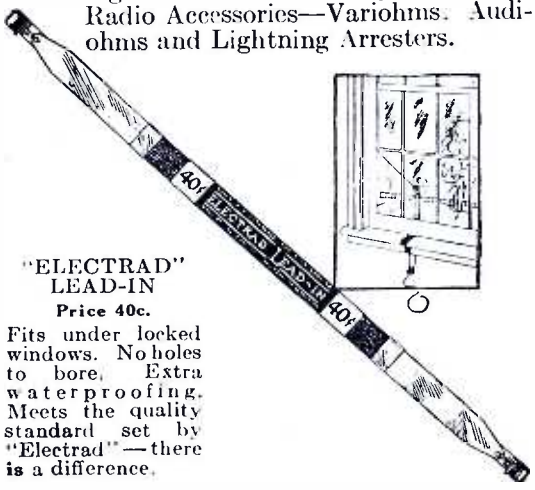
A Foe to Old Man Static

This demon tormentor with his rattles and hammers—
This outlaw of the ether.
—will be a stranger in your home when you use the "Electrad" Lamp Socket Antenna.

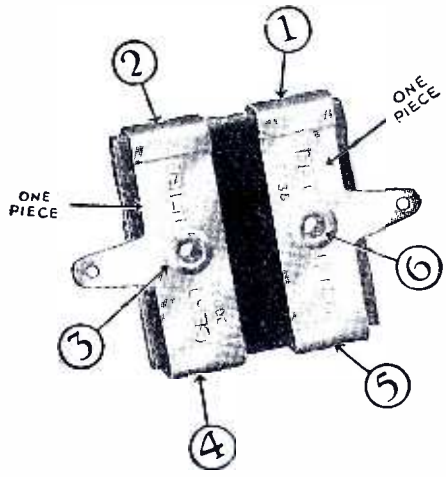
Plugs in at any electric light socket, replaces outdoor or indoor aerials. Reduces interference, a distance getter.

Price 75c. At Most Good Dealers

together with other handy "Electrad" Radio Accessories—Variohms. Audiohms and Lightning Arresters.



"ELECTRAD" LEAD-IN
Price 40c.
Fits under locked windows. No holes to bore. Extra waterproofing. Meets the quality standard set by "Electrad"—there is a difference.



The Six Point Pressure Condenser

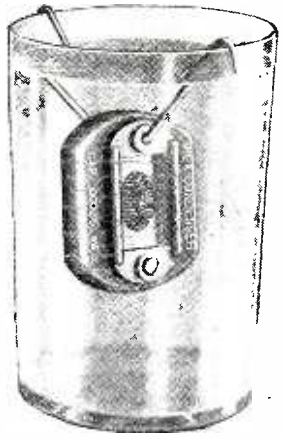
The "Electrad" Certified Fixed Mica Condenser is a revelation in accuracy and design. Ingenious, rigid binding and firm riveting fastens parts securely at six different points insuring positive electrical contact. Impervious to temperature and climatic variations. Exerts even pressure upon the largest possible surface—can't work loose. Binding strap and soldering lug in one piece. Accuracy and quietness assured always. Value guaranteed to remain within 10% of calibration. Standard capacities, 3 types. Licensed under Pat. No. 1,181,623, May 2, 1916 and applications pending. Price 30c. to 75c. in sealed dust and moisture proof packages.

Also Type G S with grid leak brackets and specially designed arms for direct connection to socket terminal.

ELECTRAD INC.

428 Broadway, New York City

Sangamo Mica Condensers



"SEE THE SANGAMO EXHIBIT AT THE NATIONAL RADIO EXPOSITION, CHICAGO, THE WEEK OF SEPTEMBER 28th."

Nothing will change their accuracy

"WHAT'S wrong with my set?," asks many a puzzled builder, forgetting that inaccurate fixed condensers throw the whole circuit out of electrical balance.

Perhaps this is your trouble. With Sangamo Mica Condensers you can be sure of dependable accuracy no matter how severely they are used.

For here is a condenser that is guaranteed to be accurate within 10 per cent of marked capacity, and to sustain that accuracy under all conditions of service. It is solidly molded in smooth brown bakelite; impervious to moisture, acid fumes or salt air.

Even boiling and freezing will not injure a Sangamo Mica Condenser. Soldering has no effect upon the capacity; heavy surges of current in special uses will not break it down. Its great mechanical strength gives protection against shipping or cracking even if dropped on hard cement. Approved by all nationally recognized radio laboratories.

SANGAMO *Accurate* Radio Parts

First class radio dealers have Sangamo Mica Condensers in stock — or can quickly obtain them for you. Insist!

Sangamo Electric Company

1320-8 *Springfield, Illinois*

RADIO DIVISION, *50 Church Street, New York*

SALES OFFICES—PRINCIPAL CITIES

For Canada — Sangamo Electric Co. of Canada, Ltd., Toronto.
For Europe—British Sangamo Co., Ponders End, Middlesex, Eng.
For Far East—Ashida Engineering Co., Osaka, Japan

RATHBUN has a complete practical solution of the Straight Line Frequency Problem. No existing apparatus is similar to this invention in theory or universal application.

Watch for the announcement story in the next issue of this and other radio publications.

RATHBUN MANUFACTURING CO., Inc.
Jamestown New York

RATHBUN (RADIO APPARATUS)

$12.00 and up
Alfred Graham & Co., London, Eng., Patentees

Adjustment at rear for "tuning" unit to your set

Test it for "Selectivity"

against any other loud speakers

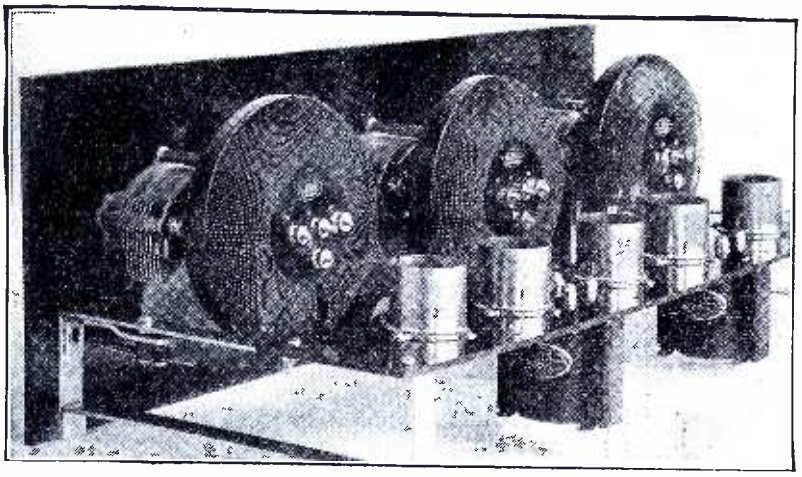
Hear The Amplion *in comparison*; let your ears tell you why this creation of the actual originators and oldest makers of loud speakers leads in sales throughout the world. Not only is The Amplion supreme for clarity, realistic tone and *long distance* volume. It also has "*selectivity*"—the ability to *separate distinctly* the different instruments in an orchestra, or the various voices in a quartet, instead of jumbling them together. Interesting Amplion literature will explain why. Write for it and dealer's name.

AMPLION

The World's Standard Loud Speaker

THE AMPLION CORPORATION OF AMERICA
Executive Offices:
Suite X, 280 Madison Ave., New York City
Canadian Distributors: Burndept of Canada, Ltd., Toronto

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Amazing new receiver

NOW anyone can build it in an amazingly short time this new easy way. Experts assemble it at factory. You simply wire. Note revolutionary new principle it contains.

NO excuse now for not having a fine radio. At a surprisingly low cost, too. For a remarkable plan is showing thousands a new way to build their own. It is so easy that anyone can do it in an hour's time. So fascinating that many continue to build them for others. No wire bending or soldering. Merely attach a few ready-cut, flexible eyeletted leads, and the job is done.

And in addition to the fun and pride of building your own, the finished receiver actually contains a phenomenal feature not yet found in the most expensive sets; that brings results otherwise impossible.

This feature follows the discovery of a new inductance principle that overcomes many vital weaknesses of present day sets. It is based on an entirely new type coil—the Erla *Balloon *Circloid.

Circloids are the backbone of the Erla kit and are largely responsible for the striking improvements this kit alone offers. Note these four advantages in particular:

1. ***Greater distance.*** Circloids have no measurable external field to affect adjacent coils or wiring circuits. This makes possible higher amplification in each stage, with increased sensitivity and greater range.

2. ***More volume.*** Higher r. f. amplification enables Circloids to bring in distant stations scarcely audible in ordinary sets with volume enough on the loud speaker to fill an auditorium.

3. ***Increased selectivity.*** Circloids have absolutely no pick-up qualities of their own. Only signals flowing in the antenna circuit are built up.

4. ***Finer tone quality.*** The self-enclosed field positively prevents stray feed-backs between coils. Hence no blurring or distortion. Tones are crystal clear.

Circloids are sold singly and in sets of three; also in kits containing three Circloids and three .00035 condensers.

Write for free information on kit—also book

See how a few minutes of fun will give you the newest and most nearly perfected set known to radio science. Examine it at any Erla dealer's, or send the coupon for full information, illustrations and diagrams contained in the remarkable new book, "Better Radio Reception," describing the sensational new Circloid principle. Enclose 10c for mailing and postage on book.

**Trade Mark Registered.*

Dealers—Exclusive franchises are available to high class dealers in localities still open. Write or wire immediately.

Electrical Research Laboratories,
2500 Cottage Grove Ave.
Dept. 119
Chicago, U.S.A.

☐ Send me free information on kit. ☐ Enclose 10c for postage for book, "Better Radio Reception."

ERLA

This sign identifies authorized Erla distributors. All are equipped to give complete radio service.

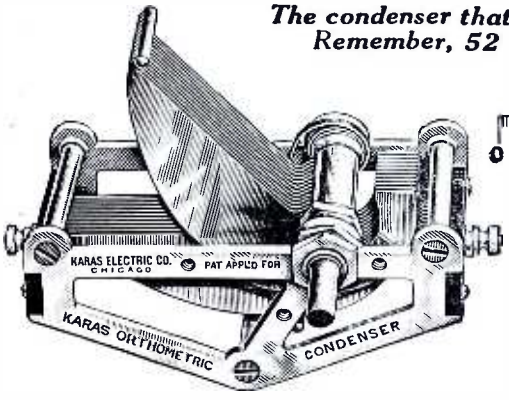
Name.....

Address.....

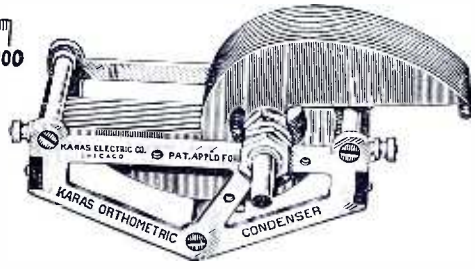
City..... State.....

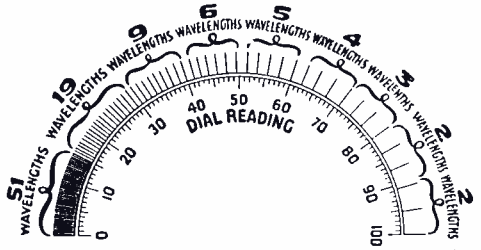
Tuning Marvelously Simplified with KARAS ORTHOMETRIC Condensers

The condenser that brings in KDKA where it belongs — at 53 on the dial. Remember, 52 of the 100 wavelengths must come in below KDKA—



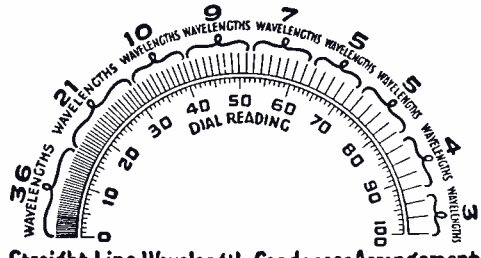
For Over 30 Years,
Makers of
PRECISION Electrical Apparatus





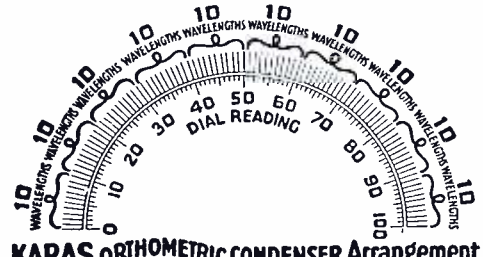
Ordinary Condenser Arrangement of Wavelengths

Ordinary straight capacity condensers crowd 70 of the 100 wavelengths into the first 30 points of the dial.



Straight Line Wavelength Condenser Arrangement

Even with the recent straight-line-wavelength condensers 57 of the 100 wavelengths are crowded into the first 30 points of the dial.



KARAS ORTHOMETRIC CONDENSER Arrangement of Wavelengths on Dial

The New Scientific Karas Orthometric Condensers insure absolutely equal separation on the dial, of all wavelengths throughout the entire broadcasting range.

Sizes and Prices

23 plate .0005, Mfd., . . .	$7.00
17 plate .00037, Mfd., . . .	6.75
11 plate .00025, Mfd., . . .	6.50

Spreads Stations Evenly Over the Dial — *No Crowding Whatever*

The Karas Orthometric Condenser positively separates all adjoining wave lengths by EQUAL distances on the dial, giving full benefit of the 10 Kilocycle frequency separation fixed by the Government.

Ordinary condensers jam 70 on the 100 Government allotted wavelengths into the first 30 points of the dial—even straight-line-wavelength condensers crowd 57 of them below 30.

With Karas Orthometrics each point of the dial corresponds exactly to one of the 100 allotted wave lengths. The result is marvelous simplicity in tuning — better, clearer reception.

The Karas Orthometric is a "job" that will delight the eye of the mechanical critic. Made entirely of brass—frame die stamped, not cast. Every joint soldered. Grounded frame and rotor. Adjustable cone bearings. Spring copper pigtail.

If Your Dealer is Not Yet Supplied Order On this Coupon!

We are supplying dealers and jobbers as fast as our factory output permits. If your dealer is not yet supplied, order direct on the coupon. Send no money. Simply pay the postman on delivery. Order today!

Money-Back Guarantee!

KARAS Orthometric Condensers are positively guaranteed to give you thorough satisfaction. Any time within 30 days they may be returned for full refund.

KARAS ELECTRIC CO.,
4037 No. Rockwell Street, Chicago

Please send me.....Karas Orthometric Condensers, size indicated below. I will pay the postman $..... plus postage, on delivery. This order is subject to your 30 day Money-Back Guarantee.

Size wanted.....

Name.....

Address.....

Dealer's name.....

If you send cash with order, we'll send Condensers postpaid.

New Reproducer That Improves "Tone Clarity"

The Kellogg Symphony Reproducer brings the artist into your very room—so realistic is its reproduction.

Piano music, the most difficult to reproduce, sounds so natural that you are completely carried away by its beauty.

Kellogg Symphony Reproducer
$20.00

Vocal selections retain all the tone colorings of the artist.

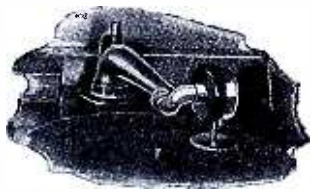
Orchestra music is a revelation, each instrument can be heard, clear and true.

Radio fans, dealers, musicians, artists, engineers, all unite in endorsing the Kellogg Symphony Reproducer.

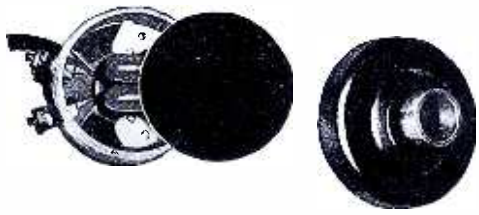
The Kellogg Symphony Reproducer uses the Kellogg unit with the magnetically controlled diaphragm. An exclusive feature.

The Kellogg unit with an adapter makes a wonderful loud speaker of any phonograph.

See a radio dealer today. Let him demonstrate this remarkable instrument.



Unit with phonograph stand in position $7.50



Kellogg unit with cord
$6.90

DEALERS: Write for special proposition immediately

Kellogg Switchboard & Supply Company

1066 W. Adams Street **CHICAGO, ILL.**

Announcing *the* Balkite Trickle Charger *at* $10 *and the new* Balkite "B" *at* $35

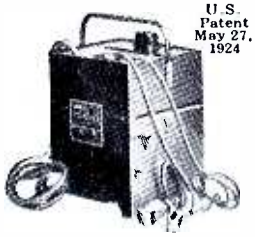
A

Balkite
Trickle Charger

Charges both 4 and 6 volt Radio "A" batteries. Will furnish more current than is used by 6 dry cell tubes, if used only while the set is in operation. If allowed to "trickle" charge continuously will also furnish enough current for 8 storage battery tubes. Size 5½ in. long, 2¾ in. wide, 5 in. high. Operates from 110-120 AC 60 cycle current.

Manufacturers are offering switches which turn on Balkite "B" and turn off the charger when you turn on your set. This makes the current supply for both circuits automatic.

Price $10
West of Rockies, $10.50



Balkite
Battery Charger

The most popular battery charger on the market. It can be used while the radio set is in operation. Charging rate 2.5 amperes. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $19.50
West of Rockies, $20

The Balkite Battery Charger is today the most popular charger on the market. It is the only charger commonly used while the set is in operation. Balkite "B" II is also well known. It replaces "B" batteries entirely and supplies plate current from the light socket.

We now announce the Balkite Trickle Charger at $10. This low-rate charger is especially adapted to use with sets of relatively low "A" current requirements—dry cell sets and storage battery sets with few tubes. Owners of dry cell sets can now make a very compact and economical installation with a Balkite Trickle Charger and a low capacity storage battery of the type offered by battery manufacturers this fall.

We also announce the new Balkite "B" at $35. This new model will serve sets of five tubes and less. It fits in your present "B" battery compartment.

Noiseless—No bulbs—Permanent

All Balkite Radio Power Units are entirely noiseless in operation. They have no moving parts, no bulbs, and nothing to adjust, break or get out of order. Each is a permanent piece of equipment with nothing to replace. They require no other attention than the infrequent addition of water. They require no changes or additions to your set. They are guaranteed to give satisfaction.

Manufactured by
FANSTEEL PRODUCTS COMPANY, Inc.
North Chicago, Illinois

FANSTEEL
Balkite *Radio Power Units*

B

Balkite "B"

Eliminates "B" batteries. Supplies plate current from the light socket. Operates with either storage battery or dry cell tubes. Keeps "B" circuit always operating at maximum efficiency. Requires no attention other than adding water about once a year.

Will serve any set of 5 tubes or less. Occupies about same space as 45 volt dry "B" battery. Operates from 110-120 AC 60 cycle current.

Price $35

Balkite "B" II

Same as the new Balkite "B" but will fit any set including those of 10 tubes or more. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $55

Tested and Listed as Standard by Underwriters' Laboratories

BALKITE BATTERY CHARGER BALKITE TRICKLE CHARGER BALKITE "B" BALKITE "B" II

$2.50

ALL TYPES

"a good tube

for a good set"

A GLASS, a base and some bunches of wire, Kipling would have said about vacuum tubes. And so they are. But what a difference the method of assembly and manufacture makes.

MAGNATRONS are built with the precision of a fine watch and tested just as carefully before they leave the factory. You can always count on MAGNATRONS to get the most and the best out of your set.

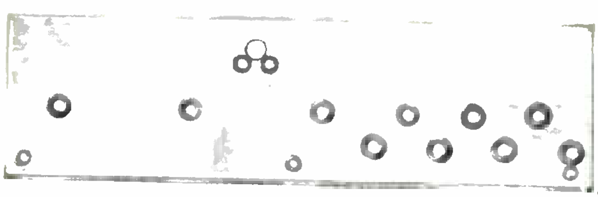
Connewey Electric Laboratories, Magnatron Building, **Hoboken, N. J.**

MAGNATRONS

Something New

Hornig Glass Insulated Terminal Strips

2 connections	$ .50	Each includes a glass tube, two mounting brackets and all necessary machine screws and nuts
3 connections	.65	
4 connections	.80	
5 connections	.95	
6 connections	1.10	
7 connections	1.25	
8 connections	1.40	



Hornig Glass Panels and Cabinets
(equipped with Safety Bushings Pat. App.)

Ask for our Bulletins

A. W. HORNIG
3921 Dickens Avenue, Chicago, Ill.
Tel. Spaulding 3156

EVERYTHING IN RADIO AT BARGAIN PRICES

Just hot off the press—big Radio Catalog & Guide brimful of latest ideas, over 100 newest hook-ups with illustrations—all free. Shows savings as high as 50% on standard guaranteed radio parts, sets, kits. Be sure to get this thrifty book before you buy. It puts money in your pocket. Unusual? You'll say so when you get it. Also please send name of radio friend. Write today.

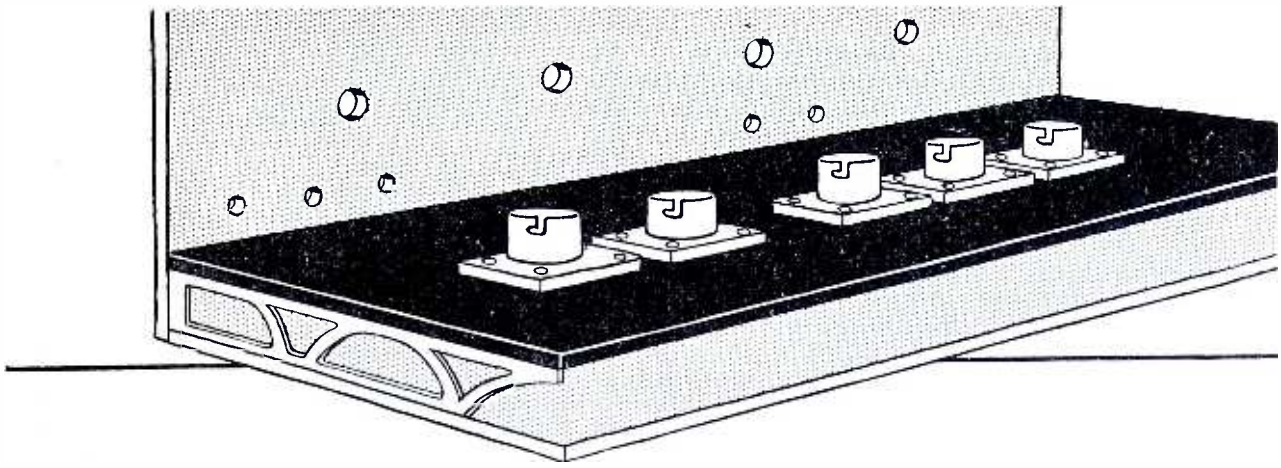
THE BARAWIK COMPANY
102-103 S. Canal St., Chicago, U. S. A.

LOW PRICES ON KITS

Craig 5-tube Radio Frequency Set as described in August POPULAR RADIO, Complete	$59 50
Cockaday 5-tube N. C. Receiver	47 50
Cockaday 8-tube Superhetrodyne	74 50
Cockaday 5-tube 4 Circuit	67 00
4 Tube Browning Drake	35 00
Best Superhetrodyne-Remler parts	52 50
Model L-2 Ultradyne Kit with all parts	59 50
5 Tube Bremer Tully Nameless All Genuine Low-loss parts	42 50
Pressley Superhetrodyne Kit, Genuine Sangamo parts	69 50

Parts all exactly as specified and of same brands or equal quality brands as in original specifications.

THE BARAWIK COMPANY
102-103 S. Canal St., Dept. PR., Chicago, Ill.



You Need Quality in the Base Panel

VERI-CHROME PANELS

By the purchase of a controlling interest in the Veri-Chrome laboratories, the financial and production resources of the Formica Insulation Company have been placed behind this remarkable new process for decorating radio panels. Elaborate decorations can be produced much more rapidly and more economically than by engraving. Decorations designed by the leading American artists are offered. Tuning scales may be marked directly on the panel eliminating the standard dial and substituting pointers instead. The reduction in cost is large. Write for prices on complete panels finished in this way in quantity.

THE use of a base panel makes possible shorter, neater and more efficient wiring. But the panel must be an insulator of the first quality that will not deteriorate with time. It must be free from any tendency to absorb water to function properly in damp, humid weather. It must not warp or distort, disturbing the angle of the coils and the arrangement of the apparatus.

There is one panel material in which you are sure of getting all of those essential qualities—and that is Formica.

For years it has been accepted by the vast majority of leading radio manufacturers, as mechanically and electrically the best available material for radio panels. It also is the most handsome, and its finish is entirely permanent. It does not check, crack or lose its lustre with time.

Formica is evidence of quality, durability and genuine worth in any radio apparatus.

Dealers: Home set builders who want the best results want Formica. It has been for years a highly profitable line for thousands of dealers.

THE FORMICA INSULATION COMPANY

4641 Spring Grove Avenue, Cincinnati, Ohio

1 Formica is used by nearly all the leading set makers—and has for years been used by more set makers than any other material.

2 Formica is unaffected by weather and time —it lasts forever.

3 Formica in appearance is the finest of all panel materials and always remains so.

4 Formica's electrical qualities of every kind far exceed any possible requirement.

5 Formica has high mechanical strength and will not break in use.

6 Formica will not sag from heat or cold flow under pressure. It retains its dimensions. Everything you fasten to it stays tight and precisely where you put it.

7 Formica panels are sold in neat craft paper envelopes which assure you that you are getting the genuine.

8 Formica is one of the most widely approved materials in radio.

SALES OFFICES

50 Church Street.....New York, N. Y.
9 South Clinton St.....Chicago, Ill.
516 Caxton Bldg.....Cleveland, Ohio
327 Cutler Bldg.....Rochester, N. Y.
422 First Avenue.....Pittsburg, Pa.
6 Beacon Street.....Boston, Mass.
55 Calle Obispo.....Habana, Cuba
1026 Second Avenue.....Minneapolis, Minn.
725 Bulletin Bldg.....Philadelphia, Pa.
708 Title Building.....Baltimore, Md.
585 Mission Street.....San Francisco, Cal.
419 Ohio Building.....Toledo, Ohio
309 Plymouth Bldg.....New Haven, Conn.
Whitney Central Bldg.....New Orleans, La.

FORMICA

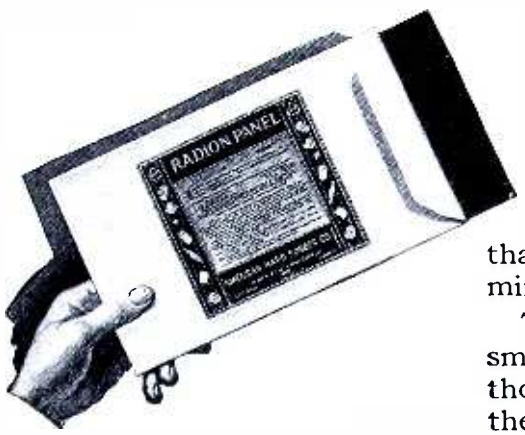
Made from Anhydrous Bakelite Resins

SHEETS TUBES RODS

Hear the Formica Orchestra over WLW every Tuesday evening from 9 to 10 Central Standard Time.

This special insulation made to order for radio

—*now built into a line of low-loss parts*



THE first choice of thousands of successful set builders is Radion Panels —made of *Radion*, the insulating material built to order by our engineers for radio exclusively.

Now we announce new developments in *radio parts* made of this perfect insulation that practically reduces losses in reception to a minimum.

These parts have the wonderful Radion finish, smooth and high-polished. This finish eliminates those losses caused by moisture gathering on the surface of ordinary insulation, causing leakage paths. The high-resistant characteristics found only in Radion Panels also mark these new parts.

You can now get Radion Sockets, Radion Dials, the new Radion Loud Speaker Horn, Radion Tubing, Radion Binding Post Strips, Insulators, etc. And, of course, Radion Panels (made in black and Mahoganite) come cut in standard sizes for whatever set you wish to build.

Ask your dealer to show you these new Radion parts. Practically every radio store carries Radion Panels and will gladly get any of the new Radion Parts if it hasn't them in stock.

The Radion Built-in Horn takes up small space in the cabinet and gives clear, rounded tones.

The new No. 10 4-inch Radion Close-Tuning Dial, built to conform to the fingers. We believe it is the most beautiful dial yet designed.

Send for Booklet, "Building Your Own Set"

MANY set builders have written us that our booklet, "Building Your Own Set," is the most practical and helpful they have seen. It gives wiring diagrams, front and rear views, shows new set with slanting panel, sets with the Radion Built-in Horn, list of parts and direction for building popular circuits. Mailed for 10c. Send the coupon today.

AMERICAN HARD RUBBER COMPANY
Dept. B9 11 Mercer St. New York City

RADION

The Supreme Insulation

Made to Order for Radio Purposes Exclusively

AMERICAN HARD RUBBER COMPANY
Dept. B9 11 Mercer Street New York City

Please send me your booklet, "Building Your Own Set," for which I enclose 10 cents in stamps.

Name, ...

Address .....

.....

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

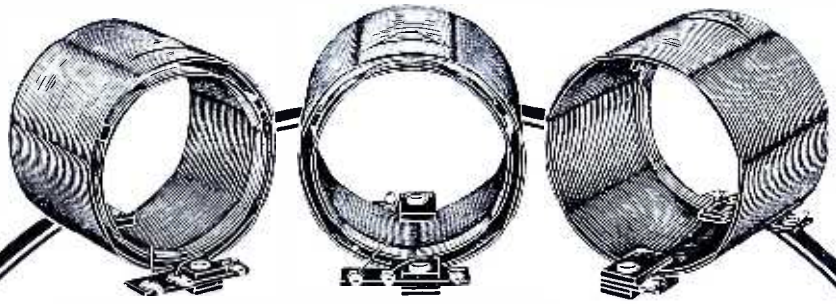
Vital Parts of Leading Radio Sets

Nowhere is the axiom "*an article is no better than the parts it contains*" more true than in the radio world. So it is not surprising that leading manufacturers of radio sets choose the accessories for their hookups only after gaining a full technical knowledge of their make-up and the results they give.

In full consideration of this, the choice of Benjamin Radio Products, above all others, by the manufacturers of many of the finest modern radio sets, bespeaks eloquently of their worth as practical radio parts made by one of the oldest manufacturers of electrical goods.

Each has been made a *super* radio part—to secure for the owner of the set the purest, loudest and clearest radio signals possible. Used together, their total efficiency spells the acme of selectivity, tuning range, the elimination of disturbance and distortion, and the reduction of radio losses. And, the logical total of these many worthy features is "*Better Radio.*"

Benjamin Electric Mfg. Co.



120-128 S. Sangamon St., Chicago
241 W. 17th Street New York
448 Bryant Street San Francisco

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

BENJAMIN
Tuned Radio Frequency Transformers

Low Resistance — Low Distributed Capacity

Wires are space wound, adjacent coils are parallel, air insulated and so separated that while capacity is reduced to a minimum, inductance is maintained at a high point of efficiency.

Greater Tuning Range — Greater Selectivity

These coils are very uniform, both in inductance and distributed capacity, so that if desired they may be geared for single control of the three tuned stages. A minimum amount of material is used in the field of the coil, and an anti-capacity cement is used only where the wires cross. Coils are coupled so as to reduce capacity coupling to a minimum. Green double silk covering provides high insulation and gives a fine appearance to the coil.

Benjamin Cle-Ra-Tone Sockets

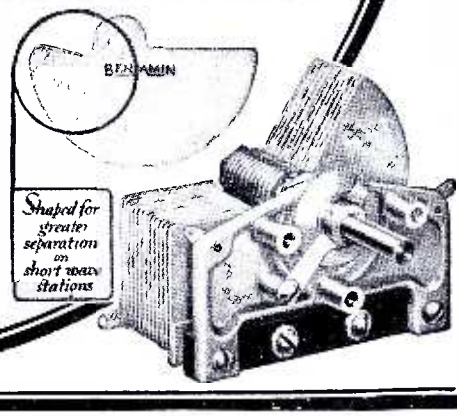
Benjamin Cle-Ra-Tone Sockets prevent the transmission of outside vibrations into microphonic disturbances. Four delicately adjusted double springs support the socket—"float" it above the base—and absorb all jars and shocks. An absolute necessity in portable sets. Used by leading manufacturers and recommended by radio engineers in their most popular hookups. There are no rubber parts to deteriorate. Bakelite is used wherever possible to insure sturdiness, long life and high insulation. Handy lugs make soldering easy. Stiff bus wiring does not affect the flexibility of the Cle-Ra-Tone springs. Furnished also in gangs on Bakelite sub-panels for compact set building, as when mounted on Benjamin brackets there is plenty of space underneath for mounting accessory equipment.

SPRING SUSPENDED SHOCK ABSORBING

Benjamin Low-Loss, Long-Range Condensers

Definite and positive control of minute changes in condenser capacity. By the use of cutaway plates this condenser spreads the broadcast frequencies over the lower end of the dial and in this way eliminates the bunching of stations within a few degrees. This cutaway feature aids in obtaining sharp tuning by making tuning easier. Minimum insulation is used and leakage must go through long paths outside of strongest field. Unpolished silver plate finish. Small size of condenser makes it adaptable to any set, regardless of crowding of apparatus on sub-panel. Friction disc on rotor shaft adjusts tuning tension without throwing rotor plates out of alignment. Drilling template furnished with each condenser. Made in three sizes:

13 plate for .00025 Mfd.
17 plate for .00035 Mfd.
25 plate for .0005 Mfd.



BLUEPRINTS FREE!

The Improved Cockaday DX Regenerative Receiver.

Portable Town and Country Receiver.

5-Tube AC Receiver.

5-Tube Tuned Radio-Frequency Receiver with Simplified Control.

The POPULAR RADIO (with which is combined *The Wireless Age*) TECHNICAL LABORATORY has prepared complete sets of Blueprints for the four Receivers named above. Each set consists of three Blueprints as follows:

A—Panel Pattern (actual size),
B—Instrument Layout (actual size),
C—Picture Diagram (all parts actual size) showing all wire connections.

The Improved Cockaday DX Regenerative Receiver (Set No. 8), 4-tubes, distortionless, automatic filament cuts down tuning controls and at the same time embodies features that eliminate the trouble experienced with this type of Receiver. This is one of the most reasonable sets to build.

The Portable Town and Country Receiver (Set No. 9), 6-tubes, three stages of transformer-coupled, radio-frequency amplification, with loop antenna, is a single control set for all-around home use, besides embracing a portable feature that makes it an unburdensome companion for the camp, cruise or motor tour.

The 5-Tube AC Receiver (Set No. 10) with 5 "McCullough" AC Tubes, two stages of tuned radio-frequency amplification, operates directly from a special step-down transformer, which can be plugged into an AC lighting socket. There is absolutely no hum produced and no "A" battery is used. The Receiver contains only three dials and can be logged.

The 5-Tube Radio-Frequency (Set No. 11) is a set particularly recommended because it will not radiate even though it uses regeneration. Operation has been simplified by using a minimum of panel controls. A special type of amplification has been used to give distortionless reproduction.

Any one of these sets of Blueprints will be mailed promptly, absolutely free of charge, if you will send us one annual subscription for POPULAR RADIO, with which is combined *The Wireless Age*, accompanied by a remittance of $3, the regular subscription price. The subscription may be new or renewal—and for a limited time will include FREE any set of Blueprints described on page 86. Only one set of Blueprints will be allowed with your own subscription.

Two sets of Blueprints for 2 annual subscriptions with remittance of $6; three sets of Blueprints for 3 annual subscriptions and remittance of $9; all four for 4 annual subscriptions and remittance of $12.

You know how helpful, interesting and practical POPULAR RADIO is. You fully appreciate that at $3 a year it is a real bargain. Consequently you should find it easy to convince one, two or three friends of the unusual value offered when any one of these four sets of Blueprints is included free with their twelve month order at the regular price of the magazine alone. So get busy today and see if you can't mail the coupon for your Blueprints tomorrow.

POPULAR RADIO
627 West 43d Street - - New York City

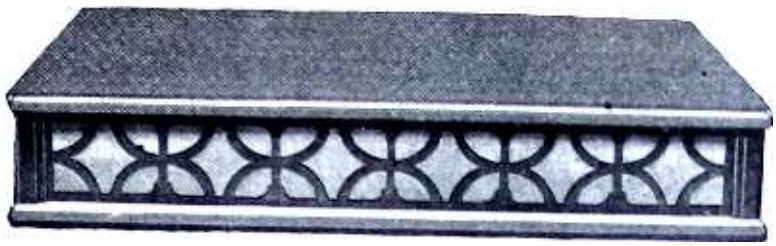
POPULAR RADIO, Dept. 93,
627 West 43d Street, New York City.

Enclosed is my remittance of $..... covering annual subscriptions for POPULAR RADIO with which is combined *The Wireless Age*. Additional names on sheet attached. Kindly send me the following sets of Blueprints:

☒ Set No. 8—The Improved Cockaday DX Regenerative Receiver.
☐ Set No. 9—Portable Town and Country Receiver.
☐ Set No. 10—5-Tube AC Receiver
☐ Set No. 11—5-Tube Tuned Radio-Frequency Receiver with Simplified Control.

Name.....
Address.....
City.....State.....

(No extra charge for Canada. Foreign countries 50 cents, magazine postage extra.)



The New TIMBRETONE

REG U S PAT OFF

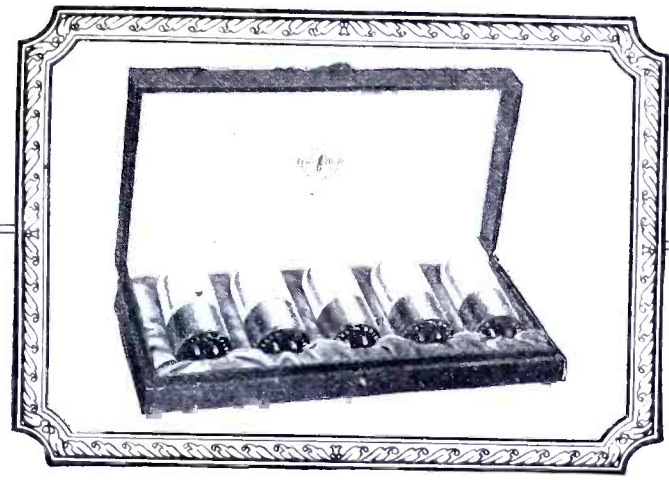
To be both Rich and Beautiful is an accomplishment. The new Timbretone is just that.

Two years ago we inaugurated a speaker made on the principle of the violin with a small horn. We now announce a cabinet type—only 4 inches high, to be placed on top or bottom of your present set and harmonize without obtrusiveness.

It is a welcome innovation for those who have a set and desire the "console" feature without the resultant high cost. It is the "Baby Grand" of Radio.

List price in United States (east of Mississippi river), $30.00. Dealers and jobbers—write for advance information.

Made in Hoosick Falls, N. Y.
by the TIMBRETONE MFG. CO.



EFFICIENCY
On Long or Short Waves

For 2 to 60 meter receivers, such as are being built at the Brightson Laboratories to communicate with WNP, the McMillan expedition, the tubes must be dependable. They must be well matched, noiseless, and have a high amplification constant. Ordinary uniform tubes cannot be expected to work efficiently on such short wave-lengths.

Brightson True Blue Tubes have been developed with characteristics making them more efficient on low wave-lengths than any other tube available to the amateur. Constant short-wave experimentation in the Brightson Laboratories has shown the possibility of making a tube, which, while more efficient than ordinary tubes on broadcast wave-lengths, is also more efficient on extremely low wave-lengths. A mutual conductance value, efficient on very low wave-lengths, will not function properly on high-powered low frequency work. Brightson True Blue Radio Tubes have that happy medium which fits a tube for both types of reception.

10 Day Return Privilege

Unless True Blue Tubes prove interchangeably uniform, noiseless, crystal clear in tone and the handsomest, finest quality tubes you have ever used, you can return them in ten days for refund.

60 Day Guarantee

Whether you buy one True Blue Tube or a set of three, five, six or eight in a safety case, each individual tube is covered by its own Brightson guarantee. If within 60 days a mechanical defect prevents any True Blue Tube from operating perfectly, you can return it for replacement.

If your dealer does not stock True Blue Tubes write us direct. Prices, 6 volt type "Power Plus" for small sockets; "Standard" for large sockets, each . . . **$3.50**

BRIGHTSON LABORATORIES, Inc.

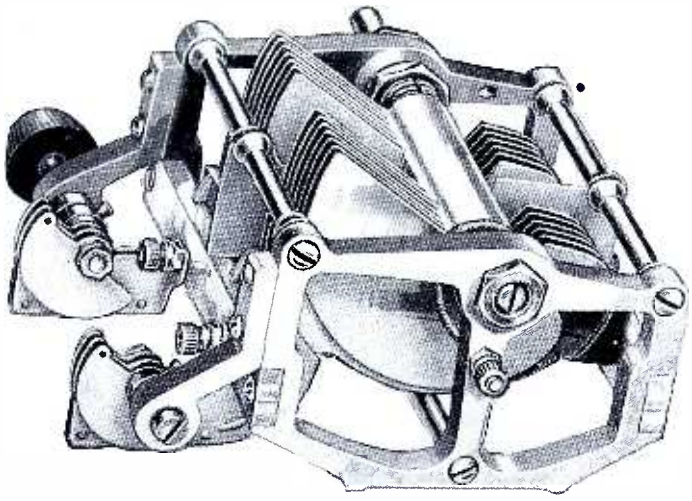
Waldorf-Astoria Hotel **16 W. 34th Street, New York City**

Philadelphia Office, 50 N. Eleventh St., Philadelphia, Pa.

BRIGHTSON LABORATORIES, INC.
True Blue
RADIO TUBE

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

B-T Tandem Condensers



B-T Tandem Condensers provide the essential elements of balance required to make this type of unit a success. Design and craftsmanship show the usual conclusive evidence of B-T's sense of obligation to the purchaser.

LD-13 (.00025 M. F.) $9.00
LD-17 (.00035 M. F.) $9.50

The B-T "Counterphase" Circuit

The new B-T "Counterphase" circuit (covered by U. S. Patents) employs the "Torostyle" Transformer. The combined results exceed anything we have ever done before. (Described in "Better Tuning.")

B-T Resistances

The highest grade Non-Inductive Variable High Resistances, Potentiometers and Modulators are now, under license, in the B-T line.

Stepless—Noiseless—Stable.

All sizes $2.00.

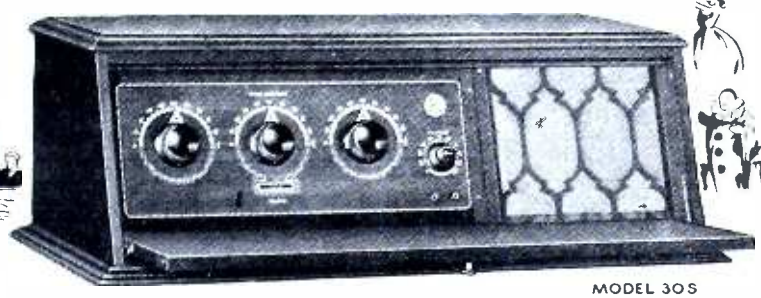
Straight Line Frequency vs. Wave Length

Three articles so far noted on Straight Line Frequency Condensers in national magazines, omit or evade the most important considerations. We build both kinds and tell both sides. "Better Tuning" 8th edition tells the whole story. Issued bi-monthly. Copy 10c. Per year 50c.

Bremer-Tully Mfg. Co.

532 South Canal St. Chicago, Ill.

KING IN RADIO



MODEL 30S

THE King Five Broadcast Receiver gives you all the joys of Radio—music, adventure, sport, education—every note of music in its full natural tone, each spoken word clear and distinct. You get it easily and surely, nothing is left to chance.

The King Five Broadcast Receiver gives you the one station you are seeking and no other—its selectivity is remarkable.

The circuit employed has the approval of eminent engineers as well as the endorsement of public demand. It can be operated by anyone regardless of age or knowledge of radio. When a station is once received at a certain dial setting, it can always be brought in at the same point on the dial.

No need for repairs or adjustments on the King Five Broadcast Receiver. It is built for dependable reception.

Beauty is combined with excellence of reception. The cabinets are attractive in design, artistic in every line. The wood is carefully selected—the quality of workmanship unsurpassed.

The King Five Broadcast Receiver meets every taste with three beautiful models—

Plain Table Type.
Built-in Reproducer.
Magnificent Console.

Offered in Mahogany and Walnut.

Fifteen years of specialized work in Radio, plus twenty years experience in the manufacture of quality precision products is behind our guarantee that the King Five Broadcast Receiver will give you the very best of radio reception—"King in Radio."

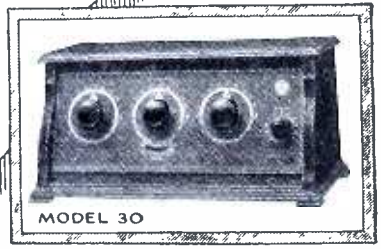
Let us send you the booklet, "King in Radio"

KING QUALITY PRODUCTS, Inc.
BUFFALO, N. Y.
BRANCHES—CHICAGO—KANSAS CITY—BRIDGEBURG, ONT.

JOBBERS AND DEALERS

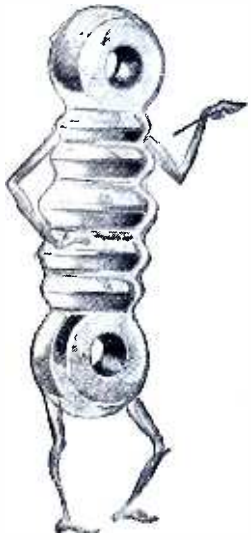
The "King In Radio" sales franchise is a valuable asset. The line is complete. The name has always stood for quality. Write for full particulars.

MODEL 30C



MODEL 30

PYREX INSULATION



WHEN you overhaul your antenna for the approaching season of real reception, consider the small cost of replacing your present insulators with PYREX Broadcast Insulators and forever forgetting insulator troubles and energy losses.

A Pair of PYREX Insulators (45c each) is a Low Premium for Insuring Reception

PYREX Insulation is used on the antennae of the "Bowdoin", "Peary", and the planes of the Navy-MacMillan Arctic Expedition. PYREX is used on the ice patrol cutters of the Coast Guard Service. PYREX is used by the Navy, Lighthouse Service, Air Mail and Signal Corps. PYREX is used by many of the class "B" Broadcasting Stations.

PYREX is used by people who demand results.

When You Buy PYREX Insulators,
Look for the Trade-mark PYREX

All Good Dealers Sell PYREX

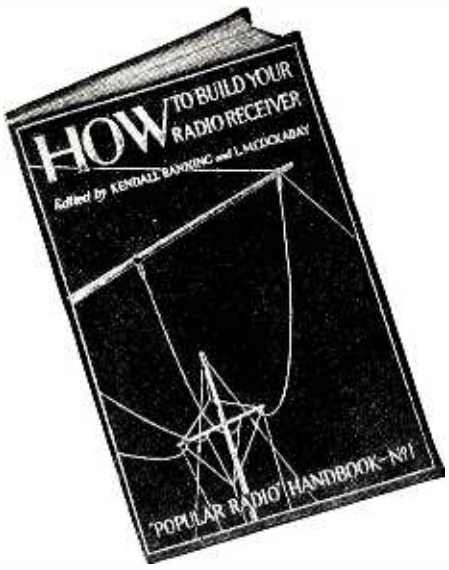
CORNING GLASS WORKS

INDUSTRIAL DIVISION

CORNING NEW YORK

World's Largest Makers of Technical Glassware

Instruction Book
and
Radio Manual
FREE
with
Popular Radio
with which is combined *The Wireless Age*



Build Your Own

Aside from the feature of economy, there is the thrill and satisfaction that comes from building your own receiving set. Instead of being a mere "dial-twister" you will necessarily have a very definite basic knowledge of what radio is all about after constructing a set.

Thousands of sets have never been constructed because of the atmosphere of mystery that has enveloped the whole subject of radio. Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO, through their close contact with the great radio public sensed this and compiled a book that will convince the veriest beginner that technical training is not essential. If you have a little time to devote to a most fascinating pastime, send for a copy of "How to Build Your Radio Receiver" and discover how simple and easy set building really is. This famous book has made it so.

Free Advisory Service

POPULAR RADIO is full of helpful suggestions as well as instructive and entertaining articles on radio and allied scientific phenomena. This information is supplemented by an advisory service that is free to all subscribers. Any problem you encounter that is not answered in the book or magazine will be answered by personal letter if you will submit it to the Technical Service Bureau. For this purpose a big modern, laboratory with a trained staff of investigators under Mr. Cockaday's personal direction is always at your service.

A Valuable Combination

For the next thirty days we will give you a copy of "How to Build Your Radio Receiver," FREE and enroll you for all privileges of the Technical Service Bureau at no further expense, on receipt of your remittance of $3.00 in payment for a 12 months' subscription for POPULAR RADIO. (As an alternative offer, if you wish the combination with POPULAR RADIO for 7 months only—send but $2.00). In any event, you run absolutely no risk as we will refund in full if you are not more than satisfied with your purchase.

POPULAR RADIO Dept. 95,
627 West 43d Street,
New York City.

Offer expires Sept. 20, 1925

Enclosed remittance of $3.00 is payment in full for a 12 months' subscription for POPULAR RADIO and copy of "How to Build Your Radio Receiver" FREE.

Name.....

Address.....

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

☐ Check here and remit $2.00 if you prefer POPULAR RADIO for 7 months only in combination with "How to Build Your Radio Receiver."

In "How to Build Your Radio Receiver" you will find complete constructional diagrams, specifications, photographs and instructions for building the following sets. Each has been selected as representative of its circuit because in laboratory tests it proved the best for distance, selectivity, tone volume, simplicity of construction, ease in tuning, reliability and all-around satisfaction.

A $5 CRYSTAL SET

The simplest up-to-date set for local broadcast reception. Approximate range, 15 miles, though distances up to 400 miles are not extraordinary. Gives clear signals on headset without distortion. No operating cost whatever.

THE HAYNES SINGLE TUBE RECEIVER

An efficient set that may be made by a novice at an approximate cost of only $15 for parts. Simple to tune, selective, good audibility. Long distance range up to 1,000 miles on earphones. Six-volt storage battery and 22½-volt "B" battery required, or may be adapted for dry cells and dry cell tubes.

A TWO-STAGE AUDIO-FREQUENCY AMPLIFIER

This instrument may be added to any set, crystal or tube, to strengthen the received signals, so that they will operate a loudspeaker. It is easy to construct, efficient and inexpensive, costing only $15 for parts. Operates on the same "A" battery that is used on the vacuum-tube detector unit.

THE COCKADAY 4-CIRCUIT TUNER

A 3-tube set, famous for its high selectivity and beautiful tone. So neat and compact that it may be kept in a bureau drawer. Cost of parts about $40. Receiving range approximately 1,500 miles on a loud-speaker. Operates on a 6-volt storage battery and two 45-volt "B" batteries, or may be adapted to dry cells and dry cell tubes.

A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER

Two stages of tuned radio-frequency amplification, detector, and two stages of audio-frequency amplification are here employed so that the possibility of "oscillation and re-radiation" is eliminated. The set can be operated on a loop antenna and may be built at a cost of only $90 for parts. Six-volt storage battery and two 45-volt "B" batteries required. Range about 1,000 miles on loop or indoor antenna and 2,500 to 3,000 miles on an outdoor antenna.

THE "IMPROVED" COCKADAY 4-CIRCUIT TUNER

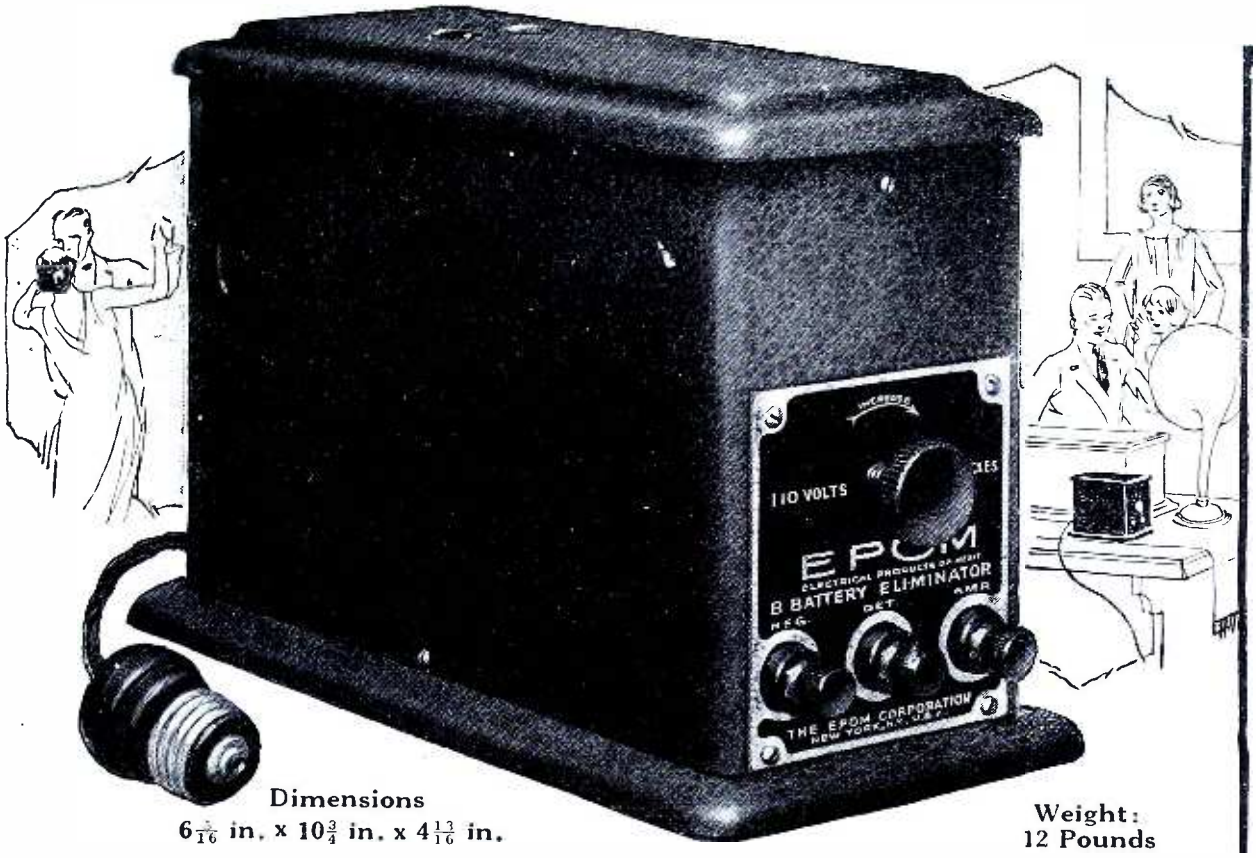
Probably the most important contribution yet made to the equipment of the radio fan. A compact 5-tube set with a receiving range of over 3,000 miles. Cost of parts about $95. Wave length range from 150 to 675 meters. Automatic tuning and power amplification. Maximum volume of sound, excellent reproduction and no interference. Requires a 6-volt "A" battery, three 45-volt "B" batteries, one 22½-volt "B" battery and a 9-volt "C" battery.

THE REGENERATIVE SUPER-HETERODYNE RECEIVER

More sensitive, more selective and more simple to tune than any other 6-tube receiver yet developed. A three-section 6-tube set employing the Haynes Single Tube Receiver as tuner. May be further extended to a four-section, 8-tube set by the addition of the two-stage audio-frequency amplifier. The cost of parts approximates $100. Range of 3,000 to 4,000 miles on a loudspeaker. Has been called the "Rolls-Royce" of radio receivers.

POPULAR RADIO
627 West 43d Street, New York City

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Dimensions
$6\frac{7}{16}$ in. x $10\frac{3}{4}$ in. x $4\frac{13}{16}$ in.

Weight:
12 Pounds

Unfailing "B" Power

Direct from your lighting socket

EPOM

ELECTRICAL PRODUCTS OF MERIT

"B" Battery Eliminator

Write to your nearest distributor or direct for details. These distributors have approved the Epom "B" Battery Eliminator

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INDIANAPOLIS, Indianapolis Elec. Supply Co.
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KANSAS CITY, B-R Electric Co.
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ANYONE CAN BUILD A SET WITH *SIMPLIFIED BLUEPRINTS*

LAURENCE M. COCKADAY has personally supervised the preparation of *Simplified Blueprints* of seven of POPULAR RADIO'S most popular circuits. Each set consists of three separate *Actual Size* Blueprints; first a Panel Pattern; second, an Instrument Layout; and third, a Picture Wiring Diagram all simplified in the fullest sense of the word ***because***

The Panel Pattern can be laid on the panel and all holes drilled as indicated. No scaling to do and so accurate there is no danger of ruining the panel through faulty calculation.

The Instrument Layout placed on the sub-base permits you to indicate by pinpricks the exact location of every screw.

The Picture Wiring Diagram gives every instrument in exact size and position with every wire clearly indicated from one contact to the other. With no knowledge of radio symbols you can assemble every part and complete your wiring with no chance of error.

Priced at $1.10 per Set of Three Prints

Set No. 4—"*Cockaday Four-Circuit Tuner with Resistance-Coupled Amplifier*" (five tubes, distortionless, two dials, automatic vacuum tube control, as described in the October 1924 issue of POPULAR RADIO).

Set No. 6—"*The Cockaday 8-tube Super-heterodyne Reflex Receiver*" (eight tubes, two tuning dials, loop, non-radiating, distortionless, as described in January 1925 issue of POPULAR RADIO).

Set No. 7—"*The Craig 4-Tube Reflex Receiver with the New Sodion Detector*" (four tubes, two tuning dials, short antenna, non-radiating as described in February 1925 issue of POPULAR RADIO).

Set No. 8—"*The Improved Cockaday DX Regenerative Receiver*" (four tubes, one tuning dial, one regeneration dial, short or long indoor or outdoor antenna, resistance coupled amplification as described in March 1925 issue of POPULAR RADIO.)

Set No. 9 — "*Portable Town and Country Receiver*" (six tubes, three stages of transformer, coupled, radio-frequency amplification, loop antenna, tuned by variable condenser as described in May 1925 issue of POPULAR RADIO.)

Set No. 10—"*5-Tube A-C Receiver*" (five "McCullough" A-C tubes, two stages of tuned radio frequency amplification, as described in June 1925 issue of POPULAR RADIO).

Set No. 11—"*5-Tube Tuned Radio-Frequency Receiver with Simplified Control*" (as described in August 1925 issue of POPULAR RADIO).

Full constructional and parts details for these Receiving Sets will be found in the issue of POPULAR RADIO indicated. Back issues of POPULAR RADIO will be furnished at the rate of 35c a copy

Popular Radio

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POPULAR RADIO, Inc., Dept. 94
627 West 43d St., New York City Date.....

Enclosed is my remittance of $..... for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

☐ **Set Number 4** ☐ **Set Number 8**
☐ **Set Number 6** ☐ **Set Number 9**
☐ **Set Number 7** ☐ **Set Number 10**
☐ **Set No. 11**

Name.....
Address.....
City..... State.....

DEALERS

Write for terms on these fast selling Blueprints. An attractive Display Chart free with orders.

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Prest-O-Lite

There are many improvements in the new Prest-O-Lite Battery

In this new battery you'll find all the good points and high quality that have made Prest-O-Lite an unfailing aid to better radio. And in addition there are many important refinements and improvements that make it the most attractive, most convenient battery you can buy.

This new battery has a beautiful stippled finish hard rubber case that blends with any furnishings. The case is molded in one piece, giving sturdy, leak-proof strength.

To make the battery convenient to carry, the handle has been given a comfortable rubber grip.

The oversize terminal nuts on the binding posts are easy to turn and insure perfect contacts.

Novel rubber insulators completely cover the tops and sides of the cell connectors, preserving the original fine finished appearance at all times and giving protection against accidental short circuits.

No effort has been spared to make this a battery you will be proud to own. Yet, like the rest of the Prest-O-Lite line, it is priced to offer you the biggest value of the day. Ask your dealer to show you this battery and the Prest-O-Lite Chart that helps you select the right battery for your set. Or write Indianapolis for a copy of our interesting handbook on radio storage batteries and how to charge them.

THE PREST-O-LITE CO., INC.
INDIANAPOLIS, IND.
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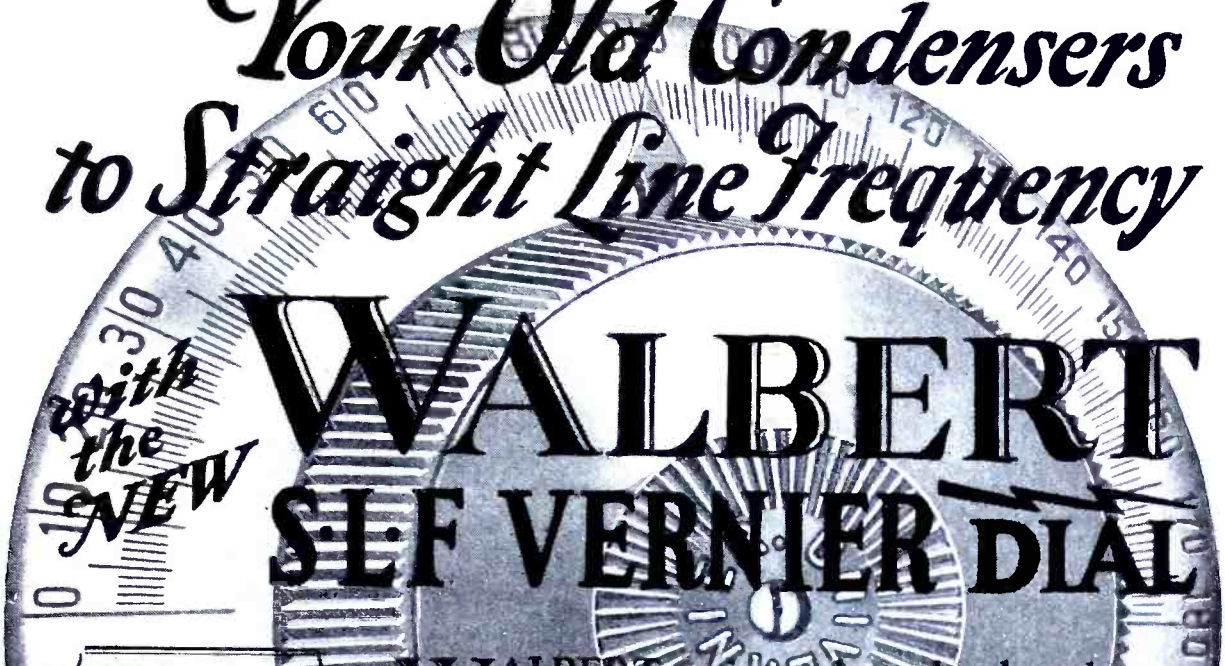
Convert Your Old Condensers to Straight Line Frequency

WALBERT made it first

with the NEW

WALBERT SLF VERNIER DIAL



Construction Data

1. Easily installed
2. Concentric mounting
3. Takes standard shaft-projection
4. No friction mounting (no slippage)
5. Heavy gears (smooth action)
6. All-bakelite knob
7. Nickeled-silver dial (not plated)
8. Precision graduations
9. Hairline pointer

WALBERT engineers have developed a *new* VERNIER DIAL that imparts *Straight-Line-Frequency* characteristics to any semi-circular plate condenser.

No more crowding of stations at low-wave lengths. The SLF VERNIER DIAL separates stations at low wave-lengths just as easily as at high wave-lengths.

The strong, positive and ingenious mechanism contained in the knob gives small increases in capacity at low wave-lengths and progressively greater increases at higher wave lengths while knob and pointer revolve at uniform speeds.

A standard 12-to-1 VERNIER DIAL giving SLF characteristics to any ordinary condenser. Write for prices.

JOBBERS AND DEALERS: *Deliveries September 10th. Orders filled in rotation as received. Catalog copy and cuts ready August 15th*

WALBERT MANUFACTURING COMPANY
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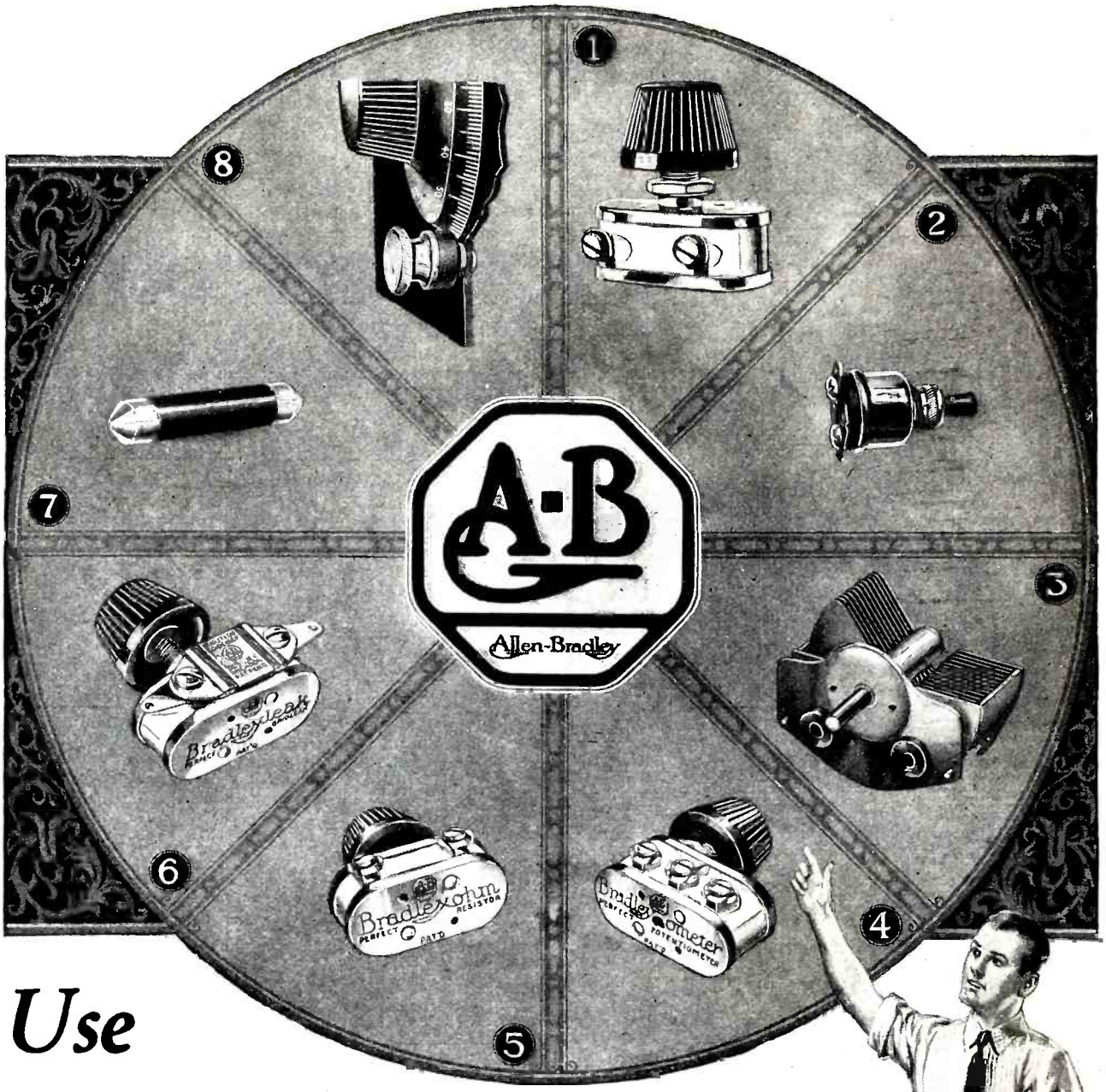

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Allen-Bradley Perfect Radio Devices
for maximum selectivity and noiseless control

1—Bradleystat—Noiseless Rheostat for ALL radio tubes.

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3—Bradleydenser—Low Loss Condenser for sharp tuning.

4—Bradleyometer—Perfect Potentiometer for all circuits.

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6—Bradleyleak—Adjustable Grid Leak for highest efficiency.

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Please send me your latest literature on the complete Allen-Bradley line of Radio Devices.

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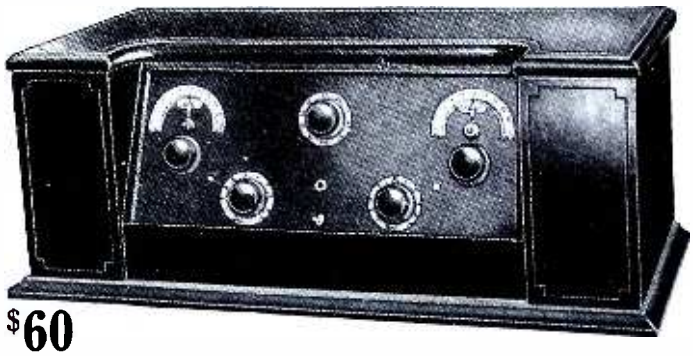
Crosley Radio ideas—1926

With these improvements Powel Crosley Jr., makes his greatest stride forward in the development of radio for the millions.

Super-Trirdyn Special with matched console table and Musicone De Luxe $112.50. Table separate $25.00.

The Super-Trirdyn Special



$60

The famous Crosley Trirdyn circuit—3 tubes doing the work of 5—greatly improved—mechanical refinements—finer and richer designs and finishes. New Crosley designed low loss Vernier condenser—new worm rotary type tickler control. Wiring concealed under sub-panel. In this model all dry batteries are contained in the cabinet. Price quoted is without accessories.

$50

The Super-Trirdyn Regular

Crosley Trirdyns have been the marvel of the radio world. Tuned radio frequency combined with Armstrong regeneration and reflex amplification do in 3 tubes what 5 do in other sets. No radiation. This model is a simple, richly finished cabinet of solid mahogany. Price is without accessories.

Add 10% to Prices West of Rocky Mountains

The Crosley "Pup"

A genuine Armstrong regenerative double circuit receiver for $9.75. A refinement of the one tube set with which Leonard Weeks, of Minot, N. D., heard the MacMillan polar expedition while the rest of the world listened in vain. One dry battery—one B battery, tube, phones and antenna only accessories needed. Price without accessories . . **$9.75**

New 2 Tube 51

Improved popular Crosley 2 tube No 51 Special De Luxe. Double circuit New Crosley Vernier condensers; worm rotary type tickler; cabinet will hold necessary dry batteries. Price without accessories . . **$23.50**

New 3 Tube 52

Another popular Crosley model—the 3 tube 52 Special De Luxe. Redesigned with new Crosley Vernier condensers, rotary type tickler and beautifully finished cabinet. Price without accessories . . . **$32.50**

The Musicones

The first loud speaker to reproduce the *full* tonal range of voice or instrument without distortion. Superior to all others regardless of cost. Investigation will prove this. Rapidly replacing other types of speakers. 500,000 in use by Jan. 1st. Crosley developed unit secret of its remarkable success. $17.50. De Luxe model, mahogany cabinet . . . **$27.50**

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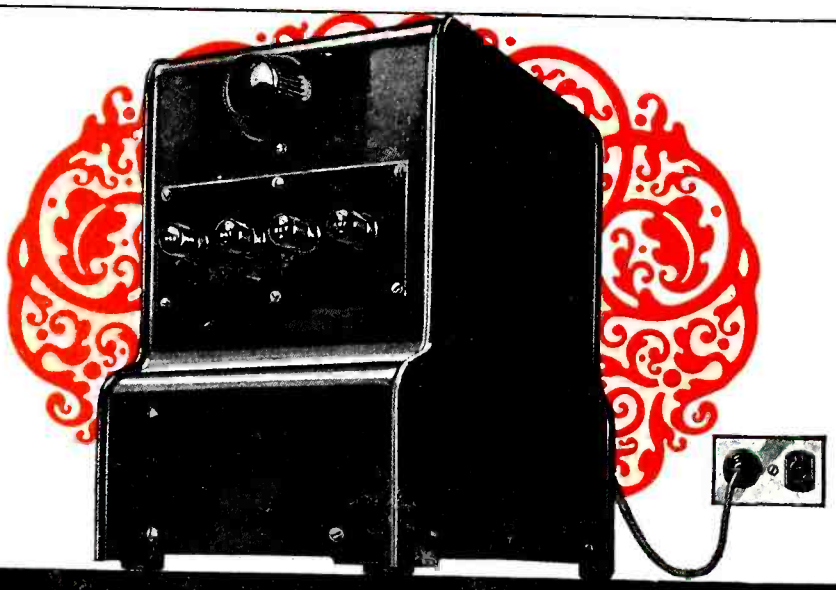

Super-Ducon

now has the *new* RCA Tube—*specially designed*

Right in your electric light wires lies all the current you need to keep your radio set at the peak of efficiency.

A Super-Ducon, which now has the advantage of a specially designed RCA tube, Rectron UV-196, delivers a steady current of just the right voltage—always constant—always silent.

It takes the place of "B" batteries. Less trouble—lower upkeep—and better radio reception always—with a Dubilier Super-Ducon. Just plug it in on the house current.

Tested and listed by the National Board of Fire Underwriters.

Write for descriptive bulletin, 238th St. and Bronx Boulevard.

Dubilier

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