

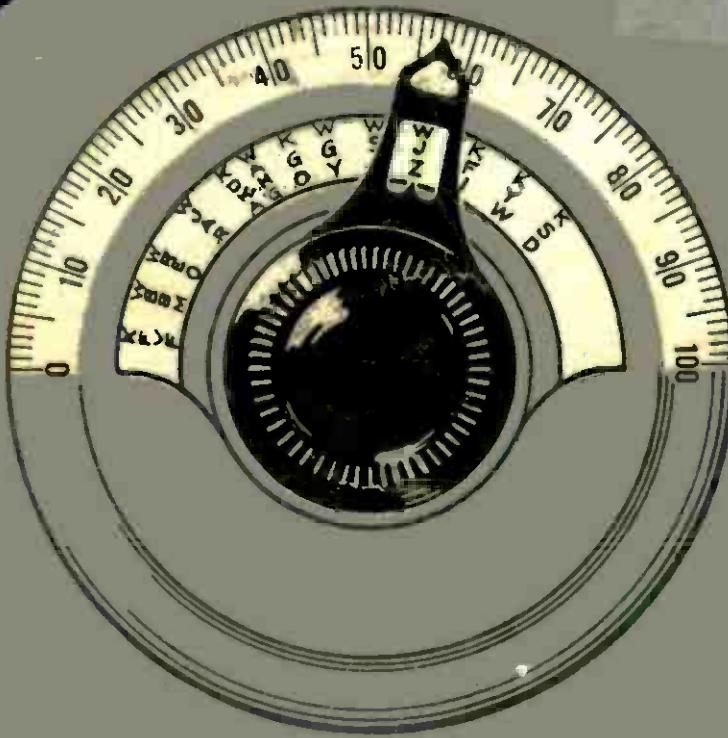
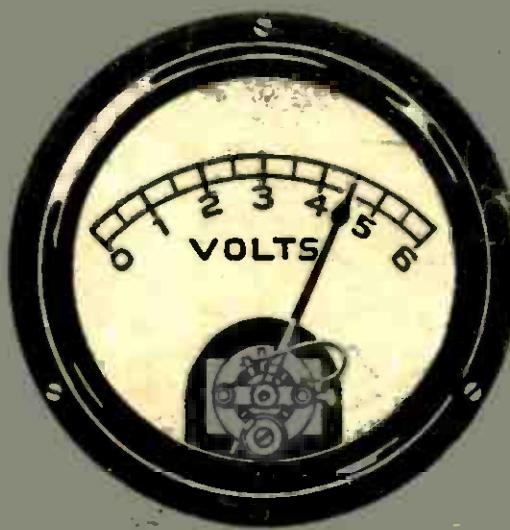
Popular Radio

with which is combined The Wireless Age

Edited by KENDALL BANNING

★ OCTOBER • 1925

25¢



How to Build the New SINGLE CONTROL Superheterodyne Receiver

CHOSEN by VICTOR and BRUNSWICK



Radiola

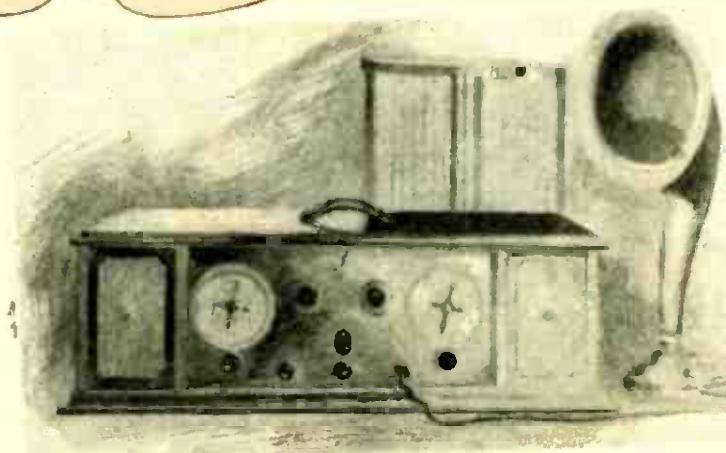
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Radiola
Super-Heterodyne,
the most famous of
Radiolas. With the
new power Radiotron
as its sixth tube, it
achieves new volume
of tone and finer tone
quality than ever.

TWO great manufacturers—working independently and competitively—set out to find the radio receiver worthy to be combined with phonographs that have a worldwide fame to uphold.

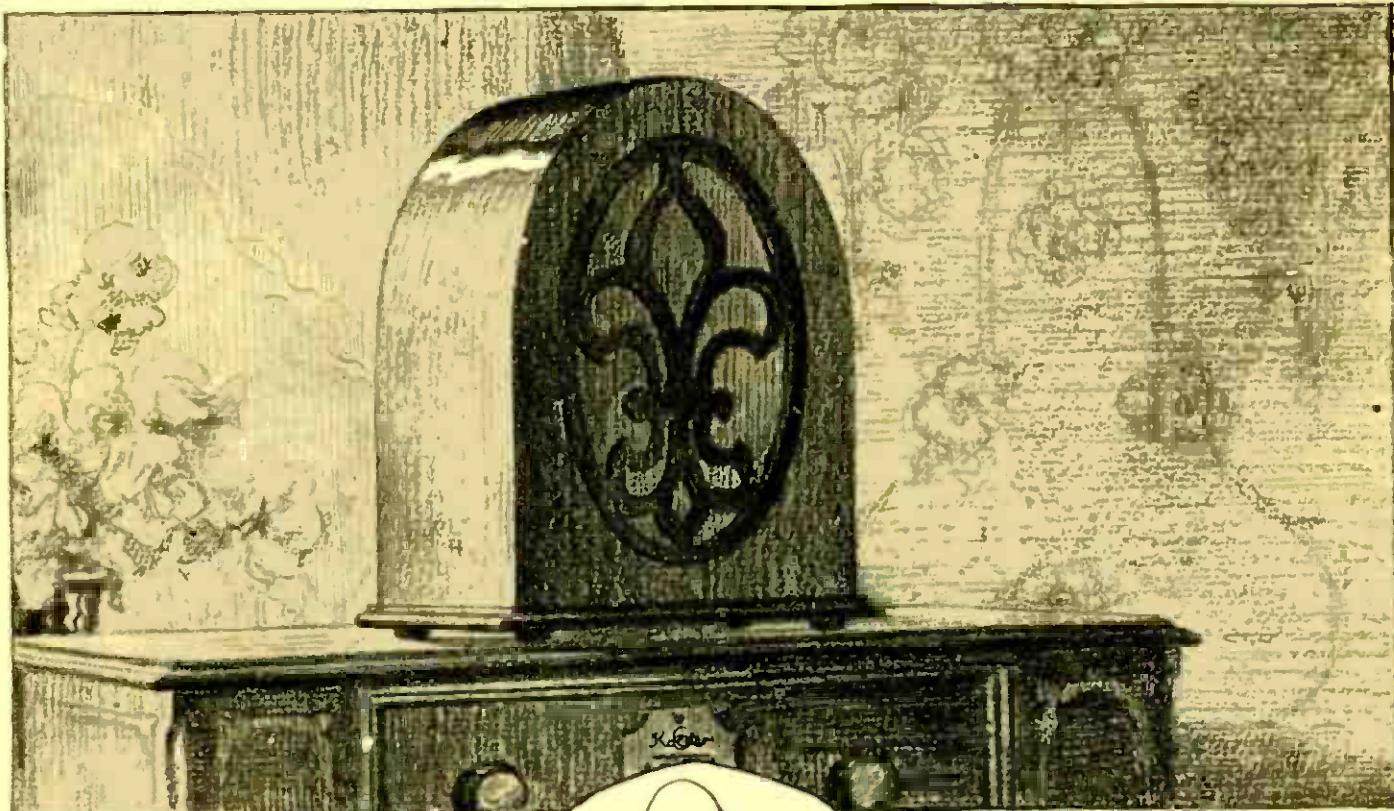
They had every known kind and variety of radio set to choose from. They had every facility for research, test and exhaustive study. And they had a firm determination to combine with the Brunswick phonograph and the Victrola only that radio set which proved to be the leader today and which carried full promise of holding that leadership through the years of tomorrow.

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Radiola.



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The Brandes Cone — a truly decorative bit of furniture that conceals a remarkable speaker.

\$38

Low tones
high tones
—all clear,
round, real



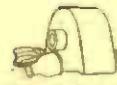
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Brandes
EXPERTS IN RADIO ACOUSTICS SINCE 1908

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POPULAR RADIO

WITH WHICH IS COMBINED "THE WIRELESS AGE"

EDITED by KENDALL BANNING



FOUNDED 1911

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VOLUME VIII

OCTOBER, 1925

NUMBER 4

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THE Synchrophase, with the new Low-wave Extension Circuits, will receive all present and projected stations. It is really two receivers in one.

This great range is accomplished by means of an *automatic* switch which enables one dial to cover two wave ranges. The first, from 550 meters down to 240, corresponds to the practical tuning range of the usual receiver. The second overlaps this and goes down to 150 meters. Simply move the center dial past the 100 mark for the high range, and beyond the zero mark for the low range.

This low-wave reception opens up over 100 existing stations, broadcasting on less than 240 meters, and not reached by other sets. This will be especially valuable later, when stations generally begin to use lower wave lengths. The Synchrophase is thus equipped for the future.

Ask your dealer to demonstrate this new feature; then compare.

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The Synchrophase is also supplied with base for batteries.

This Company owns and operates stations WAHG and WBOQ; also low-wave rebroadcasting stations, mobile WGMU, and marine WRMU.

*It is written:
"Whoever can see
three days ahead,
will be rich
three thousand
years."
The purchaser of a
Synchrophase now,
will not be rendered
unhappy by coming
changes in broadcast-
ing methods.*

Peter H.A.

PAGES WITH THE EDITOR

IN the next issue of POPULAR RADIO—for November—will appear for the first time an article on a subject of such importance that it may conceivably change the whole status of the radio art so far as broadcast reception in the home is concerned.

UNDER the title of "How to Build the Raytheon Plate-Supply Unit" will be described the construction of a full-wave rectifying and filtering unit. The model, which was developed in the Popular Radio Laboratory, provides for the use of a new tube—a tube that may have a far-reaching effect upon the methods of radio reception. For this remarkable unit utilizes the alternating current as the basis for the plate supply voltage to the receiving tubes.

IN other words, this newly developed unit is a so-called "B" battery eliminator that employs the new Raytheon tube—which is a development of the famous "S" tube.

THIS new unit operates directly from the 110 volt A.C. house-lighting lines. And it offers the first permanent solution of the problem of converting alternating current to non-pulsating direct current for receiving sets.

THE unit has been in the course of development by the Popular Radio Laboratory over a period of several months. But it was not until the unit satisfactorily met the most rigid of tests that it was "released for publication."

No radio experimenter can afford to miss the November number of POPULAR RADIO. If you are not a subscriber, ask your newsdealer to be sure to reserve a copy for you.

"\$500,000,000 will be spent by broadcast listeners in the United States for radio sets this year."

THAT is the estimate made by the Copper and Brass Research Association—which has made a careful study of the radio industry and has come to some significant conclusions. Among them are the following:

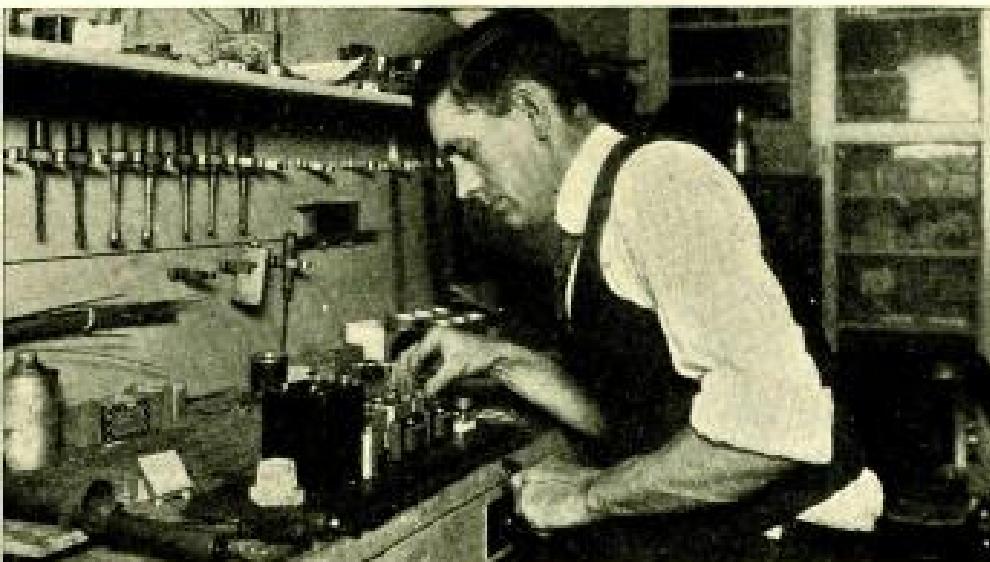
THAT the money being spent for radio sets this year, 1925, is ten times greater than the amount spent for sets in 1922:

THAT by the end of the year 1925 there will be 5,000,000 receiving sets in use:

THAT if the 25,000,000 families in the United States can own 17,000,000 automobiles, at least that number will, in all likelihood, own radio sets:

THAT there are 12,000,000 families in the rural districts of this country, where the radio set is likely to find its highest appreciation, not only because of the entertainment it provides, but because of its essentially practical value in furnishing storm and frost warnings, market quotations and other knowledge useful to the farmer.

(Continued on page 6)



CONSTRUCTING ONE OF THE FINAL MODELS OF THE NEW PLATE-SUPPLY UNIT

The new Raytheon plate-supply unit—which will be described in the November issue—is the result of five years of experimental work on the filament-less tube and one year of experimental research work on the design of the electrical circuit, including the filter for producing a true direct current without hum. This picture was made in the POPULAR RADIO LABORATORY.



Price \$47.50

Perfected with specially designed RCA Tube

The Super-Ducon replaces the "B" battery, operates from the light socket (110 to 115 volts, 50 cycle A. C.) and is absolutely noiseless when properly installed.

Every radio man knows the results he gets when his "B" battery is at its best. The Super-Ducon gives him this top-notch volume *all* the time.

As now furnished, the Super-Ducon has a specially designed R C A tube—Rectron U. V. 196, which has an average life of more than 1,000 hours.

Tested and listed by the National Board of Fire Underwriters

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Dubilier

CONDENSER AND RADIO CORPORATION

PAGES WITH THE EDITOR
(Continued from page 4)

As POPULAR RADIO has at various times pointed out, radio is destined to have a profound effect upon civilization—perhaps more than any other single invention of man.

No user of a receiving set can afford to miss the helpful and informative articles that are contributed to POPULAR RADIO under the collective title of "How to Improve Radio Reception," by the eminent radio expert John V. L. Hogan. The article, starting on page 318 of this issue, deals specifically with the methods of cutting down interference.

In the next article of this series Mr. Hogan will describe the single control applied to the small antenna circuit (such as that shown in Figure 1 on page 000), and will take up the use of these coupled tuned antenna systems for increasing the selectivity of simple regenerative sets and of radio frequency amplifier receivers.

"In the August issue, on page 182," writes Alfred C. Brower, Jr., of South Orange, N. J., "you publish a picture of a radio-equipped ship. . . . It happens that the boat is named after its owner, my uncle: the correct name is not the *Charles Bower*, as you state, but the *Charles Brower*."

YOUR magazine is wonderful. Every number seems to be better than the last.

—CLINT ROBERTSON, Denton, Tex.

WHICH department in POPULAR RADIO do you like best?

THE Editor wants to know—and the best way to find out is to ask the opinions of our readers. Which department should be enlarged? Which one reduced? What new department might be added?

ONE of the departments which is steadily gaining in popularity and value—if the letters received from our readers are any criterion—is "In the World's Laboratories," which gives a monthly review of the progress in the field of radio throughout the world. Here, for example, is a typical commentary from a reader, Mr. H. J. Hinks, of London:

"DURING the last few months I have been reading with interest your magazine POPULAR RADIO. It is with particular satisfaction that I note there exists a radio magazine to suit all classes of readers, and of the character such a magazine should be. It has been my privilege during the last few months to broadcast from the London station of the British Broadcasting Company, a series of lectures on radio, and I assure you that the department *In the World's Laboratories* has proved of great service to me in this work, especially on account of the references given."

"IT is my opinion that POPULAR RADIO is the Radio Magazine," writes Ray C. Poulson of

Detroit, Mich. "All others could be eliminated and still the whole field covered would be covered, and in a comprehensive way. We are beginning to realize what a real contribution to the art and science of radio you are making through your laboratory and your staff; you are to be commended, too, for your editorial policies."

EVER since the publication of "Religion's Raid on Radio" in the January issue of POPULAR RADIO—an article that stirred up a veritable hornet's nest of both praise and abuse—there has been a noticeable effort on the part of the church organizations to belittle the efforts that are being made to use radio for religious propaganda purposes.

"THERE are over 500 broadcasting stations in this country," writes Mr. M. D. Lyons, of St. Stanislaus Seminary, "but only ten of these are controlled by Catholic churches or educational institutions. The explanation of this apparent bashfulness is the fact that the very nature of the principal Catholic service, the Mass, requires the actual presence on the part of the Catholics."

"THE few Catholic stations that are operated for religious purposes, six in number, are intended for the instruction of non-Catholics in matters of Catholic doctrine. . . ."

"THE following is a list of Catholic broadcasters:

Villanova College, Villanova, Pa.
St. Louis University, St. Louis, Mo.
St. Patrick's Cathedral, El Paso, Tex.
Catholic University, Washington, D. C.
Marquette University, Milwaukee, Wis.
St. John's Church, Canton, O. Rev. E. P. Graham.
St. John's University, Collegeville, Minn.
St. Martin's College, Lacey, Wash.
Loyola University, New Orleans, La.
Paulists' Fathers, New York, N. Y.

Possibly the objections that have been raised to the excessive religious matter that is being broadcast in certain sections have made the churches realize that the reaction is unfavorable not only to the radio interests but to the church interests themselves—as the article in POPULAR RADIO pointed out.

POPULAR RADIO believes that there is a proper and legitimate demand for the broadcasting of religious services and talks, just as there is a proper and legitimate demand for jazz, prize fight reports, grand opera and political debates. But in the words of Abe Potash, "too much is plenty."

Kendall Banning—
Editor, POPULAR RADIO

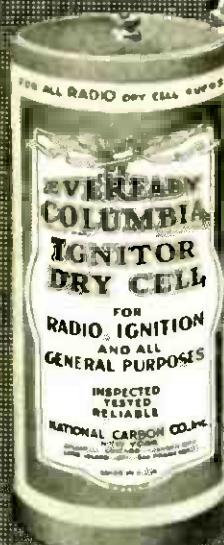
ECONOMY

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EVERY TUESDAY AT 9 P. M.**

Eastern Standard Time

For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—

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WJAR	Providence	WSAI	Cincinnati
WEI	Boston	WWJ	Detroit
WFI	Philadelphia	WCCO	Minneapolis
WGR	Buffalo	WCTS	St. Paul
WOC	Davenport		Worcester



Eveready Columbia Ignitor "A" Battery, the proven dry cell for all radio dry cell tubes 1½ volts



No. 770
45-volt
Extra
Large
Vertical
Price
\$4.75

EVEREADY Radio Batteries

-they last longer

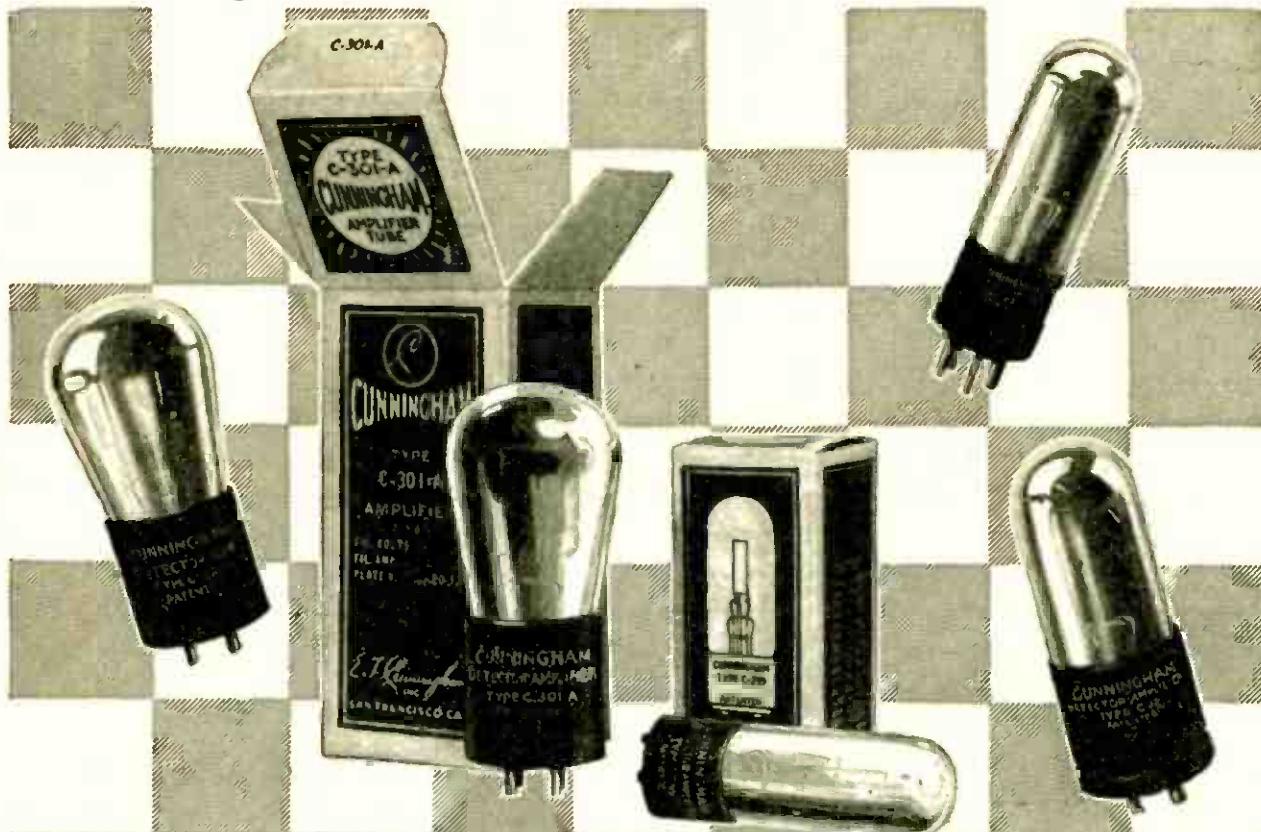
No ONE size or type of battery can be economical on every type of receiving set. That's why Eveready Radio Batteries are made in different sizes and types —so that every radio user can enjoy the economy that is to be had by fitting exactly the right Eveready Battery to his receiver. For owners of sets with five, six, eight or more tubes, and power amplifiers, there is the extra-large, powerful and unusually long-lasting Eveready "B" Battery No. 770. There is an Eveready dealer nearby.

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Canadian National Carbon Co., Limited
Toronto, Ontario

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Since 1915—Standard for All Sets



TYPES, C-301A · C-299 · C-300 · C-II · C-12

IN THE ORANGE AND BLUE CARTON

Whenever perfection is approached in any manufactured product, the qualities of that product soon become known to the great American public. Thus it has been with Cunningham Radio Tubes. From Maine to Keys to Puget Sound, they millions of American homes. tubes are now associated with you may come to know the when every variation of install Cunningham Radio your receiver. Then laughter of clear, swift-flowing water; and the human voice like something not quite human but divine.

Price
\$2.50
Each

California, from the Florida have made themselves known in Throughout the nation these all that is best in radio. That delight, the charm, of radio, tone is flawlessly recreated. Tubes in every socket of music becomes like the

E.J. Cunningham Inc.

Home Office: 182 Second Street
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CHICAGO

NEW YORK

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



POPULAR RADIO Points the Way

"POPULAR RADIO has done more than any other medium to point out to those of us who are vitally interested in both the scientific and the commercial aspects of radio what the future holds; between its covers I have found time and time again the most extraordinarily accurate forecasts of future public interest. POPULAR RADIO makes the work of all of us easier.

John W. Griffin

PRESIDENT, HAYNES-GRIFFIN
RADIO SERVICE, INC.



Underwood & Underwood

How the Western Powers Have Built a Radio Wall Around China

ONE of the chief grievances of China at the present time is that she is not permitted to own or operate a radio station of her own; therefore the outside world can get no news about China, which has not gone through the censorship of the powers that control radio in that country. Even her local broadcasting is done mainly from foreign-owned stations.

Popular Radio

WITH WHICH IS COMBINED "THE WIRELESS AGE"

VOLUME VIII

OCTOBER, 1925

NUMBER 4



Radio and the War Menace

"One of two things is certain: Either radio will become one of the most powerful agencies for peace the world has yet seen—or it will be one of the most potent causes of war in all history."

By BRUCE BLIVEN

A FRIEND of mine, an intellectual person who might fairly be described as a professional highbrow, said to me the other day:

"Why are you interested in radio? It is only a sort of substitute for a phonograph. It will certainly never amount to anything which any serious person need take seriously."

I didn't answer my friend; the day was too hot to argue. But I thought to myself that back in 1450 any of the good citizens of Strassburg might have said to Burgher Fust, who was then all excited about an invention in which he had been investing, an invention of one Johann Gutenberg:

"Why do you bother with this so-called printing press? It is only a clumsy substitute for manuscript. Mark my words, it will never amount to anything."

I

RADIO stands today about where printing stood in 1450, when it was twelve

years old. In my judgment the history of the one is a fair basis from which to predict the history of the other. I need hardly say to my present readers that the changes in human affairs brought about in the past by the printing press are likely to be paralleled in the future as a result of harnessing the ether. Remarkable as has been the improvement in the mechanics of printing since Gutenberg's day, all such progress is as nothing compared to the social development he made possible. Radio, too, regardless of its technical advance, is destined to make a new world. Of its multifarious effects, none will be more important than its bearing for good or for ill upon the relationships among the nations.

Everyone who thinks at all realizes that nowadays the prevention of war has become just about the most pressing problem on earth. In former times such a conflict was a mere incident in the life of the nations involved; today, a struggle between any two important powers requires all their resources of men, ma-

chines and money. Moreover, we know from recent and vivid experience that war between any two great powers is likely to draw in others until nearly the whole world may be involved. We know, furthermore, that such a struggle if prolonged is disastrous to all the participants, financially, economically and even spiritually, whether they win or lose. Plenty of hard-headed, conservative men, who are in a position to know, will tell you that if the European war had gone on much longer it would have meant the complete overthrow of that intangible but precious thing which we are pleased to call "Western civilization."

Twenty or thirty years ago, the effort to prevent war and seek alternative methods for settling international disputes was a matter which interested for the most part only a few elderly and rather fuzzy-minded clergymen and ladies.

Today it is a question of major concern for the whole world, to which the leading statesmen of the chief powers devote their best efforts.

Radio is certain, then, to play a most important role in the future relations among states. I should like to be able to assert, with offhand cocksureness, whether its influence will be for good or evil; but as I shall try to prove in a moment, it is impossible to be dogmatic about it. One of two things is certain:

1. Either it will become one of the most powerful agencies for peace the world has yet seen—

2. Or else it will produce such serious international discord that it may prove one of the most potent causes of war in all history.

II

EVERYONE knows that broadcast reception is already possible on such a scale that it crosses international frontiers. I am not thinking now of the few experiments conducted with special apparatus plus great skill and patience, in which ethereal messages have been sent

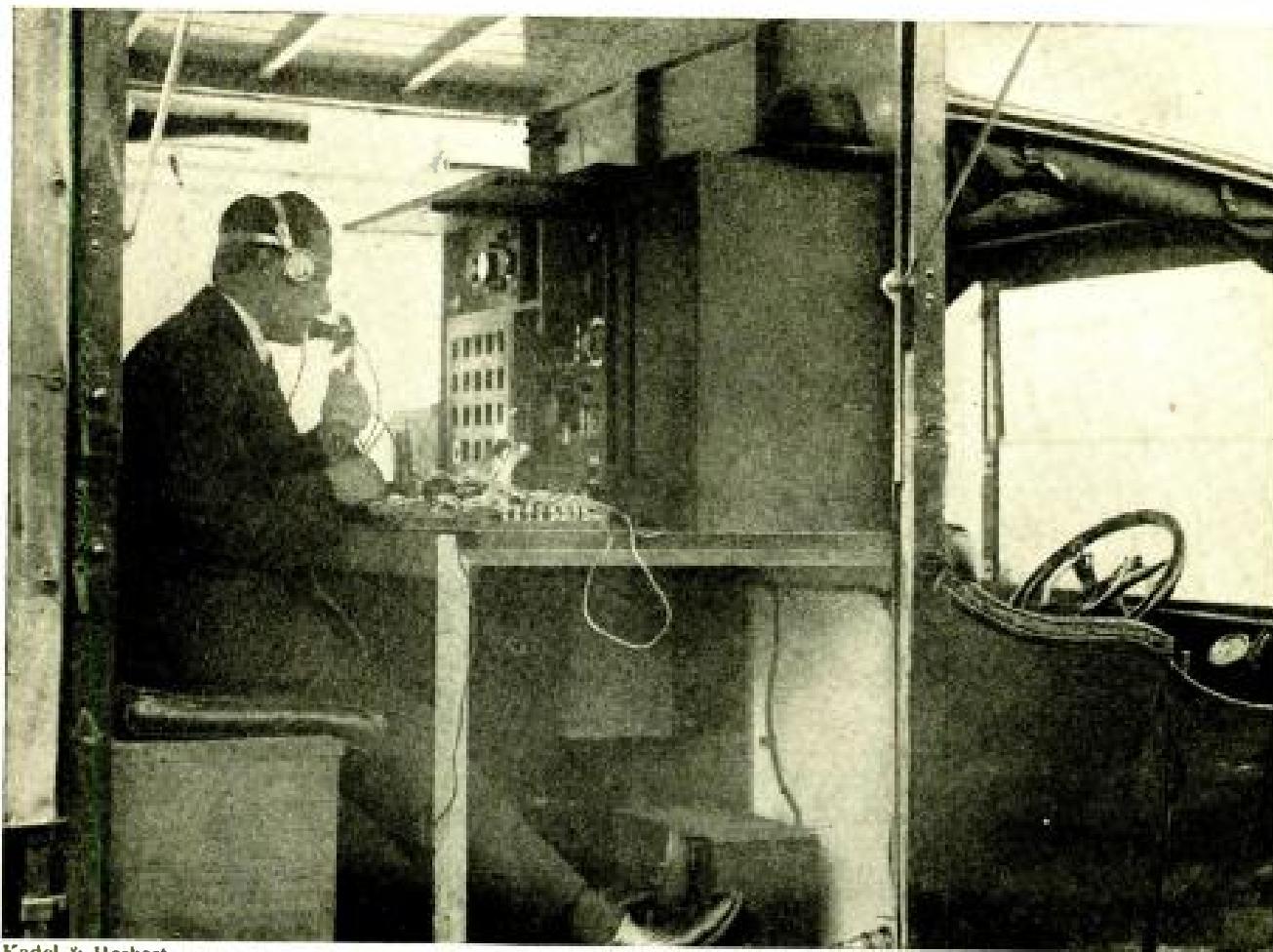
successfully halfway 'round the world, but of ordinary average reception on an ordinary average good receiving set.

If the capital of every important nation were the scene of high-powered broadcasting, already there is hardly a spot in any thickly-populated country today which is so remote that it could not get good reception, under favorable weather conditions, from at least two of these stations.

In Europe, which is one of the chief powder magazines of the world at present, so far as war is concerned, this is even more strikingly true.

Broadcasting from any European country can be received in practically every other. Everything put on the air in France, Italy, Germany, for instance, is heard in at least six or eight countries and by people speaking that many tongues, if not more.

That fact is itself beginning to produce results which are destined to be of great importance so far as international peace and understanding are concerned. Nobody wants to listen to broadcast reception in a language which he doesn't understand. Also, radio unfailingly and everywhere creates "DX hounds;" few are long satisfied merely to get local stations which use the speech of their fathers. Accordingly, although radio broadcasting in Europe is much less advanced than it is in America, there is already a good deal of pressure to have all or most of the broadcasting done in one language. Present indications are that English is likely to be selected for this. Its only possible competitor, of course, is French, which has for centuries been the common language of international diplomacy. However, English is already spoken over a large part of the earth's surface and is, of course, the language of those countries which are furthest advanced in the radio art. Broadcasting from a single station to cover an area of many thousands of square miles is not far off, and is certain to be done in English. As my readers doubtless know, the Radio Corporation



Kadel & Herbert

THE HEAVY ARTILLERY OF THE NEXT WAR?

From batteries of portable transmitting stations like this, that can elude capture, propaganda may be hurled against an enemy for the purpose of breaking down their morale—always a powerful factor in war.

of America and the British Broadcasting Company have arranged to put on the air international programs, one from England for America and one from America for England, several nights a week during the coming winter. Both these programs will be heard by thousands of listeners on the Continent of Europe; and it is possible that a similar "transatlantic" program—in English—will be broadcast from Germany with still larger numbers of European listeners.

The broadcasting stations in the Netherlands have found it necessary to have much of their material in English, since they are forced to compete with the excellent programs from across the channel which Dutch listeners-in can easily pick up. Both in China and Japan, the limited amount of broadcasting which is now being done is largely in English.

This is because in both countries a majority of the receiving sets are owned not by natives but by foreign residents, nearly all of whom speak English.

Radio has also given a great impetus to the movement for an artificial language like Esperanto or Ilo. Esperanto, for instance, has the advantage over English that anybody, no matter what his native tongue, can pick it up in a few weeks' time, whereas English is hard to learn. Partly in response to popular pressure, lessons in Esperanto have recently been broadcast in France, and prizes offered for the best essays written in that tongue by beginning students. All in all, it is safe to say, therefore, that we seem for the first time in history to be justified in hoping that the age-old barrier of speech may at last be broken down and that radio broadcasting will be the means to this end.

III

EVEN more important, of course, than the speech question is the larger one of the spreading of ideas. If radio does even one-tenth of what is expected, it will result in a far wider dissemination of information about various countries and the ideas prevalent in them, than is at present possible. A cynic might very well argue that this process is likely to make more trouble among the nations rather than less. It is the members of a family, who know each other best, who most frequently quarrel—not strangers living at opposite ends of town. While there is a grain of truth in this observation, it is not important enough to outweigh another very useful factor. The most valuable tool the makers of war have is the fear which people in one country have in those of another. That fear is based upon ignorance which does not realize that all people everywhere are very much alike, all actuated by the same motives and subject to the same human desires. Radio can help, in obvious ways, to dissipate this fear and establish in its place intelligent understanding.

There are some definite emergencies in which radio will serve to mobilize assistance from all quarters at almost incredible speed. Suppose for instance that worldwide broadcasting from one microphone were feasible as it probably will be in the not distant future. Suppose a famine in Russia, an earthquake in Japan, a volcanic eruption in the Caribbean made help urgently necessary. Radio could acquaint the whole world with the necessity, at a speed which seems fantastic even to a generation which is already not unaccustomed to rapidity.

Finally, we must not forget the possibilities of radio as a general educational force. The more people know, the more they are inclined to substitute reason and the orderly reign of law for physical force. I hardly need mention the potential usefulness of broadcasting in opening up a new world of ideas to people who,

largely because of the accident of geographical isolation, have hitherto lived parochial and secluded lives.

IV

So much for the bright side of the picture. What about the dangers to international relations which grow out of radio?

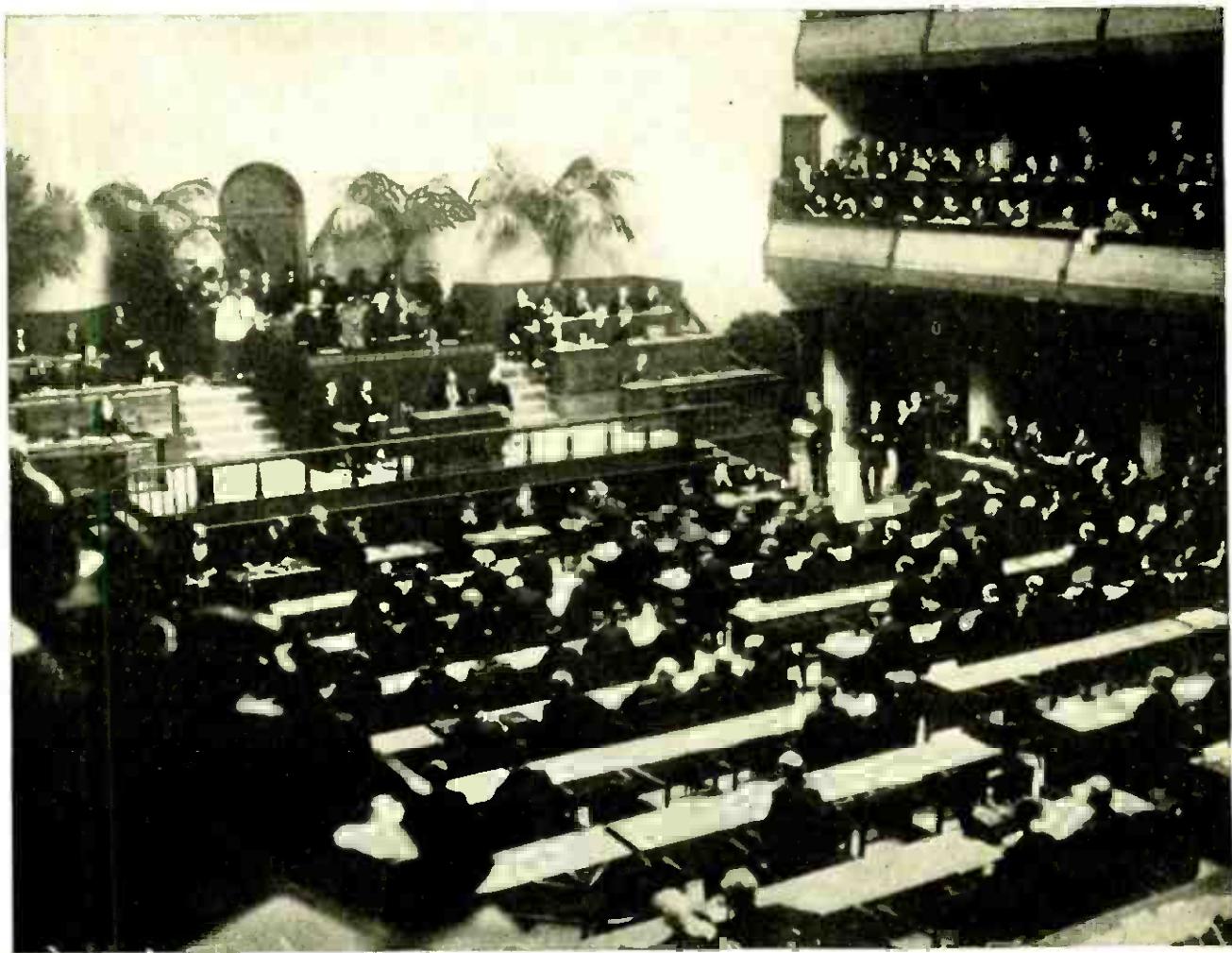
These center about the two distinct aspects, broadcasting and radio telegraphy. For the sake of clearness I shall discuss these separately.

No one can dispute the fact that in radio broadcasting we have the most marvelous instrument for propaganda that the world has ever seen.

Hitherto, the two chief media for getting ideas across to large masses of people have been the printed word and the motion picture. Neither of these in any degree approaches the potential efficiency of radio. They are, compared to it, very slow, extremely expensive and weak and uncertain. Printed matter presupposes a population which both knows how to read and habitually does so. Motion pictures presuppose the existence of theatres and audiences. Even after all this, getting one's "message" into the pages of periodicals, or onto the motion picture screen is so difficult that in many cases it is impossible.

For the propagandist seeking to put his ideas across radio is, technically at least, almost a perfect medium. Where newspapers and motion pictures reach at most a few hundred thousand at a time, radio already has an audience of many millions in the United States, as it soon will in every other country. Radio is instantaneous. While the listeners actually do pay for broadcasting in the long run, they do so incidentally in the purchase of receiving sets. Whatever they pick out of the air seems to them "so much velvet;" and they are, at least at present, less critical than are either readers of periodicals or motion picture spectators.

The radio audience, then, is certain to become the subject of a desperate and



Brown Bros.

A DELICATE EXPERIMENT IN INTERNATIONAL BROADCASTING

Four microphones were used for broadcasting the proceedings of the last meetings of the League of Nations at Geneva; it is now considering the wisdom of broadcasting all of its public debates, in the hope that they will be a force for international understanding. Or will it bring discord?

unending fight by propagandists of every sort, including those who are seeking to bring about a given result in the field of foreign policy—the field which, needless to say, sees the beginnings of nearly all wars.

One of the obvious potentialities is in stirring up public opinion which will help to force a nation's rulers in a given direction.

It is often said that President McKinley did not want to fight with Spain in 1898; but that yellow journalism created a public demand for war which he found himself unable to resist. If the same circumstances should recur—and I am aware of no reason why they couldn't—it might easily be the radio which would play the rôle taken by yellow journalism in 1898. I am, of course,

stating what is possible, not what is necessarily likely.

The reply will at once be made that the owners of the broadcasting stations would not permit their facilities to be used for such a purpose. Yet the owners of the stations might easily believe that the propaganda I speak of was altogether right and wise, exactly as the owners of the yellow journals in 1898 believed it was altogether right and wise that we should fight Spain.

V

If radio broadcasting would be useful in starting a war, it would be simply invaluable in keeping one going. I have already referred to the fact that modern warfare requires the united co-operation of all the people in the countries engaged.

This is impossible, as we clearly saw in the Great War, without a spiritual mobilization of the whole nation. In the next struggle, the most important division of the Committee on Public Information will be the Radio Branch, by which censored (and perhaps doctored) news of the struggle will be given out, general orders to the population disseminated and appeals broadcast to the patriot that he shall eat less meat and wheat, leave his car in the garage on gasolineless Sundays, save peach pits for gas masks and buy Liberty Bonds.

Similarly, radio will be used in propaganda behind the enemy's lines. The dispute is still in progress whether the Great War was won by soldiers in the trenches, by starvation or by the American propaganda service dropping leaflets in Germany containing President Wilson's Fourteen Points. While the usefulness of propaganda in breaking down enemy morale is usually exaggerated, it does have its place. In the next war no doubt we shall see portable broadcasting sets mounted on trucks for mobility or concealed in remote mountain fastnesses. From these orators with persuasive voices, speaking the enemy's tongue without an accent, will argue hourly to the invisible audience that they are licked and had better quit while the quitting is still good. Meanwhile, the latter's own broadcasting stations will be laying down a counter-barrage of argument and appeal, or, more likely, will broadcast the dulcet tones of a buzz-saw on the same wavelength to drown out the propagandists' remarks.

This matter is one of great importance for those Oriental and African countries which have long been under the rule of the white man and are today seething with revolt. The leaders of the revolutionary forces in each of these countries are usually men with European educations who have borrowed from the West the ideals of political freedom because of which they now seek to shake off the yoke. But propaganda by the printed word is enormously difficult among these

illiterate peoples, who are frequently of mixed racial origins and are separated from one another by religious and social barriers. Not long ago an expert on India estimated that probably half the people in that country know nothing of Gandhi, the great leader in the present anti-English movement. The chief activities open to revolutionists in the past have been making speeches at meetings, which can easily be broken up and the speakers arrested; or circulating small quantities of printed matter which are readily confiscated and are ineffective at best.

But suppose that in India, for example, those interested in revolutionary activity were to buy a small portable broadcasting outfit mounted on a truck, and ten or fifteen receiving sets with loudspeakers. It would then be possible to hold simultaneous meetings in a number of villages. Patriots could assemble in some out-of-the-way corner and hear inflammatory speeches in their own language, broadcast from the portable transmitting station concealed perhaps in the wilderness somewhere near by. The police might be able to break in occasionally and confiscate one of the receiving sets; but the attempt to find the chief conspirators and their broadcasting equipment would be like hunting for one fish in an ocean. In fact, the broadcasting might be done from across the border of a neighboring state, where pursuit and capture would be delayed or made impossible by legal complications. Radio could undoubtedly increase a hundredfold the power of the political agitator even in a country like India or China. The potentialities are even greater in more advanced localities where private radio sets are numerous.

The governments of several nations have begun to display apprehension about these possibilities. In Japan, no station is allowed to broadcast except under direct government control; and no one is allowed to possess a receiving set unless he has obtained a special license. Until a few months ago each set had to



Underwood & Underwood

AN ADVANCE SCOUT IN THE ARMY OF INTERNATIONAL AMITY

Years before broadcasting became known to the public, radio amateurs had been communicating with each other in nearly all civilized countries. This station in New York (2ABT and 2AYZ) has been in touch with amateurs in England, France, Germany, Spain, Italy, Holland, Belgium, Australia, New Zealand, South Africa and the Orient—as the verification cards attest.

be tuned to one wavelength, to receive some one Japanese station and was then sealed; and grave penalties were threatened for tampering with one's set in order to bootleg illicit messages. In several European countries broadcasting is either entirely forbidden or severely restricted and controlled by the government. In India no one can import a receiving set without filling out an elaborate form explaining just why he wants it. Heavy penalties are invoked for building a set of your own without notifying the authorities.

VI

ANOTHER question of an even deeper character is of course involved here. Who owns the air? There is a doctrine in

maritime commerce of "the freedom of the seas." May we expect a similar doctrine of "the freedom of the ether?" Or will each country seek to control all messages originating, or received, in its own territory?

Such a policy, of course, would be enormously difficult to maintain, when we have such a situation as that in Europe, where messages broadcast from any one of a dozen countries may be heard in each of the others. This problem will steadily grow more difficult, as the normal range of the ordinary station and receiving set are increased.

I have no desire to pose as a prophet; but I think it altogether probable that the first development we shall see will be a series of mutual defensive treaties

arranged by existing governments on their own behalf. Under them each country will guarantee not to permit anything to be broadcast from a station within its borders which is inimical to the interests of the other governments. There is a precedent for such action in existing treaties to prevent the smuggling of arms to revolutionists. There is also a precedent in the terms of the International Telegraph Convention signed at Leningrad (*née* Petrograd, *née* St. Petersburg) in 1875. Article I of this convention grandly says that "the high contracting parties recognize the right of all persons to correspond by means of the wireless telegraph." But Article VII hastily adds that the powers "reserve to themselves the right of stopping the transmission of any private telegram which may appear dangerous to the security of the state, or which may be contrary to the laws of the country, to public order or decency."

There is no doubt that most of the existing powers have the will to suppress broadcasting by revolutionaries (unless, of course, it be directed against an unfriendly government). The only question is whether they will be able to do so. Already it is feasible to put on the air "scrambled broadcasting," unintelligible to everyone not possessing a certain special receiving set.

Suppose, for instance, that Soviet Russia were to begin broadcasting communist propaganda in this way for the benefit of receiving sets secretly owned in Western European countries. What could the latter do about it?

VII

CONTROL of international radio telegraphs is a fertile field for creating disputes among the nations. One of the grievances of the Chinese nationalists is that China has no radio telegraph station of her own. Everything sent out of that country is transmitted by foreign-owned radio or cable companies which, to put the matter conservatively, are always able, whether they do so or not,

to exert a censorship in favor of the interests of their own government and against those of China. Not dissimilar conditions exist elsewhere. Viewing the world as a whole, long-distance radio telegraphy is at present almost a British monopoly. The entire British Empire is linked up by a series of high-power stations. Messages from London are relayed to Abou Zabal (Cairo), then to Poona (Bombay), to Singapore and to Port Darwin and Perth, Australia. A branch station at Bagdad picks up Cairo, as does one at Nairobi which in turn, with one relay, gets Cape Town, South Africa. Singapore reaches Hongkong.

France, like Great Britain, has realized the importance of maintaining radio communication throughout her far-flung empire. She has a series of stations which pick up such remote localities as Indo-China and French Guiana. Both Britain and France justify these extensive radio telegraphic systems by the plea that they are a useful adjunct to foreign trade. There is no doubt, however, that the monopolistic or semi-monopolistic conditions existing in various parts of the world are a disturbing element in the harmony of the nations and a serious menace in time of war.

VIII

FOR the last two centuries, the world for all practical purposes has been shrinking in size through improvements in the technique of transportation and communication. Radio is accelerating that process more than anything else has done in all history and the smaller the world gets, the more will sheer grim necessity demand that people shall learn how to get along with one another without resorting to large-scale violence in order to settle their differences.

The realization of this fact is certainly one of the most potent forces for peace in existence. And the radio gives an unequalled opportunity, which will inevitably be utilized to a large extent, for spreading this truth among the people of every land.



From a photograph made for POPULAR RADIO

THE CO-AUTHORS IN THE LABORATORY

Since 1916 Mr. H. W. Nichols (at the left) has been in charge of the research in radio communication of the Bell Telephone Laboratories; Mr. J. C. Schelleng has been engaged in similar activities since 1918. These two physicists have been the first to work out the remarkable effect of the earth's magnetic field on radio waves.

How Earth Magnetism Affects Radio Waves

We live on a great magnet. With its north pole located in northeastern Canada and its south pole on the Antarctic Continent, our earth is surrounded by a continual magnetic field, quite like the field around an ordinary bar magnet. In former theories of radio transmission this earth magnetism has been ignored. In this important article the authors show that magnetic effects on the air ions probably have a very significant rôle in long-distance radio. You will be hearing much, this year, of the ideas of polarized waves and magnetic twists, which are here described.

By H. W. NICHOLS and J. C. SCHELLENG

EVERY radio amateur is aware of the great range which is sometimes obtained by the use of short waves.

Not many years ago it was thought that short-wave transmission must mean

the same thing as short distance transmission since all the experience gained with wavelengths greater than the few hundred meters indicated the general rule that the optimum distance of trans-

mission is roughly proportional to the wavelength. In fact within this range of frequency, the practical rule was evolved which said that it was unreasonable to expect reliable transmission over distances greater than 500 wavelengths.

Now we know that with short wavelengths, satisfactory transmission is often obtained over many thousands of wavelengths with extremely low power.

These observations have usually been qualitative, however, and it is unsafe at present to conjecture to what extent this favorable result is due to superior transmission, and to what extent due to a lower level of atmospheric interference. However, it is not to be questioned that there is a great deal in transmission with short waves which was wholly unexpected a few years ago.

In passing through the wavelength range we find at low frequencies that the attenuation is small; that is, the signal travels with comparatively little loss. At higher frequencies, in spite of the fact that greater radiation efficiency is obtained from the transmitting antenna, the signal is damped out before it has gone as far as the long wave.

It is common experience that long distance transmission within the fre-

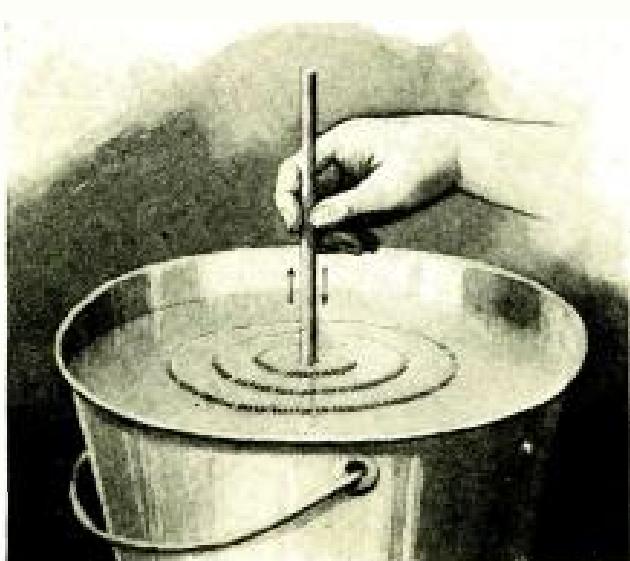
quency band allotted to broadcasting is unreliable. Between two points separated by a great distance, it is often found that a one hundred meter wave is received far better than the wave within the broadcast range. The turning point is hard to determine, but it seems to be approximately at 250 meters or thereabout. Furthermore, within this range, fading is found to be most annoying. One is inclined to say that there may be some selective phenomenon taking place in the upper atmosphere which discriminates against this range of wavelengths, and makes it the worst one for long distance transmission.

It therefore becomes a matter of importance to see if we are able to find some mechanism which is able to produce these effects at this frequency.

It is generally believed, except perhaps in Germany, that the upper atmosphere contains ions (that is, electrified particles) in sufficient quantities to have an important and usually beneficial effect on the transmission of electric waves.

These ions are of course very small. They may consist of several molecules with a small charge. This is the type of ion found near the surface of the earth. At higher altitudes, the number of molecules clustering together apparently decreases, so that at great heights an ion may have an average mass no greater than that of a single molecule. In fact there are reasons to believe that there is also an appreciable number of "free" (detached) electrons. Everyone nowadays is more or less familiar with the fact that electricity itself is atomic, and that the atom of negative electricity is called the electron. It is the flight of electrons through the vacuum which constitutes the plate current in a receiving tube. This particle is very minute, having a mass approximately $1/2000$ as great as that of the hydrogen atom.

In 1912, Eccles, an English scientist, developed the theory of ionic refraction. Since that time others, for example, Sir Joseph Larmor, have made contributions



From a drawing by Arthur Merrick

VERTICAL POLARIZATION

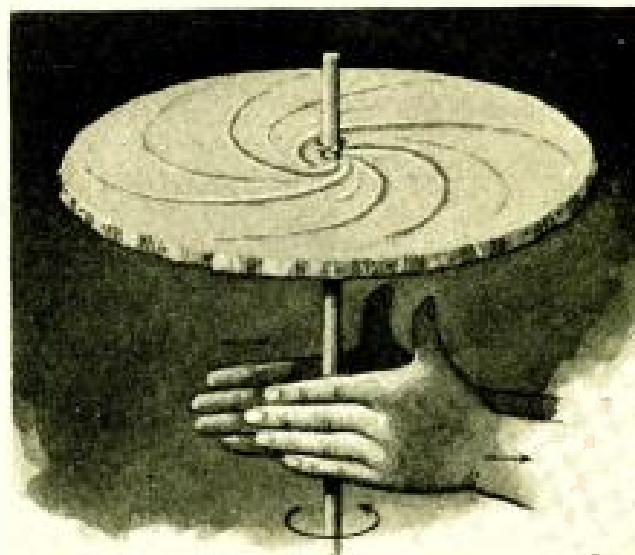
The water wave set up by the up-and-down motion of the stick is an example of a vertical polarized wave. The particles of water vibrate up and down as the wave passes them.

along the same line. The purpose of this theory was to show how an electromagnetic wave traveling through a medium which contains free ions will have a velocity which is different from the velocity of the waves in vacuo. The theory of propagation of radio waves is identically the same as the theory of light, and exactly the same methods are used.

We are all familiar with the action of the lens which causes light incident upon it to be bent out of its original path. This is due to the fact that the velocity of light in passing through the glass is less than the velocity of light in a vacuum. This difference is explained in the electromagnetic theory of light by the fact that the glass itself is electrical in nature, the atoms being made up of positive and negative electricity. When the light wave passes through the glass, the electric field of the wave causes the electric particles to move, and this motion of the electricity constitutes a current which produces a reaction on the wave itself. In this way, the wave is made to travel more slowly than it did before entering the glass, so that the direction of the wave is changed if different parts of it travel through different thicknesses of glass.

Much the same thing happens when the light passes through a medium containing free ions. In this case, however, the fact that the ions are free whereas in the case of the glass they are bound by "elastic" forces which are usually very strong, leads to the opposite effect, namely, that the velocity of the wave is greater than the velocity in vacuum. (The velocity referred to above is known as the "phase velocity" and it is different from the speed with which light advances into a previously undisturbed medium. The latter velocity is never greater than the velocity in vacuum, even though this is true of the phase velocity.)

On this theory, therefore, we may regard the atmosphere as having the same effect on the radio wave that a glass



From a drawing by Arthur Merrick

HORIZONTAL POLARIZATION

The stick is attached to the rubber sheet through which it projects. As the stick is twisted a vibration wave is set up in the rubber. It is a horizontally polarized wave; that is, the particles of the rubber vibrate back and forth along the circumferences of horizontal circles as the wave passes them.

prism has on light. At higher altitudes, the number of ions in unit volume is supposed to be greater than at low altitudes, hence a wave will travel faster at the higher elevations than at the lower. This therefore gives a good picture of a way in which a radio wave can bend around the earth. The attenuation of the signal is in part explained by the fact that the moving ions collide with air molecules and hence lose some of the energy which originally came from the wave.

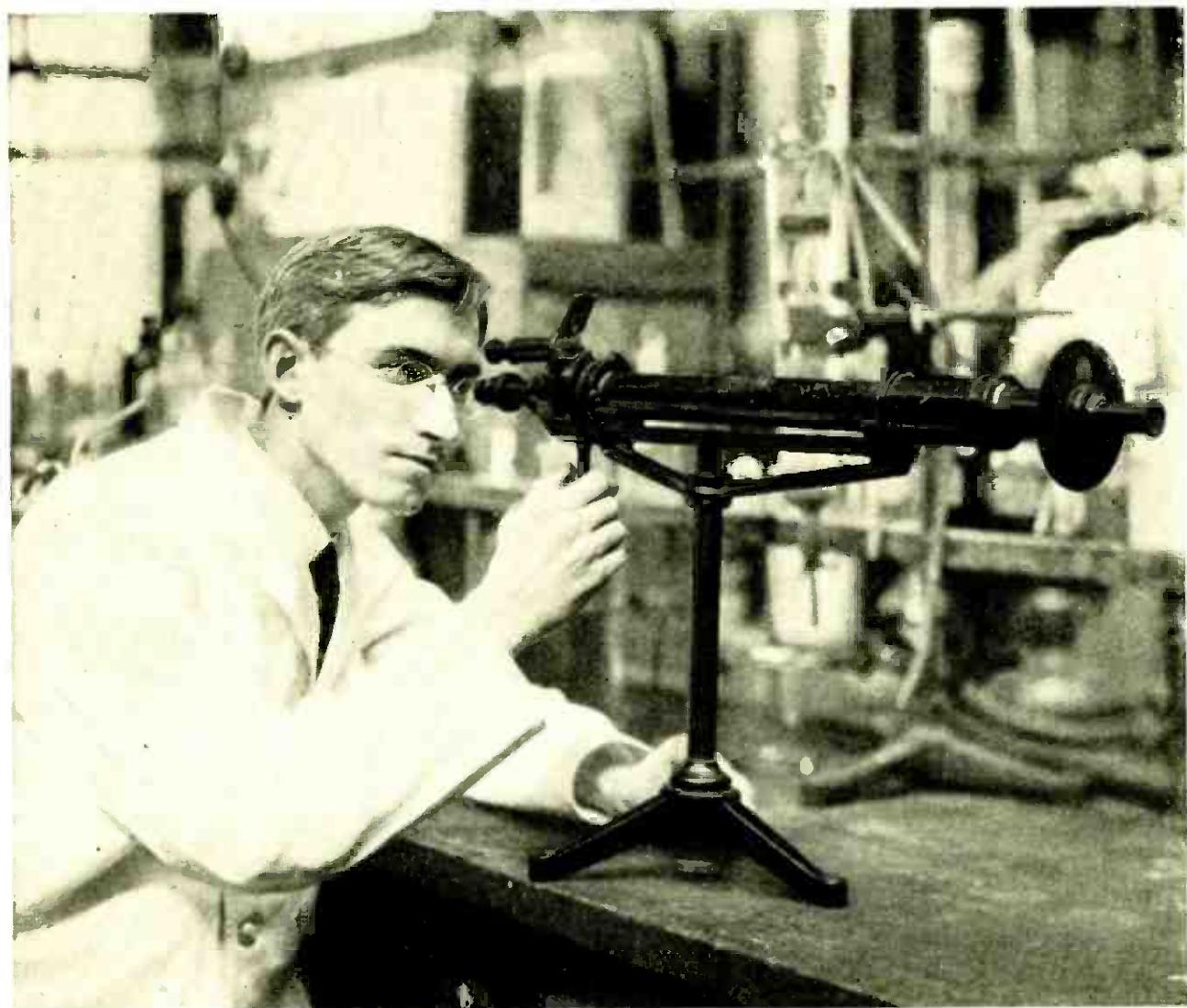
It may be seen that there is nothing in this theory which explains the experimentally observed selective effect discussed above. We will now show how such an effect can be produced as a result of the fact that free electrons in the atmosphere are traveling in the magnetic field of the earth. Other ions will effect transmission but will produce no selective effect in the radio range.

It is a fact that when an electron moves in a direction perpendicular to a magnetic field, a force is exerted on the electron perpendicular to the direction of its motion and to the direction of the magnetic field. This is one of the fundamental laws of electricity and numer-

ous familiar examples of it might be mentioned. For instance, it is the principle underlying the operation of the electric motor. The purpose of the field coils of the direct current motor is merely to set up a magnetic field. The armature coils are merely paths through which electrons travel in a direction perpendicular to the magnetic field. Hence, according to the law just stated, a force will be exerted on these electrons perpendicular to the magnetic field and to the wires of the armature. Since the electrons cannot be drawn out of the wire, this force is communicated to the wire itself and causes the armature to revolve.

Consider now what happens to an electron when it moves unimpeded in a direction perpendicular to the magnetic field. Since a force is exerted on the electron perpendicular to both its motion and the magnetic field, it will move in a circle (see Figure on page 315) and the direction of motion will always be the same with respect to the magnetic field. If the magnetic field is called H , the charge of the electron e and its velocity v , the force F is numerically equal to $\frac{H e v}{c}$

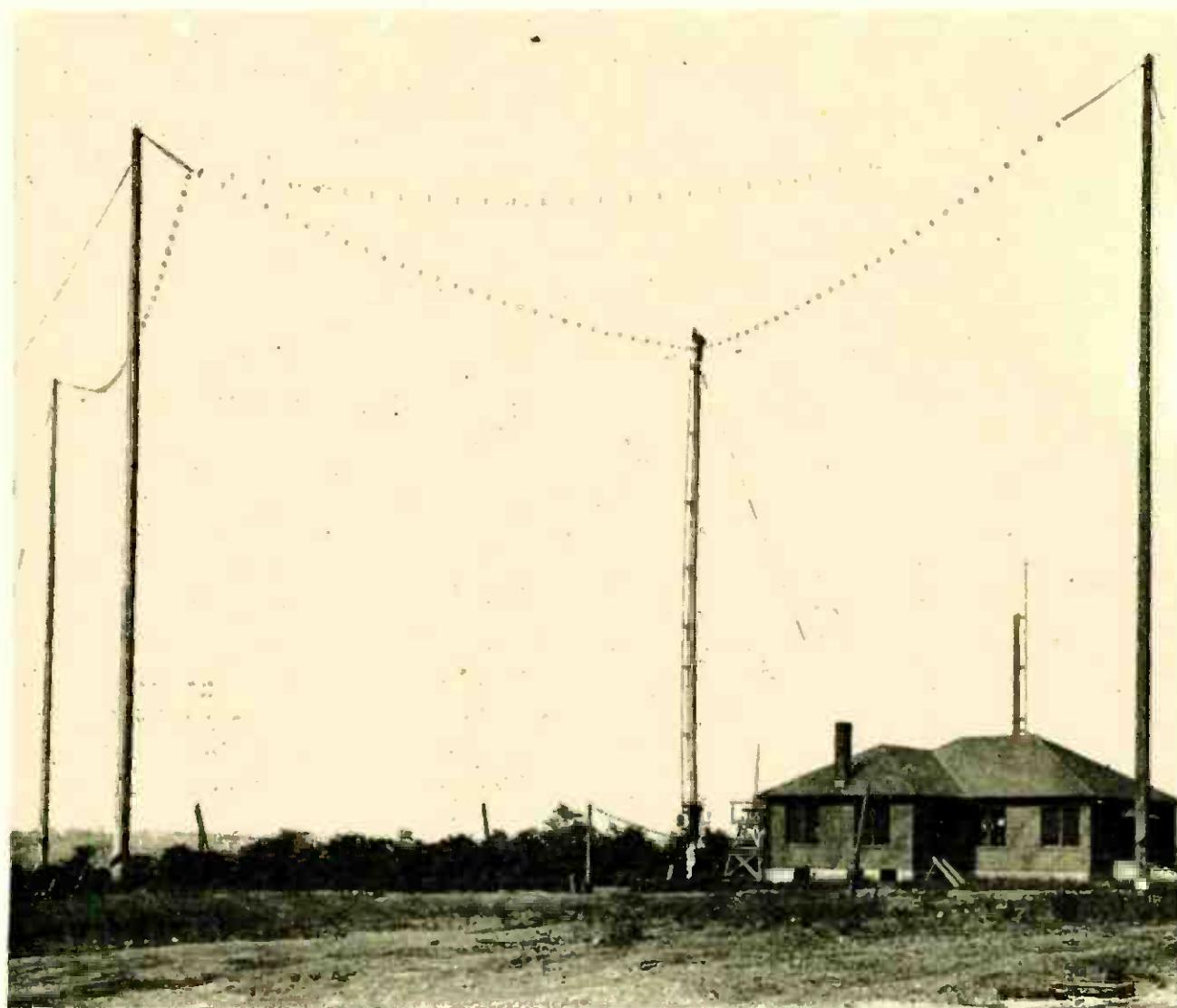
which c is the velocity of light and is equal to 3×10^{10} cm per second. But $v = 2\pi r f$ in which r is the radius of the circle and f is the revolutions per



From a photograph made for POPULAR RADIO

OTHER ETHER WAVES ARE ALTERED BY MEDIUM

Not only are radio waves affected by the ions and electrons in air, but the much shorter ether waves of light are altered by media through which they pass. This picture, made in the Pease Laboratories of New York City, shows a polariscope—an instrument which measures the amount of sugar in a solution by the effect of the sugar atoms on the rays of polarized light.



Westinghouse

A CENTER FOR SHORT WAVE EXPERIMENTS

This antenna system, in use at the experimental station of KDKA, at Pittsburgh, represents one of the antenna types now used for short-wave transmission. The growing mass of data on short waves is proving significant for the new theories of radio wave propagation, including the air-ion and magnetic hypotheses outlined in this article.

second of the electron. Therefore the force is $\frac{e}{m}H^2$. It is proved in me-

chanics that if m is the mass of a particle, the radial force which is necessary in order to make it travel in the circular path equals $4\pi^2 mrf^2$. Equating the two expressions for the force, we find that $f = \frac{He}{2\pi cm}$. This result is interest-

ing for it shows that the number of revolutions which the electron makes per second depends only upon the strength of the magnetic field.

The earth's magnetic field differs at different parts of the earth and the average is probably somewhat lower

than 0.5 gauss; $\frac{e}{m} = 5.3 \times 10^{17}$. Therefore the electron makes 1.4×10^6 revolutions per second.

An interesting point about this calculation is that the rate of rotation of the electron lies within the range of radio frequency, this frequency corresponding to a wavelength of 214 meters. Since, as stated, the average value of H is somewhat less than 0.5, the critical wavelength will be somewhat greater than 214 meters.

Suppose now that a radio wave whose frequency is 1,400,000 cycles per second passes over the electron and that the latter is free to move without much interference by the molecules of the atmos-

sphere. We have just seen that it is easy for the electron to rotate in one direction about the magnetic field at a rate equal to 1,400,000 revolutions per second. As one would guess, the electron acts in many ways like a circuit which is tuned to this frequency. An electric wave passing through the medium containing electrons will cause them to vibrate and when the frequency of the wave is equal to this critical frequency, the velocity of the electron may become very great. Obviously, this motion will have a pronounced effect on the wave itself and in what follows we will briefly describe some of these effects.*

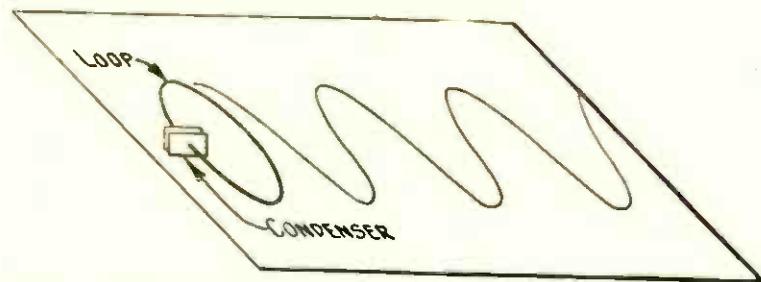
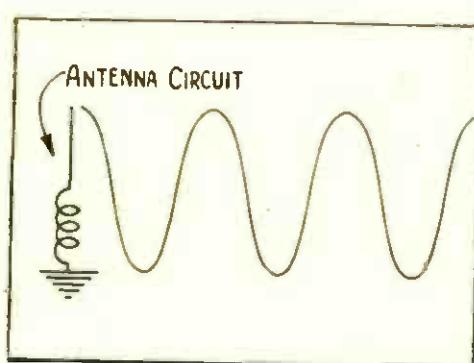
When the wave travels parallel to the magnetic field, it is in general split into two parts. These two components travel with different velocities, and for frequencies lower than the critical frequency, they are usually refracted in opposite directions. Electrical engineers are accustomed to think of a simple alternating field as made up of two oppositely rotating fields and the same idea can be used in the case of a radio wave. These rotating fields tend to make the electron revolve in opposite directions. But since the latter rotates more easily

in one direction than the other, it is natural to expect different transmission phenomena for the two components of the wave. For high frequencies, these two components travel with the same velocity. Near the critical frequency, the velocity of the first component changes rapidly with frequency and the wave is strongly absorbed. At a frequency somewhat higher than the critical value, the rays are in general bent in the same direction. One would expect that when the velocity of the ray changes greatly for a small change in frequency, fading would be pronounced.

A few years ago, the Bureau of Standards in co-operation with the American Radio Relay League made a study of fading, the results of which are given in *Scientific Papers* of the Bureau of Standards, No. 476, by Dellingler, Whittemore and Kruse. One of their tentative conclusions is interesting in this connection.

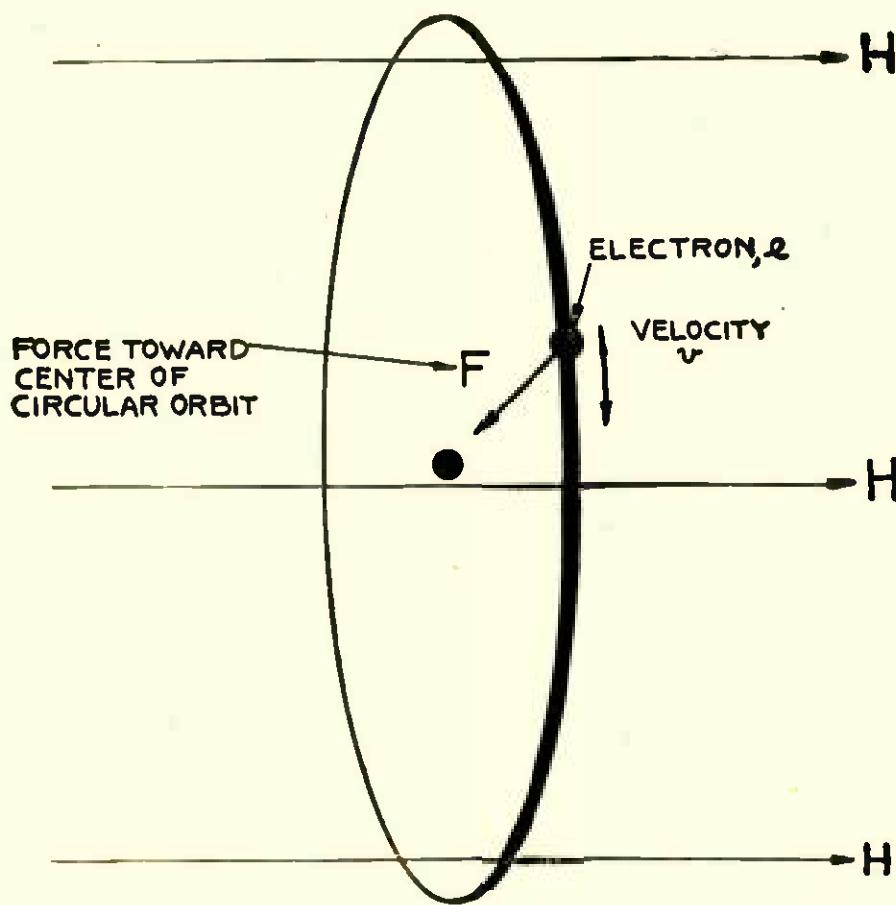
"Observations to date indicate that fading is greatest for waves within a certain range of wavelengths and is less for either longer or shorter waves. Fading is more pronounced at wavelengths in the neighborhood of 250 meters than at longer wavelengths. Transmission experiments using 100-meter waves indicate less severe fading than on 250 meters."

There are two causes for the bending of the rays—variation from point to point of the medium in the ionic density and variations in magnetic field. The former is probably by far the more important cause.



HOW THE KIND OF ANTENNA CONTROLS WAVE POLARIZATION

A vertical-rod antenna, illustrated at the left, sends out waves which are mostly polarized vertically. On the other hand, a wire loop, placed parallel to the earth's surface, sends out a wave polarized in the plane of the loop. This gives a horizontally polarized wave, as is illustrated at the right.



HOW ELECTRONS MOVE IN A MAGNETIC FIELD

When an electron moves freely in a direction perpendicular to a magnetic field, it will not travel in a straight line but in a circle. If an electric wave passes it the electron will have a forced elliptical motion added to the motion produced. H indicates the direction of the earth's magnetic field. It is the reaction of these moving electrons on the wave itself that is responsible for most of the magnetic effects on the direction and intensity of the wave.

Fading on the other hand must be explained by changes in the properties of the medium with time. Again, large time changes of ionic density are more likely than time changes in magnetic field.

Another result of the presence of the magnetic field is that it causes the direction of the electric field of a wave traveling parallel to the magnetic field of the earth to be rotated and this may be a further cause of bad reception since a vertical receiving antenna is affected by a wave only if it is polarized with its electric field perpendicular to the earth. This rotation may also cause errors in the apparent direction of a received signal.

When the wave travels perpendicularly to the magnetic field, it is again split up into two components. One of these is strongly affected near the critical frequency. The other one is

not affected by the magnetic field in any way.

Again, in this case, the two rays travel with different velocities and are bent in different directions. Under some circumstances, it is possible for a ray to follow the bend of the earth even though the number of ions is decreasing with height, a statement which applies also to the case of propagation along the magnetic field. It may be mentioned here that the fact that the magnetic field in general breaks the wave into two components which travel along different paths leads to the expectation that they may arrive at the receiving station in different phase and hence destructively interfere with one another. Any small variations in the velocity of propagation along the path of one of these will thus tend to produce fading and this is most likely to occur near the critical frequency.

Another conclusion to be drawn from this theory is that for low frequencies, the magnetic field prevents the electron from moving in as large an orbit as it otherwise would describe. This results in smaller absorption of energy, hence the presence of the magnetic field in the ionized medium may greatly reduce the attenuation under such circumstances, resulting in a greater range than would be found otherwise.

Even when the magnetic field is taken into account, it produces no effect if it is parallel to the electric field of the wave. It is shown in the paper cited that strong absorption is produced at long wavelengths by a small number of electrons per cubic centimeter in the case of such a wave. Such an effect might explain the observation made by Round, Eckersley, Tremellen and Lunnon that transmission across the North and South Poles is difficult or impossible. The observations were made at low frequencies. In these regions the magnetic field is vertical and hence parallel to the normal direction of the electric field of the wave. This phenomenon should be considered with reference to the magnetic rather than the geographic poles but the difference is probably not sufficient to judge between them in the case of the evidence now at hand.

That the magnetic field is of importance in radio transmission is possibly indicated by the observed fact that during magnetic storms (times of unusual variations in magnetic field) radio transmission is abnormal.* However, on account of the small magnitude of these variations in magnetic field it seems more likely that the magnetic and radio phenomena are both results of some other phenomenon (e. g., abnormal ionization due to sun spots) rather than that the first is the cause of the second.

A computation was made of the absorption for the case in which the magnetic field is zero, or negligible

because the wavelength is very short. It was found that at that height where the average number of collisions per second made by an electron equals 2^{π} times the frequency of the radio wave; at that altitude there is a maximum of energy absorption per electron. For a given radio frequency there is, therefore, a more or less definite altitude at which this maximum absorption occurs, the altitude being less the higher the frequency because the air is more dense and the collisions more numerous at low altitudes.

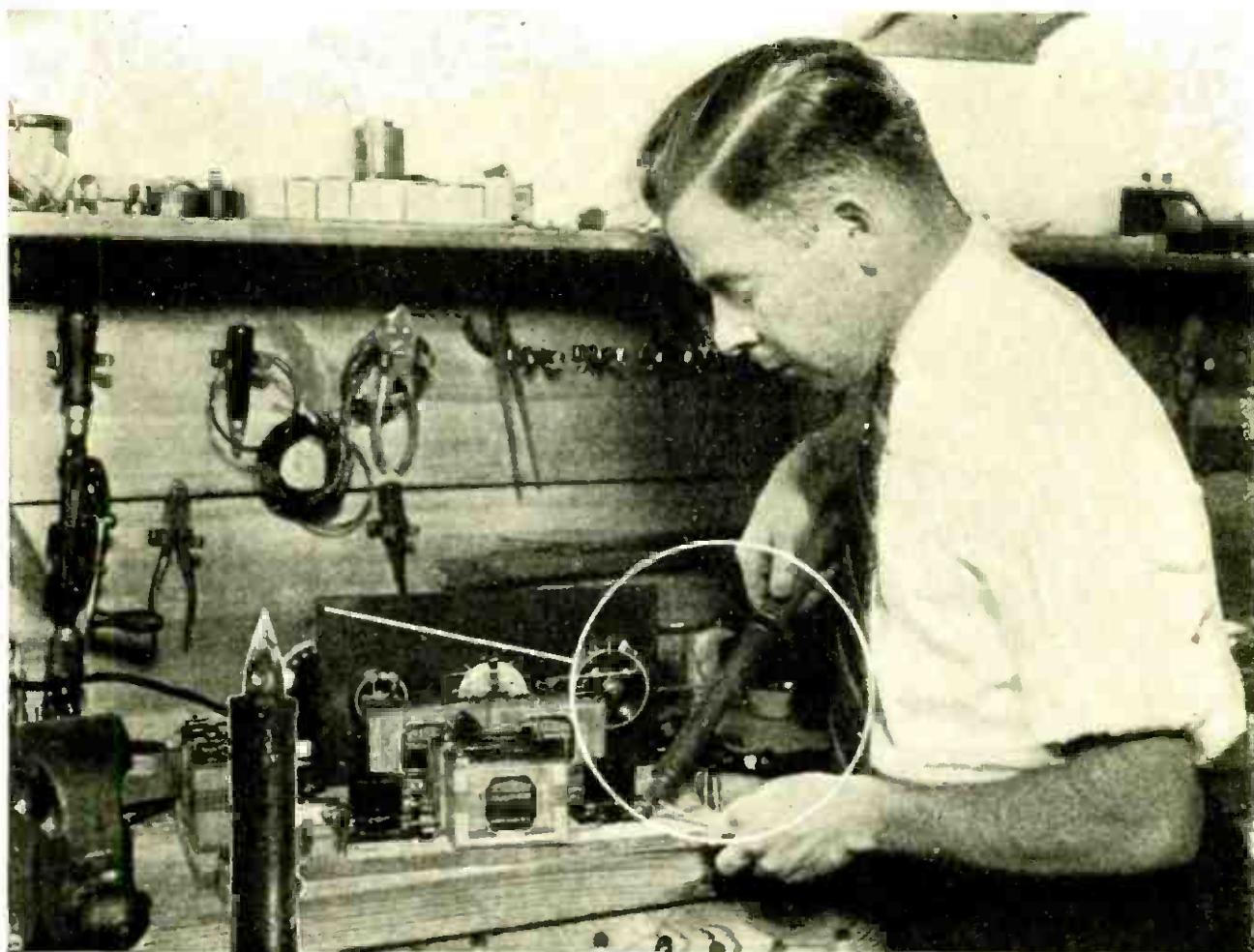
Now it has been supposed that ionization increases with height. Might not some new type of phenomenon be encountered when this altitude of maximum absorption per ion becomes so low that even in day time the wave can pass through it without appreciable loss and be bent back to earth by the more intensely ionized region above?

This would provide a mechanism similar to a common conception of the mode of night-time transmission on longer waves, according to which the wave glides along the inside of an ionized sphere as in a "whispering gallery." For short-wave night-time transmission, the reduced ionization after sundown might make refraction impossible, thus spoiling the transmission. This might be used to explain the apparently improved daylight transmission on wavelengths of the order of 20 meters or so.

In passing from long to short waves, transmission at first becomes more difficult for reasons explained by Watson and others. It seems to be most unreliable near 250 meters due to a selective effect resulting from the presence of electrons in the earth's magnetic field. At shorter wavelengths (for example 100 meters) night-time transmission over long distances is improved due to the separation from the critical frequency. At very short wavelengths there is the possibility of improved daylight transmission due to a condition similar to that which favors longer-wave night-time transmission.

* *Transatlantic Radio Telephone Transmission*, by Messrs. Espenschied, Anderson and Bailey; paper presented May 6, 1925. Institute of Radio Engineers.

Handy Tools for Radio Fans: No. 7



From a photograph made for POPULAR RADIO

THE ELECTRIC SOLDERING IRON

An indispensable tool for wiring

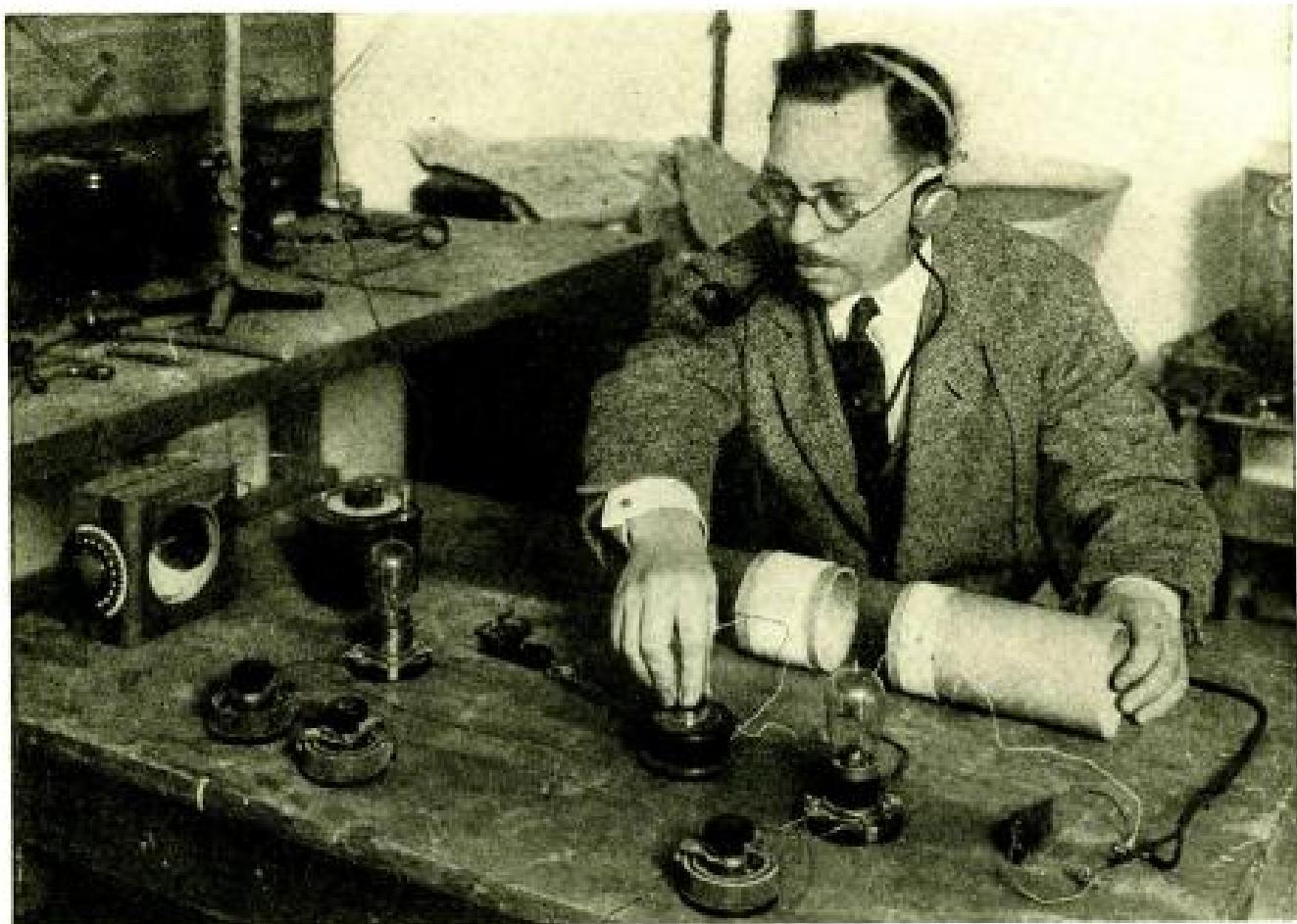
THE radio fan's kit of tools and accessories should include, as one of its most necessary items, the electric soldering iron. With it he can speed up set building and experimental work on new receivers many times in advance of what he could do with an ordinary iron.

The electric iron, if it is a reliable one and properly designed, will remain at just the right temperature for doing a good soldering job on the wiring without damaging the iron or the parts to be soldered.

It eliminates the trouble from faulty joints and large unwholesome-looking gobs of solder that the inexperienced fan usually is bothered with when using the ordinary soldering iron.

With little practice the experimenter can make neat and efficient joints of high conductivity with the modern electric soldering iron.

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



From a photograph made for POPULAR RADIO

The author of this series is one of America's foremost authorities on the theory and practice in radio. This picture shows him at work in his laboratory obtaining the information contained in this series of articles.

HOW TO IMPROVE Broadcast Reception

VII: How to Reduce Interference

This series of tuning-circuit articles was prepared by one of the most experienced radio engineers in the world for the special benefit of the broadcast listener. The preceding five articles of this series include: "The Effects That Occur in the Transmitting Station," August, 1924; "Helpful Hints on Tuning," September, 1924; "Oscillations in the Receiver," October, 1924; "Noises That Come in With the Waves," January, 1925; "Cutting Down Spark Interference," February, 1925; "Increasing the Selecting Power of Your Receiver," April, 1925.

By JOHN V. L. HOGAN

WITH the approach of the winter season of long distance broadcast reception the question of reducing interference once more becomes prominent, for as a result of the large number of stations that are running today the biggest single problem of satisfactory receiver operation is the attainment of high selective power.

In the old days of radio, when relatively few transmitters were in simultaneous operation and when amplification was far from the present high state of development, the question of "getting distance" was mainly a matter of increasing the sensitiveness of the receiver.

That is not the case today, for with the average receiver in the average

location the probability is that we shall hear too much transmission—not too much *desired* transmission, but too many unwanted and interfering signals.

In the preceding articles of this series the several sources of disturbing noises were analyzed, and a number of remedies for them suggested. The most pernicious interfering sounds were classed as the "noises that come in with the waves," and among these we have already given some attention to spark or code signals.

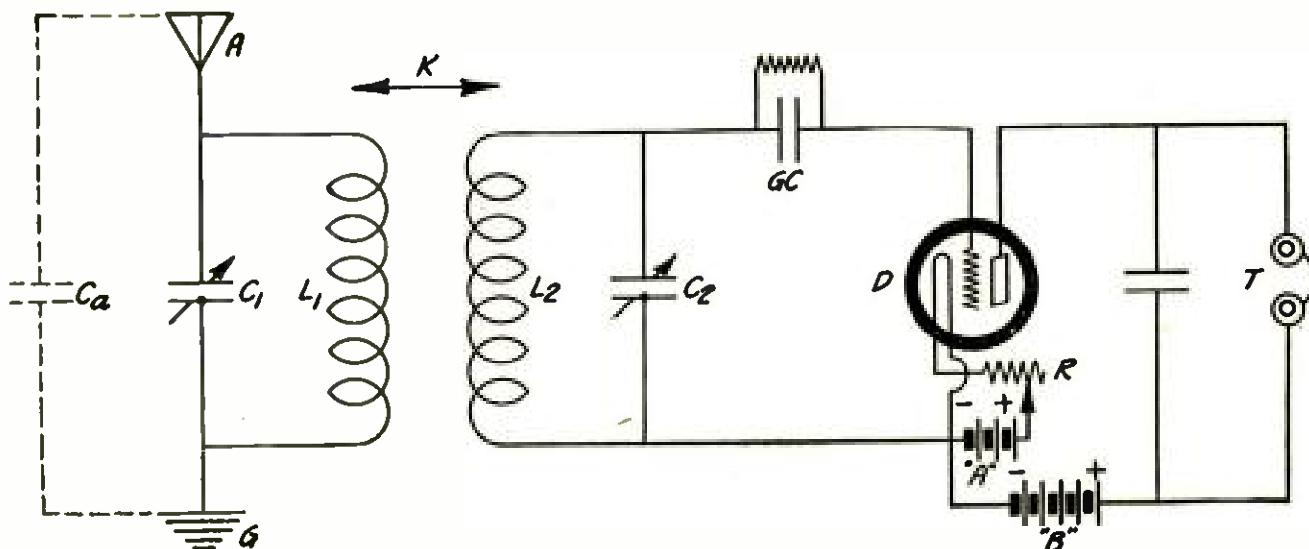
It has been pointed out that although very strong interference from spark transmitters can hardly be excluded, it can be minimized by increased selectiveness of the receiver. Fortunately this increase of discriminating power in a radio receiver will not only aid in reducing code interference, but also will help to reduce "cross-talk" or the simultaneous reception of signals from two or more broadcasting transmitters.

A previous article (which appeared in the April 1925 issue) explained how a reduction of coupling between the antenna system and the detector will aid in getting rid of interference. Simple loose-coupled circuits for crystal and plain vacuum tube detectors were described, and the operation of tuning explained.

Such receivers are typified by Figure 1, which is like Figure 3 of the April article except for a change in the antenna-to-ground circuit. Here the primary variable tuning condenser C_1 is connected directly across the primary coil L_1 and the antenna and ground are connected respectively to the stator and the rotor of the condenser.

Such an arrangement works well with relatively small antennas, and permits one to use identical coils for L_1 and L_2 . For the same wavelength the tuning setting for C_1 will ordinarily be a little lower on the scale than for C_2 , as the capacity of the antenna is in effect added to that of C_1 as indicated by the dotted lines including C_a at the left of the figure. C_a is intended to represent the capacity of the antenna with respect to the ground, by which approximate amount the value of C_1 must be reduced (as compared to C_2) to bring the two circuits into resonance if the coils are identical.

It is not hard to see that if this circuit arrangement is used with a fairly large antenna it will not be possible to tune the primary circuit to the higher frequencies corresponding to the shorter wavelengths. This is because even with C_1 set at zero the capacity of the antenna system will remain effectively in circuit,



A SIMPLE CIRCUIT FOR SHORT ANTENNAS

FIGURE 1: This one-tube receiver employs inductive coupling and permits of the use of two similar coils for L_1 and L_2 . By loosening the coupling between the two coils shown at K sharper tuning may be obtained.

and, in conjunction with the coil L_1 , will make the circuit resonate to a moderately low frequency.

There are two ways to avoid this difficulty and thus to keep the two circuits more or less in step.

One method is to reduce the size of the primary coil L_1 .

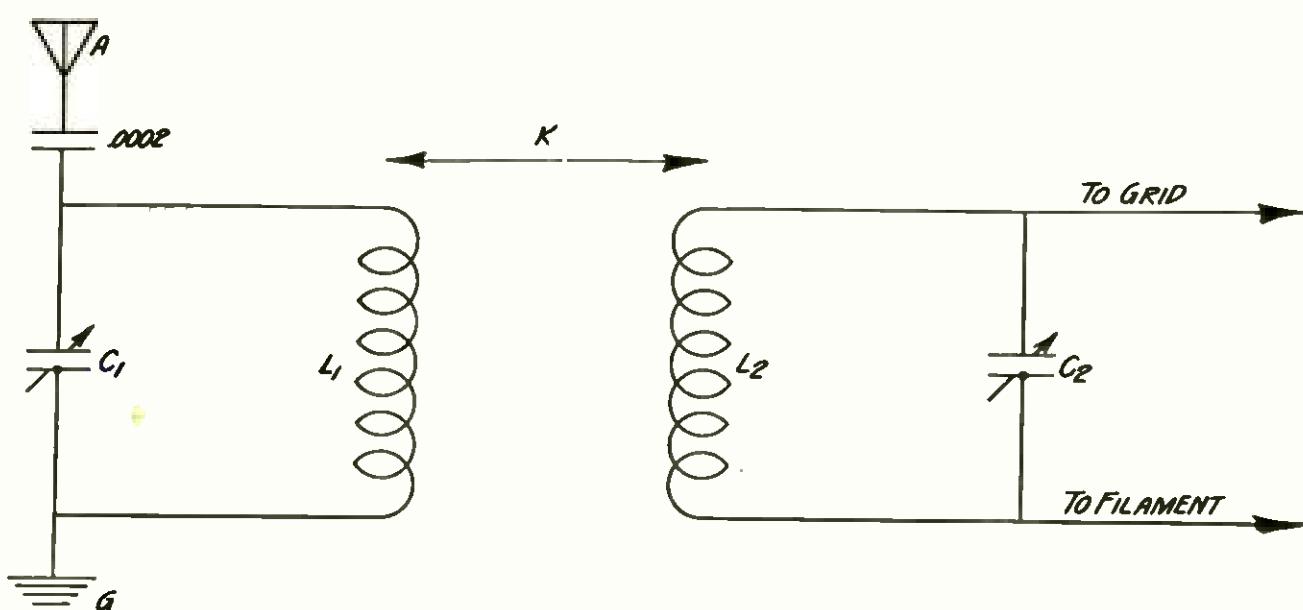
The other plan, which is for most purposes the better one, is to insert a small fixed condenser (of about 0.0002 microfarad capacity) directly in series with the aerial as shown in Figure 2. Under these conditions the effective capacity of the antenna-ground system can never become large enough to interfere very seriously with the adjustment of C_1 , since it is limited by the small series condenser.

In building a receiver of this type there is considerable latitude for choice of sizes of coils and condensers. For the broadcast waves from 1,500 to 500 kilocycles (200 to 600 meters) the two coils may each be of 60 turns of about No. 22 DSC wire wound on a 3 or $3\frac{1}{2}$ inch tube, and the condensers C_1 and C_2 may each be of 0.0005 microfarad maximum capacity. If smaller condensers are used the coils must be larger to cover the same range of waves, and it would also be advisable to reduce the

capacity of the series antenna condenser shown in Figure 2.

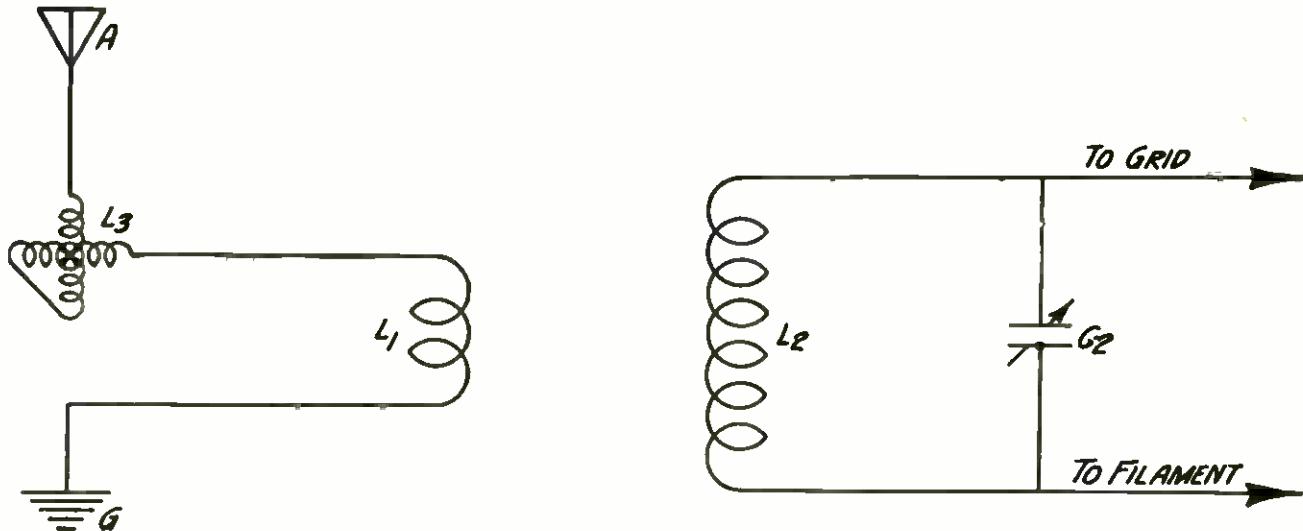
If you have been using direct connected antenna systems, with only a single coil and condenser for tuning, you may expect a great improvement when you change over to the arrangement of Figure 1 or Figure 2, for the loosely coupled two-coil system may be made so selective that the tuning adjustment becomes rather difficult. In fact, this requirement of somewhat skilful manipulation is perhaps the reason that separately tuned antenna systems (with their characteristic increased selectivity) have not been commonly used in radio broadcast reception.

The best way to learn how to handle any of these double-tuned receivers is to follow the procedure outlined in the April article, *i. e.*, to begin with the coils L_1 and L_2 close together and make a list of the best tuning settings of condensers C_1 and C_2 for a number of stations. Then you may separate the coils about an inch and make a new but similar list; the tuning points will usually come a little lower on each condenser scale (for the same stations) when the coils are moved apart, but the first list of settings will aid you in finding the values for the looser coupling. In



THE USE OF A FIXED SERIES CONDENSER IN THE ANTENNA

FIGURE 2: To eliminate as much as possible the effect of varying antenna capacities on the tuning of the condensers C_1 and C_2 , a small fixed condenser of about .00025 mfd. may be inserted in the antenna circuit.



A VARIOMETER TUNED ANTENNA CIRCUIT

FIGURE 3: *This system gives very efficient operation for tuning wavelengths that are longer than the natural period of the antenna circuit itself.*

the same way, lists may be made for several additional coupling separations—say two, three and four inches. The greater the distance the two coils are separated, *i. e.*, the looser or weaker the magnetic coupling between them, the sharper will be the tuning of the receiver.

This plan of using the tuned antenna system with well spaced primary and secondary coils is one of the most effective ways of reducing strong interference from powerful nearby spark or broadcasting stations. It does not increase the strength of signals produced by the desired station, as compared to the intensity that could be had with the same receiving antenna when connected directly to the vacuum tube circuit. In fact, for the looser couplings and greater selectivity it will often reduce the strength of signals. But the important point is that the arrangement cuts down the intensity of interference *more* than that of the signals you desire to hear, and consequently makes reception easier and better.

Having once minimized the interference, you can strengthen the desired signals to the greatest practicable amount by adding amplification (as will be shown in a later article) and thus obtain a substantial net gain.

There are a number of variations of the coupled double tuned receiver, all of which give practically equivalent re-

sults. Each arrangement has its special advantages for particular conditions, however, and the choice among them rests mainly upon the relation between the size of aerial used and the range of wavelengths it is desired to receive.

The circuit of Figure 1 is particularly adapted for small aerials; Figure 2 permits the same condenser arrangement to be used with larger antennas. The series tuning condenser shown in the April article is generally more desirable for the reception of high frequency (short) waves with moderately large aerials.

Figure 3 illustrates a third arrangement, in which the antenna system is tuned by a variometer L_3 , and coupling to the secondary L_2 is provided by a small coil L_1 which may have only five or ten turns. No antenna tuning condenser is used in this circuit, the adjustable element being the variometer; such a system is very efficient for wave frequencies below (*i. e.*, wavelengths longer than) the "natural" of the antenna.

For higher frequencies (shorter wavelengths) a series condenser C_1 of either the fixed or the variable type may be inserted, as illustrated in Figure 4.

In the coupled tuned antenna circuit with tuned secondary, we have, then, a powerful weapon against local interference. Many times it has been found not only possible but easy to eliminate

interference from a powerful nearby broadcaster that, with a single-tuned-circuit receiver, produced a constant and bothersome "background" when listening to other stations—simply by adding the tuning condenser and coil in the antenna circuit. True, this arrangement adds one dial that has to be adjusted, in tuning; but the improvement in results is almost always well worth the effort.

Fortunately, however, the benefits of this double circuit tuning can be had without adding to the number of tuning controls. By following the plan that I described some years ago,* in connection with a single control receiver for ship-and-shore radio telegraph service, we may tune both the primary and the secondary circuits simultaneously by means of one common tuning element such as a tandem condenser or double variometer.

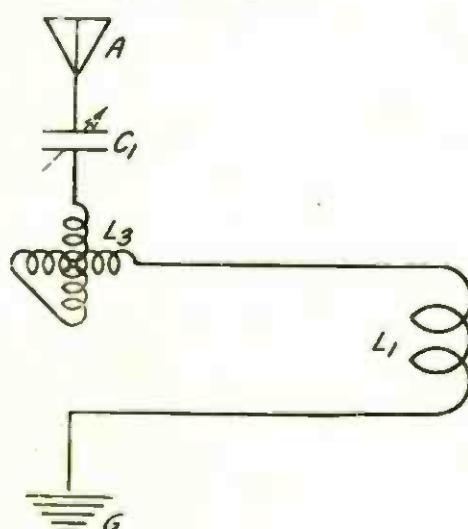
Let us first see how this problem may be solved for use with relatively large aerials, since while the strongest signals can thus be had there is also the greatest need for sharper tuning. The series-condenser circuit is usually the best when broadcasting waves are to be received by means of large antennas. Such a circuit is shown in Figure 5,

where, if we are to use single-control, the several tuning coils and condensers must be matched together. Suppose coils L_1 and L_2 are identical, each being made by winding 100 turns of Number 22 DSC wire on a four-inch tube, and that the two condensers C_1 and C_2 are alike in design and both of 0.0005 microfarad maximum. The primary circuit includes C_1 , L_1 , and the effective capacity of the antenna system which is represented in Figure 5 by the dotted condenser C_a . These three elements are in series, and the whole primary circuit comprising them may be tuned through a range of frequencies by varying C_1 .

If we are to make our secondary tuned circuit match the primary, which is important for single control, we will need to have in it two condensers in series. One of these is C_2 and the other C_3 . Now, by setting C_3 at a value equal to the capacity of C_a (representing the antenna-to-ground effect), the two circuits may be made to match or equalize and thereafter any equal changes in C_1 and C_2 will produce equal tuning effects in both primary and secondary. Thus, so long as the settings of C_1 and C_2 are alike the two circuits will remain in tune.

Since C_1 and C_2 , under these condi-

*U. S. Patent 1,014,002.



ADDING A SERIES CONDENSER TO THE VARIOMETER TUNED ANTENNA CIRCUIT

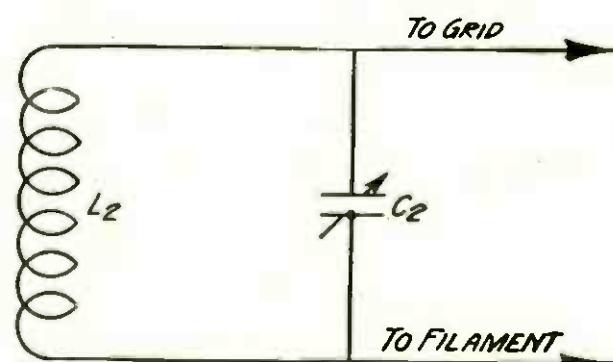
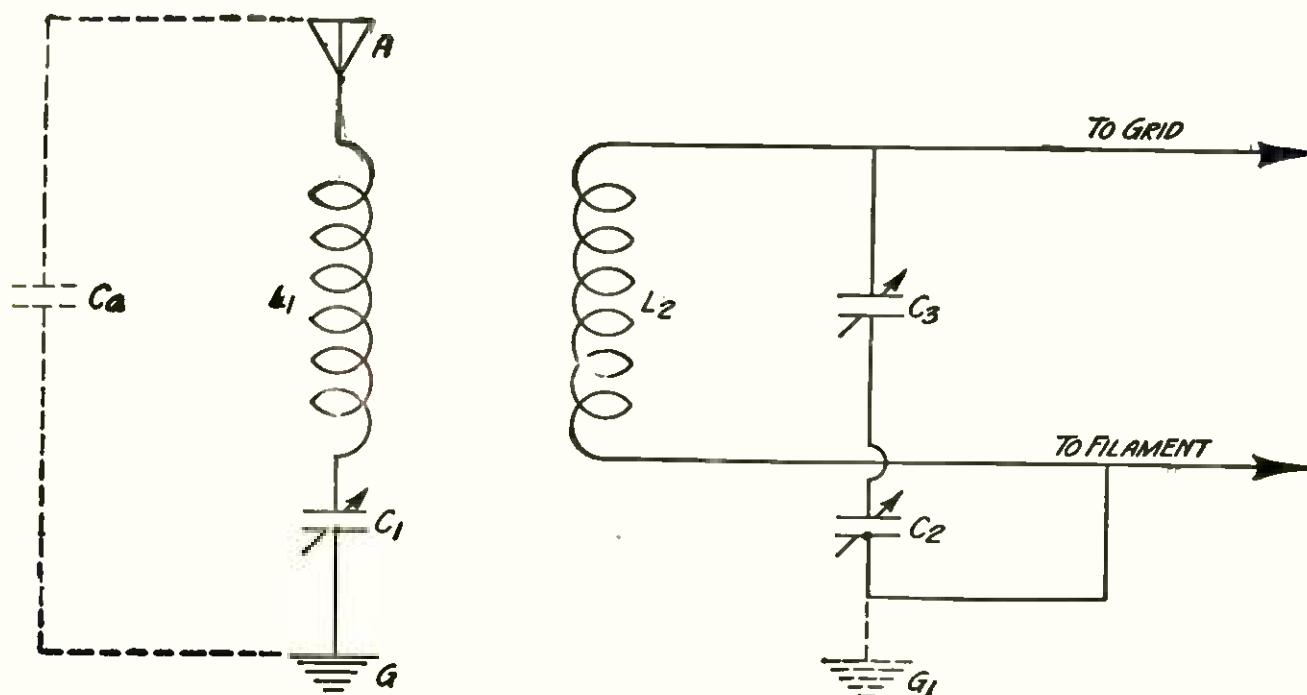


FIGURE 4: This diagram shows how to enable efficient reception of short wavelengths than allowed by the circuit in Figure 3. A small fixed or variable condenser is here inserted in series with the variometer.



TANDEM TUNING OF TWO CIRCUITS AT THE SAME TIME

FIGURE 5: This diagram shows the connections for tuning the antenna and the secondary circuits by means of two condensers, C_1 and C_2 . These two condensers may be mounted on the same shaft or they may be a double-unit condenser with both rotors connected together. This effect would be suitable in this circuit as all it would do would be to connect another ground on to the condenser, C_2 . After tuning in a station with this kind of a tuning unit, the best results will be obtained by adjusting condenser C_3 to compensate for the antenna capacity shown at C_a , after which this adjustment may be left set and all further tuning being done by turning the knob that controls C_1 and C_2 simultaneously.

tions, are moved practically in unison, they may be replaced by a tandem or double condenser having a single shaft and dial for operating both. If the tandem condenser has the rotors electrically connected together, as is the case usually, no harm will result; the effect is that of connecting the secondary circuit (as well as the primary) to ground, as indicated by the dotted earth G_1 in Figure 5.

To set up and use this circuit you do not need to know in advance what the capacity of your antenna may be. By using matched coils and a well-equalized tandem condenser you eliminate all uncompensated elements except the condenser C_3 . If as your first operation you pick up a broadcasting station by careful adjustment of both the tandem condenser (C_1 , C_2) and the series condenser C_3 , you will quickly and practically automatically find a setting for C_3 at which signals are loudest and which thereafter needs not be changed. If you make this preliminary adjust-

ment with L_1 and L_2 fairly well separated, and if your various circuit elements are properly balanced, you can thereafter tune with the one knob of the tandem condenser.

If the coils and condensers or the other circuit elements are not equalized, their variations may tend to prevent the simultaneous attainment of exactly the best conditions in both circuits. This may be compensated for by using C_3 as a supplementary "vernier."

Figure 1 indicates the tuned secondary circuit connected directly to a vacuum tube detector with telephone receivers in its plate circuit. The same connections may be used with any of the tuned circuit arrangements shown.

In the next article I will describe the single control applied to the small-antenna circuit such as that of Figure 1, and will take up the use of these coupled tuned antenna systems for increasing the selectivity of simple regenerative sets and of radio frequency amplifier receivers.



The MEN WHO

10th Installment

One of the Developers of the Superheterodyne Idea

H. W. HOUCK worked with Major Edwin H. Armstrong during the war, and was one of the men responsible for the development of the important superheterodyne idea. In more recent years he has attracted attention by his invention and development of the method of using the second harmonic for amplification according to the superheterodyne principle.



The Father of the Reflex Circuit

WILLIAM H. PRIESS might be called the "father of the reflex circuit." Reaching an early decision that this circuit offered great possibilities for high-quality reception on the broadcast wavelengths, as well as by its familiar economy of tubes, Mr. Priess has stuck consistently to its development, being responsible for the design of several popular types of receiver.



The Inventor of the Magnetron

THE application of magnetic forces to the control of the electron stream in vacuum tubes is the subject with which the name of Dr. A. W. Hull is especially connected. He is the inventor of the magnetron, an electron tube in which the alternating magnetic field of the filament is made to control the electron stream. These magnetrons are used as low-frequency oscillators and as protective devices against surge currents induced by lightning.

MADE RADIO

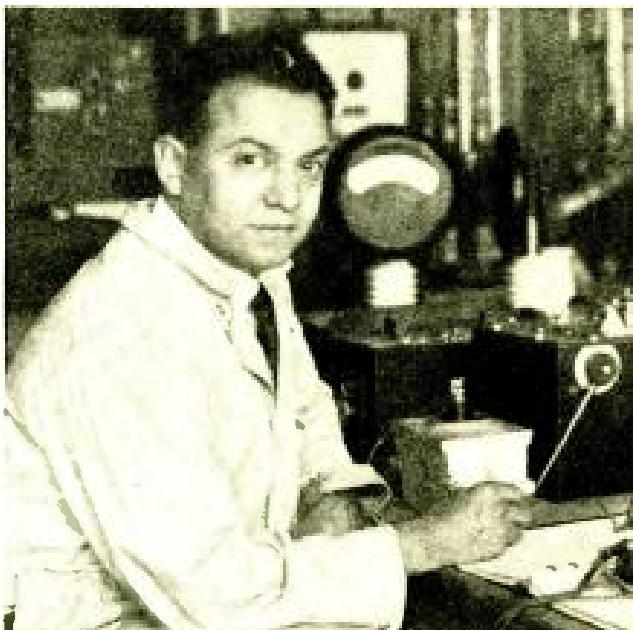
The Creator of the High- Speed Finch Relay

PRESENT-DAY use of radio for the rapid distribution of news and similar telegraphic dispatches owes much to the genius of William G. H. Finch. He is the inventor of the sensitive, high-speed relay used in such devices and which bears his name. Many other devices used in modern radio and telegraph printers have also been worked out by him.



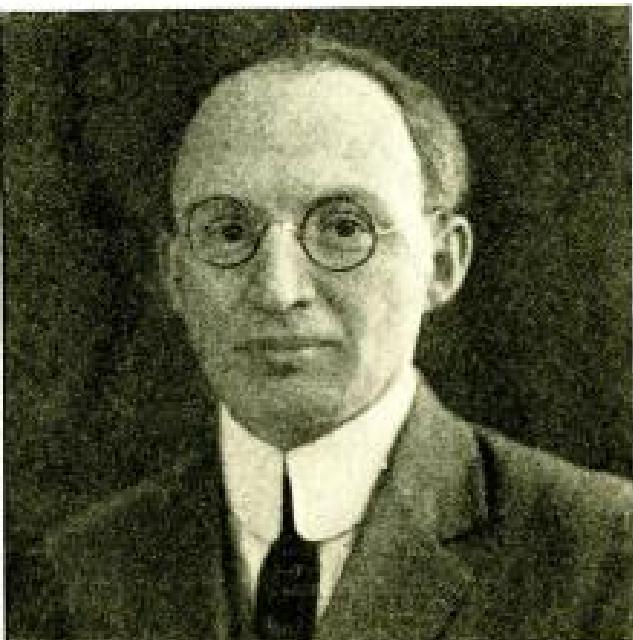
A Pioneer Maker of High-grade Condensers

WILLIAM DUBILIER was a pioneer in the manufacture of high-grade condensers for radio use. Transmitting condensers of his design were used by many of the early amateurs. His name is well-known to present-day broadcast enthusiasts through the small fixed condensers now so widely used, a field of manufacture which he has made particularly his own.

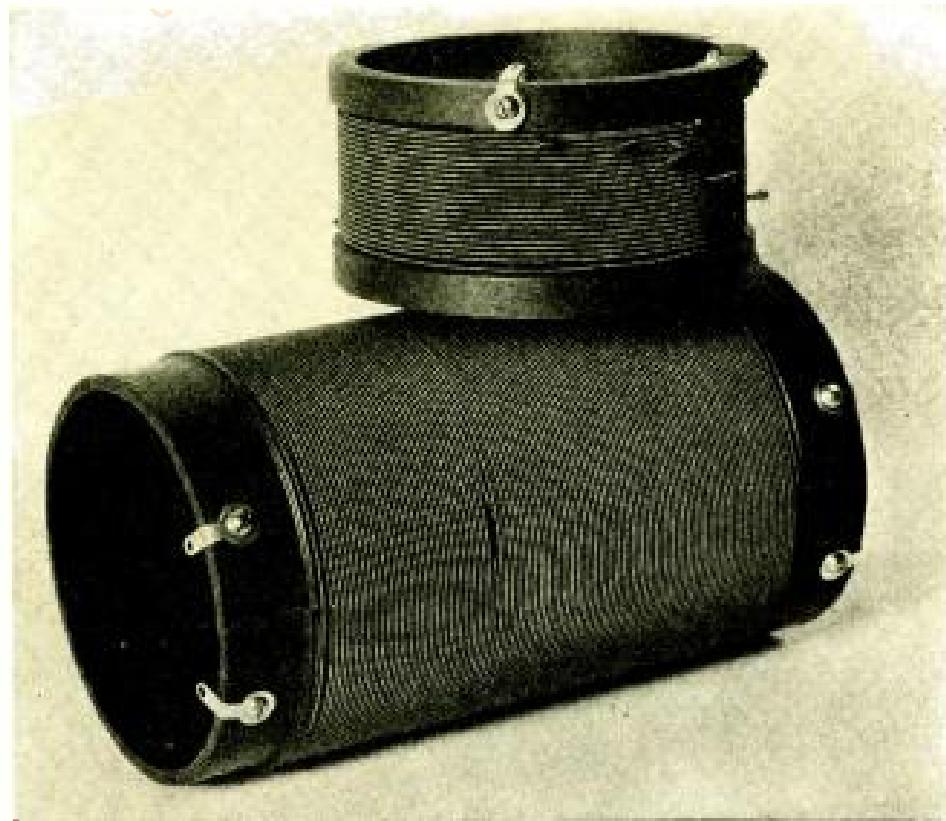


A Foremost Expert on Vacuum Tubes

ONE of the American physicists whose work has been of great importance to radio is Dr. Saul Dushman, of the Research Laboratories of the General Electric Company. Dr. Dushman is known especially for his work on the properties of very high vacua and on how to obtain these extreme degrees of evacuation. This work has been of utility in the design and manufacture of radio vacuum tubes.



General Electric



THE SINGLE LAYER SOLENOID IS THE IDEAL RADIO-FREQUENCY COIL

FIGURE 1: *This type of coil has been shown to have the highest efficiency (together with the one shown in Figure 2) of any of the coils in the following illustrations.*

WHAT MAKES A Low-loss Coil?

Radio fans and experimenters usually connect the term "low-loss" coil in their minds with some sort of a multi-layer coil which contains no dielectric supporting material. Some interesting facts that prove that this is not the case are contained in this short article by--

CHARLES T. BURKE

THE elusive ohms have been all but driven out of condensers—although a few still lurk here and there.

Now the attention of designers and manufacturers is being concentrated on the task of driving out the ohms that reside in the coils.

It would seem that some of the designers are in league with the enemy, for instead of driving out the ohms, they are actually opening wide the gates and letting a stream of the destroyers of efficiency and sharp tuning pour through their open-work windings.

It is the purpose of this article to point out the places where the ohms

sneak in, and straighten out the corners where they hide.

In judging a coil, it is not sufficient to know only the number of ohms that have found their way in and settled down. We must also know the size of the coil, as electrically large coils will always have more ohms than small ones.

The electrical size of a coil, called its inductance, is measured in henries. This name is derived from Joseph Henry, perhaps America's greatest electrical genius. The more henries a coil contains the less serious is a given number of ohms.

The wavelength or frequency, at

which the coil is measured or used, is also important. The resistance should be measured at some frequency within the band used in broadcasting. The figure often given is the "power factor" of the coil. This is the resistance (ohms) / 6.28 X frequency (cycles) X Inductance (henries). This figure is an actual index of the behavior of the coil in the circuit, and should be as low as possible.

By considering the coil at one frequency, for example one million cycles (300 meters), we can reduce the number of factors that must be borne in mind. The "figure of merit" for a coil then becomes, ohms henries, or ohms per henry. The ohms measured at one million cycles are here used.

Coils used at broadcast wavelengths have much less than a henry inductance, so that they are usually measured in microhenries, just as condensers are measured in microfarads.

A microhenry is one millionth of a henry. For use with a .0005 m.f. condenser, a coil should have about 200 microhenries inductance.

Another unit, the millihenry is also used. A millihenry is 1,000 microhenries, that is, a 200 microhenry coil has 0.2 millihenries.



AN INDUCTANCE STANDARD

FIGURE 2: This type of coil is a standard inductance manufactured by a well-known concern; its efficiency is of the same high order as that shown in the coil in Figure 1.

Ohms come from several sources. The resistance loss, properly speaking, arises from the reluctance of the metal in the wire to allow a current to pass. It is comparable to the friction in an automobile running on a hard level road. There are other losses, however, that have the same effect as resistance. These are due to absorption of energy in metal and dielectric near the coil. These losses may be compared to the energies wasted by an automobile running through sand. They depend on frequency and on the shape of the coil, as the wind resistance in an automobile does on the lines of the car. They have the same effect as the wire, or friction resistance, that is, absorb power. They are therefore lumped together with the wire resistance and known as the effective resistance. It is these "effective ohms" we must consider.

The wire resistance is the largest contributor to the total ohms of well-designed coils. For this reason the most obvious way of removing ohms is to reduce the wire resistance. Any method of coil construction which increases wire resistance must be viewed with suspicion. Wire resistance increases with the length of the wire and decreases to a certain point as the wire size is increased.



A COIL WITH CUT-AWAY INSULATOR

FIGURE 3: A cut-away coil wound with multi-strand wire that has been found to be almost but not quite as efficient as the straight solenoid type.



A BASKET-WEAVE COIL

FIGURE 4: *The losses in this form of coil are considerably greater than in the coils shown in the three previous figures.*

Perhaps the first question to be decided in building a coil is the size of wire to be used.

At first it would seem that the larger the wire, the lower its resistance would be. This is not the case, however, when radio-frequency currents are involved. This is because only a part of the area of the wire is then used. The tendency to crowd toward the outside of the wire is more marked in the larger sizes of wire. Currents are also set up in the larger wires that swirl about inside the wire, causing a loss and increasing the effective resistance. Because of this, we find the coil resistance will gradually decrease as the wire size grows larger, until a certain point is reached, when further increase in the wire size increases the resistance. The size of wire where minimum resistance is obtained falls in the lower twenties for the broadcast wavelengths. Measurements show that the hollow is not very sharply defined, and wire as small as No. 26 may be used. For sizes larger than No. 18 or No. 20 the resistance begins to rise.

The spacing of the turns also affects the distribution of current in the wire. Near-by wires tend to still further re-

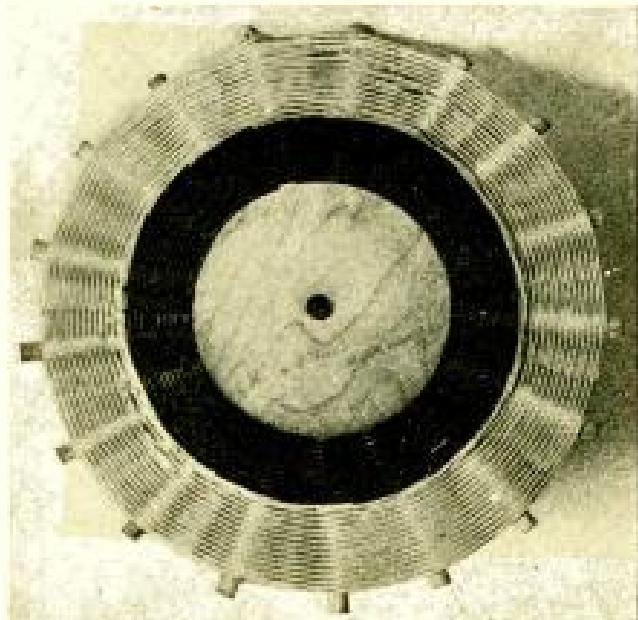
duce the effective area. For this reason double cotton or silk over cotton insulation is advisable to provide spacing.

The next question that must be settled is the shape of coil.

The inductance is determined by the requirements of the circuit in which the coil is to be used. In order to keep the wire resistance at a minimum, the coil must be so shaped that the smallest possible amount of wire shall be used. The inductance per turn is proportional to the area, so that the cross-section of the coil should be such as will have the greatest area for its circumference. This shape is the circle.

The length of the coil is also important. The leakage in long coils reduces the inductance and makes more turns necessary. The resistance rises in the shorter coils. Experiments show the most desirable length to be about equal to the coil diameter.

So far we have not considered the effect of absorption in the material, or of distributed capacity. The effect of distributed capacity is to slightly reduce the effective inductance, making more turns and more ohms necessary to get



A BASKET-WEAVE COIL ON A FORM

FIGURE 5: *This type of coil wound on a wooden core with radial spokes was also found to be less efficient in a tuning circuit.*

the required inductance. The effect of distributed capacity has been greatly exaggerated. In single-layer cylindrical coils of the type described above, it is almost entirely negligible.

Another source of loss is absorption of energy by the form on which the coil is wound. This loss has also been greatly overestimated. Absorption decreases as the frequency is increased. At radio-frequencies it can be made one of the smallest sources of loss. The reduction of absorption loss is one of the factors that establishes the rule that coil length should equal diameter. This same question was raised in condenser design and gave rise to the metal end-plate craze. Metal end-plates in condensers may introduce as much loss as they eliminate, and hard-rubber end-plate condensers are again rated high among "low loss" equipment.

In coils also, care must be taken lest in trying to eliminate one loss we cause a greater loss. A great number of coils have appeared having various kinds of criss-cross windings that make them self-supporting. As the cross-section of these coils is *not circular*, more wire is required to obtain the desired inductance and loss is introduced in order to eliminate other losses. The question is whether or not there is a net gain. Measurements have shown that when the form (of bakelite) was removed from a cylindrical coil designed along the lines of the ideal cylindrical coil, a barely measurable decrease in resistance was found.

Bearing in mind that the resistance increases in proportion to the length of wire, it seems certain that the increase of resistance when the self-supporting coils are substituted will be more than "barely measurable." This proved to be the case. Some of these coils had as high as twice the resistance of the cylindrical coil.

Even if the coil has been well-



ANOTHER SELF-SUPPORTING COIL

FIGURE 6: A special form of multi-layer coil, in which the losses were found to be excessive as compared to the straight single-layer solenoid type of winding.

designed, losses having the same effect as resistance may be introduced by metal near the coil. Large terminals should be avoided. Coils mounted on the backs of condensers should be spaced an inch or so from the condenser. The practice of mounting condensers inside of coils is very bad.

To sum up: if you are seeking a coil to give your set its highest efficiency, a dwelling place of "active vigorous henries" rather than a home for "infirm ohms," you will do well to select or wind a coil to these specifications.

When building your coils keep these points in mind:

1. Select cylindrical, single-layer coil, wound on a moistureproof form.
2. The length should be about equal to the diameter. (This permits wide spacing on coils for low wavelength, where it is important).
3. Use wire sizes from No. 18 to No. 28 (the nearer to No. 18 the better).
4. Use small terminals.

By following these rules, the coil resistance may be reduced to less than 10 ohms for the broadcast range of frequencies.

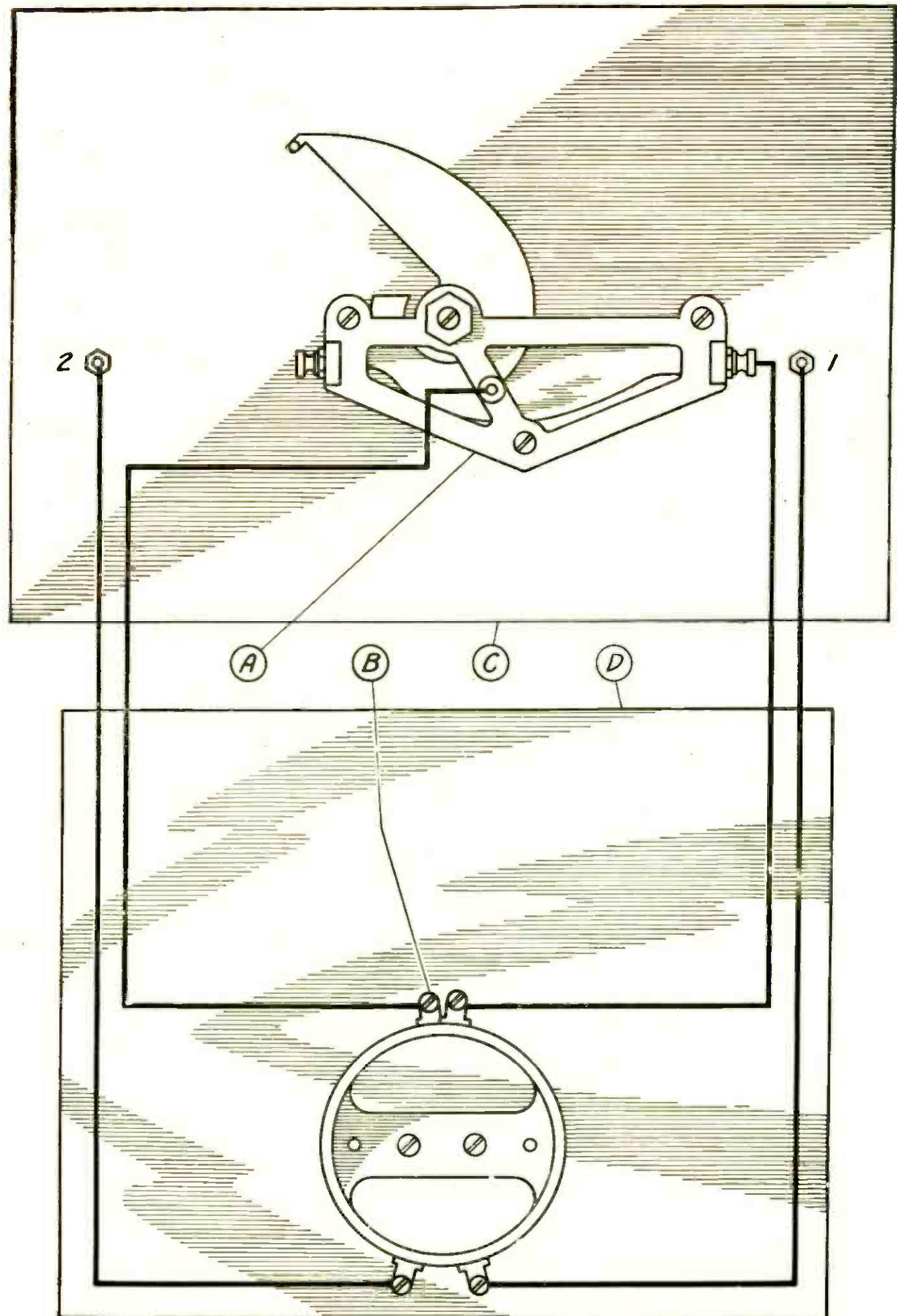
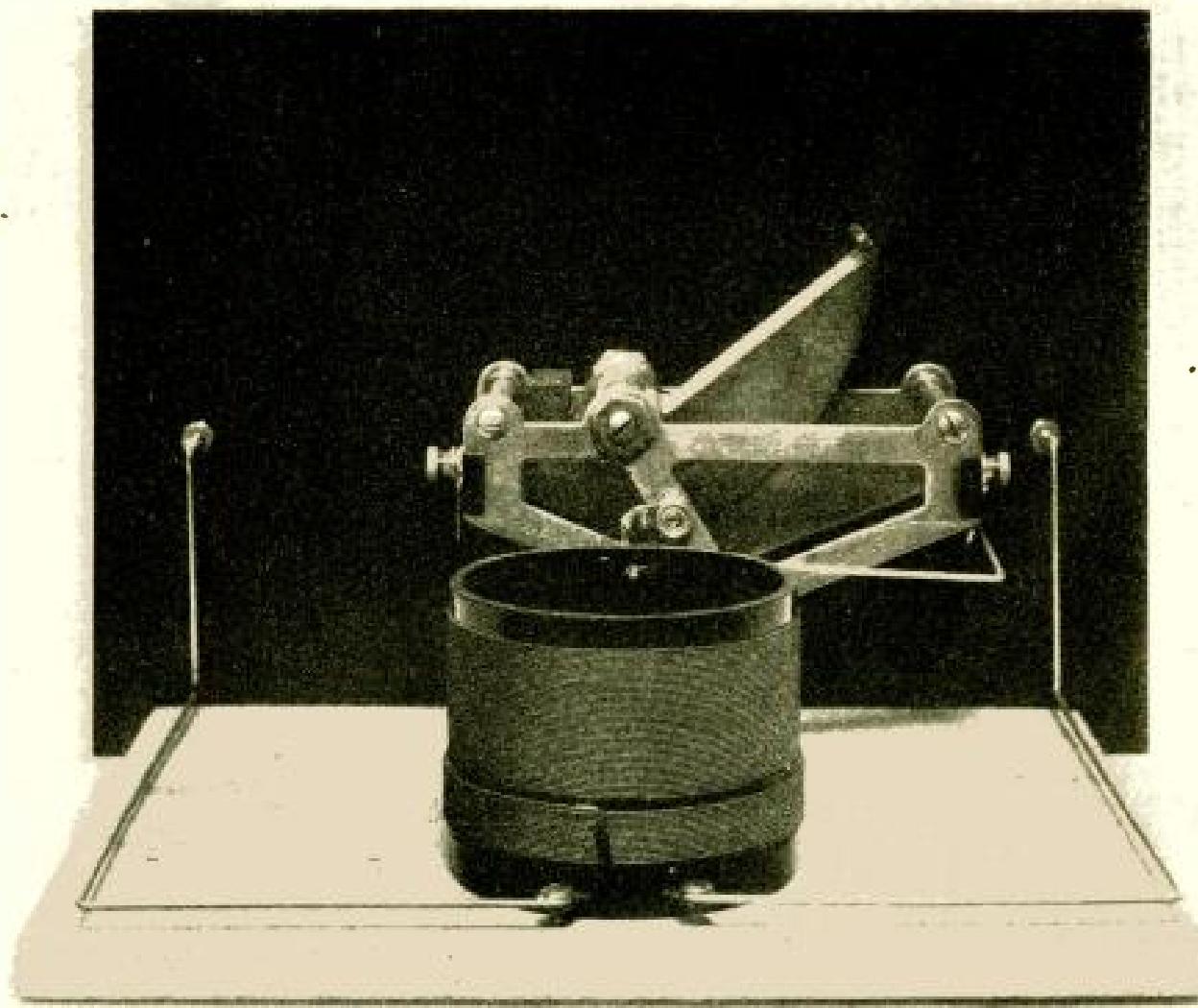


FIGURE 1: *The "picture diagram" of the wavetrap*



THE REAR VIEW OF THE WAVETRAP

FIGURE 2: This view shows the wavetrap just as it was constructed. It clearly indicates the relative position of instruments and should be studied in connection with the picture diagram of Figure 1.

Simple "How-to-Build" Articles for Beginners No. 12

How to build an inductively-coupled wavetrap

By LAURENCE M. COCKADAY

COST OF PARTS: Not more than \$12.00

HERE ARE THE ITEMS YOU WILL NEED—

A—Karas Orthometric variable condenser,
.0005 mfd.;
B—General Radio antenna-coupling coil,
277-D;

C—composition panel, 7 inches by 10 inches
in size;
D—baseboard, 7 incnes by 8¾ inches;
2—Eby binding posts.

THE twelfth unit to be described in this series is an inductively-coupled wavetrap that is tuned with a straight-line-frequency variable condenser.

This unit has been especially designed to operate ahead of simple detector tuning units in which the tuning is not sharp enough for given locations extremely

close to broadcasting stations.

The unit will be found efficient when used with any of the preceding tuners described in this series, or with any other type of receiver in which tuning is not satisfactory.

This particular unit was built in the POPULAR RADIO LABORATORY for the purpose of supplying the beginner and the experimenter with details for an efficient wavetrap that can be used in connection with any crystal or vacuum-tube receiver.

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

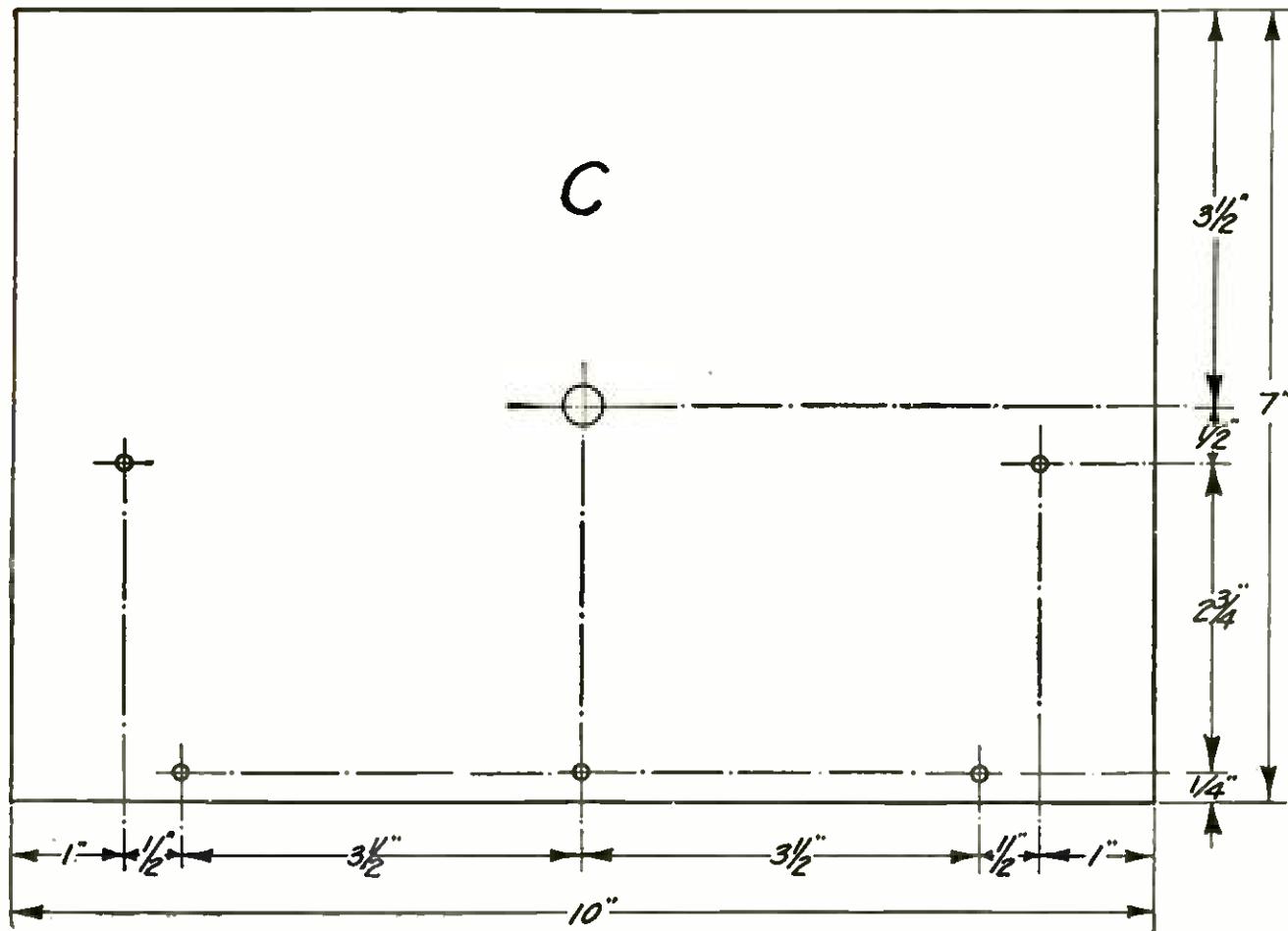
After you have obtained all of them find a satisfactory table or workbench on which to work, and lay out the parts on the baseboard as shown in Figures 1 and 2, after first drilling the panel "C" as shown in detail in Figure 3.

The position for the holes should be marked as shown in this latter diagram, in which the centers for the holes are given.

After drilling the panel, it should be fastened to the baseboard with one-inch nickel-plated screws, inserted through the three holes in the panel into the edge of the baseboard "D." Flat-head screws should be used and the holes in the panel should be countersunk to make a neat job.

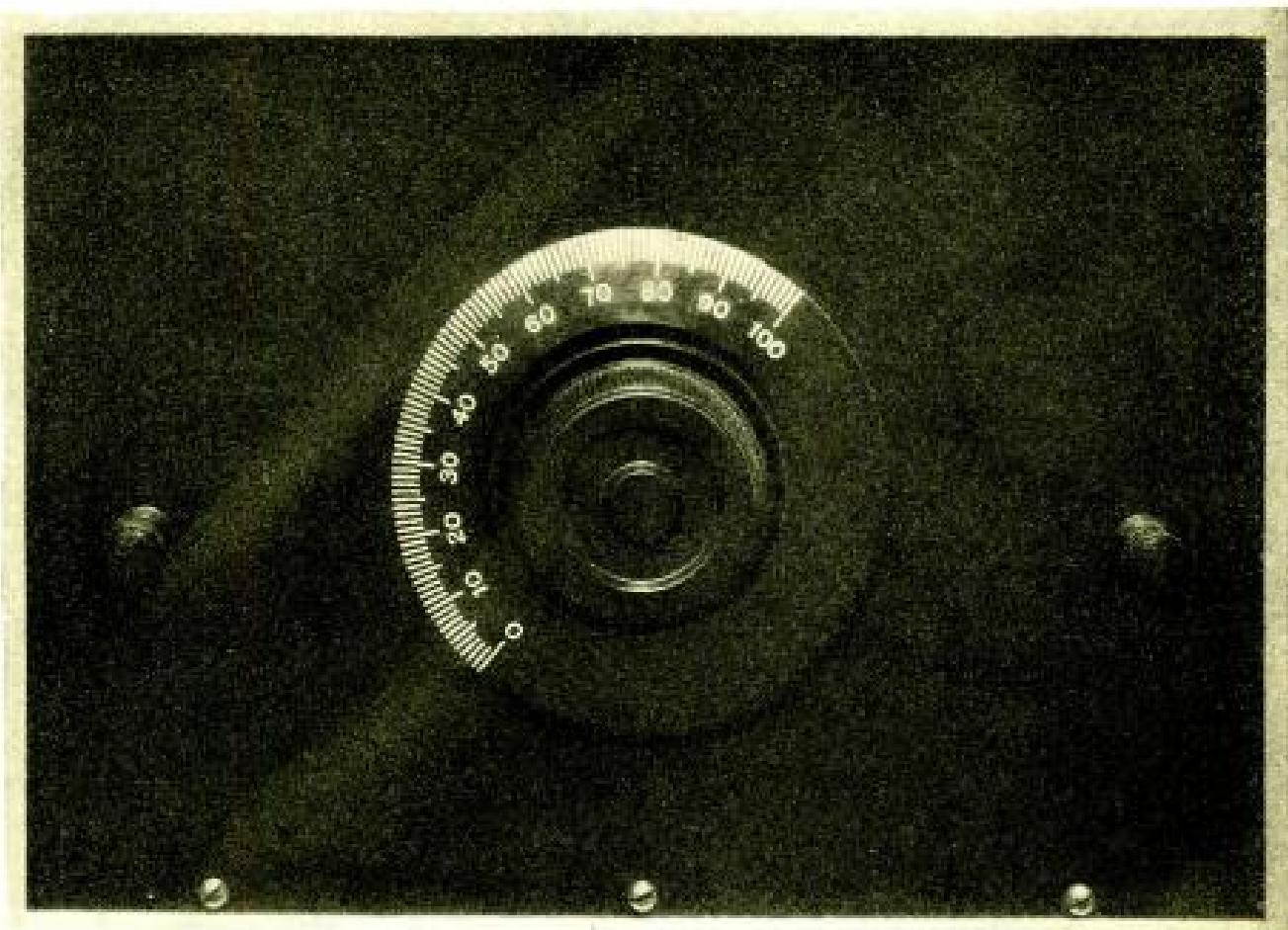
You are now ready to wire the unit and should have no difficulty if the picture diagram in Figure 1 is carefully followed. All parts are here marked with their designating letters which are also used in the list of parts so that there can be no possibility for mistake.

When the wiring has been completed the unit may be set up slightly to the left of your present apparatus, and connected in series with the antenna lead-in



THE PANEL DRILLING PLAN

FIGURE 3: This drawing gives the dimensions for the panel and also the exact spacing for all the holes which must be drilled in the panel.



THE PANEL ARRANGEMENT

FIGURE 4: This picture shows the front view of the panel with the condenser mounted in the center and one binding post at each end.

wire that goes to the set.

Connect the binding post numbered 1 in Figure 1 to the antenna wire which used to run to your set. Then connect the binding post numbered 2 to the antenna post on the receiver.

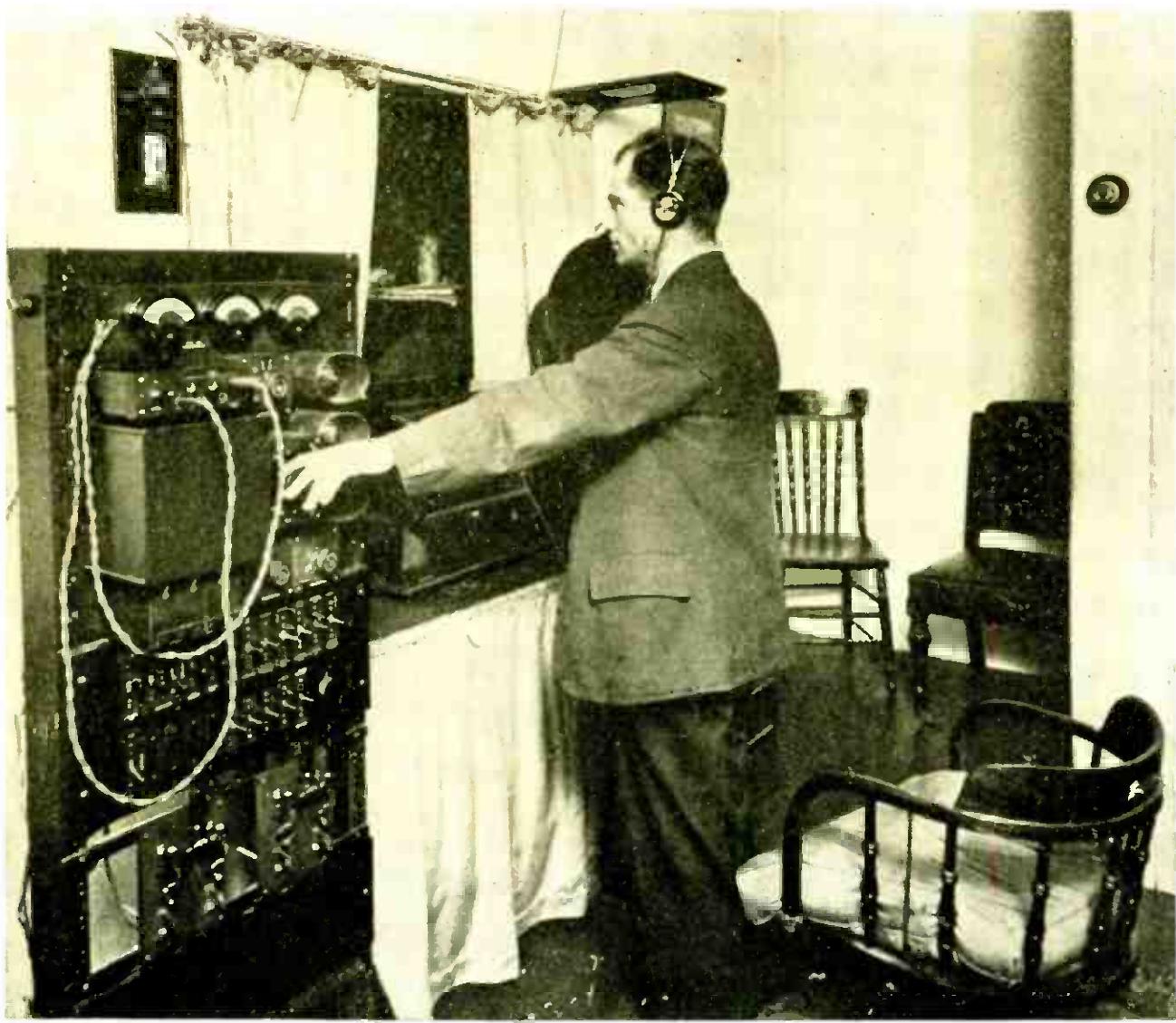
By adjusting the variable condenser "A" to a particular setting this unit will tune out any interfering station that gives you trouble, and you may leave

it "set" at this point while you tune in other and more distant stations that you want to hear on your receiver.

When this unit is properly built and properly connected, it will provide the experimenter with a tuning element that will help him eliminate much trouble and inconvenience from interfering signals that are transmitted from powerful nearby stations.

The Causes and Cures of "Soured Sounds" in the Receiver

The next article of the series by Paul Godley (the first of which starts on page 334 of this issue) will tell about the distortion that is caused by improper rectification by the detector, improperly designed amplifier transformers and the overloading of the tubes. The cures of these common troubles are simple—as the author will point out.



Barratt, London

"MONITORING" A PROGRAM

During orchestral and vocal renditions there are sometimes spots of the program that are too weak to broadcast or too powerful for the modulating apparatus to handle satisfactorily. So an operator listens in on the amplifying circuit and tries to reduce or bring up the volume so that these two extreme limits are never overreached. This picture shows the modulation control apparatus in station 3LO, in Melbourne, Australia.

Secrets of the Studio

How science is solving some of the finer problems
in the broadcasting of music

By PAUL GODLEY

TO the majority of fans radio means music of one sort or another.

I believe that pleasant music is the only kind of music that anyone really cares to listen to. What a despicable individual would he be who, during the performance of a great artist, cast upon the ears of those who listened some

fiendish spell to sour the harmony! Many radio set builders, unknowingly no doubt, do just this!

Have you ever looked into the funny mirrors at the amusement park? If so, you should be able to imagine what music would sound like after reflection from such a mirror.

Ninety-five percent of all radio listeners hear funny "ear-pictures" of pianos, orchestras, quartets, and voices every day. A great many of these listeners have learned to know the difference for obvious reasons. Yet, given the opportunity, anyone can select the true picture from the cartoon. Even the most unsophisticated ear may be depended upon to turn away from the radio music that now fills many hundreds of thousands of homes when this same music is reproduced there in its *true* likeness. Very few persons would care to give up their radio. But, so many have shown keen interest in the business of improving the quality of music and speech to which they listen that it seems worth while to review some of the efforts being made to supply good radio programs—some of the difficulties which are encountered in doing this, and some of the quite convenient methods recently made available for tremendously increasing the effectiveness of radio programs in the home.

The high tide of broadcast entertainment during the season of 1924-25 was reached when one of the largest of America's musical instrument manufacturers put on a short series of radio programs through a group of broadcasting stations. Scattered over the entire continent, east of the Rockies, these stations were linked together by super-perfect long-distance telephone lines. This series of programs was so well advertised—so much talked about—that the reader has probably already guessed "Victor—John McCormick."

To the music lover the voices of McCormick and the other artists were, alone, enough to entrance. The fact that this experiment might prove of transcending importance to the future of broadcasting passed unnoticed by the average listener. On the other hand, there were a few listeners who were able to visualize what was taking place in the studio and actually hear with satisfaction everything for which they listened. The difference between the abilities of

the few and those of the average is wrapped up, entirely, in the character of the receiving and reproducing equipment used. It might as well be stated right here that a large percentage of the radio receiving equipment which has been sold to the American public up to this time fails miserably when it comes to the reproduction of sweet music.

A considerable amount of progress has been made in the art of producing the proper effects before the microphone and in getting these effects onto the air.

There are, of course, different classes of broadcasting stations. Some are well equipped and properly manned by technical experts and are provided with sufficient funds to insure that their work is of the best. Many of the smaller stations, while doing the best with what they have, are unable through lack of facilities to perform with the startling effectiveness of that goodly number of major stations which are now to be found throughout the country.

The first difficulty encountered by the engineer in the faithful transmission of a musical program is that of designing his microphone and its auxiliary voice-amplifying equipment so as to handle effectively all of the tones of the musical scale. This difficulty he has been able to overcome through a careful analysis of the limits of voice-amplifier equipment. Perfect programs are now being perfectly transmitted. When handled with the same effectiveness on the receiving end, quality of tone, the beauty of shading, the actual atmosphere of the studio, and best of all, those certain intangible bits of personality of the artist himself are thrown with uncanny reality into the home of the listener in a way which the most perfect laboratory phonograph ever conceived could not hope to approach.

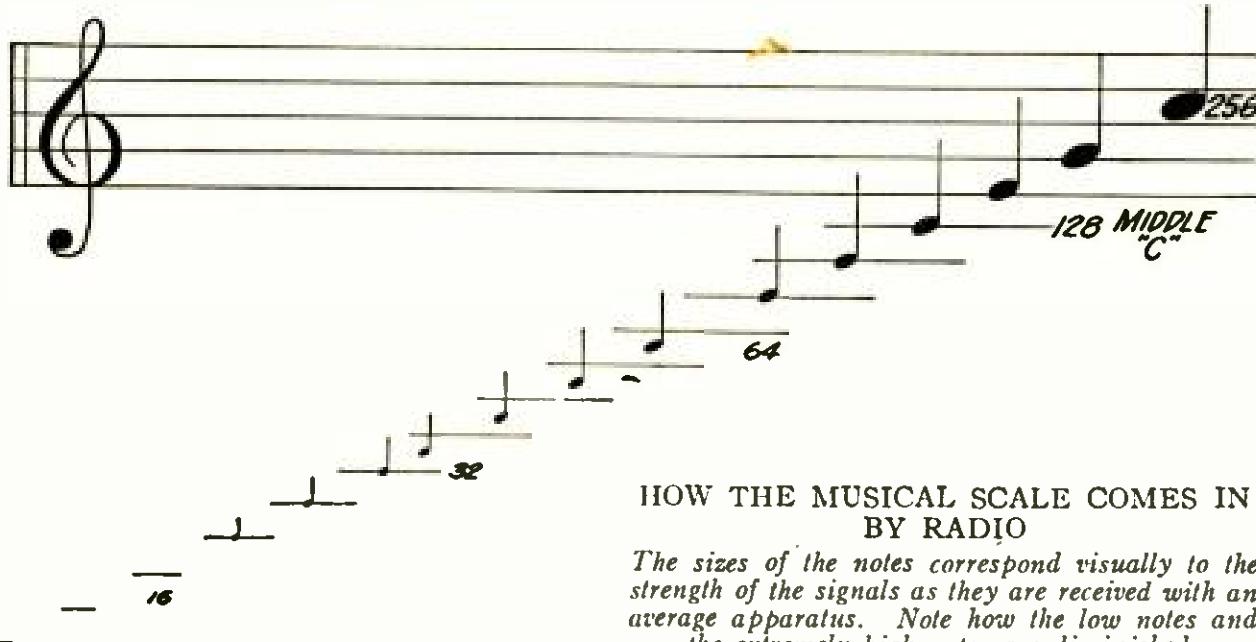
To those who are properly equipped by experience and with apparatus, an interesting pursuit is that of watching the unfolding of some of the special programs which broadcast stations now offer. Special programs in particular

are carefully rehearsed beforehand. A first-class broadcast station nowadays dares not offer an artist without insuring beyond all doubt that the artist and his musical numbers are suited to the radio and to the radio audience. No matter what the reputation of the artist may be, a rehearsal is always insisted upon and invariably that rehearsal takes place in the studio so that the artist may feel at home when he comes before the microphone.

Strange as it may seem, the greater the artist, the more apt he is to lose his poise when his performance begins. Usually he has been trained to sing before a visible audience. He invariably looks

shrieked that something was wrong. McCormick was unsteady. The volume of his voice was far from satisfactory with respect to that of the orchestra. The balance was poor, and although the selection itself was creditably performed, there was a sense of disappointment to think that with the unusual talent available in the Victor organization and in the organization of the broadcasting station such an unfortunate "hearing" should have developed.

It is interesting to note here how well the observations of these analysts and their deductions concerning what was happening checked with the actual happenings in the studio. The human



HOW THE MUSICAL SCALE COMES IN BY RADIO

The sizes of the notes correspond visually to the strength of the signals as they are received with an average apparatus. Note how the low notes and the extremely high notes are diminished.

for and depends upon the reaction of the audience for inspiration. Before the microphone he pictures a vast throng of attentive, listening people. His inability to see or hear this audience affects him as would a chilly reception. The studio environment—the cold mechanics of the microphone—no doubt encourage this trend of thought.

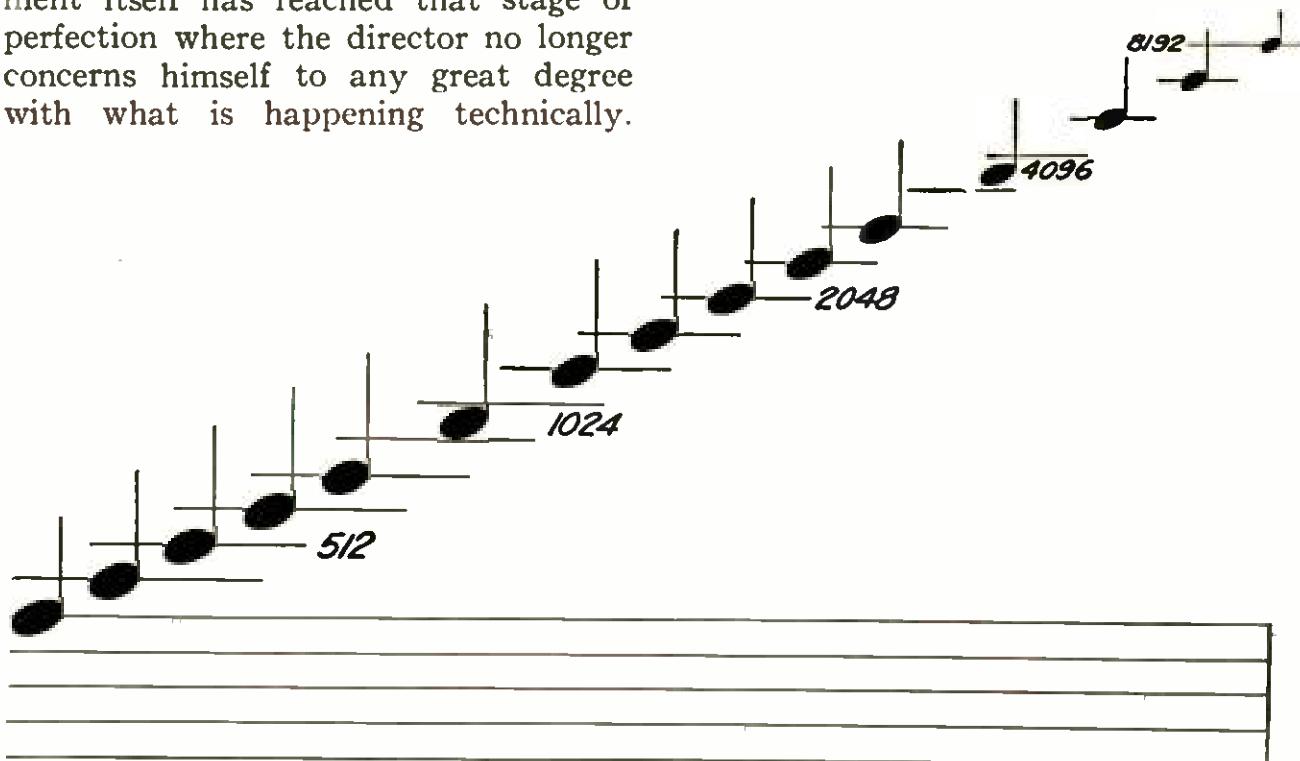
A small group of analysts were listening to McCormick's first radio effort. In the prelude of the orchestra no flaws due to lack of balance of the various instruments could be noticed. As soon as McCormick began to sing, however, the very atmosphere of the studio

factor had crept in to spoil the finish of an otherwise beautiful number. McCormick was actually frightened, and although he had rehearsed this number in this same studio before the microphone and reproduced satisfactorily, the actual performance found him a subject of microphone fright. Succeeding numbers showed improvement, due to maneuvers on the part of the directors, such as a change in the position of the microphone. Many of these maneuvers were clearly followed by the critical listeners.

This illustrates some of the finer points with which the directors of radio

programs deal. That thing which they fear most is the human element and is, of course, the thing over which they have the least control. The technical development of the broadcasting equipment itself has reached that stage of perfection where the director no longer concerns himself to any great degree with what is happening technically.

of equipment which has given most trouble is that one popularly known as the audio-frequency transformer, and it is in connection with this device and others that the latest important ad-



What actually does happen technically is, of course, very interesting.

During the few years in which we have had broadcasting, the microphone has been refined considerably.

Microphones used in the first-class stations, although they vary in construction and in principle of operation, are all capable of comfortably handling the required amount of tonal energy regardless of the pitch of the tone. It should be apparent to the reader that for true fidelity of reproduction, the microphone must treat all tones exactly alike. Having accomplished this result it is necessary that all tones should be handled in the same manner by such other equipment as lies between the microphone and the air. Circuits of all descriptions, from the tone amplifiers to the modulator circuits of the high power transmitter working into the antenna, must function without the introduction of tone distortion of any sort. The particular unit in this chain

vances in the broadcasting station equipment have been made. This will be taken up in detail in the second of this series of articles.

In all properly-manned broadcasting stations there is placed at the switchboard an operator who spends his time carefully—or idly—watching the caprices of a small electrical indicating instrument. In the early days of broadcasting the "game" which this operator played was that of controlling the skippings and hoppings of this indicator. On the dial over which the indicator plays perhaps a red mark might be observed. When the needle goes above it, what is known as "blasting" is taking place.

"Blasting" is the overloading of the electrical equipment in the station by the performer. It may come about because the artist has been placed too close to the microphone or because the artist is speaking, singing, or playing with too great volume. Regardless of



Barratt, London

A DIFFICULT FEAT IN BROADCASTING
To reproduce all the harmonics that occur with a selection on the large chimes, is a difficult problem, as the lowest notes of the larger tubes only reproduce in the loudspeaker with a portion of their true volume, as explained in the diagram on the two preceding pages.

the cause the result is the same, and it is easy to foresee some of the effects upon the rendition of various numbers which the efforts of this operator might produce. If a few bars of music are being played softly, and the needle hovers down toward the lower part of the scale, the operator manipulates a control-dial which renders the soft music loud. Contrariwise, if certain portions of the selection are being rendered with vigor it is likely that this operator will soften it to a considerable degree. These operations are, of course, ruinous to the

expression which the composer has, at such great pains, instilled into his composition.

There are many radio broadcasting stations which still use this despicable method. It should be abolished. It is wholly unnecessary and is a process painful to the lover of music.

The up-to-date method leaves nothing to be desired in the way of expression. The retention of this expression calls for intermediary equipment capable of satisfactorily handling energies which vary considerably in their magnitude. But, while the operator above mentioned is still watchfully present his duties are more in the nature of an observer of unusual phenomenon. As an augmentation to his efforts a listener with the ear of a musical critic is placed on duty in order that he may take note of the shadings and balance and the many little touches of the maestro which go to make up the superlative in musical creations. He it is who suggests a re-positioning of an instrument here or there or a change in the position of the microphone, or the adjustment of one of the draperies on the further wall.

Presumably, it is quite generally known by now that all broadcasting stations are specially decorated. Somewhere, in relating her first experience in the studio of a broadcasting station, one of our well-known artists referred to the studio as a "padded cell." In the past, most studios have literally been this. The ceiling has been covered with felt, the walls with felt or drapery, and the windows with heavy drapery or curtains. The intent has been to prevent any rebounding or echoing from the walls.

The effect of speaking in one of these rooms is rather surprising. The speaker feels as though he were shut away from all earthly contacts. To the temperamental artist this effect is particularly distressing and is perhaps another reason why we have what is known as "mike-fright."

The effect at the listening end, when a

program is coming from a studio of this character, is also noticeable. It can best be likened perhaps to the phonograph record. There is nothing of studio atmosphere to be found in a phonograph record although the effect which the phonograph attempts to produce is that of the "living voice." The radio is, of course, expected to reproduce this effect and in the past perhaps the psychology of the moment, more than anything else, has enabled the broadcasting director to obtain the excellent reactions which he has secured. On the other hand, all radio listeners must have noticed that certain programs seem actually to project the atmosphere of the station into his own home and the thing which lends the most to this reproduction of atmosphere is the transmission of desirable, natural, studio sounds.

A great deal of time and study has been necessary before it was possible for the director to properly differentiate between those studio sounds which are desirable and those which are not. It is now possible for him to do this and in a large measure the "padded cell" idea has been replaced by the proper one where rebounding sounds from certain directions are actually encouraged in order that the natural effect at the

microphone may be obtained. The faithful reproduction of all tones and overtones from the very lowest ones of the tremendous pipe-organ to the highest tones of the violin, the subdued echoes of the studio, the bated breathing of the artist or artists, the rustling noises which are always present even with a small group of performers, taken together are the atmosphere of the studio and it is predicted that the ability to transmit and receive these minor and heretofore discarded sounds will increase the popularity of radio tremendously.

As pointed out at the beginning of this article, an almost negligible percentage of listeners have to date been able to get these things on their radio and it is not because they are not now being transmitted. They are being transmitted from dozens of stations. The fault lies in the receiving equipment.

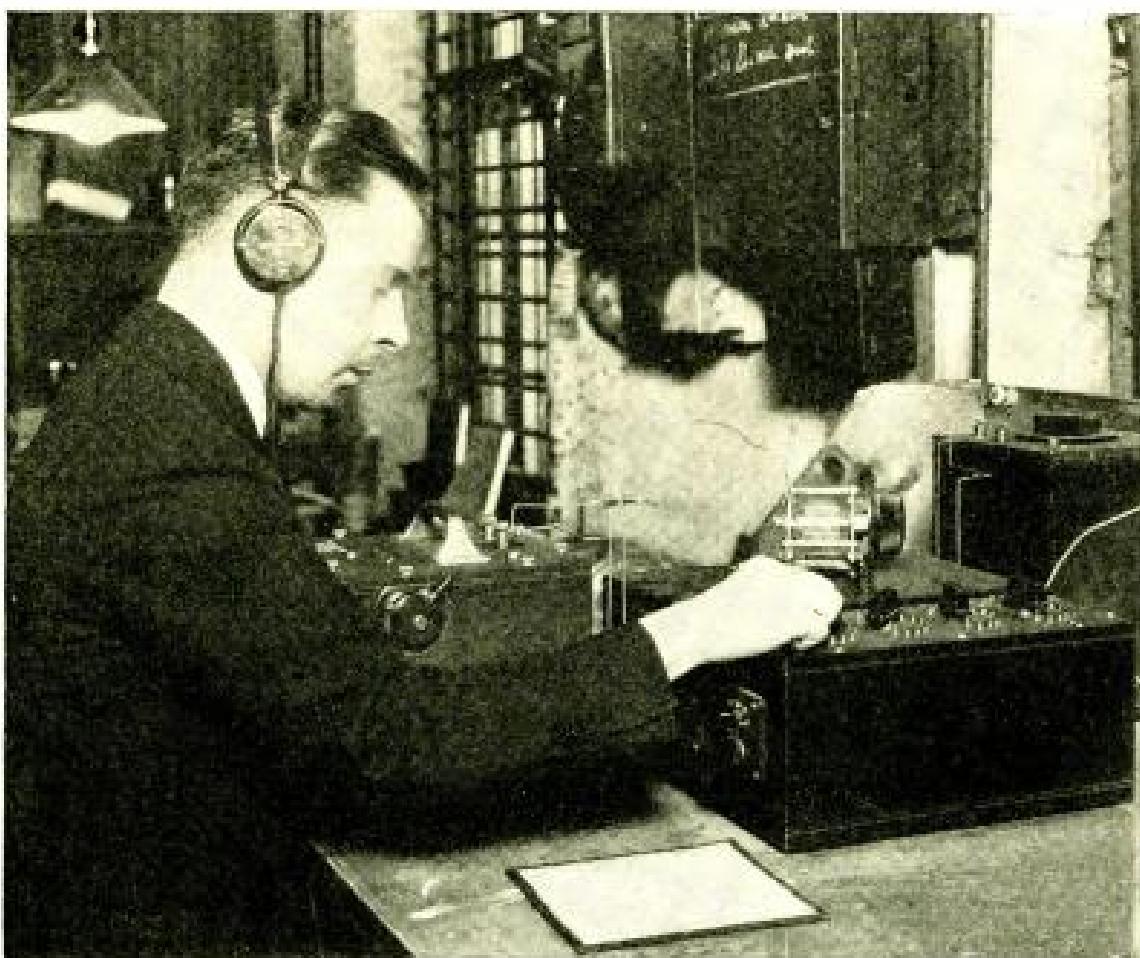
Articles that follow this one will point out wherein those deficiencies lie and will provide the reader with the simple instructions necessary to enable him to either revamp his present receiver or provide him with sufficient information to enable him to intelligently select truly modern types of radio receiving and reproducing equipment.



Kadel & Herbert

JAPANESE GIRLS GET INSTRUCTION BY RADIO

One of the business schools for women in Tokyo has installed a loudspeaker in a classroom, in order that its students may benefit from the lectures on radio mechanics that are broadcast from a local station.



From a photograph made for POPULAR RADIO

THE 1,000 CYCLE BRIDGE TEST

The author points out that this method of testing the resistance of condensers with a bridge (at the right) and a standard condenser is inaccurate because of variable factors that affect the resistance at audio and radio-frequencies.

HOW TO COMPARE LOSSES IN CONDENSERS

By SYLVAN HARRIS

BOTH manufacturers and engineers have sought the type of condenser that is most suitable for radio-reception apparatus, but they have neglected facts that have only recently been found; for example, that the resistance of a condenser rises to relatively great heights at the low dial settings. Furthermore, few have suggested that there might be causes of resistance in a condenser other than dielectric absorption, or questioned the generally accepted statement that the resistance of a condenser bears a simple inverse relation to the frequency.

That these miscalculations have been checked by a series of intensive tests, which have extended over a period of several months, is, therefore, a matter of importance to not only the set owner but to the manufacturer as well.

The most common way in which experimenters attempt to compare two condensers is illustrated in Figure 1. Here the two condensers to be compared are C₁ and C₂. They are connected to a double-pole, double-throw switch so that either one may be thrown in series with a pick-up coil and a current-indicating

device, such as a thermogalvanometer. This circuit is excited by electromagnetic waves that emanate from an oscillator shown in the figure.

Engineers have maintained that, in this comparison, when the condenser with the least resistance is thrown the current in the circuit becomes greater.

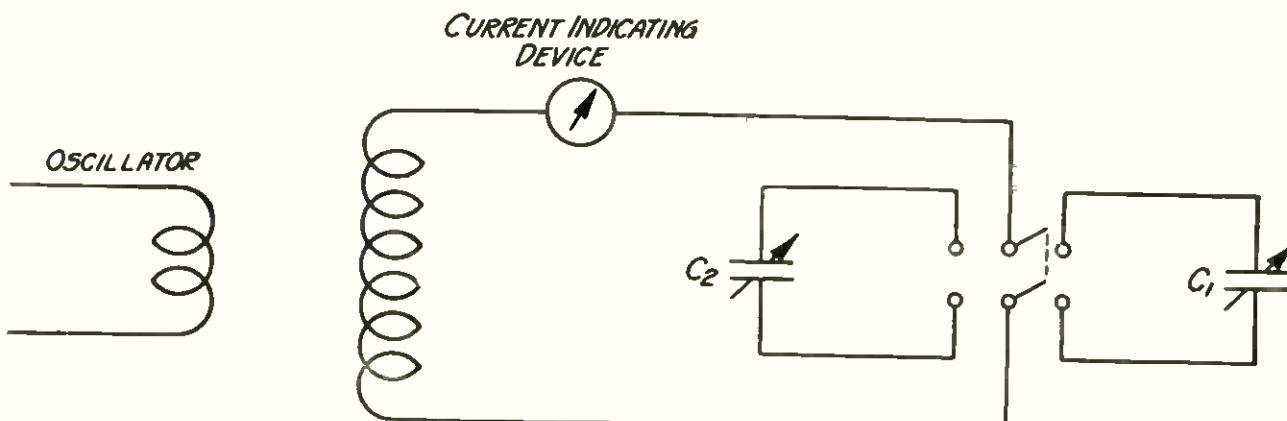
Fundamentally this idea is correct. But, there are technical details which, if neglected, may easily cause errors.

In the first place the condensers must be exactly the same size as regards capacity and dial setting. In the second place, the capacities of the two condensers must be the same at every dial setting. The reason for this primary requirement in making tests is that, since the measurements are made at a constant wavelength or frequency, the setting of C_2 may be way down on the dial, while that of C_1 may be at the other end of the dial.

Figure 2 shows that in a given condenser the resistance will vary with the setting of the plates, so that a fair comparison of two condensers could not be made unless it were made at the same dial setting. Thus, if C_1 were a large condenser, say .001 microfarad, and C_2 were a small one, say .00025, for both of them to resonate to the same wavelength with a given coil, the plates of C_1 would have to be way out and those of C_2 nearly entirely enmeshed.

The next difficulty with this method of making comparisons is the fact that generally the coil used at L has considerable resistance as compared with the resistances of the condensers to be compared. Suppose the resistances of these two condensers do not happen to differ much. Suppose they are .7 and .8 ohm, while the resistance of the coil is 10 ohms and that of the current meter is 4 ohms. Each condenser, when thrown into the circuit, will then be in series with a resistance of 14 ohms. The total resistance of the measuring circuit will be 14.7 ohms in one case, and 14.8 ohms in the other case. Changing from one condenser to the other, therefore, will mean a change of only .1 ohm out of over fourteen and a half ohms, or will represent a change of less than 7/10ths of one percent of the total resistance of the circuit. It is doubtful if, in most cases, this small change in the resistance of the circuit will show up in the current meter.

It has been found in the series of measurements referred to that the resistance of most of the condensers on the market does not differ much. The average of them all is slightly less than one ohm, and the majority of them lie between .7 and 1.5 ohms. It may be seen that, even if condensers are compared by this method, size for size, there may be many disturbing influences pres-



THE SIMPLEST METHOD OF TESTING A CONDENSER

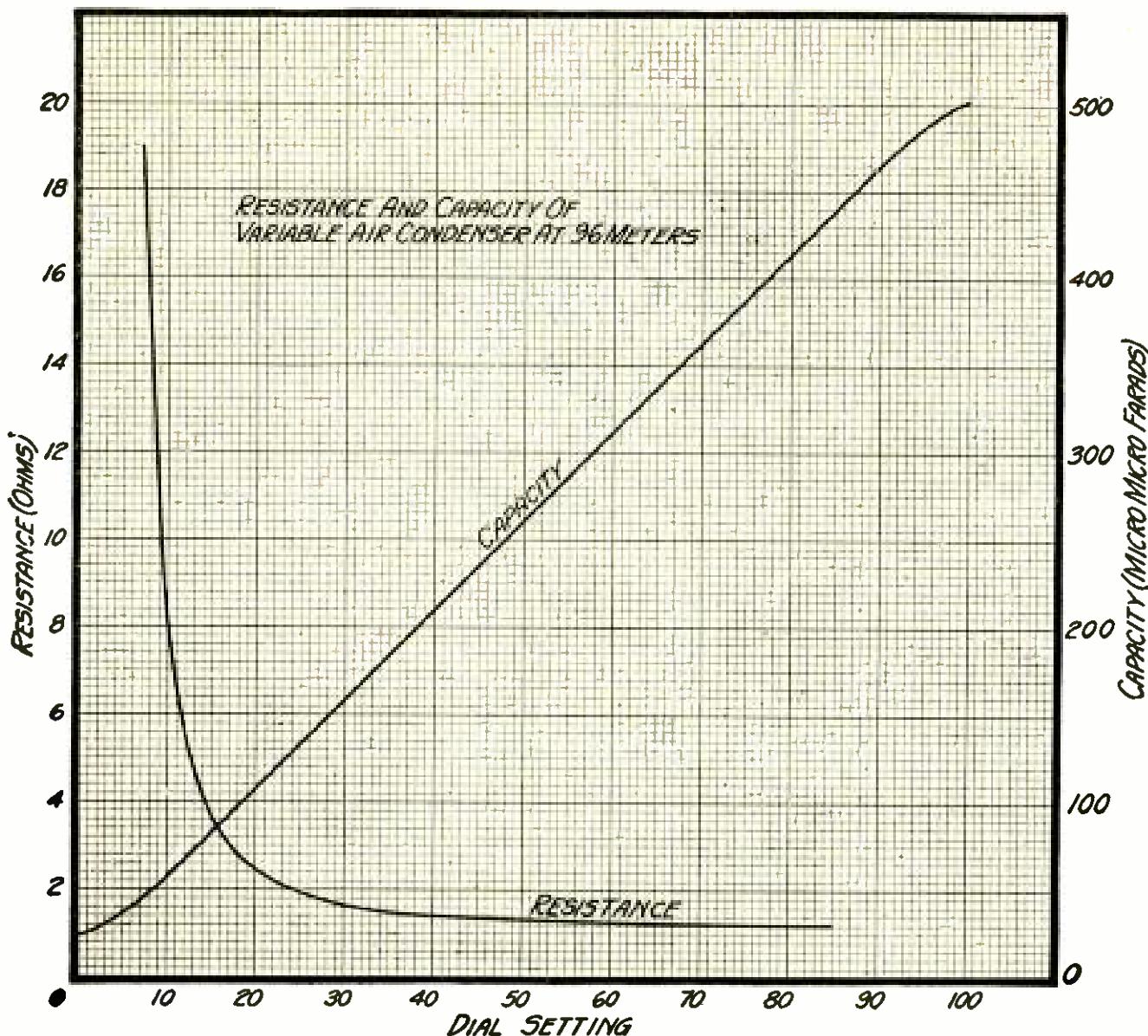
FIGURE 1: In this circuit the current is supposed to rise when C_1 is thrown in series with the pick-up coil circuit, if C_1 has a lower resistance than C_2 with which it is compared.

ent which will make such small changes very variable. The solution of this difficulty is the same as with the other method to be described; that is, the resistance of the coil or other inductor in the circuit must be made as low as the resistance to be measured, or lower. Likewise the resistance of the meter must be taken out of the circuit by using a shunt.

A method that has been often used to determine the resistance of a condenser at high frequencies is to measure the resistance of the condenser at a low or audible frequency, say 1,000 cycles, and

then to compute what its resistance ought to be at, say 1,000,000 cycles (or 300 meters). This has been done without accurate knowledge of the law of variation of condenser resistance with frequency. Reference to this method was given in the writer's previous article.* The resistance of the condenser is assumed to decrease in the same proportion as the frequency increases. Thus, if the resistance is 300 ohms at 1,000 cycles, its resistance at 1,000,000 cycles is supposed to be

* What You Ought to Know about Condensers, POPULAR RADIO, February, 1925; page 129.



THE VARIATION OF RESISTANCE WITH DIAL SETTINGS

FIGURE 2: These curves show that with a given condenser, the resistance is not the same when two condensers are set differently. This graph shows that no fair comparison can be made except at the same dial settings.



From a photograph made for POPULAR RADIO

HOW THE ORDINARY CONDENSER COMPARISON IS MADE

This shows the method of Figure 1 in operation. A current measurement with the standard condenser (at the left) is taken while the standard is in the circuit that contains the galvanometer, the pick-up coil and the oscillator on which the man's right hand rests. Then, the DPDT switch is thrown to take a galvanometer reading of the condenser (shown in the foreground) that is under test.

$$300 \times \frac{1.000}{1,000,000} = .3 \text{ ohm}$$

This would be correct if the resistance of the condenser were due only to its dielectric losses, but in this calculation the other losses are neglected.

Figure 3 is a chart which has been drawn from measurements made on a .0005 microfarad variable, air condenser of the so-called "low-loss" type. The horizontal scale has been divided evenly as an axis for the frequency. On account of the great range of the condenser resistance over the range of frequency covered, it was necessary to adopt a logarithmic scale for the vertical axis that represents the condenser resistance. This cuts down the size of the chart as each block (moving vertically) is ten times the block under it.

The actual points measured are A at

1,000 cycles (or 1 kilocycle), D at 3,125 kilocycles (96 meters) and twelve points falling between B and C. The points between B and C, when plotted to a more suitable scale, indicate very clearly that the curve is not linear, and the other points certainly indicate the same thing.

The shape of this curve will no doubt surprise many, especially those who have based their ideas and work on the simple inverse relation between resistance and frequency. This relation is shown in the computed curve marked "dielectric losses," and has been computed from the 1,000 cycle measurement, as explained above.

The reason for the shape of the curve may be explained somewhat as follows:

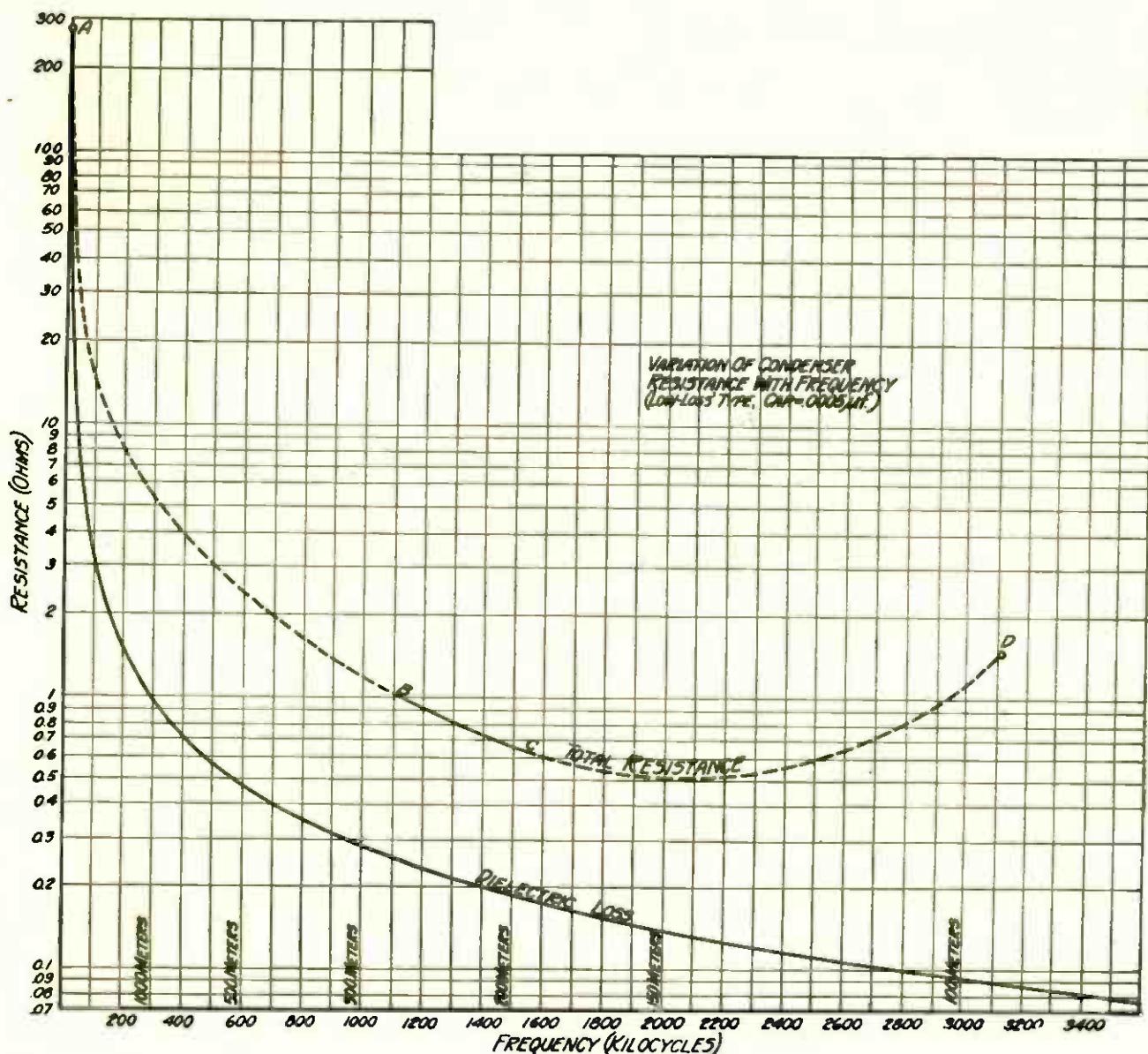
At low frequencies the losses in the condenser are mainly due to dielectric absorption. Hence the two curves coin-

cide at the low frequencies. As the frequency becomes higher, the dielectric losses decrease in exact proportion as the frequency increases, while the losses due to skin-effect increase at a greater and greater rate. There comes a time, however, when the rate of increase of the skin-effect equals the rate of decrease of the dielectric losses. This is the lowest point of the curve. As the frequency becomes higher, the skin-effect increases more rapidly than the dielectric losses decrease; and hence the curve turns upward.

It seems, therefore, that there is an

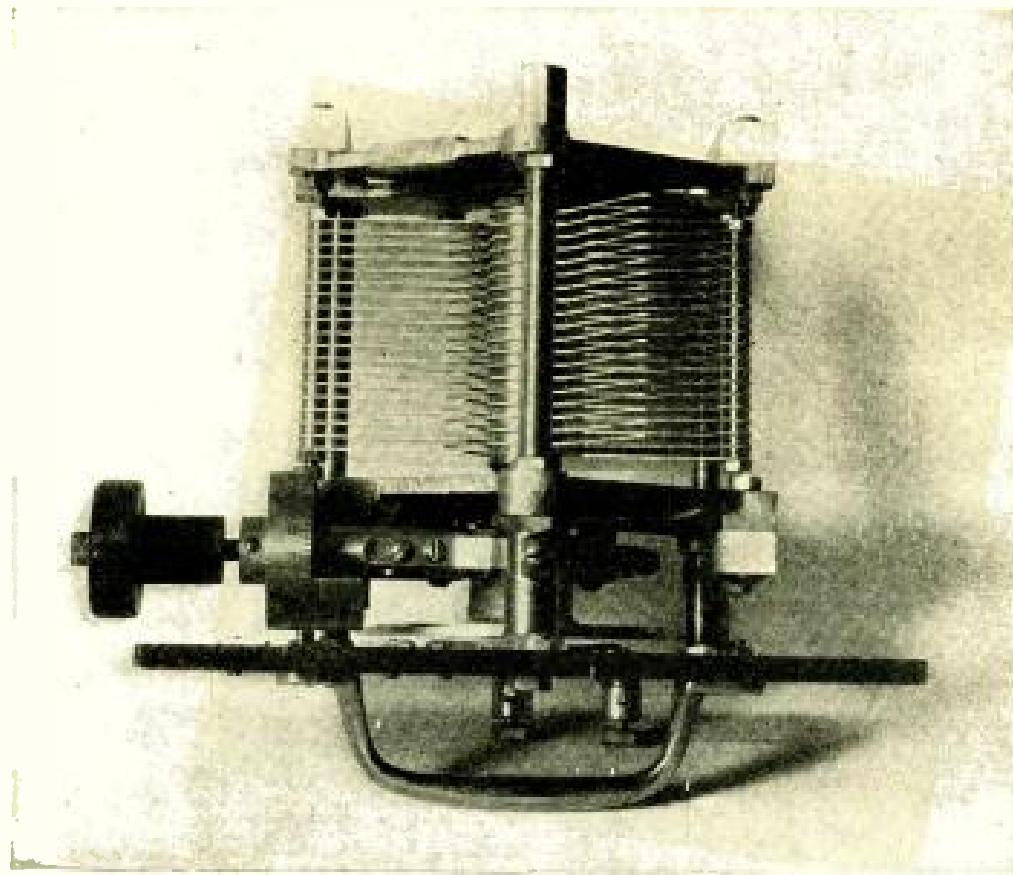
optimum frequency at which the resistance of a condenser is lowest. It was not possible, at the time of making these measurements, to explore the ranges of frequency including the dotted portions of the curve, as the great power required (20 watts) in the oscillator, made it necessary for other activities in the laboratory to stop.

There can be little doubt about the general shape of this curve, although the entire range of frequency investigated was relatively small. There is no doubt about the accuracy of the measurement made at 1,000 cycles (point A on the



THE RELATION BETWEEN RESISTANCE AND FREQUENCY

FIGURE 3: This curve shows how resistance rises sharply at the lower frequencies and again at the higher frequencies where "skin-effect" increases. Each block in the figure is ten times the block beneath it.



From a photograph made for POPULAR RADIO

A STANDARD CONDENSER

How a standard condenser looks when removed from its case. This is the apparatus that is used in most comparative condenser tests. The vernier knob at the left makes fine adjustment and close readings possible.

curve) as measurements at low frequencies are very accurate. There is also little question about the various points between B and C as these follow in regular succession and have been checked by measurements made on known resistances of short, straight pieces of very fine manganin wire.

There might be some question about the point D if this were only a single, isolated measurement, but the truth of the matter is that D represents a series of measurements made at the frequency indicated (3,125 kilocycles or 96 meters) as shown in Figure 2, which is for the same condenser at that frequency. Furthermore, the accuracy of point D was also proven by the check measurements.

The curve in Figure 3 should not be taken as giving accurate values except over the solid portion and at the points A and D. The rest of the curve, in broken line, is sketched in to indicate only the general shape of the curve.

The position of the lowest point of the curve, or the frequency at which the resistance is lowest, will probably vary with each make of condenser. It may be possible for one condenser to have a lower resistance than another at, say, 1,000 cycles, and yet have a higher resistance at radio frequencies.

Although the dielectric losses may be less in the first, the skin-effect in it may increase at a much greater rate. Skin-effect in conductors of electricity is determined by their cross-section, among other things, so that this idea suggests experimentation to determine how the resistance of condensers varies with the thickness of the plates.

These experiments tend to show how worthless, in radio work that employs high frequencies, are measurements made at 1,000 cycles. Even rough comparisons at low frequencies cannot be relied upon, even when we only want to find out which condenser is the better of two.

"What Set Shall I Buy?"

LESS than a year ago there were only a very few ready-made sets on the market; today there are about 140, ranging from small and inexpensive crystal receivers, which sell for as low as four or five dollars, to elaborate superheterodynes that run into the hundreds. Those that have been approved by the POPULAR RADIO LABORATORY will be pictured each month until the series is completed. They will be accompanied by brief but specific data concerning them—as a helpful guide to the broadcast listener and to the prospective listener who is thinking of selecting the receiver that will best meet his special needs as well as the limitations imposed by his purse. The data following each of the sets pictured in this series are the manufacturers own specifications and claims; they were obtained through a form of questionnaire sent to all manufacturers of receiving sets approved by POPULAR RADIO.



The Gilfillan Neutrodyne GN-5

MANUFACTURER'S NAME: Gilfillan Bros., Inc.

MODEL: Gilfillan Neutrodyne GN-5

NUMBER OF TUBES: five

TYPE OF TUNING: condenser and coil

TYPE OF DETECTOR: vacuum tube

RANGE ON PHONES: 2,000 miles

RANGE ON LOUDSPEAKER: 1,500 miles

COST WITHOUT ACCESSORIES: \$110.00

ANTENNA RECOMMENDED: single wire outside, 60 feet long (including lead-in). Not designed to operate on a loop.

KIND OF TUBES FOR R. F.: UV-201-a or C-301-a

DETECTOR TUBE: UV-201-a or C-301-a

DETECTOR PLATE VOLTAGE: 22.5 volts

AUDIO TUBES: UV-201-a or C-301-a

TYPE OF "A" BATTERY: 6 volt storage

TYPE OF "B" BATTERY: 90 volt

WAVELENGTH RANGE: 190 to 575 meters

NUMBER OF TUNING CONTROLS: three tuning controls, two filament controls;

"A" BATTERY CURRENT USED: 1.25 amperes

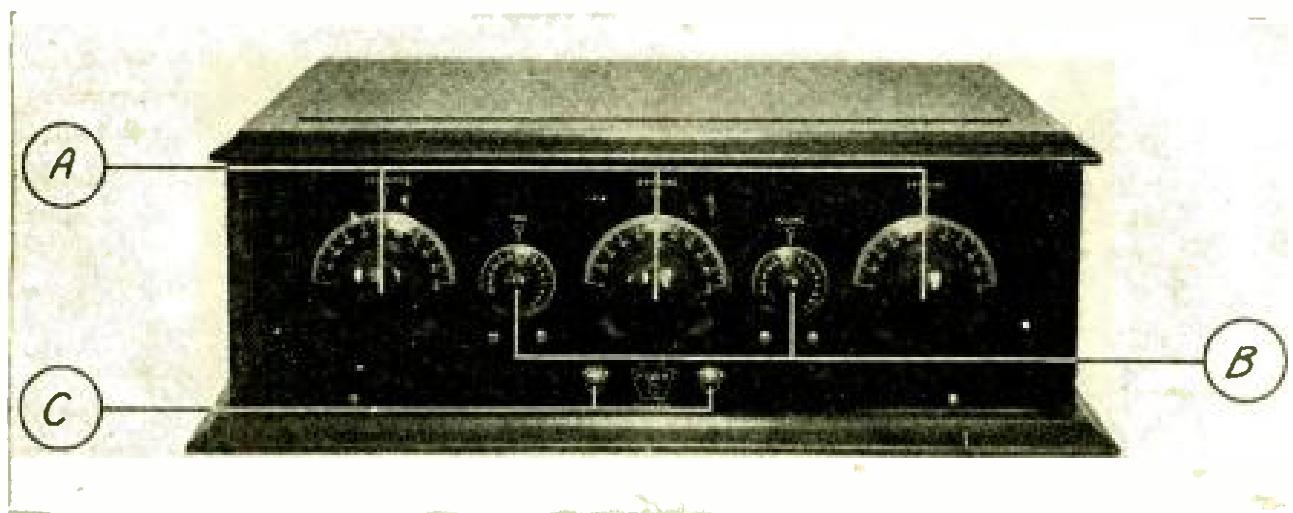
"B" BATTERY CURRENT USED: 12 milliamperes

STAGES RADIO AMPLIFICATION: two

STAGES AUDIO AMPLIFICATION: two

"C" BATTERY USED: on radio and audio

WEIGHT IN CARTON: 35 lbs.



The Penn-C De Luxe Five

MANUFACTURER'S NAME: Pennsylvania Wireless Mfg. Co.

MODEL: "Penn-C" De Luxe Five

NUMBER OF TUBES: five

TYPE OF TUNING: tuned-radio-frequency

RANGE ON PHONES; same as any good 5-tube set (2,500 to 3,000 miles)

RANGE ON LOUDSPEAKER; from 10 miles up to 3,000 miles

COST WITHOUT ACCESSORIES; \$90.00

ANTENNA RECOMMENDED; single wire, 80 feet

KIND OF TUBES FOR R. F.; C-301-a

DETECTOR TUBE; C-301-a

AUDIO TUBES; C-301-a

TYPE OF "A" BATTERY; storage or dry cells

TYPE OF "B" BATTERY; storage or dry cells

DETECTOR "B" VOLTAGE; 45 volts

WAVELENGTH RANGE; 200 to 600 meters

NUMBER OF TUNING CONTROLS; three

"A" BATTERY CURRENT USED; $1\frac{1}{4}$ amperes

"B" BATTERY CURRENT USED; 12 milliamperes when using "C" battery

The Wave Master

MANUFACTURER'S NAME: Kellogg Switchboard & Supply Co.

MODEL: Wave Master

NUMBER OF TUBES: five

TYPE OF TUNING: tuned-radio-frequency

TYPE OF DETECTOR; vacuum tube

RANGE ON PHONES; 4,800 miles

RANGE ON LOUDSPEAKER; 4,800 miles

COST WITHOUT ACCESSORIES; \$125.00

ANTENNA RECOMMENDED; outdoor, 80 feet

KIND OF TUBES FOR R. F.; 201-a or 301-a

DETECTOR TUBE; 201-a or 301-a

AUDIO TUBES; 201-a or 301-a

TYPE OF "A" BATTERY; 6 volt storage

TYPE OF "B" BATTERY; 90 volts, dry cells or storage

DETECTOR "B" VOLTAGE; 45 volts

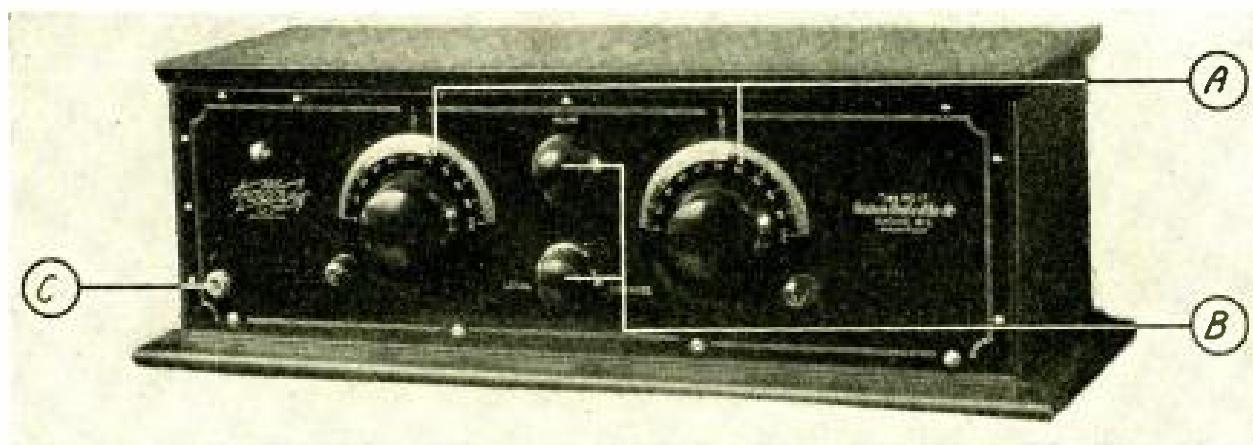
WAVELENGTH RANGE; 170 to 600 meters

NUMBER OF TUNING CONTROLS; one

"A" BATTERY CURRENT USED; $1\frac{1}{4}$ amperes

"B" BATTERY CURRENT; 15 to 25 milliamperes





The Radiodyne Receiver

MANUFACTURER'S NAME: Western Coil & Electrical Co.

MODEL: Radiodyne type WC-17-a

NUMBER OF TUBES: five

TYPE OF TUNING: tuned-radio-frequency

TYPE OF DETECTOR: vacuum tube

RANGE ON PHONES: 2,000 miles

RANGE ON LOUDSPEAKER: 2,000 miles

COST COMPLETE: \$150.00

ANTENNA RECOMMENDED: single wire, 125 feet long

KIND OF TUBES FOR R. F.: UV-201-a

DETECTOR TUBE: UV-201-a

AUDIO TUBES: UV-201-a

TYPE OF "A" BATTERY: storage, 6 volts

TYPE OF "B" BATTERY: 90 volts

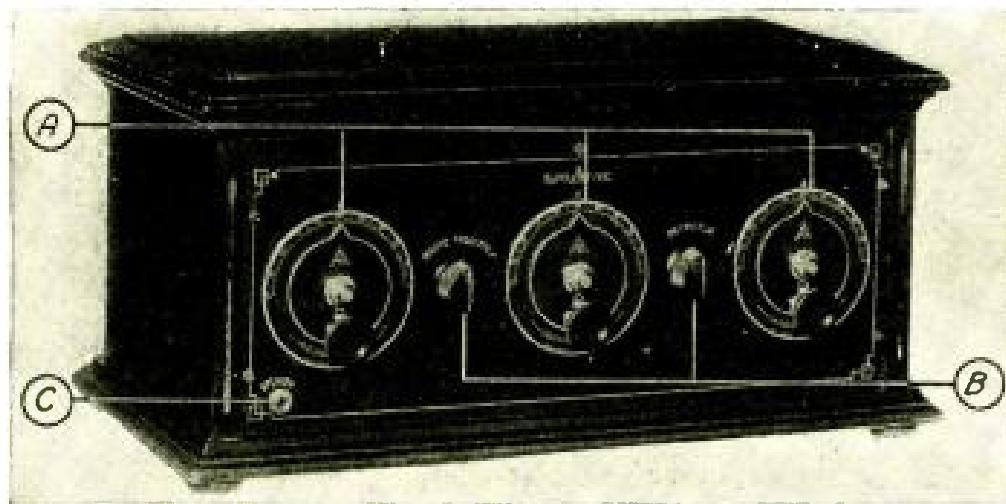
DETECTOR "B" VOLTAGE: 45 volts

WAVELENGTH RANGE: 200 to 550 meters

NUMBER OF TUNING CONTROLS: two

"A" BATTERY CURRENT USED: 1½ amperes

"B" BATTERY CURRENT USED: 9 to 11 milliamperes



Apex Super Five Receiver

MANUFACTURER'S NAME: Apex Electric Mfg. Co.

MODEL: Apex Super Five

NUMBER OF TUBES: five

TYPE OF TUNING: T. R. F.

TYPE OF DETECTOR: vacuum tube

RANGE ON PHONES: none given

RANGE ON LOUDSPEAKER: 2,500 miles

COST COMPLETE: \$95.00

ANTENNA RECOMMENDED: 35-100-feet single wire

KIND OF TUBES FOR R. F.: UV-201-a

DETECTOR TUBE: UV-201-a

AUDIO TUBES: UV-201-a

TYPE OF "A" BATTERY: 6 volts

TYPE OF "B" BATTERY: dry or storage

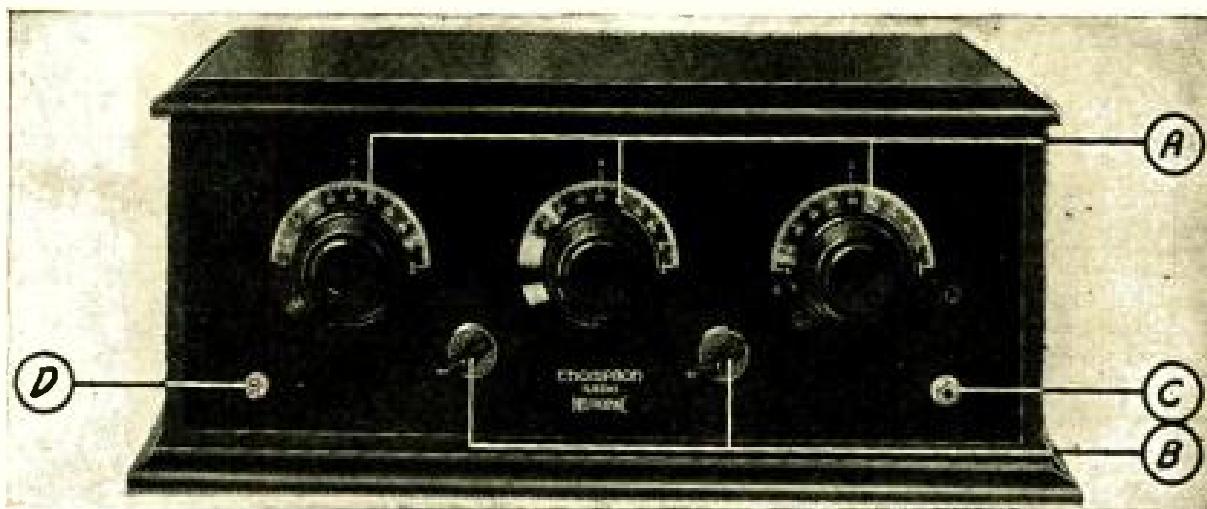
DETECTOR "B" VOLTAGE: 18-24 volts

WAVELENGTH RANGE: 224-556 meters

NUMBER OF TUNING CONTROLS: three

"A" BATTERY CURRENT USED: 1.25 amperes

"B" BATTERY CURRENT USED: 20 milliamperes, when "C" battery is used



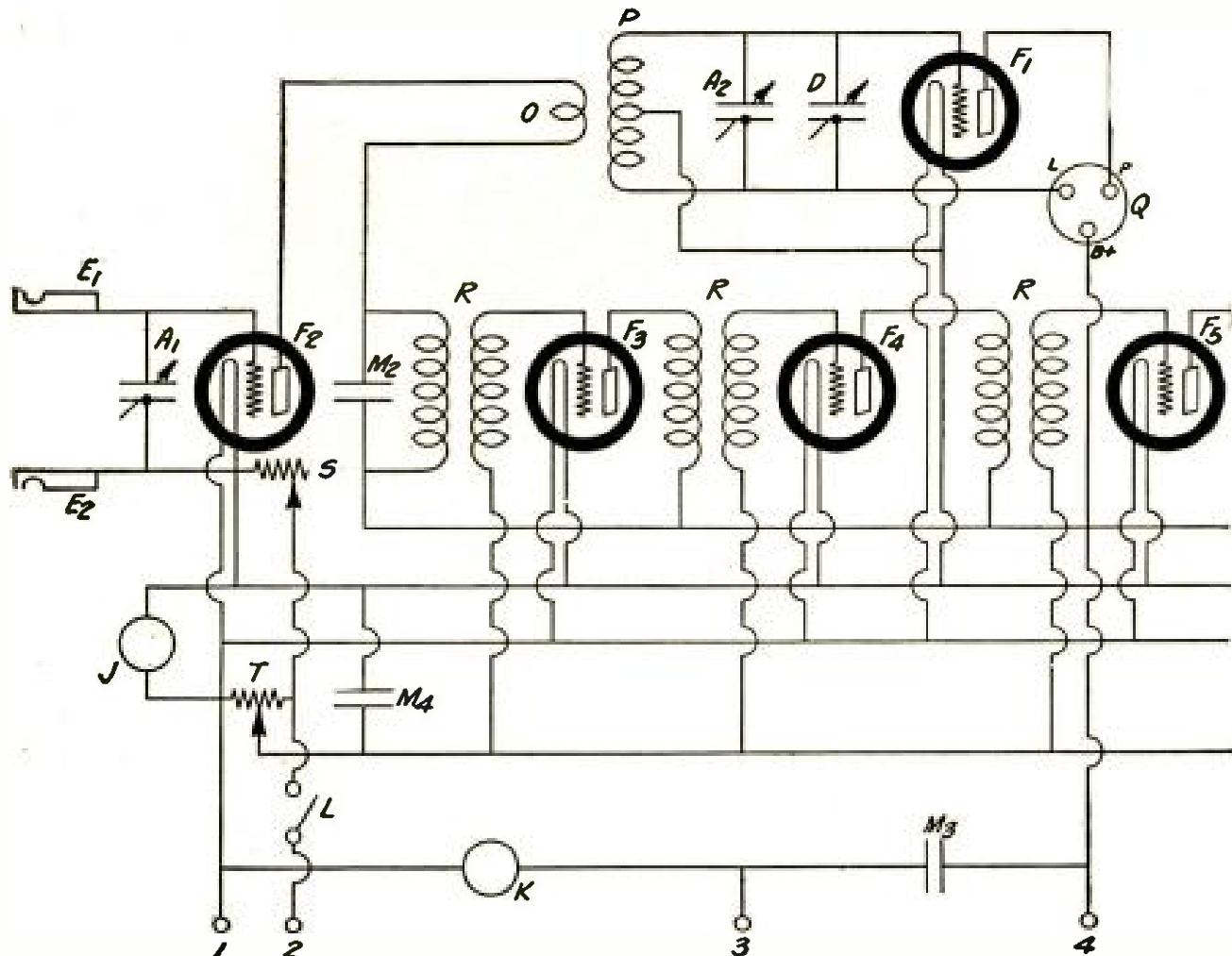
The V-50 Receiver

MANUFACTURER'S NAME; R. E. Thompson Mfg. Co.	DETECTOR TUBE; UV-201-a AUDIO TUBES; UV-201-a
MODEL; V-50	TYPE OF "A" BATTERY; 6-volt "A" battery
NUMBER OF TUBES; five	TYPE OF "B" BATTERY; 90 to 100-volt dry or storage battery
TYPE OF TUNING; tuned-radio-frequency (neutral-trodyne)	DETECTOR "B" VOLTAGE; 22½ to 45 volts
TYPE OF DETECTOR; vacuum tube	WAVELENGTH RANGE; 195 to 570 meters
RANGE ON PHONES; transcontinental	NUMBER OF TUNING CONTROLS; three
RANGE ON LOUDSPEAKER; transcontinental	"A" BATTERY CURRENT USED; 1.25 amperes
COST COMPLETE; \$125.00	"B" BATTERY CURRENT USED; 10 to 18 milliamperes according to "B" battery and "C" battery voltage used
ANTENNA RECOMMENDED; outdoor, 100 feet	
KIND OF TUBES FOR R. F.; UV-201-a	



The Elkay Super-selector

MANUFACTURER'S NAME; The Langbein-Kaufman Radio Co.	KIND OF TUBES FOR R. F.; 201-a DETECTOR TUBE; 201-a; UV-199; sodion
MODEL; Elkay Super-selector	AUDIO TUBES; 201-a; UV-199
NUMBER OF TUBES; four 201-a; four U-199; or any combination	TYPE OF "A" BATTERY; 6 volts
TYPE OF TUNING; tuned-radio-frequency	TYPE OF "B" BATTERY; 90 volts
TYPE OF DETECTOR; vacuum tube	DETECTOR "B" VOLTAGE; 22½ to 45 volts
RANGE ON PHONES; 3,000 miles	WAVELENGTH RANGE; 200 to 600 meters
RANGE ON LOUDSPEAKER; 2,500 miles	NUMBER OF TUNING CONTROLS; two
COST COMPLETE; \$70.00	"A" BATTERY CURRENT USED; maximum, 1 ampere
ANTENNA RECOMMENDED; 75 to 125 feet outside	"B" BATTERY CURRENT USED; 10 milliamperes



HOW TO BUILD THE NEW SUPERHETERODYNE WITH A SINGLE CONTROL

The application of simplified tuning to various kinds of radio circuits for reception is one of the most important contributions that have been made to the radio art during the last year. The superheterodyne receiver here described is the most advanced of all the single-control developments that have as yet been made. This eight-tube set operates from a single dial as easily and satisfactorily as the simplest crystal receiver.

By JAMES L. McLAUGHLIN

COST OF PARTS: *Not more than \$100.00*

RECEIVING RANGE: *Up to 3,500 miles*

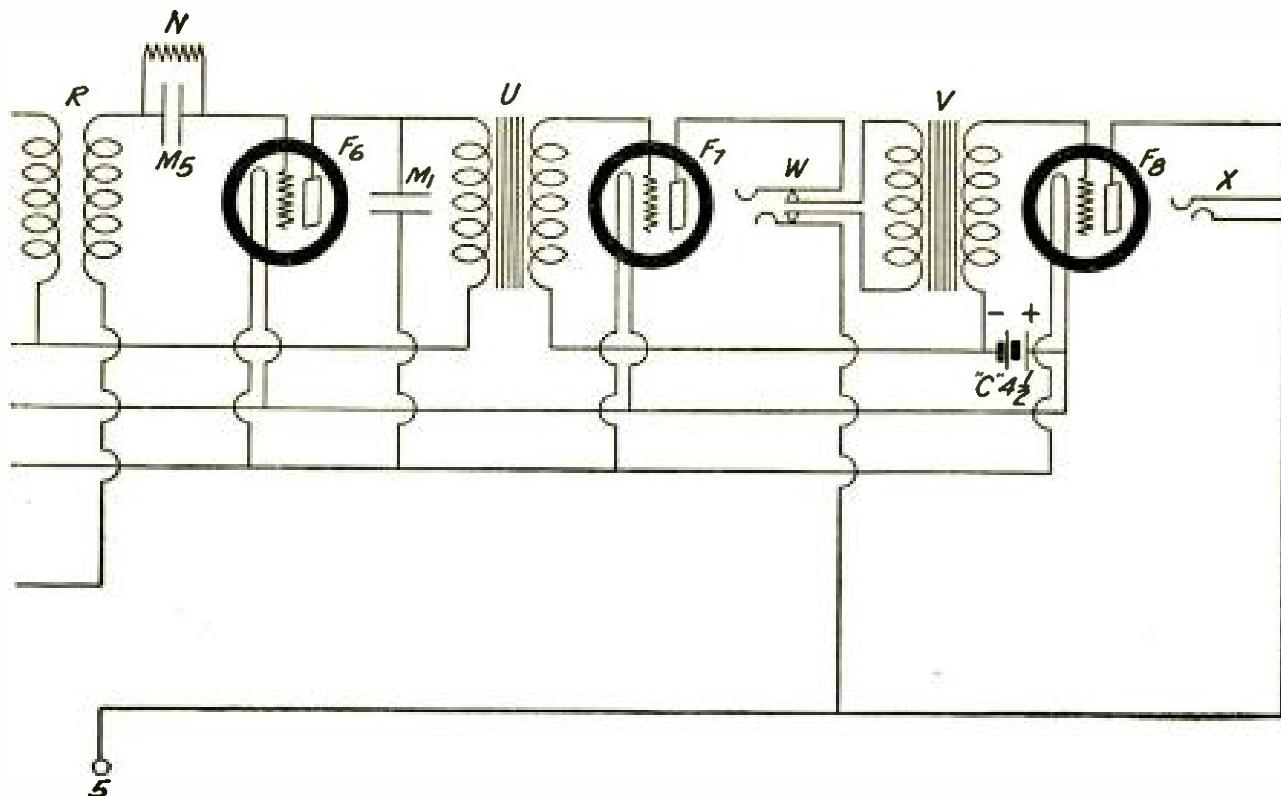
HERE ARE THE ITEMS YOU WILL NEED—

A1 and A2—Precise No. 750 syncrodensers, .0005 mfd.;
 B—Precise No. 744 connector;
 C—Marco 4-inch vernier dial, clockwise;
 D—Hammarlund, Jr., midget condenser;
 E1 and E2—Carter imp jacks (with plugs for loop wires);
 F1, F2, F3, F4, F5, F6, F7, F8 and G—
 Benjamin No. 9050 8-gang socket-shelf;

H—bakelite panel, 10 inches by 14½ inches by 3/16 inch;
 I1 and I2—Precise aluminum brackets No. 99;
 J—Weston No. 301 voltmeter, 0 to 7 volts scale;
 K—Weston No. 301 milliammeter, 0 to 25 milliamperes scale;
 L—Benjamin battery switch;
 M1—New York Coil mica fixed condenser,

THE COMPLETE CIRCUIT DIAGRAM

FIGURE 1: This is the hook-up for the single control superheterodyne. All the symbols of the instruments bear designating letters which appear in the list of parts and throughout the text and illustrations.



.006 mfd.;
M2—New York Coil mica fixed condenser,
.00025 mfd.;
M3 and M4—Dubilier 1. mfd. by-pass con-
densers;
M5—Dubilier No. 640 mica fixed condenser,
.00025 mfd. with grid-leak clips;
N—Daven grid-leak, 2 megohms;
O—stranded wire loop with braided cover-
ing for coupling oscillator to circuit;
P—Precision Inducto-coupler No. 260;
Q—Precise No. 1900 filtoformer;

R—Precise No. 1700 super-multiformer;
S—General Radio rheostat, type 214A 2 ohm,
 $2\frac{1}{2}$ ampere;
T—General Radio potentiometer, type 214A
400 ohm;
U—Precise audio-frequency transformer
No. 480 (5 to 1);
V—Precise audio-frequency transformer No.
480 ($2\frac{1}{2}$ to 1);
W—Carter double circuit "holdtite" jack;
X—Carter single circuit "holdtite" jack;
Y—cabinet.

IN this article on superheterodyne theory and construction, it is my purpose to describe a single-control superheterodyne that employs eight tubes.

This receiver combines some of the latest scientific developments and contains the best designed instruments and can be assembled easily by any one—even if he has never before built any kind of a set.

All the parts used in this receiver are standard, well-known parts that may be obtained from any dealer.

From an efficiency standpoint this receiver insures an unusually long life for the "B" batteries, as it draws only approximately 10 milliamperes for the total plate current. This results in very economical operation.

By the use of a combination of two straightline-frequency type condensers the application of single control has been advantageously applied to the superheterodyne receiver, as the difference in the frequency of the oscillator and the incoming signal is always a fixed value. In this design the oscillator and loop in-

ductances are identical or as near alike as practicability will permit in regard to their inductance-capacity ratios.

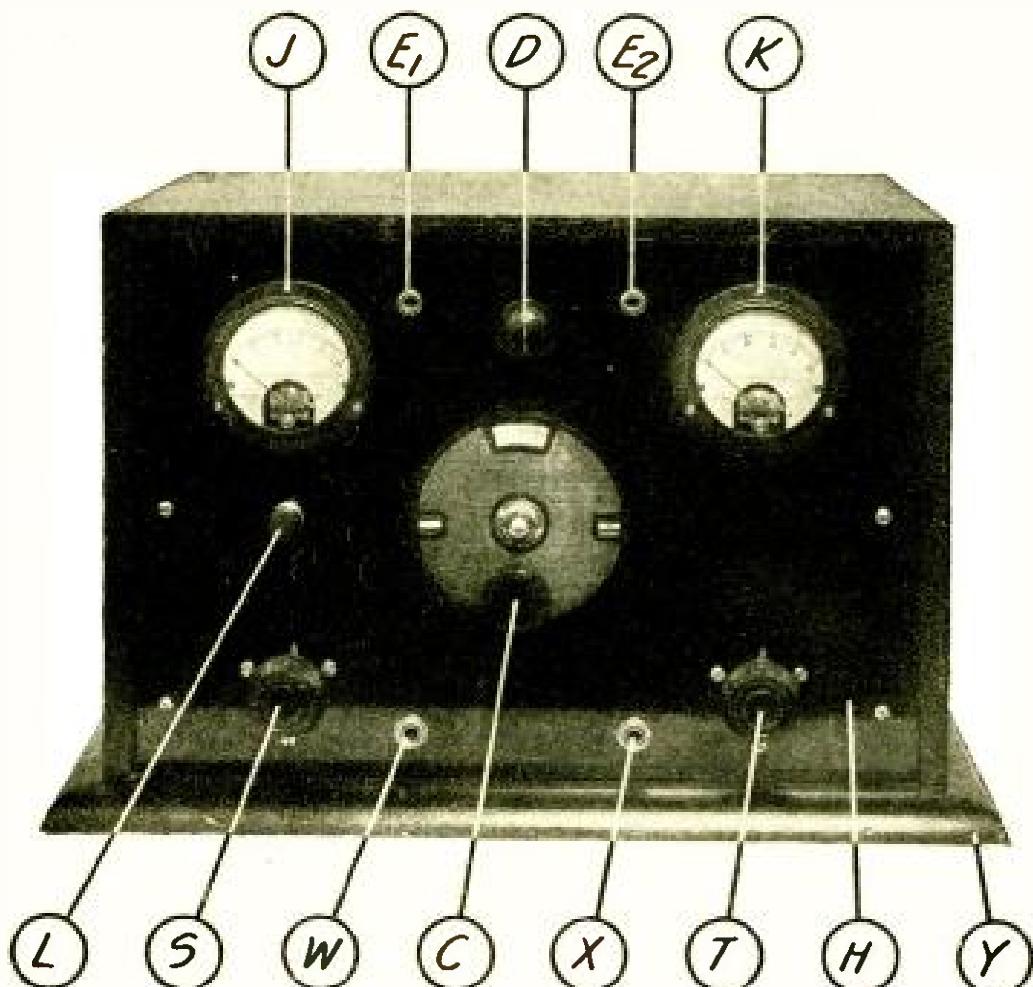
The straightline variable condensers are placed across the loop and the oscillator for tuning, and a small midget variable condenser is also shunted across the oscillator condenser in order to make up for any small discrepancies there may be in either the coils, the condensers or the loop values. This allows the two condensers to be adjusted once and for all so that they operate synchronously.

The practice heretofore in multi-tube design has generally been to place all tube sockets in a row, making the resultant set a long, narrow, coffin-like affair when more than four tubes were employed. The reason for this elongated design was the necessity for keeping the output and input circuits of the unit as

far apart as necessary to prevent reaction at radio or audio-frequencies. In this present receiver, after consideration and experiment, a unique design has been obtained in a system of tube placement which allows the set to be arranged in a more compact relation.

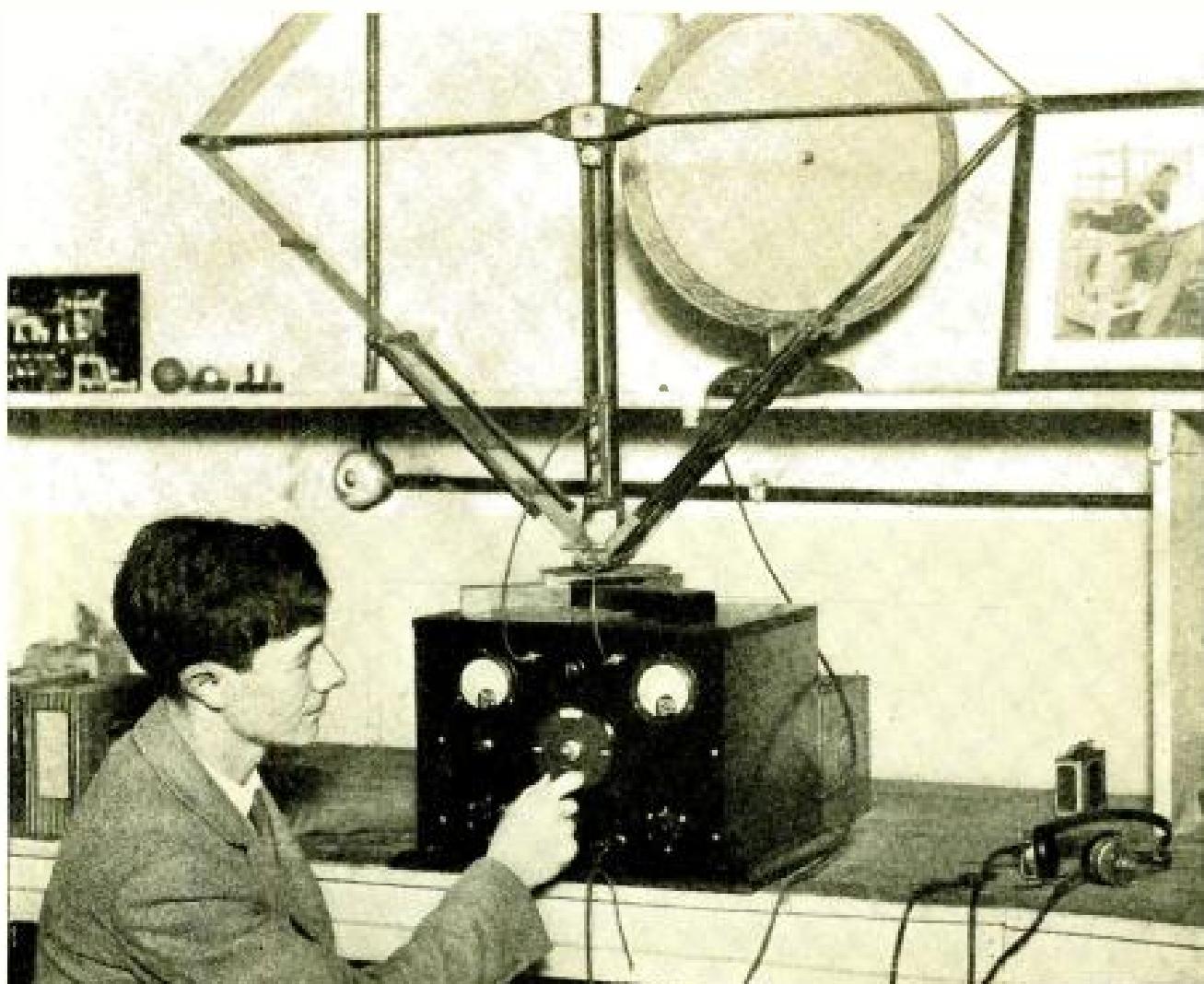
The placement of the tube sockets in this set follows the design of an exaggerated letter "H" in width. The oscillator tube forms the upper part of the left-hand vertical side of the "H," the first detector forms the lower side, the three radio-frequency tubes together with the second detector make up the horizontal connecting bar and the two stages of audio-frequency amplification form the right-hand vertical side, thus completing the other two legs of the letter "H."

The variable condensers are mounted in approximately the center of the sub-



HOW THE SET LOOKS FROM THE FRONT

FIGURE 2: The vernier dial *C* is the single control for the two tuning condensers, while all other knobs are marked with the same letters as the instruments to which they are attached.



From a photograph made for POPULAR RADIO

A SINGLE DIAL FOR TUNING A SUPERHETERODYNE

The author demonstrates the almost unbelievable simplicity for tuning a multi-tube set such as shown in this picture. This is the only control that is necessary—aside from the turning of the loop in the proper position to pick up signals.

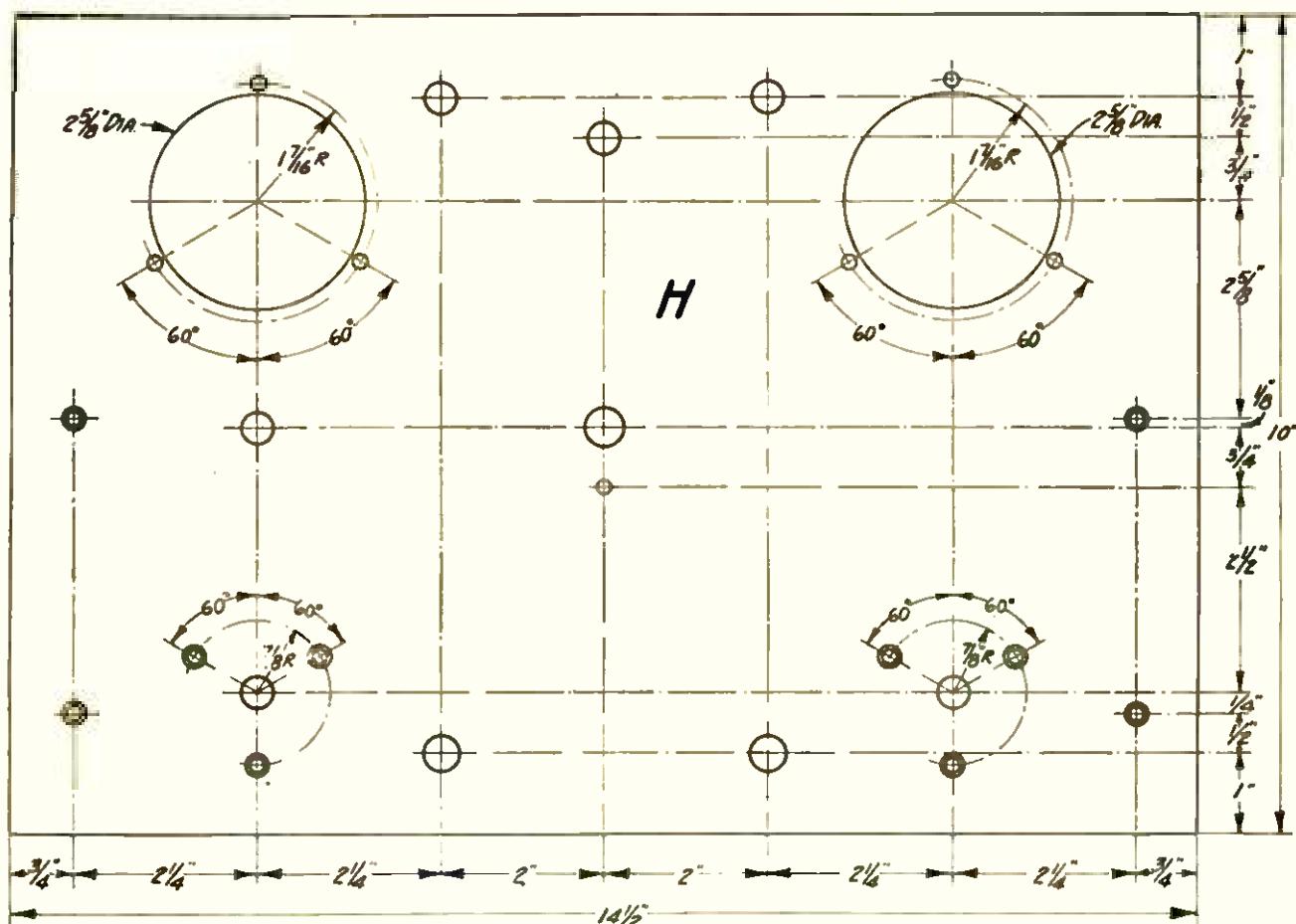
panel and are connected by means of a fiber connector which is attached to the shafts by means of set screws. This results in short connections to all the sockets, as the oscillator condenser is directly alongside of the oscillator tube and the tuning condenser is alongside of the first detector. On the underside of the sub-panel are the intermediate gang-transformer, the audio-frequency transformers and the oscillator coil, fixed condensers and other parts. I have chosen for the intermediate gang-transformer the super-multiformer, a high-wave radio-frequency unit, as it is easy to connect into a circuit in one unit and operates on what is the most feasible intermediate frequency.

In the comparison of efficiency resulting from this arrangement and the use of the correct values as described in this article we have proved conclusively that there is no operating disadvantage at all in making this receiver so compact although the small shape and general design make it a much better looking set.

In operation the receiver produces very fine quality, is decidedly selective and may be operated over a range in excess of 3,500 miles, covering the whole broadcast range of wavelengths.

Parts Used in Building the Set

In all the diagrams in this article each part bears a designating letter; in this way, the prospective builder of a set may easily determine how to mount the instruments in the cor-



THE DRILLING PLAN FOR THE PANEL

FIGURE 3: This drawing shows where to drill the holes for mounting the instruments. The large holes for mounting the meters should be cut with a special adjustable fly cutter for bakelite. Holes outlined with a double circle should be countersunk.

rect places and connect them properly in the electric circuit.

The same designating letters are used in the text and in the list of parts at the beginning of the article.

G The list of parts there given includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which may be used with equally good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections.

If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are to be drilled in the panel for mounting the instruments.

How to Construct the Set

After procuring all the instruments and materials for building the set, the amateur

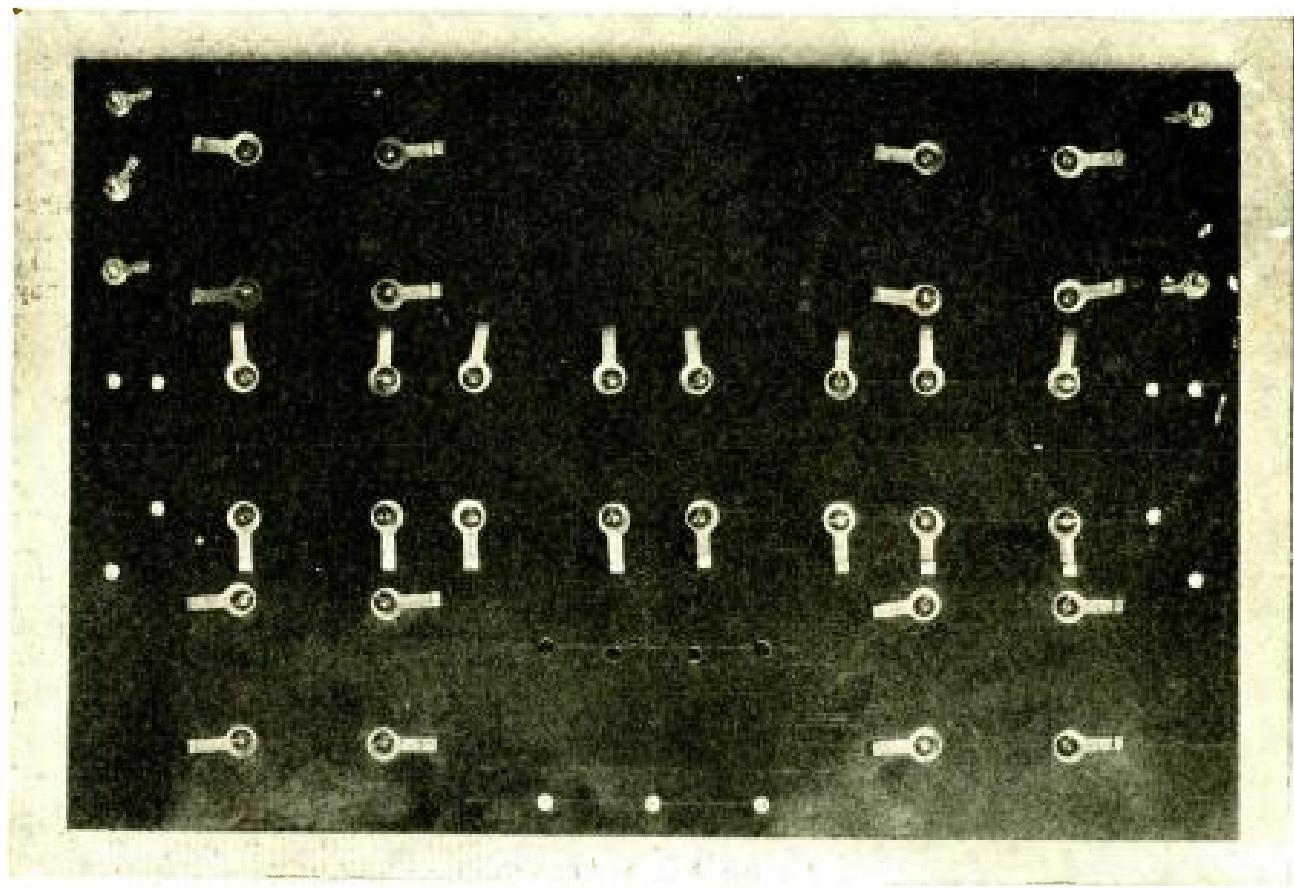
should prepare the panel H. (Shown in Figures 2, 3, 6, 7, 8 and 10.)

First of all, cut the panel to the correct size, 10 by 14 inches. Then square up the edges smoothly with a file. The centers for boring the holes (which are necessary for mounting the instruments) should be laid out on the panel as shown in Figure 3. A convenient method for doing this is to lay out all center holes on a piece of paper the same size as the panel; then the piece of paper may be fastened on the panel and the centers marked directly on the panel by punching through the paper with a sharp, pointed instrument.

If all the holes to be drilled are first started with a small drill, one-sixteenth inch in diameter or less, they can be more nearly centered.

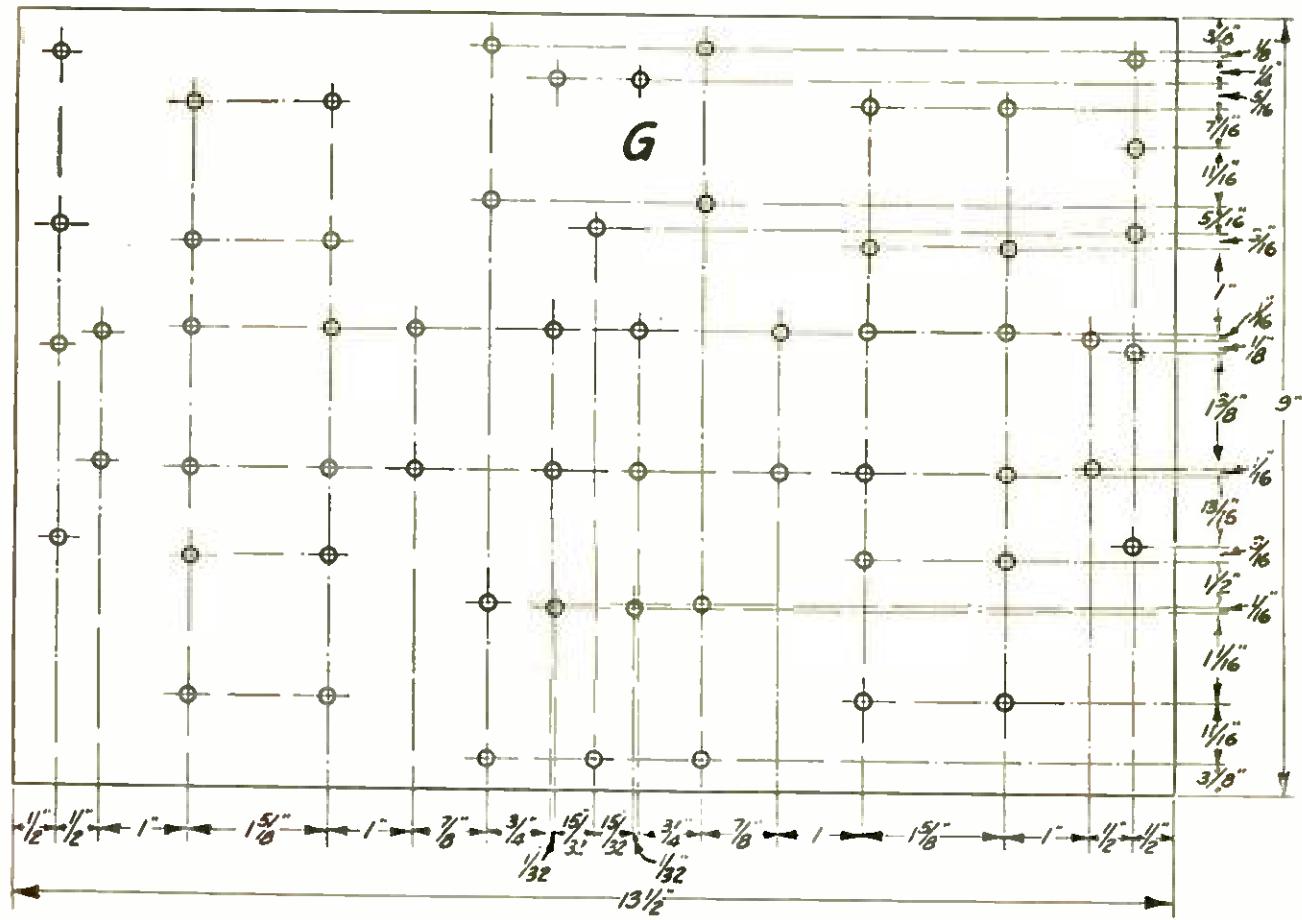
The holes outlined with a double circle should be countersunk, so that the flat-head machine screws used for fastening the instruments are flush with the panel. All the rest of the holes in the panel are straight drill-holes. Sizes for the diameters of these holes have not been given, but the builder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

When the panel is drilled, the builder may give it a dull finish by rubbing the face of the



THE SUB-PANEL FROM BELOW

FIGURE 4: This picture shows how the lugs and screws that connect to and mount the sockets are arranged on the bottom of the sub-panel.



THE DRILLING PLAN FOR THE SUB-PANEL

FIGURE 5: *Where to drill the holes for mounting the various instruments.*

panel lengthwise with fine sandpaper until it is smooth. This process should be repeated, except that light machine oil should be applied during the second rubbing. Then rub the panel dry with a piece of cheesecloth. A permanent dull finish will be the result. Or, the panel may be left with its original shiny-black finish, if care has been exercised, so that it has not been scratched during the drilling.

After the panel has been prepared the experimenter is ready to mount the instruments on it.

The rheostat S should be attached to the panel by screws inserted in the proper places as shown in the diagrams in Figures 2, 7, 8 and 9. Do the same with the potentiometer T, and be sure that the terminals are turned in the correct position as shown for both of these instruments in Figure 8. Place soldering lugs underneath every connection for making the wiring easier and insuring a more efficient job.

Next, mount the two meters J and K in the two holes cut for them in the panel. This should be attached by three nuts and bolts for each instrument as shown in Figures 2, 6 and 10.

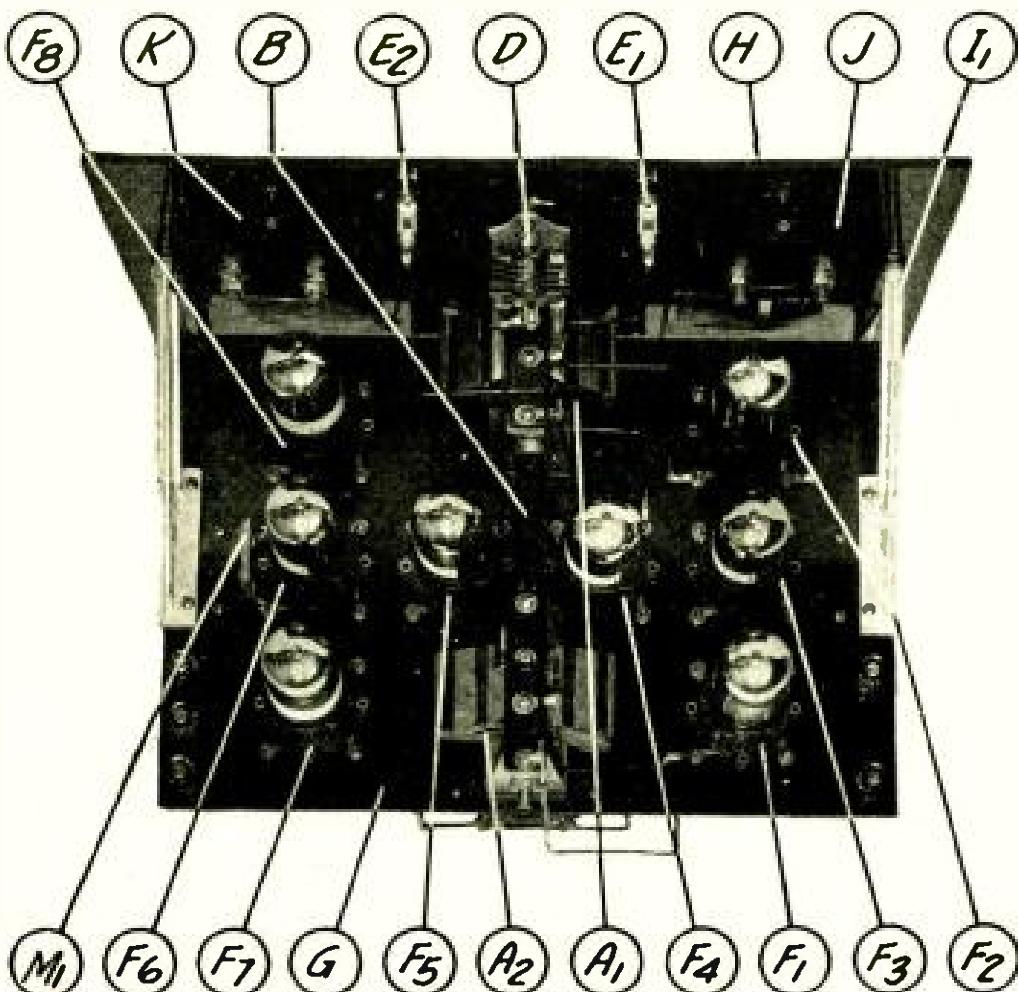
Next attach the midget condenser D in the

proper place on the panel as indicated in Figures 2, 6 and 10 and tighten up the single-hole mounting nut firmly. Also mount the battery switch L and the two large jacks W and X and the small loop-jacks E1 and E2 in their proper places as shown in Figures 2, 6, 7, 8, 9 and 10.

This completes the mounting of instruments on the main panel H. Now turn to the work on the sub-panel or socket-shelf G. If the builder wishes he can procure this already drilled with the sockets mounted upon it as indicated in the list of parts under F1, F2, F3, F4, F5, F6, F7, F8 and G.

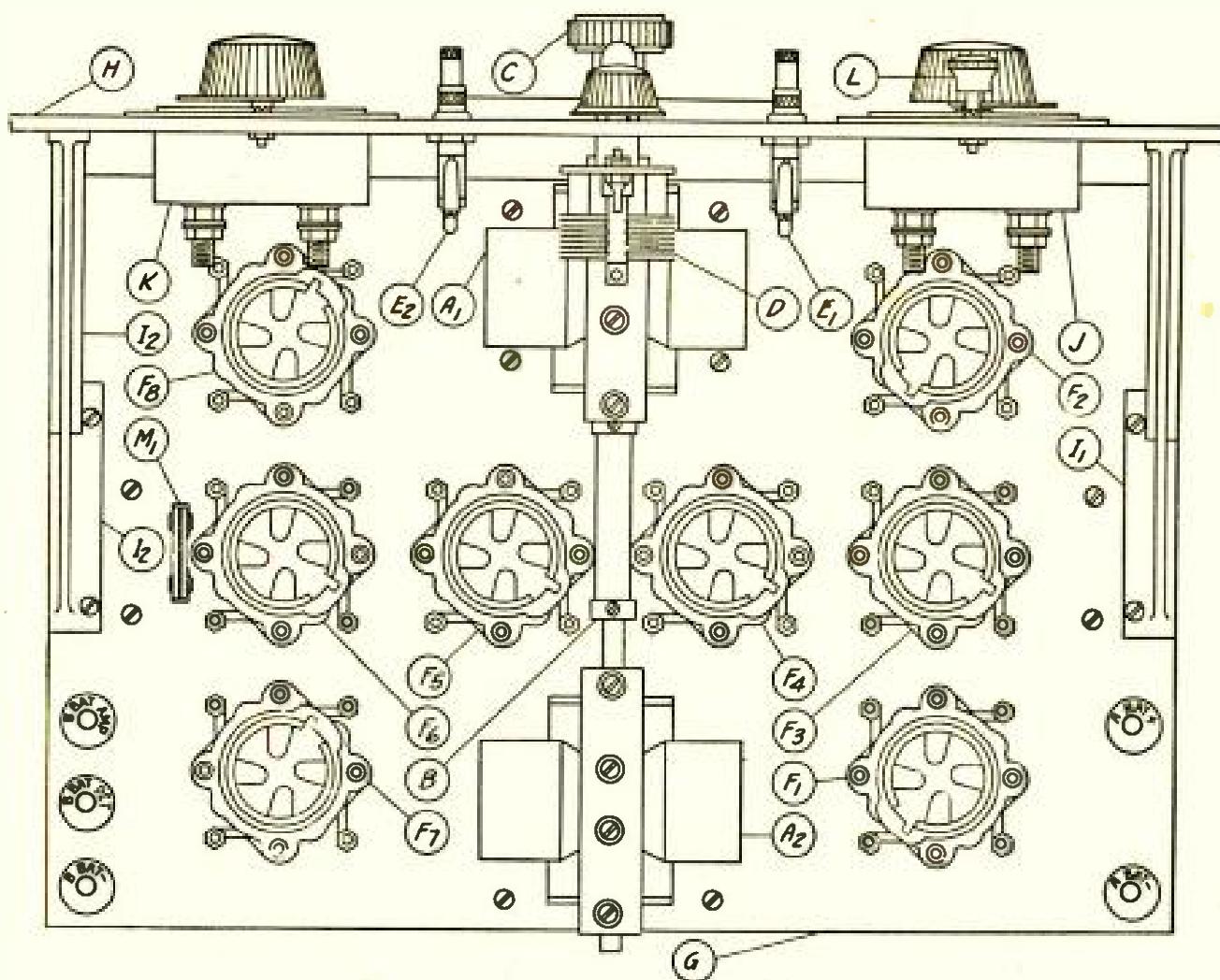
However, if he decides to make it himself he may procure the bakelite according to the size shown in Figures 4 and 5 and drill it according to the dimensions given there and after procuring the eight sockets they should be mounted (minus the separate bases that come on them) as shown in Figures 6, 7, 10 and 11.

Whether the complete assembly has been bought or whether you have drilled the panel and mounted the sockets yourself, you are now ready to mount the rest of the apparatus. The two variable condensers A1 and A2 are mounted directly in the center of the top side of the panel G. They should be connected together



VIEW OF THE SET FROM ABOVE

FIGURE 6: Note the general arrangement of the two synchronously controlled condensers, the sockets and the meters when viewed from above with the cabinet removed; also the similarity of the socket mounting to the letter H.



THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 7: Here are shown the correct positions for the instruments that are mounted on the panel and on the top of the sub-panel. The positions are shown clearly as they actually are in the receiver.

with the coupling-unit B, as shown in Figures 6, 7 and 11.

When these have been installed attach the intermediate-gang transformer (super-multi-former) as shown in Figures 8 and 9 by inserting screws through the places indicated at the two ends and fastening with nuts.

Next mount the two transformers U and V —being sure that you place the proper "ratios" in the right places as indicated in Figures 8, 9, 10 and 11. Also be sure that they are turned with the terminals in the correct position as shown in Figure 9.

Next mount the inducto-coupler in the proper position as shown in Figures 8, 9 and 10, utilizing the same screw terminals to replace the screws to mount half of the socket F1. Then fasten the filtoformer Q in proper position at right angles to the inducto-coupler with the terminal marked P next to the sub-panel and the terminals marked B and L pointing away from the panel. See Figures 8 and 9 for this data.

Next, mount the grid condenser M5 (in the terminals of which place the grid-leak) on the last binding post marked G of the super-multi-former. This is clearly indicated in Figures 8

and 9. On the first terminal marked B of the multi-former mount the fixed condenser M2 as shown in Figures 8 and 9. Also mount the fixed condenser M on the two terminals of the second detector socket as shown in Figures 6 and 7.

Another job that can now be done is to attach the two brackets I1 and I2 with two screws and bolts as shown in the various Figures. The last job to do is to mount the two bypass condensers M3 and M4 with a single point of support under the screws as shown in Figure 9. This finishes the construction work on the sub-base and the two panels are ready to be wired up and placed together.

How to Wire the Set

The design of this set is such that the wiring of the grid circuit of each of the four tubes is made extremely short and is isolated from other parts of the circuit. In fact, this idea has been employed throughout and the leads are so arranged that the shortest connections may be used. As this is the case, the set should be wired with bus-bar.

A tinned-copper, round bus wire is recom-

POPULAR RADIO

mended. All connections should first be shaped so that they will fit. They should then be soldered in place. Refer to the wiring diagram in Figure 1 and more specifically to the picture diagram in Figure 12 for the exact way in which to run the wires.

Start wiring by making all the connections on the sub-panel first on the bottom side then on the top side that can be done without attaching the sub-panel to the main panel, by means of the brackets 11 and 12. If you follow the picture-wiring diagram in Figure 12 for making these connections you cannot go wrong. This drawing shows every instrument mounted on either the top or below the sub-panel G as included in the lower rectangle. The instruments outlined here in solid black lines show only those instruments that are mounted on top of the panel, whereas the instruments outlined in dotted lines show those that are mounted below the sub-panel.

Also the heavy black lines shown in Figure 12 indicate the wiring connections for the wires that run above the panel and the wires that run below the panel are shown in dotted lines.

It is best to begin wiring with the filament circuits underneath the panel and finish all con-

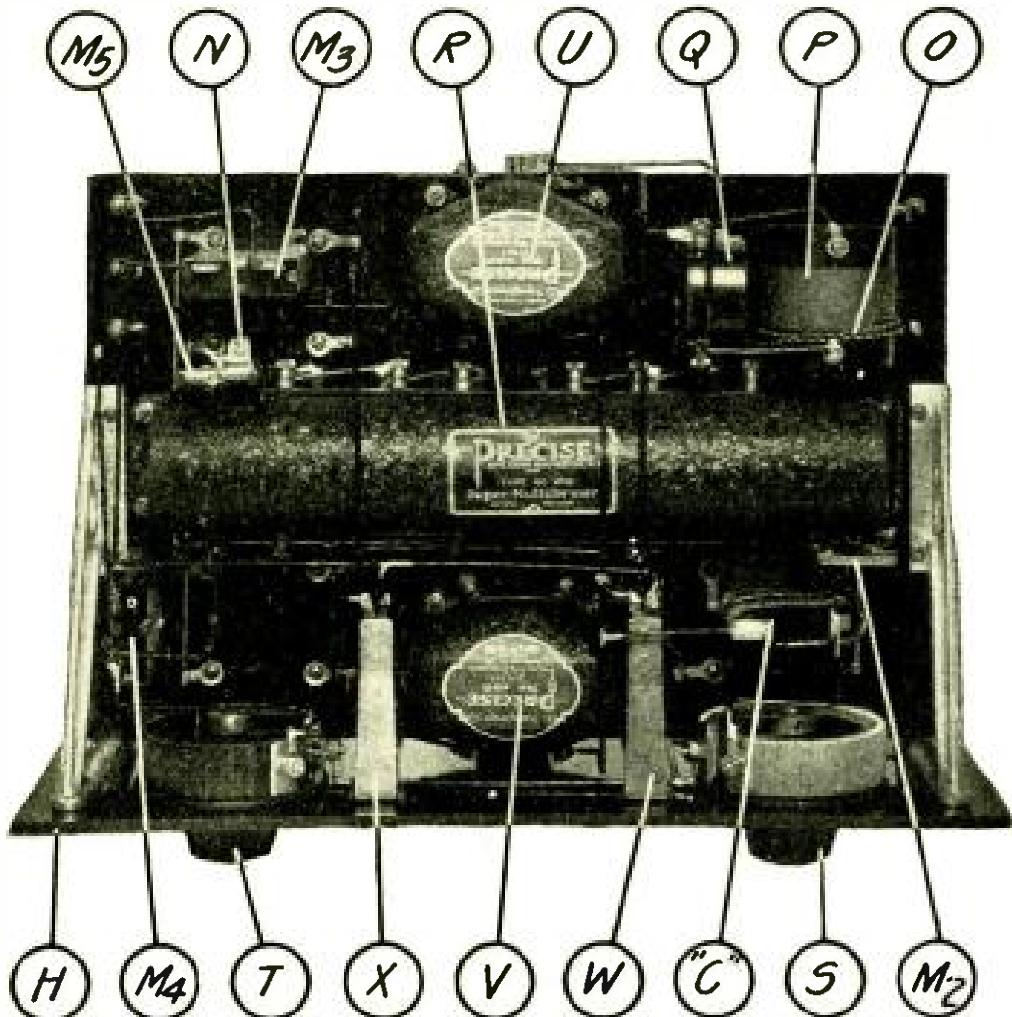
nnections that can be made in inaccessible places first. Then finish up the wiring to the two condensers on top of the panel with the leads running to the proper place below, as shown in Figure 12.

When you have done as much of this work as is possible, and you have the sockets, transformers, coupler, binding posts and the condensers all connected as shown, you may start on the wiring of the main panel H.

There is one connection between two of the terminals of the potentiometer and the rheostats which should be finished before the sub-panel is attached to the main panel H. When this is done attach the two brackets to the main panel by means of two screws and nuts to each bracket. Then you can finish the wiring incorporating in it the connections to the jacks and the meters and the filament battery switch as well as finishing up the wiring to the rheostats.

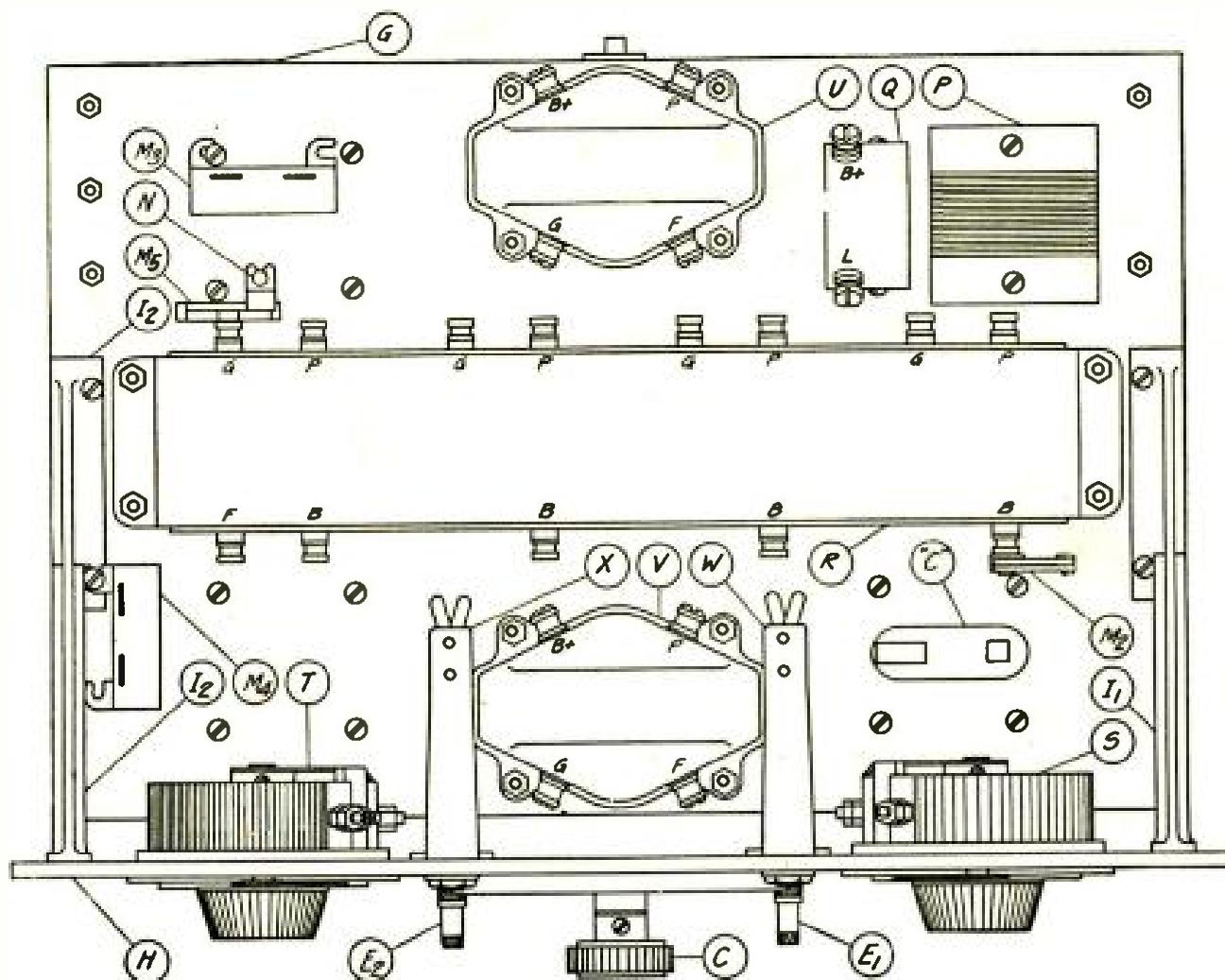
The schematic diagram that shows you the circuit used in this receiver is shown in Figure 1, but in making electrical connections it is easier to follow the diagram as set forth in Figure 12.

If you make every connection exactly as



VIEW OF THE SET FROM BELOW

FIGURE 8: Note how the transformers, rheostats, bypass condensers, inducto-coupler, filter-former and the jacks are mounted in compact assembly below the sub-panel. All the parts are accompanied by designating letters which re-appear in the text and in the list of parts.



ANOTHER CONSTRUCTIONAL WORKING DRAWING

FIGURE 9: This drawing shows the exact arrangement of the various parts that are mounted below the sub-panel. Notice that the various terminals of the transformers are marked with the same letters that appear on the transformers; this will enable you to place them without any chance of error.

shown you will have no trouble in getting the set to work properly. It is advisable to use for this purpose some kind of insulated bus-bar. The wiring of the experimental set was done with Celatsite. Connect the wiring wherever possible to soldering lugs and use only enough solder and flux to make a good electrical connection, wiping each joint dry after it has been made. The No. 751 Eveready "C" battery shown on the diagram at "C" may be supported by the wiring or it may be held with a small brass bracket, if preferable.

In doing your wiring job remember that care and neatness will enable you to do a correct and efficient job. Don't hurry. Take it easy and check over your wiring as many times as necessary to be sure that you have done exactly the right thing as shown in the picture diagram in Figure 12.

All the instruments are marked with designating letters and the important binding-post terminals on the transformers and coils are marked with designating letters for your information.

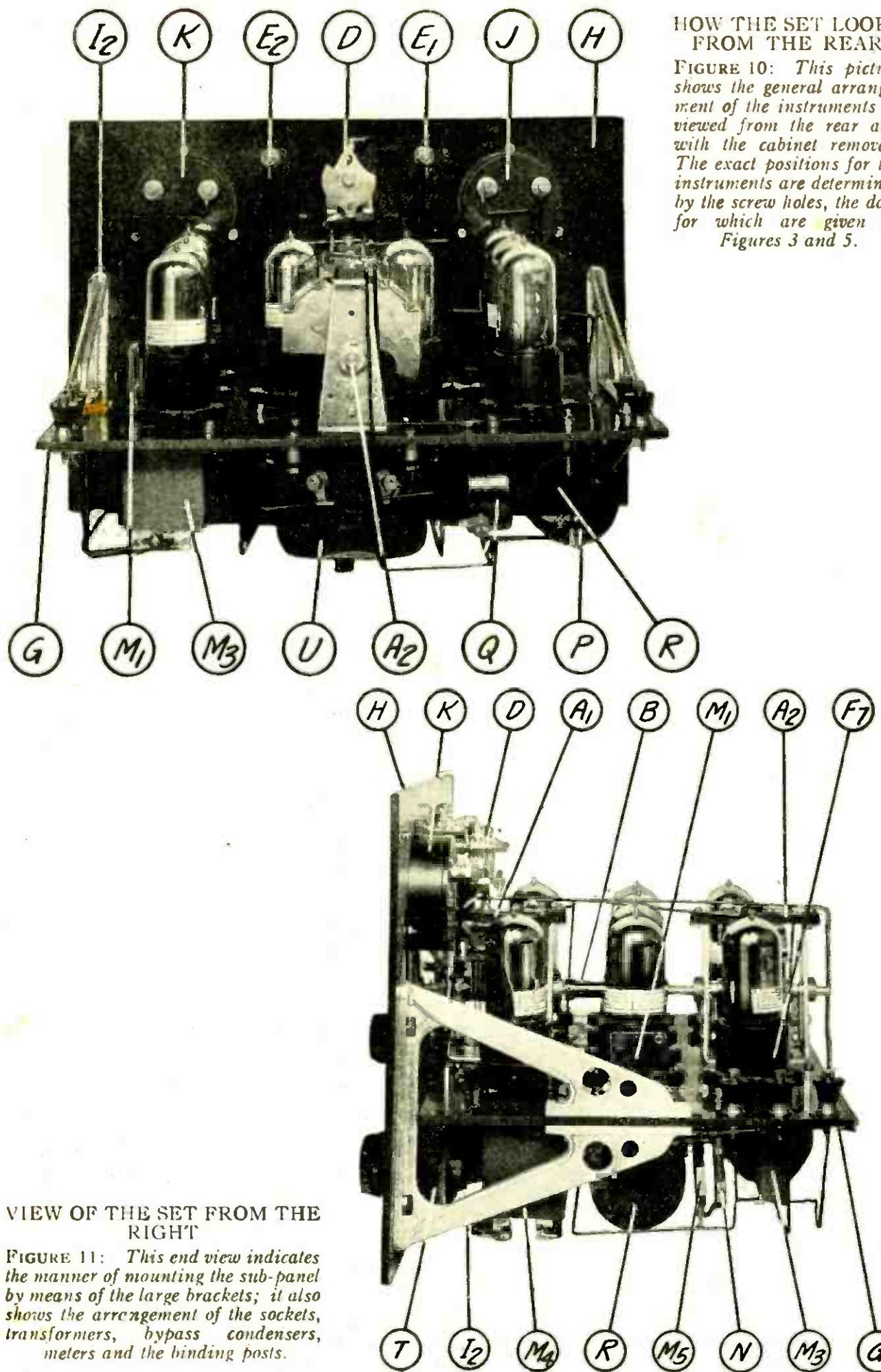
It will be noticed that the loop terminals are brought out to the small Imp jacks E1 and E2.

How to Install the Set

After the wiring has been completed the large dial C should be attached to the condenser shaft that protrudes through the face of the main panel H. Instructions for mounting this dial will be found in the small folder that comes with the dial. This leaves the set ready to be installed in the cabinet; the details of which are given in Figure 14, which shows all the mechanical dimensions for the cabinet. One of these may be obtained from a cabinet manufacturer or you may take the dimensions to a neighboring carpenter who can build it from the diagram. Slide the panel down into the cabinet with the lid open. You will notice that there are two grooves that hold the panel in a vertical position. This is all that is necessary as a support for the receiving set.

Next insert the eight standard tubes in the sockets—first being sure that the battery switch L is pushed all the way in on the "off" position. I have used the Brightson tubes in this set with fine results, although any standard make of tube can be used.

Then connect up the two 45-volt "B" bat-

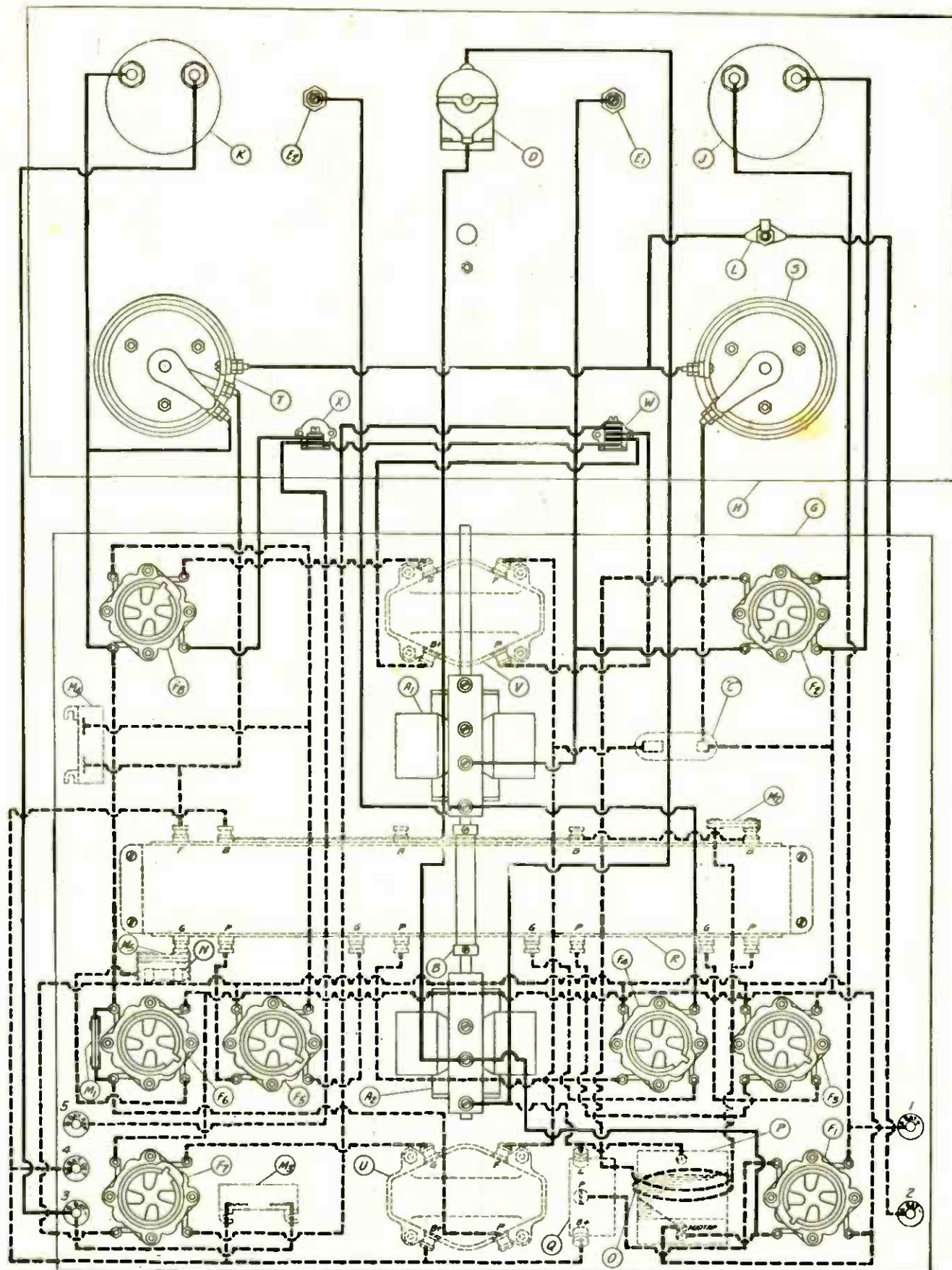


HOW THE SET LOOKS FROM THE REAR

FIGURE 10: This picture shows the general arrangement of the instruments as viewed from the rear and with the cabinet removed. The exact positions for the instruments are determined by the screw holes, the data for which are given in Figures 3 and 5.

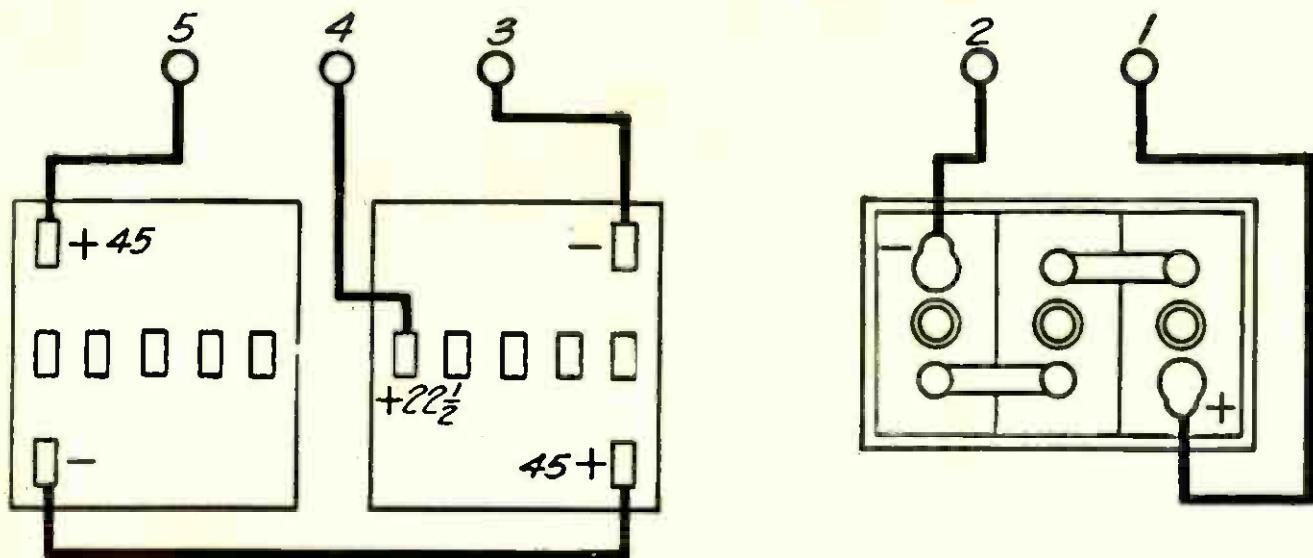
VIEW OF THE SET FROM THE RIGHT

FIGURE 11: This end view indicates the manner of mounting the sub-panel by means of the large brackets; it also shows the arrangement of the sockets, transformers, bypass condensers, meters and the binding posts.



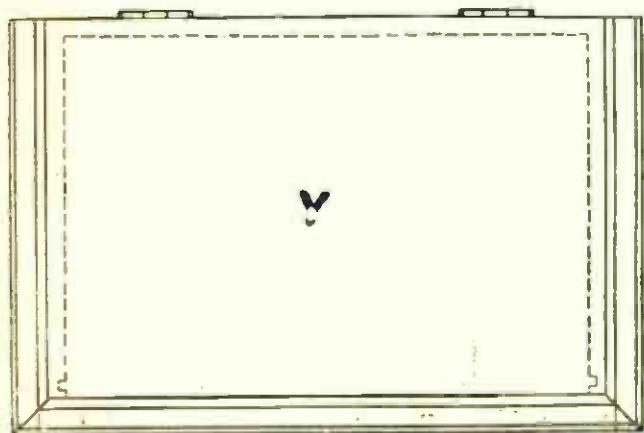
THE WORKING PLAN FOR CONNECTING UP THE INSTRUMENTS

FIGURE 12: The upper rectangle represents the main panel and on it the instruments are drawn as they appear as viewed from the rear; the lower rectangle represents the sub-panel. The instruments are represented in about their relative position. Those instruments indicated in this diagram in heavy black lines are mounted on TOP of the sub-panel and those in dotted lines are mounted BELOW the panels. Likewise the wiring that is shown in heavy continuous lines should be done on top of the sub-panel and the wiring shown in dotted lines should be completed underneath the sub-panel.



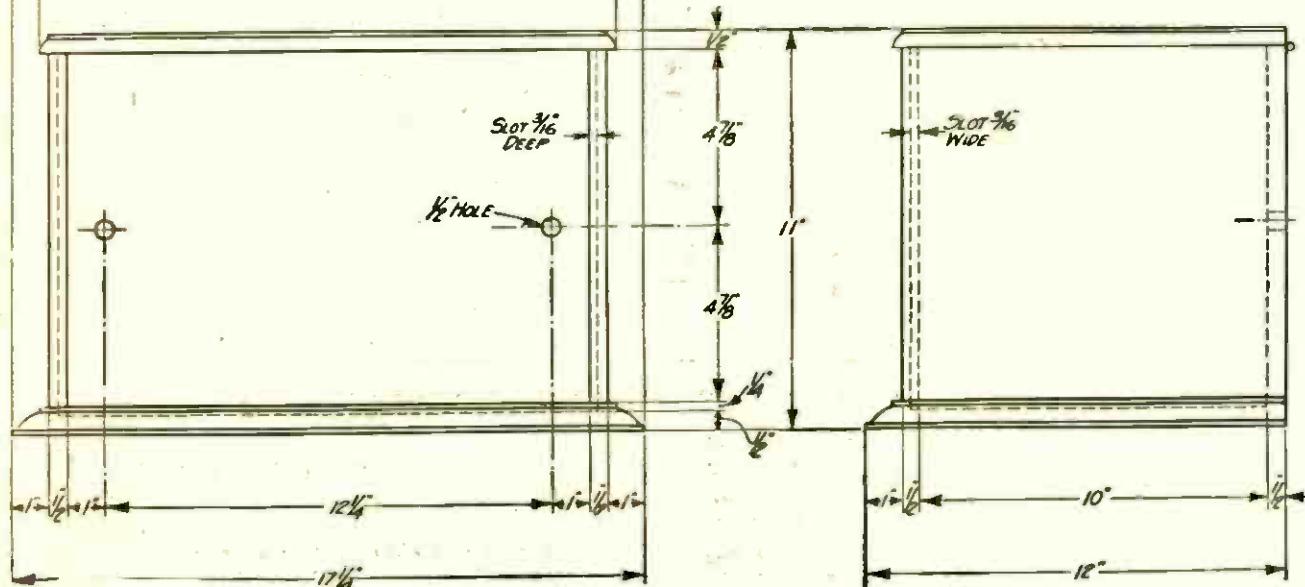
HOW TO CONNECT THE BATTERIES

FIGURE 13: This drawing will prevent you from making mistakes in connecting the batteries to the terminals at the back of the receivers. If you follow these instructions the set will be hooked up correctly, as the terminals shown in the wiring diagram are marked with the same numbers that are given here.



A WORKING PLAN FOR THE CABINET

FIGURE 14: This diagram, which contains the top, front and side measurements for the mahogany cabinet, may be turned over to a competent cabinet maker who can build a cabinet from these instructions exactly the right size for the panel.



series as indicated in the diagram in Figure 13. Also connect the 6-volt "A" battery in the manner indicated in the battery hook-up in Figure 13.

Then set the "DTW" loop on top of the set as shown in the illustration on page 353, in which the author is shown tuning the receiver. The receiver is designed especially to be used with this large German loop, which is an extremely efficient piece of apparatus and contains just the correct value of inductance when the two wires leading from the plugs and jacks E1 and E2 are connected to the top and bottom terminals on the loop. Use two short flexible pieces of wire in making this connection.

How to Operate the Receiver

The next procedure is to place the head telephones in jack W or the loudspeaker in jack X prior to operating the receiver. Then with the rheostat S turned over and to the left in an anti-clockwise direction pull out the battery switch L and adjust the rheostat S by turning in a clockwise direction (over to the right) until the voltmeter J reads approximately $4\frac{1}{2}$ volts. Then adjust the potentiometer knob T until a reading of approximately 10 milliamperes is obtained on the milliammeter K. These are practically the final adjustments for the potentiometer and the rheostat.

Then revolve the dial C by means of the small knob until a station has been picked up. Tune it in as loud as possible and leave this dial fixed. Then with a slow motion of the small knob D, adjust the vernier condenser until the oscillator and loop circuits are in perfect synchronism. This will bring up the signal to its greatest strength, and when this is once

done the knob D can be left fixed.

For tuning in any other stations after this nothing is necessary to do but revolve the white sectoried dial C by means of the small knob located on the round black disc.

Stations that are tuned in between zero and 50 on this dial may be logged by writing in the call letters in the small white rectangular aperture at the left side of the dial with a pencil. Stations that tune in above 50 on the dial should be written in on the small white rectangular aperture on the right-hand side of the dial.

To re-tune stations all that is necessary is to rotate this dial C until the correct call letters of the stations that you want to hear appear in these two apertures.

Of course, for best operation the loop should be turned so that its plane is in line with the station you want to hear.

On distant stations it may be necessary to slightly adjust the potentiometer T to the right or to the left in order to bring the signal in with great intensity. This will cause the milliammeter K to vary slightly above or below the 10 milliammeter mark. The voltmeter, however, should always read $4\frac{1}{2}$ volts and the rheostat S adjusted only when the battery voltage changes, thus making an adjustment of the rheostat necessary. *Watch your meters for best operation.*

To turn off the set all that is necessary is to push in the battery switch L, which completely opens the filament circuit.

If all the instructions that have been given in this article are followed minutely, even a beginner can build this set and obtain very fine and enjoyable results from it both on local and distant reception. The receiver tunes as sharp as a hair.

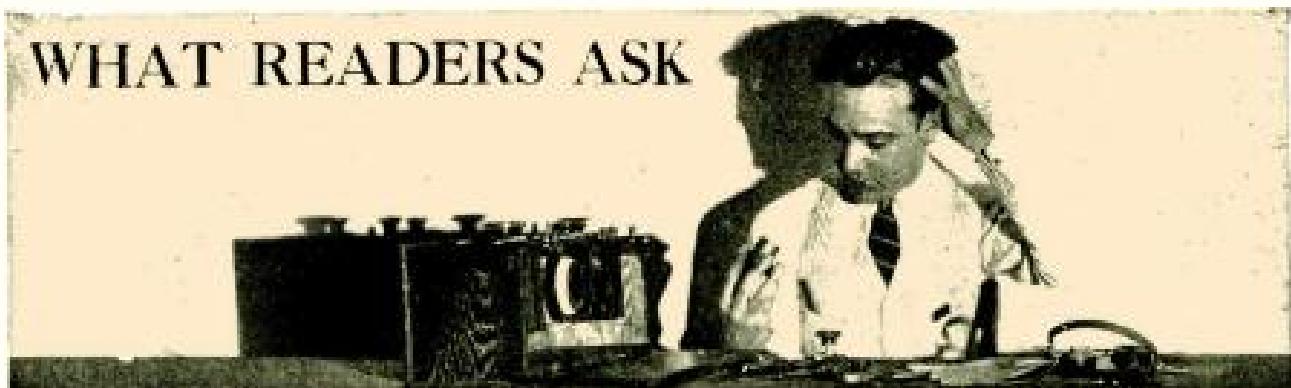
TAPPING THE BRAINS OF THE AMATEURS

In order to take advantage of the ideas of ingenious young radio experimenters, Mr. Edward H. Jewett of Detroit, Michigan, recently invited radio amateurs to come into the laboratory of his million-dollar factory and submit ideas. Three of the hundreds who applied were turned loose in the laboratory—and between them they worked out a device which has come to be one of the chief products of the factory.



International

WHAT READERS ASK



CONDUCTED BY HUGH S. KNOWLES

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.

An Inductive Coupled Transmitter

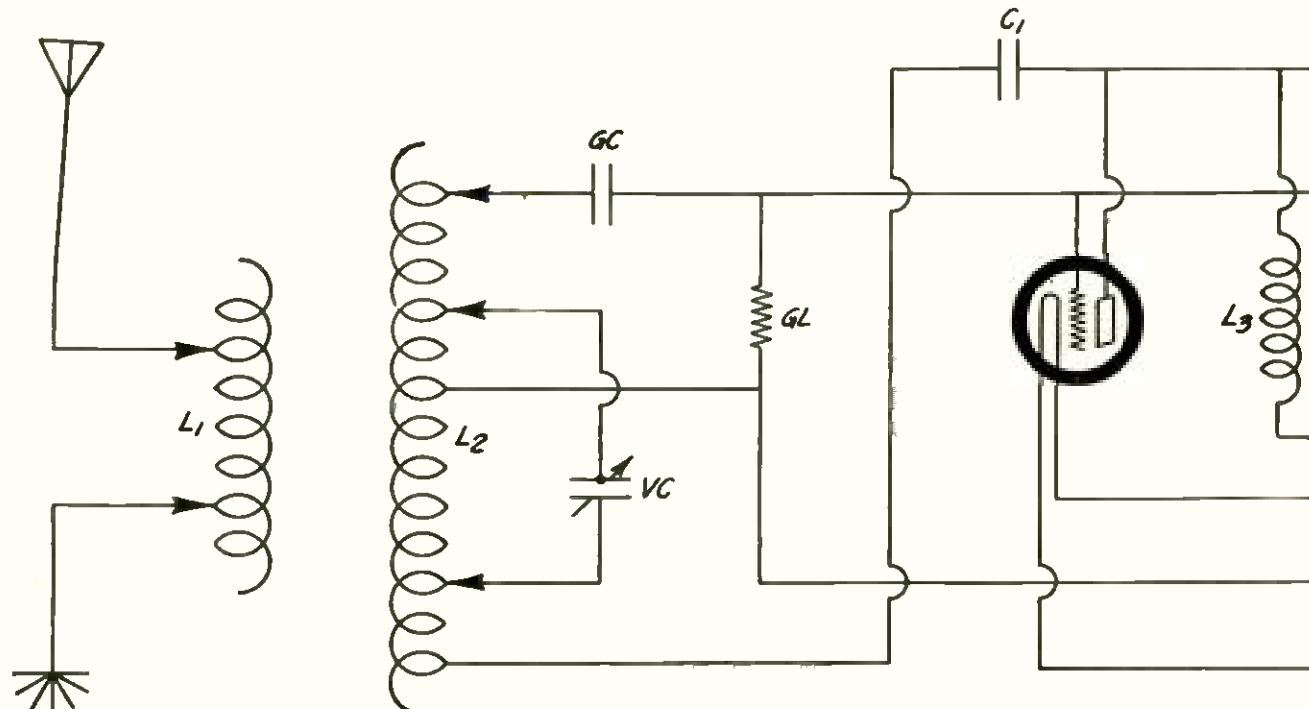
QUESTION: I have a transmitter that uses two five-watt tubes in parallel in a conductively coupled Hartley circuit with 60 cycle A.C. on the plates. I should like to change this transmitter to conform with the new regulations requiring inductive coupling and full wave rectification. I want to operate it on the eighty meter band.

DICK BINNIN

ANSWER: In Figure 1 you will find a diagram of a transmitter of the type you require. You will need the following parts:

L₁ and L₂—secondary and primary of an O. T. (oscillation transformer);
VC—.00025 double spaced variable condenser;
GC, C₁ and C₂—.002 mica transmitting condenser;
L₃ and L₄—radio-frequency chokes;
C₃ and C₄—.002 low voltage condensers;
T₁—plate supply transformer giving 550 volts on each side of the mid-tap and having a capacity of 50 or more watts;
T₂—filament supply transformer (8-9 volt, 50 watt);
R—primary rheostat;
GL—5,000-10,000 ohm grid-leak.

L₂ can be made by winding 12 turns of number 8 or 10 bare copper wire on a skeleton frame 5 inches in diameter with the turns spaced the diameter of the wire. L₁ should be made on the same type of frame and 6 turns should be used. It should be mounted



so its coupling to L2 can be readily changed.

In changing over from the conductively to the inductively coupled type of transmitter it must be borne in mind that the closed circuit comprising the grid and plate coil variable condenser and input to the tube has to carry as much as fifteen times the current it carries when conductively coupled to the antenna. To minimize the losses in this circuit the inductance should be designed to carry the heavier current and the condenser should be a low-loss double spaced or transmitting type such as the Cardwell transmitting.

L3 and L4 should be made by winding 150 turns of No. 30 D.C.C. wire on a 3-inch tube.

The circuit given is for a separate filament transformer. This arrangement is advisable as it allows close control of the filament voltage without the use of a rheostat directly in the filament circuit which would upset the balance obtained by the use of the mid-tap. The rheostat R should be one similar to the new E 210 Bradley.

If the fundamental of the antenna circuit is above 80 meters insert a variable condenser in the counterpoise or ground lead. Loose coupling between L1 and L2 will minimize interference to broadcast receivers, make the transmitter stable and the note better. Test with a receiving station as the maximum deflection point on the antenna meter may not be the best place to operate.

"C" Battery for Neutrodyne Receiver

QUESTION: I have a homemade five-tube neutrodyne receiver with which I use three large-size, 45-volt "B" batteries. It seems to me that the "B" batteries have to be replaced altogether too fre-

quently, and I wonder if there is some way in which I can prolong the life of these batteries without interfering with the good results I am now getting so far as volume and distance are concerned. Can you advise me? I might add that I have been thinking of installing a "C" battery, but do not know whether this would help.

BEN WEBSTER

ANSWER: By all means install the "C" battery in the grid returns of the audio-frequency amplifier tubes. This should make the "B" batteries last at least 25 percent longer. Next try using only two of the 45-volt batteries instead of three. This will undoubtedly improve the tone quality of the receiver, will give only slightly less volume than you now obtain, and will lengthen the life of your batteries materially. Finally, use the "oversize" 45-volt batteries, such as the Eveready No. 770 type. The first cost of these larger batteries is somewhat higher than the batteries you now use, but their life is almost twice as great. By following out these suggestions the life of your "B" batteries should be several hundred percent greater than at present. It is highly probable, too, that tone quality will be improved and volume equal to that obtained at present.

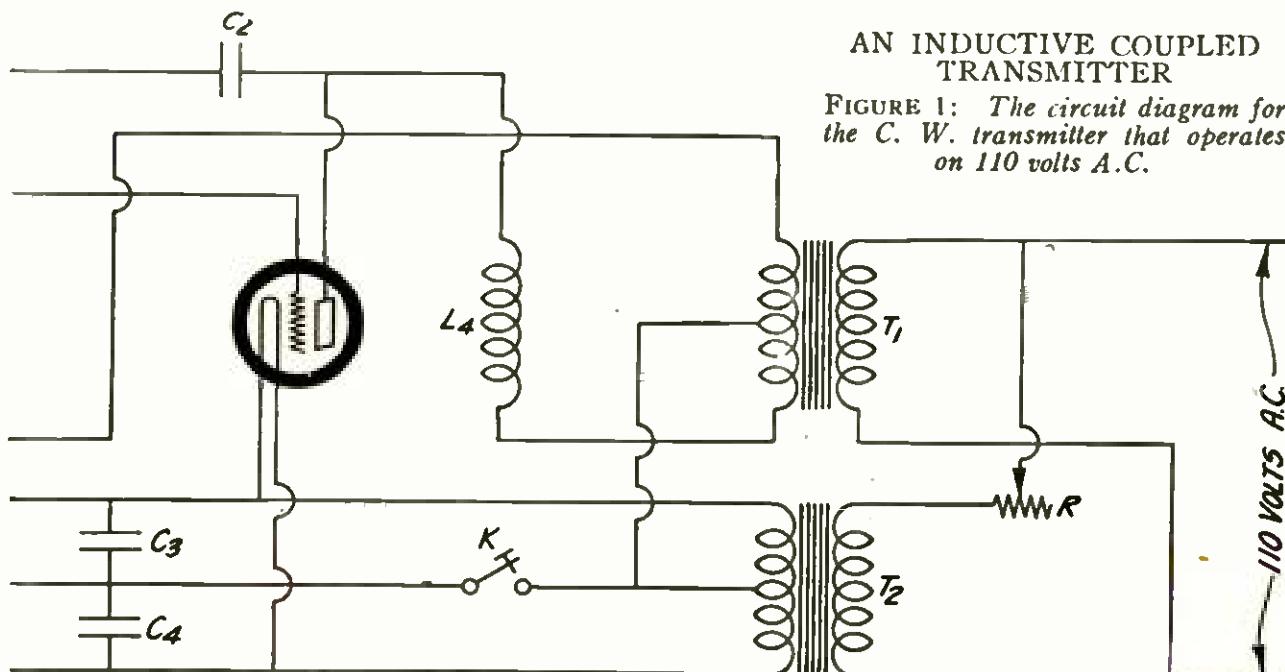
Static on Various Wavelengths

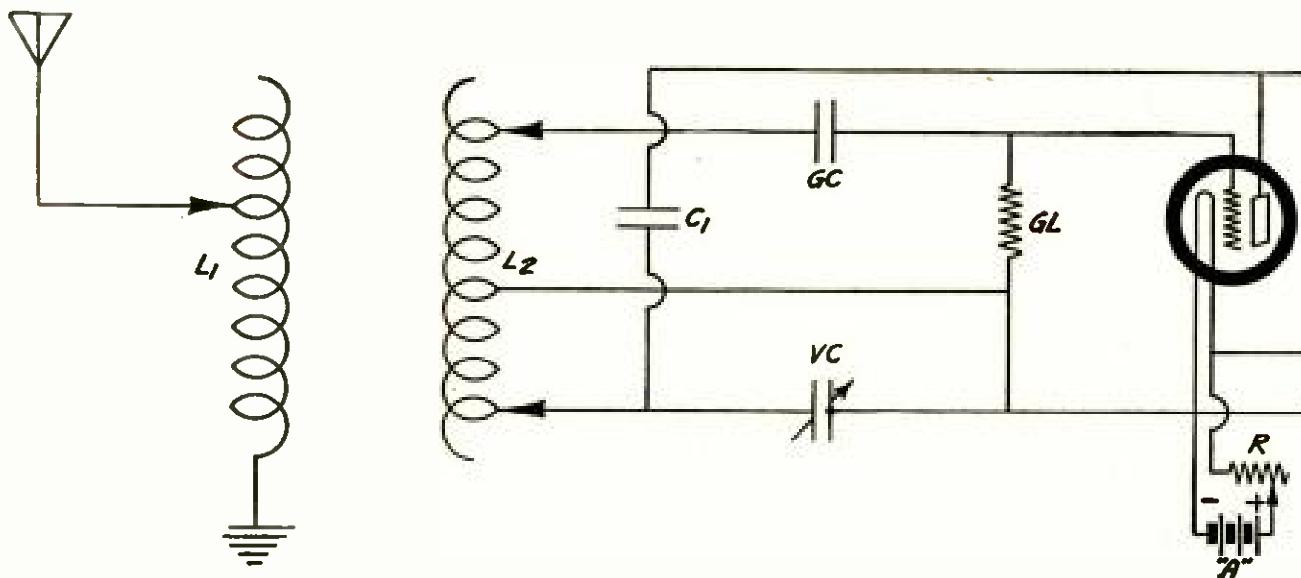
QUESTION: Is it true that the static that is heard on the broadcasting waves of 300 to 500 meters is absent on short waves of 40 to 80 meters?

ALEXANDER SMYTHE

AN INDUCTIVE COUPLED TRANSMITTER

FIGURE 1: The circuit diagram for the C. W. transmitter that operates on 110 volts A.C.





A LOW POWER TRANSMITTER FOR TELEPHONY

FIGURE 2: This diagram shows how the various instruments in the circuit should be connected for a simple transmitter employing Heising modulation.

ANSWER: Yes, sometimes this is the case although by no means a rule. Static is no respecter of wavelengths and is sometimes prevalent over a considerable band. As an instance, static conditions may prevail on 40 meters, be considerably less on 80 meters and again very loud on 250 meters.

A Low Power Phone Transmitter

QUESTION: I should like to experiment with a small telephone transmitter which would be capable of transmitting a couple of miles. If possible I should like to operate it on a storage battery and regular B batteries. Will I need any license to operate a low power transmitter of this type?

HOWARD BEAN

ANSWER: In Figure 2 you will find a diagram of a low power phone transmitter. You will need the following parts:

L1 and L2—secondary and primary of coupler;
C1—.002 condenser which will stand the B voltage;
VC—.00025 variable condenser;
GC—.0005 condenser;
GL—variable grid-leak;
L3—radio-frequency choke;
L4—audio-frequency choke;
M—microphone;
MT—modulation transformer;
R—filament rheostat.

L2 should be made by winding 36 turns of number 18 D.C.C. on a 4-inch tube and tapping it in the middle. L1 should have about 20 turns of the same size. This should be

mounted so the coupling to L2 can be varied. If the fundamental of the antenna is below the wave you wish to work on L1 can be tapped every two turns and adjusted until the maximum power is emitted. If it is above this value you will have to insert a variable condenser in the ground lead.

L3 can be made by winding 200 turns of number 32-36 D.C.C. on a 3-inch coil.

Any good audio choke or the secondary of an audio transformer designed to carry a fairly high current can be used for L4.

Any good amplifier or power tube can be used in this circuit. If 201-a tubes are used B should not be over 150 volts. Better results can be gotten by using VT2s (Western Electric) or a power tube which will operate on a storage battery. Up to 350 volts can be used on the latter permitting transmission over a greater range.

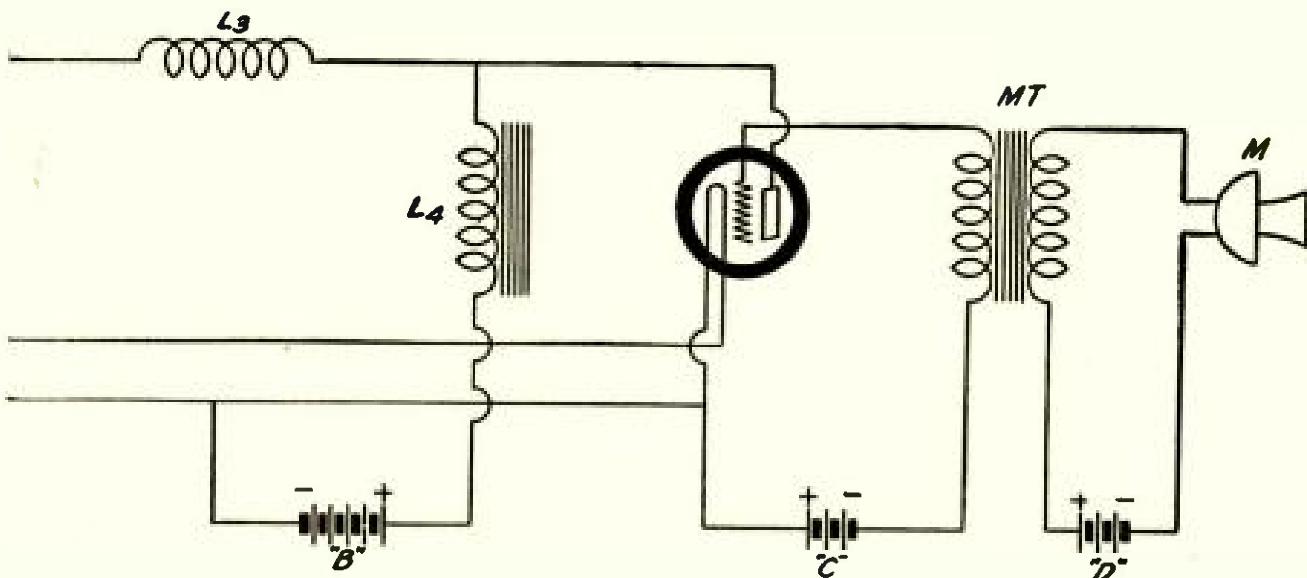
The voltage of C will vary from about 6 to 30 volts, depending on the tube and plate voltage.

D is the microphone battery, and its voltage is determined by that necessary for the "mike."

Regardless of how little power is used both a station and operator's license must be obtained before you do any transmitting. The latter means that the code must be learned even if you are to use only a phone transmitter. Communicate with the radio inspector in your district for blanks and particulars on how to obtain a license.

Sub-panel Instrument Mounting

QUESTION: I want to fasten some transformers under a $\frac{1}{4}$ inch thick bakelite sub-panel. Is it possible to drill and



tap holes without drilling clean through the bakelite?

TOBIAS S. NORTON

ANSWER: This is quite possible but requires much care. For 6/32 screws use a No. 31 drill, and while drilling stop frequently to plumb depth of hole. Drill the hole only 3/16 inch deep. It will be necessary to file the tip off a 6/32 tap to permit of it cutting a thread to the very bottom of the hole. Run your tap down slowly and do not attempt to force tap when nearing the finish of the process, as it may result in the breaking of the tap. Make sure your screws are not too long. This method of mounting instruments while neat and quite effective requires considerable time, patience and care.

Dry-cell or Storage Battery Tubes?

QUESTION: I have the blueprints for a small two-tube receiver which I am planning to build. The specifications call for the use of UV-199 or C-299 tubes. If superior results could be obtained with UV-201-a tubes I would prefer to use them, if not I would prefer the dry-cell tubes. Can you help me in this problem?

THOMAS NELSON

ANSWER: We presume your receiver consists of a detector and one stage of audio-frequency amplification. In that case there will be little difference whether you use dry-cell or storage-battery tubes. As doctors the two are about equal, and also in the first stage of audio-frequency amplification. It is not until the second stage of amplification is

used that the real difference between the two types of tubes becomes apparent. If there is any possibility of your adding another stage of amplification at some later date, therefore, we would advise the use of UV-201-a type of tubes.

Loudspeaker Operation on One Tube

QUESTION: Is it possible to operate a loudspeaker on one tube?

E. DUNLAP

ANSWER: With some models, laboratory built, and using special circuits, this has been possible. For this purpose super-regeneration has, as a rule, been employed. This necessitates a complicated filter system and is therefore not practical for the average broadcast listener. A loudspeaker is not an amplifier and simply transforms the electrical energy which it receives into sound energy.

Rushing Noises in a Receiving Set

QUESTION: Kindly explain the reason for the rushing noise that you hear before music is heard from the broadcasting station.

F. FARMER

ANSWER: The broadcasting station first produces a carrier wave of its specified wavelength, sends it through the microphone and to their antenna. This is the cause of the rushing noise as the microphone is not an absolutely silent device.

A Short-wave Regenerative Receiver

QUESTION: Please give me the circuit diagram and the necessary information to make a single-tube receiver of the Reinartz-Zenith type. I would like this receiver to cover a range of about 30 to 100 meters.

J. ANDERSON

ANSWER: In figure 3 is shown the wiring diagram necessary to construct the Reinartz-Zenith single-tube outfit. The parts you will need for building this set are the following:

L1 and L2—hand-wound single layer coils;
L3—hand-wound choke coil;
VC1 and VC2—variable condensers, .00025 mfd.;
GC—griddenser, .00025 mfd.;
GL—grid-leak, variable;
TEL—telephones;

R—filament rheostat, 20 ohms.

The coils, L1 and L2 should be changed for various wavelength bands. The smaller coils should consist of—for L1 a single coil wound No. 18 DSC wire wound with 9 turns on a $3\frac{1}{2}$ inch diameter tube tapped every 3 turns as indicated in the diagram.

Coil L3 should be wound on the same size tubing and should consist of about 6 turns of the same kind of wire.

For the medium wavelength band, coil L1 should consist of 11 turns for this waveband wire on the same size tubing and tapped every 6 turns. Coil L2 should consist of 7 turns of

the same kind of wire on the same size of tubing.

For the higher wavelength band, coil L1 should consist of 36 turns of the same size wire wound on the same size tubing. Coil L2 should consist of 11 turns for this waveband.

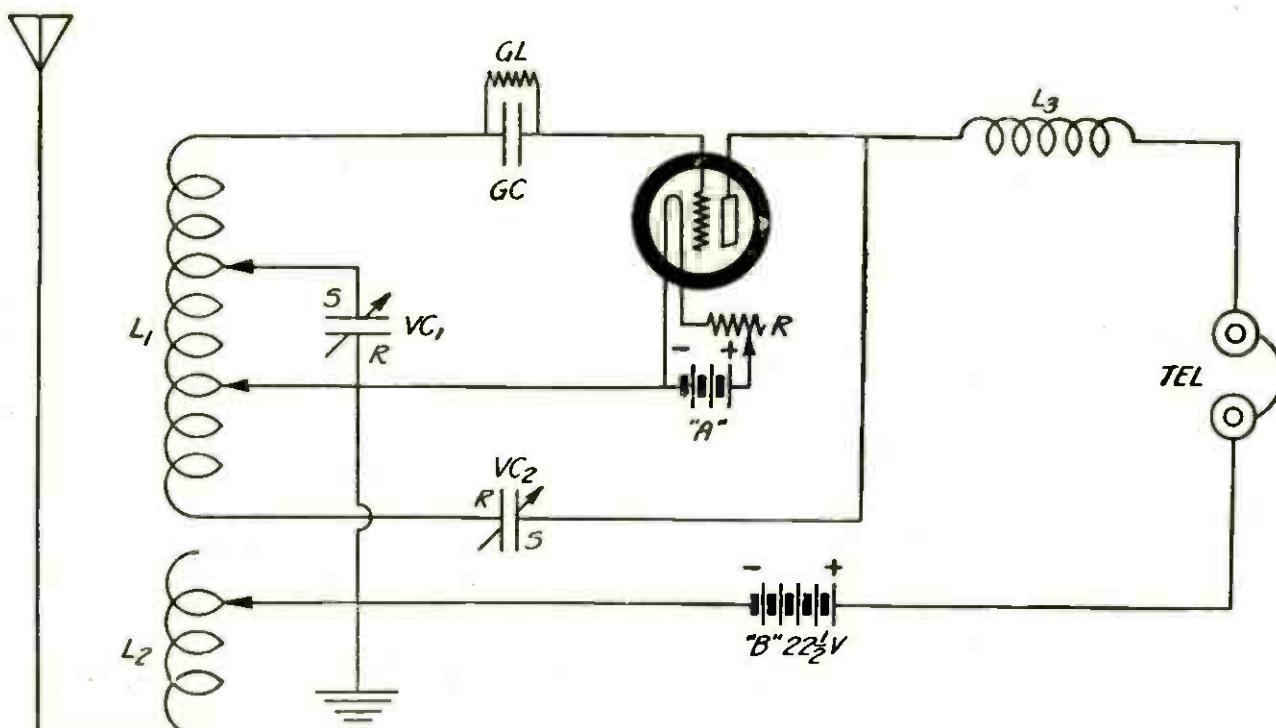
Coil L3 which is used as a radio-frequency choke coil should consist of No. 30 DSC wire wound on a form 1 inch in diameter. The wire should be wound on a wooden spool in a single layer of this section to a length of $3\frac{1}{2}$ inches. An ordinary antenna of 25 to 150 feet in length should be used.

The Commercial Tube Tester

QUESTION: When buying tubes in different stores I have noticed that the reading of the tube tester varied considerably. Does this indicate that the tubes are not uniform?

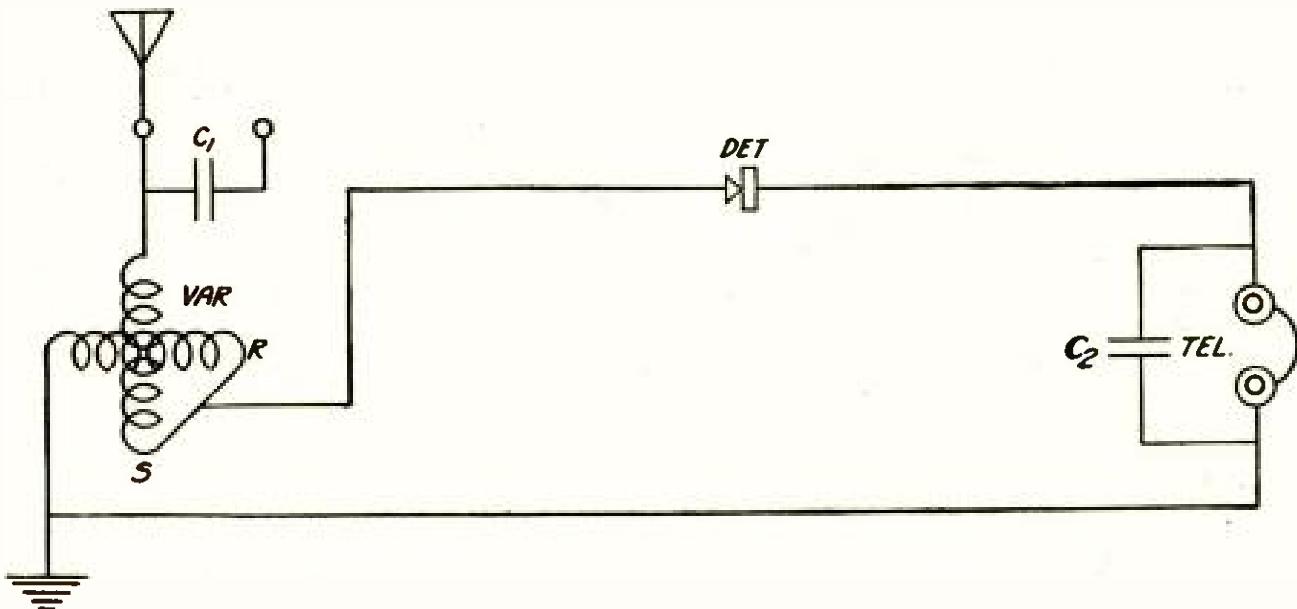
C. KANE

ANSWER: The testing device generally used merely measures the plate current of the tube for a given plate voltage and a given grid bias. One store may choose a certain value for the plate voltage and grid bias which will give them a certain reading for the plate current which they will come to recognize as a standard to judge the tube by. Another store may choose a different plate voltage or grid bias and this will give them a different standard plate current reading for the same type vacuum tube.



UNIQUE SHORT-WAVE REGENERATIVE RECEIVER

FIGURE 3: This diagram gives the connections for the Reinartz Zenith short-wave circuit which is noted for its ease of handling on waves below 150 meters.



A VARIOMETER-TUNED CRYSTAL CIRCUIT FOR LOCAL RECEPTION

FIGURE 4: This circuit shows the electrical connections for the variometer, the two fixed condensers, a crystal detector and the telephones to the aerial and ground wires.

A Simple Crystal Circuit

QUESTION: Please show me how to hook up a variometer and a crystal detector in a simple receiving circuit for use with the headphones. I do not want to use any amplifier or loudspeaker with this set.

E. COLLINS

ANSWER: The circuit you require is shown in Figure 4. The parts you will need for this set are the following:

VAR—variometer;

C1—mica fixed condenser, .00025 mfd.;

C2—mica fixed condenser, .0005 mfd.;

DET—crystal detector;

TEL—telephone.

You should use two binding posts as indicated for the antenna circuit and connecting to the left-hand one for long waves and to the right-hand one for short-wave stations.

This receiver should give you all the local programs up to a distance of 15 miles with clear headphone reception.

Where to Locate the Loudspeaker

QUESTION: Is it necessary to keep the loudspeaker adjacent to the receiving set? Sometimes it would be more convenient to move mine to the adjoining room.

M. E. FORD

ANSWER: The loudspeaker may be moved a reasonable distance away from the receiving set and still give perfectly satisfactory repro-

duction. In fact, some manufacturers make an extension cord about 25 feet long for just this purpose. The extension cord is supplied with a plug on one end for connection to the receiving set and a jack on the other end for connection to the loudspeaker.

The "Trickle" Charger and Its Principle of Operation

QUESTION: What is the principle of the "trickle" charger and how often must one of these be used? Is it a kind of charger that must be used in conjunction with an ordinary charger or does it replace the older type? How is the trickle charger used and what does it do? I have been told that it is used all the time that the set stands idle. Is this true? Does this cause any deterioration in the battery?

J. O. MURRIN

ANSWER: This type of charger depends on charging the storage battery practically continuously at a very low rate. One commercial unit, for instance, consists of a very low ampere-hour capacity storage battery combined with a "trickle" charger. Permanent connection is made to the electric light socket and also to the radio receiving set and a switch is provided for lighting the vacuum tubes of the set. The unit is arranged so that the storage battery is connected directly to the receiving set while the set is in use and so that the battery is connected to the electric light mains through the charger at all other times. Thus the battery is charged continuously except while the receiving set is in use.



F. M. Delano, Paris

WHY RADIO FANS ARE INCREASING IN SPAIN

Ever since POPULAR RADIO initiated the broadcasting of the outdoor concerts of the Philharmonic orchestra in New York back in 1922, this particular form of "pick-up" transmission has become widely popular. Above is shown the Madrid Municipal Band playing in the Plaza del Rey; the microphone may be seen hanging on a tree.

The BROADCAST LISTENER

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

By RAYMOND FRANCIS YATES

The WEAF Opera House

FRESH from the barber shop with a nice new hair cut and a heavy dose of Pinaud's we sat down to hear what WEAF would do to the good opera "Samson and Delilah." After it was all over we decided that this department should stop being nasty in the first paragraph and come right out and say something constructive and complimentary for a change. If we were given to the use of superlatives, we could say a lot of fine things about this good program, but we are just going to put it down as one of the ten best broadcasts of the year. This sweeping statement may mark us as one of the softest-hearted radio reviewers in the

business, but this department must be kept frank and honest above all things.

There was just a tiny little bit of fault that we had to find with the presentation. The descriptive matter lacked that imaginative touch so graciously imparted by that very capable announcer, Milton J. Cross (WJZ). Cross talks easily and intelligently about the opera, and we have yet to find a man who can match his meaty prologues. It is one thing to talk elegantly and blandly about "Miserere" and the prison scene of "Il Trovatore" or the hut of the Ulrica in "Ballo Maschera," and another thing to equip the radio listeners with a vivid, living picture of the action and the *locale*. Unless there is back of it a wise old head that

knows its opera and knows it well, it all amounts to so much pale pink *pfui*. If there is one thing that racks this old frame with rage it is the pathetic spectacle of an ex-usher or ex-poultry feed salesman unloading his version of "Baker's Biographical Dictionary of Musicians" into the unforgiving microphone.

* * * *

Opera Without the Flesh and Pasteboard

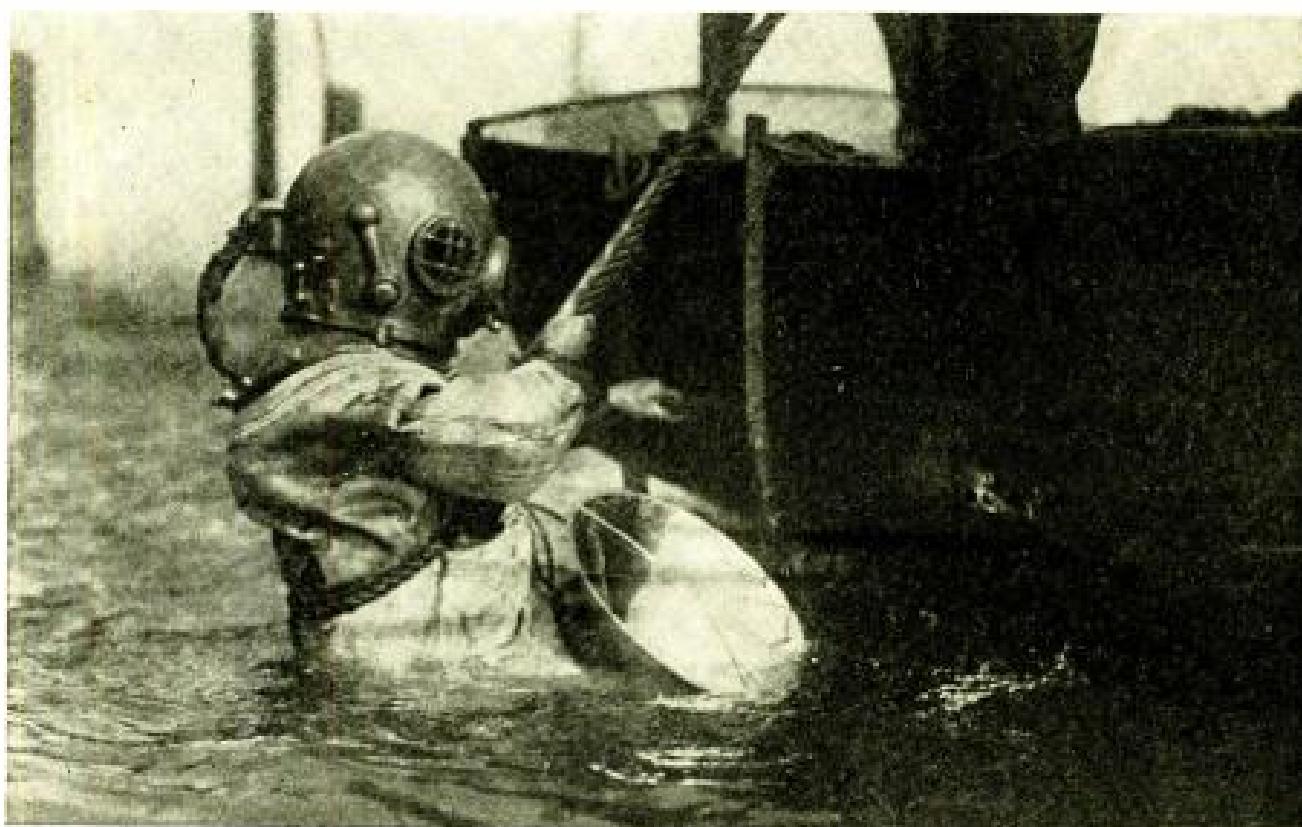
SOME of our very sophisticated friends complain that the radio opera is horribly unfinished and naked without its gaudy, gilded scenes of pasteboard and papier-maché filled with the bulky and unromantic figures of fleshy tenors and sopranos. Thank God our operatic education is so incomplete and plebeian that we are cold to the demands made by the more erudite students. For one thing, we have always thought that nature has been both indiscriminate and careless in the manner in which she bestowed gifts of voice and physical charm, and it is no tragedy in the life of this reviewer to be spared the sight of the bulky flesh (and sometimes the reverse) that animates the average opera scene. It is maddening to see a 210-pound female waddling about the stage in a sickly and insufficient effort to depict a tragedy of Verdi's or a romance of Puccini's. The voice is willing, but the flesh says "No" with several 24-point exclamation marks after it.

It is strange, isn't it, that Mr. Ziegfeld is so successful in finding heavenly figures with grade E voices and that Gatti-Casazza is so sure to find 5,000-watt vocal chords residing in a Mack truck chassis. Perhaps the radio is very kind to us after all, in that it spares us the unpleasantness of associating bird-like sounds with the heaving bulks of the dinosauria. The radio may be blind, but thank heaven, it is not grotesque.

* * * *

Too Much Chopin Is Enough

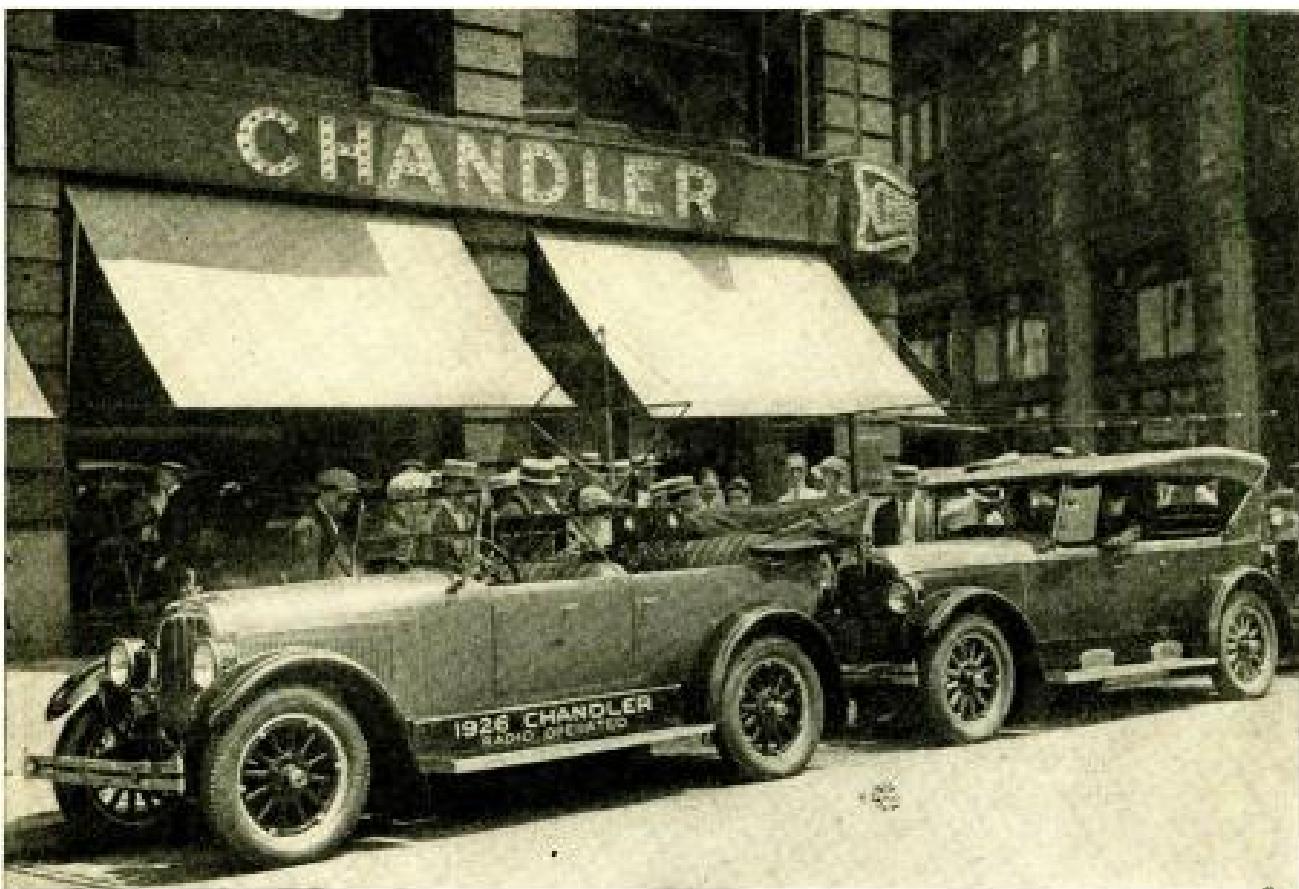
HAVING been a slave to the charm of Frederic Chopin's dainty nocturnes, mazurkas and études since the age of twenty (that's over forty years ago). Yes, the years do fly), we should be one of the last ones to say anything against his presence on the air. The fact that we are raising our voice a little just goes to show how serious the matter is and how upset we are about it. It seems that every pianist, near-pianist (*ditto* for the violinists) picks Chopin for public performance, and for three years now we have been Chopined on the air until we are just downright tired of it. The great "Nocturne in E Flat" has been played with all manner of technique, ranging from bright red down to Italian barber shop blue, on an average of three times a day in New York and vicinity. Let's let poor Chopin rest awhile. Men like Ernest Ball and Irving Berlin have to make a living, you know.



Pacific & Atlantic

A NOVEL BROADCASTING EXPLOIT

Equipped with a 1,000 watt pressure-resisting lamp, Dr. M. F. d'Elise of Philadelphia recently descended into 75 feet of water off New Jersey at 9 o'clock in the evening and described what he saw to the fans who were listening in to Station WIP.



Kadel & Herbert

AN AUTOMOBILE DIRECTED BY ETHER WAVES

Another experiment has recently been made with a "radio controlled" automobile, under the control unit in a pilot radio transmitter on 80 meters and operating on 100 watts; by means of relays picked up by special 5-watt receivers, the various controls of the car were operated. It has been proposed to drive the radio car and its pilot (following at a distance of 200 feet) across the continent.

Making Advertising Medicine from Old Favorites

OUR advertisers, now that they have taken to the radio, are certainly getting nice and clever in putting their stuff over on the radio audience. For a time there we thought they were going to run out of ideas, but it seems that we made a bad mistake, for it was only yesterday that we heard a New York furniture installment house start its half hour off with "Home Sweet Home." If Payne and Bishop wrote "Home Sweet Home" to bring on the furniture buying mood, it was nothing more or less than a dirty trick. Anyway, this is just a little warning to be on the watch for these subtle little pieces of air-copy designed to set the good wife off on a buying streak.

* * * *

Familiar Airs Ready for Cold Storage

WHEN the announcer says that the next number is going to be "an old favorite," that means that you are supposed to like it, or at least that the chances are pretty good that you will like it. We have a large number of "old favorites," but whether or not a thing will be

an old favorite with you depends upon what kind of music makes up your diet. Some like it harsh, some mild, some tender, some sentimental, some jazzy and some heavy. Some think "Marcheta" is or should be a classic (which reminds us, by the way, that it is pretty closely related to the "Merry Wives of Windsor" overture; hum the first few bars of each and listen for yourself) and others believe that Rimsky-Kosakow's "Coq d'Or" is a mere mess of unrelated and themeless notes.

At any rate, our announcers are too sure that they know the "old favorites," and it seems to us that is just a way they have of passing off the old, stale ones so they won't sound so bad. We're a wise old bird, and just to show these youngsters that they can't sell us quite so cheaply as that we are going to list a few "favorites" that should be kept off the air for the remainder of this year. It has reached a point where somebody has got to put a stop to this old favorite business, and it might just as well be us.

"Pale Hands."

"Kiss Me Again."

"Give a Man a Horse He Can Ride."

"At Dawning" (we're real mad about this one).

"By the Waters of Minnetonka."

"My Laddie."

"Tommy Lad."
 "Sunrise and You."
 "My Curly Headed Baby."

* * * *

The Craving for Broadcast "Stunts"

It's marvelous the way the studio publicity men think up ways and means of keeping up their lineage in the daily press. If they are not writing silly paragraphs about this or that "well-known star" they are molding up a new scheme to put the station on the air with some sort of "first-time-it-was-ever-done" stunt. The prize for this sort of business goes to the young scheme-specialist who thought of broadcasting from a diver's suit at the bottom of the ocean at Atlantic City. Although the news item was probably handled through at least twenty-five press associations and appeared in every great American daily, this bellicose old thing saw in it not a single sign of merit. It is no trick to carry a microphone to the bottom of the Atlantic. It would be no more difficult than the simple trick of broadcasting from the ice box of a kosher meat market in the Bronx. It would probably be the first time anybody had broadcast from the ice box of a kosher meat market in the Bronx, and with the aid of the thousands of industrious, news-grabbing editors we have throughout this big country of ours, the thing would go over big. Some day we are going to write a big thesis on this publicity bunk over the radio, and when we do a lot of these smart publicity men are going to be told a few things. Yes, sir!

* * * *

1,800,000 Compositions Broadcast Yearly

It is little wonder that the radio often loses some of its charm and freshness when we stop to think of how many hungry broadcasting studios we have that must be fed. Working on the theory that 300 studios are hard at it every day, and that each studio broadcasts at least twenty different musical numbers each day, we find (leaving out the Sundays), that no less than 1,800,000 compositions run through the mill yearly. That's eating up our musical resources at a pretty fast rate when you come to think it over. You know it has been worrying us a lot lately that radio may sooner or later make a positive bore out of the very best music. Give the public too much of anything, be it Beethoven or be it Berlin, and it eventually becomes fed up.

With that robust figure of 1,800,000 in mind we can see how it is that so many "Tommy Lads," "At Dawning" and "By the Waters of Minnetonkas" have to be thrown in to keep the broadcast pot boiling. Still that's the American way of overdoing things, feel about it as you may. In another five years we shall either be a very musical nation with every tot able to whistle Bach, Saint-Saëns and Mozart, or we shall learn to loathe the very sound of music.

Now that the world has been warned, we feel that we have done our part. Take your course, stupid old world, but don't blame us for what happens!

* * * *

Proposed Rules of Conduct in a Station

If we ever own a broadcasting station (God knows we have never craved such a thing, for we are a very lazy and indolent person) we are going to post a long list of rules for the conduct of those who perform acoustically before the microphone.

Rule No. 1 would warn each speechmaker against the facetious practice of referring to the microphone as (1) ash receiver, (2) tin pan and (3) pill box. If there is one thing that causes much biting of the finger nails out in the Morris Heights section of the Bronx where these brisk little paragraphs are pecked off, it is the gentleman who slips into his subject with, "Well, folks, this is my first offense. This little dish pan before me here—"

Rule No. 2 would read, "Pat and Mike were kicked down the stairs from this studio six months ago. Do not refer to them over the air." Speechmakers calling upon Pat and Mike stories would be severely dealt with. Mr. Rube Goldberg would be hired to devise an apparatus so that the mere utterance of the words, "That reminds me of the story of Pat and Mike," would release from a point directly over the microphone a large basket of paving bricks, each one with the power to induce long periods of butterfly chasing.

* * * *

Riding to Fame on Radio

FAME is a funny thing after all. Here we have been struggling along for sixty-four years and we have yet to hear somebody whisper, "Why, don't you know that guy, he's the man who—" You can do many things to become famous. Chorus girls shoot millionaires and get sentenced to six months in vaudeville. Just do something unusual, something big or something sensational, and you'll cash in. At least that formula held until broadcasting came along.

If you are a persistent sort of a person you can become famous on the air just about as cheaply and as thoroughly as you wish. Take some of our famous announcers for example. They're famous not because they're particularly good, but because they do a lot of talking that is heard by a large number of people and they keep at it. By the same process you could make a nanny goat famous by putting him (or her) near the monument at Columbus Circle. The nanny goat would do nothing to merit fame, but thousands of people would see it every day and finally people would begin to talk about the nanny goat at Columbus Circle.

Yes, these radio people ride to fame in an easy way, and here we are, just nobody, writing a wonderful line of stuff like this. Justice? Bah!

WHAT'S NEW IN RADIO APPARATUS



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.

AN EFFICIENT TUBE

Name of instrument: Vacuum tube.

Description: This tube is made in a somewhat similar manner to the ordinary standard tube, except that a different kind of filament is used. The base is of mahogany-colored bakelite with silver-tipped terminals on the bottom. The glass portion of the tube is of blue glass with straight sides rather than the ordinary pear-shape that is used on most vacuum tubes. The tube characteristics run very

uniform and make the tube extremely satisfactory for radio-frequency amplification, although they may also be used with good results as detectors and audio-frequency amplifiers.

Usage: As an amplifying or rectifying device in a radio receiving set.

Outstanding features: Uniform in electrical characteristics, sturdy construction, good appearance, efficient.

Maker: Brightson Laboratories, Inc.



These tubes come packed in a carton as shown in the illustration. They are well protected from shock and breakage in this kind of a case.

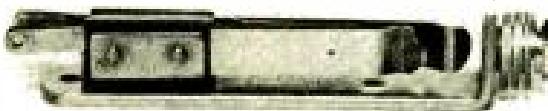
A NEW TYPE OF JACK

Name of instrument: Two-stage jack.
Description: This accessory is novel, in that it may be installed in a radio receiving set for controlling one or two stages of audio-frequency amplification. By inserting a plug into this jack until the first notch is encountered one stage of amplification may be cut into the circuit, and by pushing the plug all the way in the two stages are automatically attached to the loudspeaker. This eliminates the use of one extra jack and allows the operator to control the volume with a single operation.

Usage: In connection with radio receiving apparatus for attaching loudspeaker or phones to the amplifier.

Outstanding features: Neat workmanship. Novel connection feature. Good appearance.

Maker: Leich Electric Company.



A jack that performs double duty.

A NOVEL CABINET LOUDSPEAKER

Name of instrument: Loudspeaker.
Description: Here is an electrical-acoustic reproducer which is in a low cabinet and may be placed directly underneath the receiving set. It contains a well-known make of an electric reproducing unit with a new design of flat horn which gives good tone quality and ample volume for the ordinary living room.

Usage: With any radio receiving set as a reproducer.

Outstanding features: Novel shape and design. Good tone quality. Very fine appearance when installed.

Maker: Timbretone Mfg. Co.



This loudspeaker may be set on top of or underneath the ordinary receiving set. It takes up but small space and is very attractive in appearance.



A quality instrument useful to any experimenter.

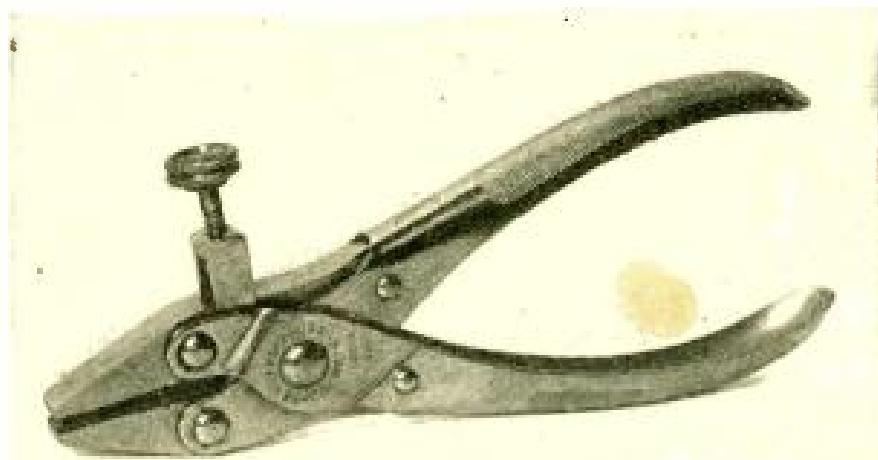
AN ACCURATE MILLIAMMETER

Name of instrument: Milliammeter.
Description: This is a standard size flush mounting meter of the moving coil type with a scale of 0 to $1\frac{1}{2}$ milliamperes. It is also furnished in 0 to 25 and 0 to 50 milliamperes, which latter sizes are suitable for insertion in the plate circuit of radio receiving sets. For laboratory use the instrument can be mounted on a small metal bracket as shown in the photograph, which contains two binding posts at the top that may be connected to the binding posts on the instrument with two short lengths of wire. This makes the instrument serve a double purpose for both mounting in the set and for separate work in laboratory testing.

Usage: Can be mounted directly on a panel of a receiving set or as shown above for portable laboratory work.

Outstanding features: Neat in appearance, accurate, sturdy in construction, standard finish.

Maker: Weston Electrical Instrument Company.



This hand plier contains the novel feature of a small vise-like attachment which enables various objects to be clamped tightly in the plier without holding the two handles compressed together.

HANDY PLIERS WITH VISE ATTACHMENT

Name of instrument: Combination pliers and clamp.

Description: A simple pair of pliers equipped with a spring that holds the jaws open under ordinary conditions. At the side of the jaws is a small nut and clamp that can be used for holding an article tightly in the jaws without pressure on the handles. The workmanship is such that this tool should be useful over a long period of time.

Usage: In the experimental laboratory for holding and clamping small bits of metal or small units while building a receiving set.

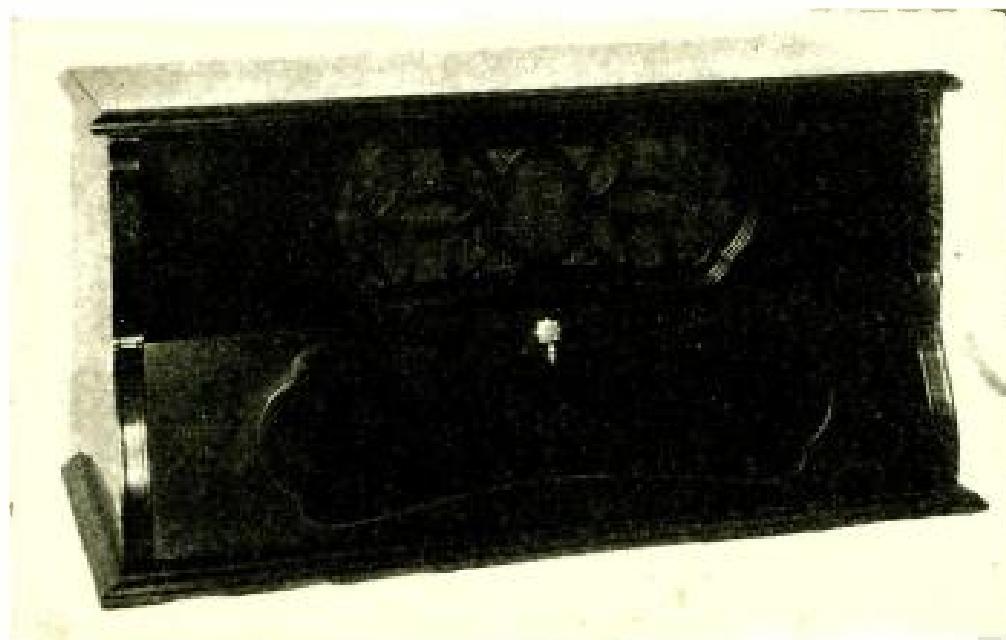
Outstanding features: Extremely handy. Light weight. The small clamp helps in holding pieces of apparatus without remaining in the operator's hands.

Maker: Wm. Schollhorn Co.

COMBINATION CABINET AND HORN

Name of instrument: Complete cabinet for a radio receiving set.

Description: A fine cabinet that is at the same time exceptionally beautiful in design and very satisfactory for encasing a home-made receiver. It is made of finely polished mahogany and is really an attractive piece of furniture. A loud-speaker horn is incorporated in the top portion of the cabinet and is all ready to have the unit clamped in position. The lower portion of the front is on a hinge which opens outward and leaves a space for writing down call letters, etc. Directly in back of this door is the section taken up by the receiving set which is installed by fastening the panel at each end with screws to a sloping or straight guide. The cabinet is suitable for mounting either a sloping panel or a straight panel as the builder desires,



This beautiful cabinet has a folding door in front that opens to the receiver. The loudspeaker is incorporated in the upper portion.

by simply reversing two triangular pieces, one at each side on the inside of the cabinet.

Usage: As a housing for a radio receiving set and loudspeaker unit.

Outstanding features: Fine appearance, simplifies the radio receiving set by housing batteries and loudspeaker. A real piece of furniture.

Maker: Blandin Phonograph Company, Inc.

A FILAMENT TRANSFORMER FOR RESTORING TUBE FILAMENTS TO ACTIVITY

Name of instrument: Tube rejuvenator.

Description: This instrument contains in a metal case a transformer with an attached winding which is suitable for applying the proper voltages to the thoriated filament vacuum tube to activity. It contains the sockets for both types of tubes and two sets of switches for applying the heavy and the light currents for this work. It is equipped with a long extension cord with a plug for installing in the lighting socket.

Usage: For restoring wornout filaments.

Outstanding features: Compact. Easy to operate. Economical in operation.

Maker: Jefferson Electric Mfg. Co.



A device for making new tubes of old ones.

A NEW BRACKET FOR MOUNTING SUB-PANELS

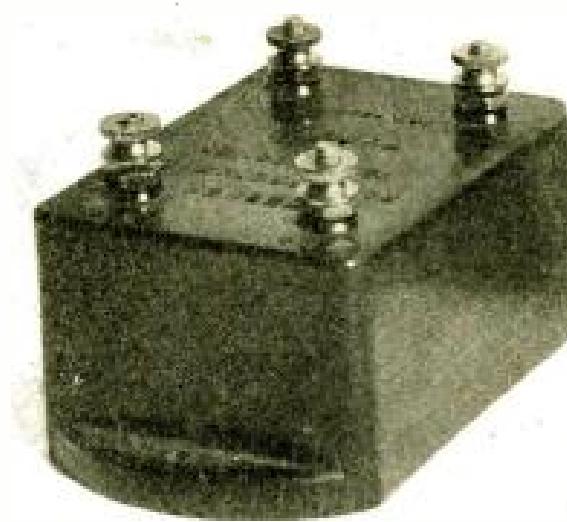
Name of instrument: Aluminum bracket.

Description: This light and strong aluminum bracket (which goes by the name of "Kelbracket") is cast in a single piece in the shape shown in the illustration with suitable holes for accommodating screws and bolts for attaching to the main panel and sub-panel of a radio receiving set. This makes a very useful accessory for the amateur and experimenter to keep on hand at all times.

Usage: As a brace and mounting for the panels in a radio receiver.

Outstanding features: Light weight. Strong. Easy to install. Neat in appearance.

Maker: Keller Company.



A radio-frequency transformer of merit.

A NEW RADIO-FREQUENCY TRANSFORMER

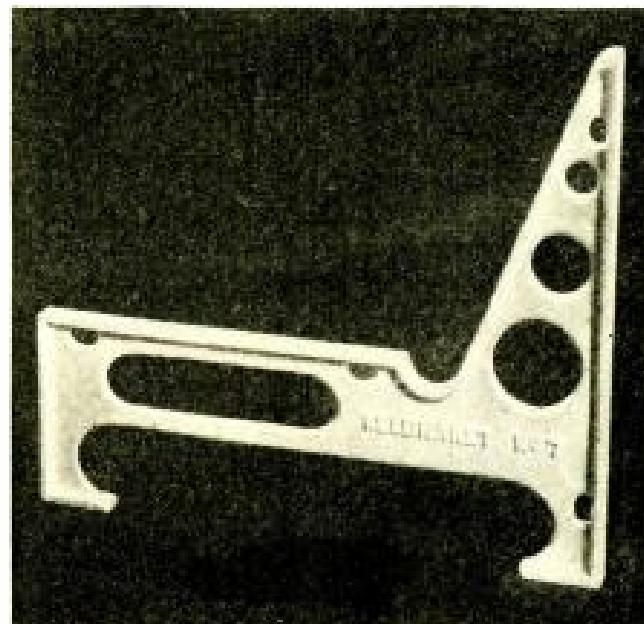
Name of instrument: Radio-frequency transformer.

Description: This is a fixed transformer, the coils of which are enclosed in a neat case with the terminals brought out at the top and plainly marked. The coils are of novel construction as is also the magnetic path that couples the two circuits together. The coils embrace the usual broadcast range. The terminals are brought out in the conventional manner on the top of the case and are marked with letters which indicate the proper connections to the coupled vacuum tubes.

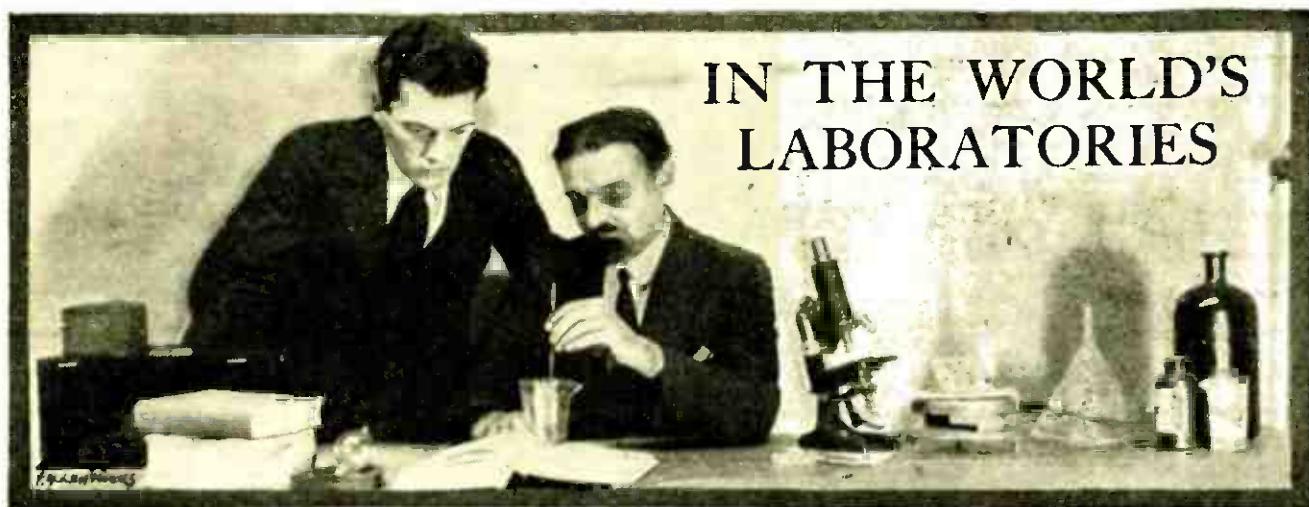
Usage: In a radio-frequency set as an inter-stage coupling at radio frequencies.

Outstanding features: Easy operation. Extended waveband. Neat construction.

Maker: Werner Radio Mfg. Co.



An aluminum bracket that is light and strong.



IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

Is the Electron Divisible?

MODERN students of electricity have grown accustomed to regard electrons as the ultimate, indivisible particles of electricity. All electrons are assumed to be alike. They are believed all to carry exactly the same electric charge. It is felt that no smaller electric charge than this could exist in nature. On these fundamental principles are based the deductions of all modern electric theory. For example, these principles underlie the theory of the radio vacuum tube.

During the past few years, however, Professor Felix Ehrenhaft, head of the Physics Institute of the University of Vienna, has been attacking this view.* It is possible, he maintains, to detect fractional parts of an electron. He believes that the experimental evidence does not favor the idea of uniform electrons at all. If electrons exist, they must be variable, he thinks, in the charge that they carry. Quite possibly electrons do not really exist at all. Electricity may not be composed of particles. Instead it may really be some kind of continuous "fluid," as used to be supposed before the electron was discovered. These are his suspicions.

It is impossible to exaggerate the importance of these criticisms to modern theories of electricity and radio. Were Professor Ehrenhaft's conclusions proved correct it would be necessary to abandon almost everything that we believe about vacuum tubes, about the electro-chemistry of storage batteries, about the structure of atoms, about the photo-electric cell and about a score of other physical developments. Fortunately, it is the almost universal opinion of scientists that Professor Ehrenhaft is mistaken.

In connection with the publication of the professor's paper in the *Philosophical Magazine*, Sir Oliver Lodge (who is one of the editors) prints a note saying that it is impossible to agree

* Professor Ehrenhaft's first communication on this subject was presented to the Vienna Academy of Sciences on March 4, 1909. His views are summarized by himself, in a recent paper entitled "The Electrical Behavior of Radioactive Colloidal Particles of the Order of 10^{-5} Centimeter as Observed Separately In a Gas." *The Philosophical Magazine* (London), vol. 49, pages 633-648 (April, 1925). There is another recent paper by Th. Sexl (a pupil of Ehrenhaft) in *The Physical Review* (Corning, N. Y.), vol. 26, pages 92-96 (July, 1925).

with Professor Ehrenhaft but that his paper is presented in fairness and in order that there may be no claim that a viewpoint has been ignored.† The editor of *The Physical Review*, Dr. Gordon S. Fulcher, appends a similar note to the paper of Mr. Sexl referred to in the preceding footnote. More important still, Professor R. A. Millikan himself contributes a review of the available evidence, with especial reference to the conclusions of Professor Ehrenhaft.‡ No valid evidence has been adduced, Professor Millikan concludes, to weaken at all the idea that all electrons are indivisible and that they carry the same electric charge.

So far as we know, Professor Ehrenhaft's ideas have not attracted the attention of radio engineers outside of Austria. But perhaps they will do so, and it is as well for the radio public to realize that the professor's peers in the field of physics do not agree with his conclusions.

Exploding Wires with Forty Thousand Amperes

ABOUT five years ago Dr. J. A. Anderson, of Mount Wilson Observatory, devised an ingenious and spectacular method for studying the behavior of atoms of metals under the influence of high electric densities and tremendous heat. He built a great condenser of glass plates and sheets of tin foil. It had a capacity of one microfarad and could be charged to 20,000 volts. The entire charge of this condenser was then allowed to pass through a tiny metallic wire. Of course, the wire instantly blew up. By observing the spectrum of the light given out by the flash Dr. Anderson obtained valuable information concerning what happened to the atoms

† In *The Philosophical Magazine*, following Professor Ehrenhaft's article just cited (page 648).

‡ "The Nature of the Evidence for the Divisibility of the Electron," by R. A. Millikan, *The Physical Review* (Corning, N. Y.), vol. 26, pages 99-104 (July, 1925). It was Professor Millikan, as all radio fans should know, who proved the existence of the electron and measured its electric charge. This fundamental research is described in "The Electron," by R. A. Millikan, first edition issued by the University of Chicago Press in 1917; second and revised edition (the latest), 1924, 293 pages.

caught in what was, for them, so tremendous a cataclysm.

Several investigators have worked with this method since Dr. Anderson invented it * and now Mr. Sinclair Smith, working under the direction of Dr. Anderson himself, has added to the method a way of determining the time of the explosions and of discovering how the behavior of the atoms alters as the explosion proceeds.† To do this Mr. Smith allows the light from the exploding wire to fall on a moving mirror which reflects the light, in turn, onto the photographic film on which the record is made. The photograph of the flash is thus spread out over a certain length of the film, as it would be in a motion picture record, but with a much greater "time resolving power." This last ex-

pression means that changes occurring in much shorter time intervals can be detected and studied. It has proved possible, in fact, to detect, with some precision, the progress of the explosion in a time as short as one millionth of a second.

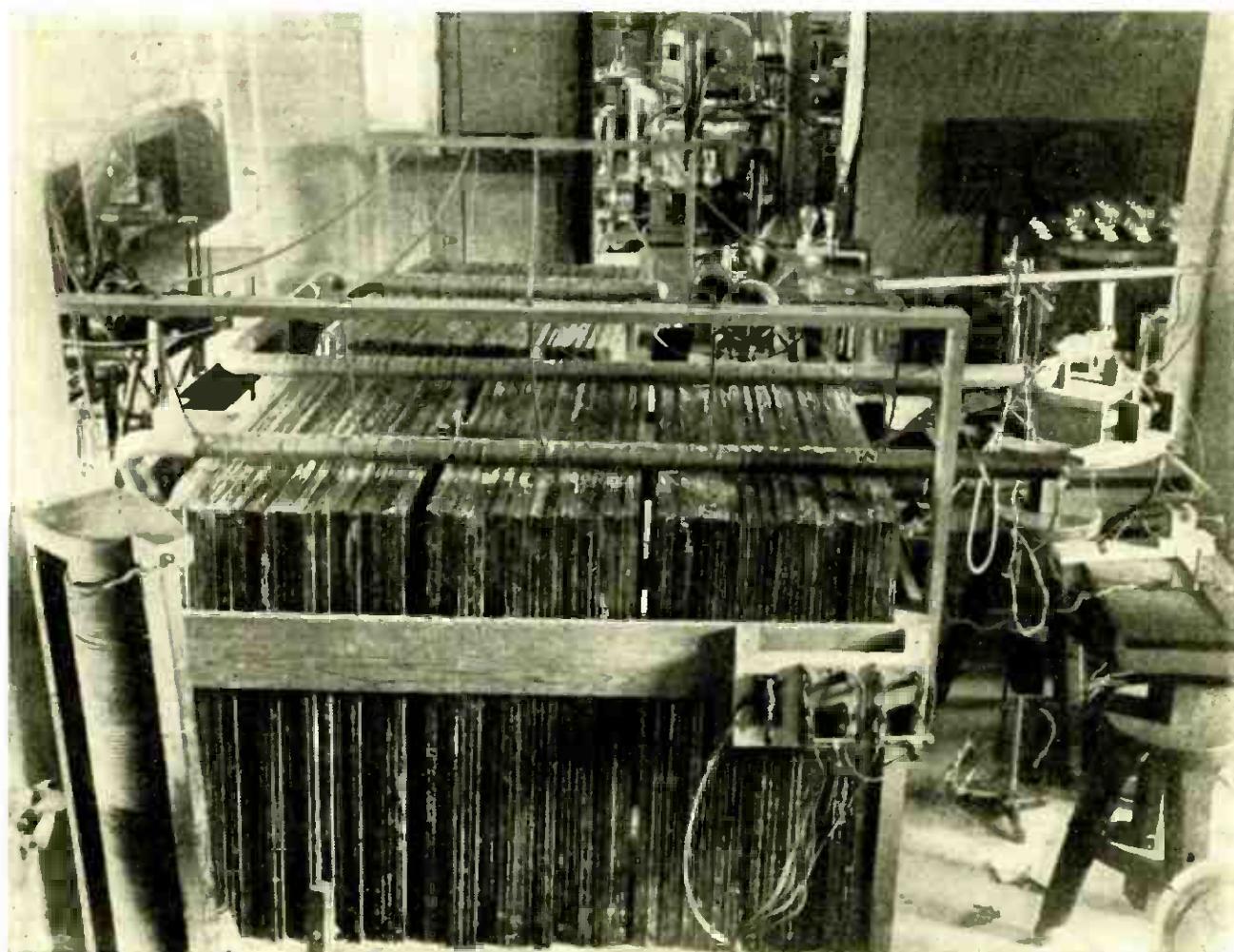
This time is not much longer than the times required for some of the changes inside the atoms themselves and work with this method will probably result during the next few years in greatly increased knowledge of the most intimate atomic secrets. A few of the facts already disclosed are indicated by the spectrum photographs reproduced herewith. They are set forth in more detail in Mr. Smith's paper already referred to.

Radio engineers will be especially interested, however, in the constants of this tremendously powerful oscillating circuit and in the novel construction used for the new condenser which Mr. Smith has constructed.

The original condenser built and used by Dr. Anderson was made, as already noted, of glass plates carrying sheets of tin foil. Ordinary window glass was used. The tin-foil sheets were 17 by 21 inches, there were 200 glass plates and

* An account of some of this work was given in this department in POPULAR RADIO for February, 1925, on pages 185 to 187.

† "A Study of Electrically Exploded Wires," by Sinclair Smith. *The Astrophysical Journal* (Chicago), vol. 61, pages 186-203 (April, 1925). We are indebted to Dr. Walter S. Adams, Director of the Mount Wilson Observatory, and to Dr. Anderson for some additional information concerning the apparatus, as well as for the photographs reproduced herewith.



Mt. Wilson Observatory.

THE GIANT CONDENSER USED TO EXPLODE WIRES

The glass-plate condenser in the foreground has a capacity of .6 microfarad at 60,000 volts. The electricity stored in it is discharged suddenly through a tiny wire stretched between the two upright terminals seen on the table at the right. The wire instantly explodes, its light yielding information about the behavior of the atoms in it. The wooden block on the table, just behind the spark terminals, contains two other terminals used for explosions in confined space.

the capacity attained was one microfarad, at a potential difference of 20,000 volts. In the new condenser of Mr. Smith the tin foil sheets are discarded. The conductors are fine-mesh wire screens placed inside the substance of the glass plates, just as wire reinforcing material is placed, nowadays, inside the sheets of fire-resistant glass. The wire is inserted in the molten glass when the sheets are being made.

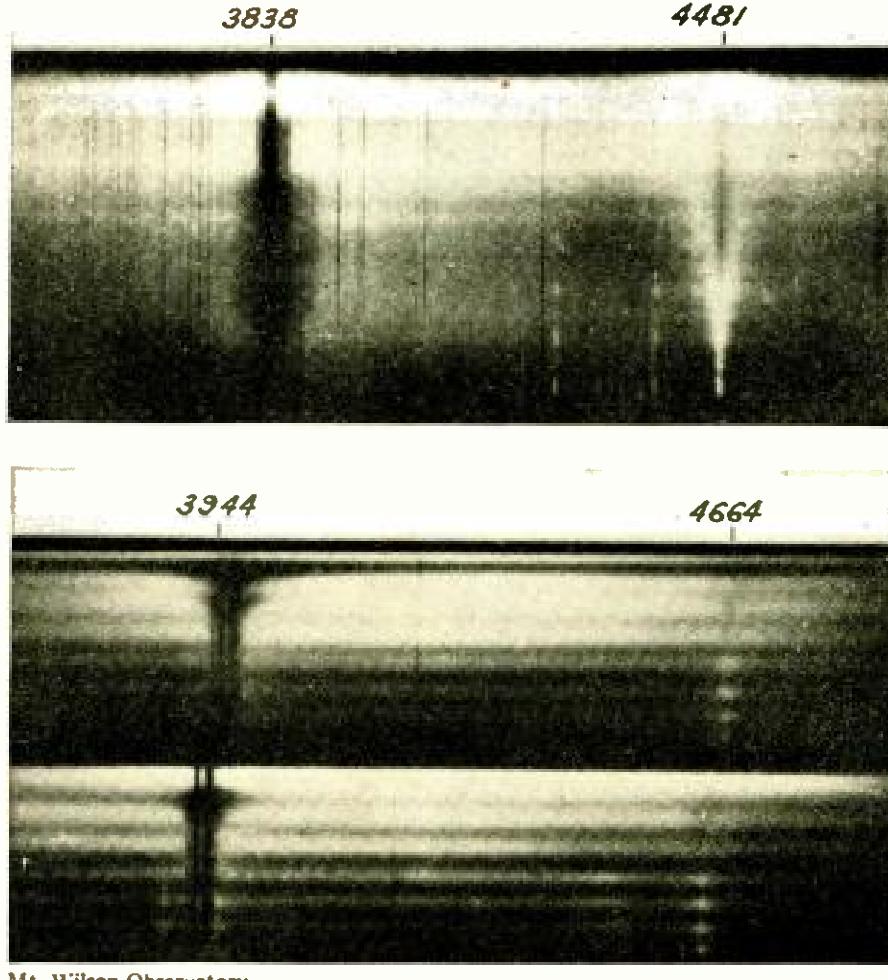
In the wire-and-glass sheets used by Dr. Smith a connecting wire was brought out at one edge of each sheet. The condenser was assembled in such fashion that these connecting wires came out, alternately, at opposite ends of the condenser. Thus the wire screens were charged, alternately, positively and negatively. The dielectric between them was formed by the surrounding glass. With this condenser, while the capacity was only about .6 microfarad, the potential difference attainable was found to be as high as 85,000 volts. Only 55,000 to 60,000 volts were used in the experiments now reported.

It is worth noting that the wire-glass sheets employed were made by the Mississippi Glass

Company. This material ought to prove useful for many purposes in radio experimentation and in physical laboratories generally.

When operated with a 55,000-volt charge the frequency of the oscillations set up on discharge was found to be 185,000 cycles per second, which means 185 kilocycles and corresponds to a radio wave of approximately 1,620 meters. The maximum of the current at the peak of each half-cycle (one peak being for current in one direction, the other for the reverse current) reaches the tremendous figure of about 40,000 amperes. Of course this large current endures for only a tiny fraction of a second; perhaps for even less than the one millionth of a second which is the limit of the time-resolving power of Mr. Smith's apparatus. If it does last for one millionth of a second, the number of electrons that cross the gap where the wire was during that instantaneous period reaches the virtually incomprehensible number of 250,000,000,000,000,000.

It must be remembered, too, that these electrons surge back and forth several times across the gap where the wire blew up. Each



Mt. Wilson Observatory.

THREE RECORDS OF EXPLODING WIRES

The explosion begins with the white edge at the top of each record. Time is measured downward, the entire first record covering about one twenty-thousandth of a second. The horizontal bands of light correspond to the surges of current back and forth through the condenser. The top record shows the explosion of a wire of metallic magnesium. Note that the spectrum line marked as having a wavelength of 4,481 Angstrom Units is at first a dark (absorption) line, then a bright line. The two bottom records show explosions of aluminum wires.

complete cycle of the discharge means one surge forward and another surge back. It is like passengers rushing from one side of a steamer to the other and then back again as the boat begins to list. With each peak of current, on each half-cycle of the oscillation, the metal atoms of the exploded wire glow brilliantly. That is what causes the horizontal bands so clearly visible in those of Mr. Smith's spectra which are reproduced herewith. These bands are actual pictures of the effects of the condenser discharge on the metal atoms.

Broadcast Interference in Europe

In the nature of the case there can be no central authority in Europe with power to assign wavelengths and to regulate in other matters the activities of broadcasting stations in the various nations. The result is a growing difficulty from interference of one station with another. For long-distance work the European ether is already well "jammed."

To attempt the solution of this situation the European broadcasting interests have organized an informal international Bureau at Geneva, Switzerland. Mr. Arthur Burrows, formerly an official of the British Broadcasting Company, has been made director. Since Mr. Burrows has no actual power to enforce any regulations which he may make, his task will be a difficult one. This has been indicated already by the failure of the first international broadcasters' conference, held at Geneva during July, to reach any decision whatsoever on the very vital question of apportionment of wavelengths.

At this note is written, it is the intention to conduct a series of general interference tests during the first week of September, in the hope of discovering which stations will be likely to interfere with each other in the various parts of Europe. The same wavelengths will then be assigned to stations which are far enough apart to show no interference within their usual range of distance.

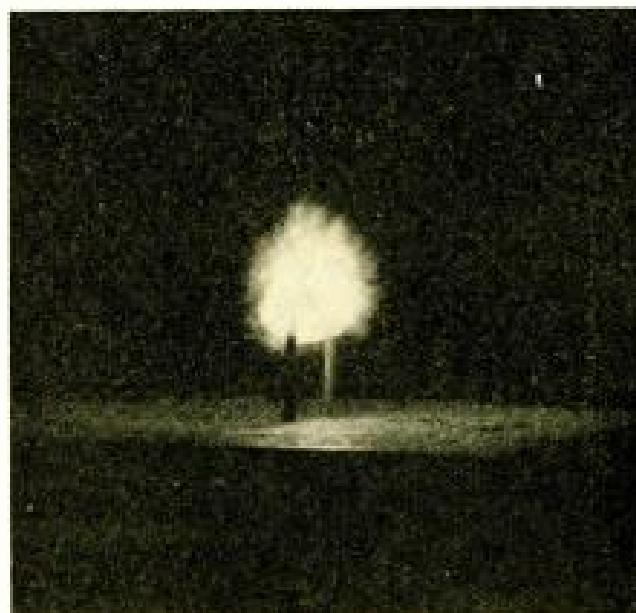
Radio for Both Ears

A SYSTEM of "binaural" radio—which means, literally, "two-ear" radio—was invented some months ago by Dr. F. M. Doolittle of Yale University and was described in the invention department of POPULAR RADIO.* It has now been put in operation at an experimental transmitting station at New Haven, Connecticut.†

The idea is that ordinary radio fails to seem perfectly natural to the ear because the microphone which picks up the sound occupies only one point. In normal hearing we hear with two ears, slightly separated in space. Thus we get a kind of "space sense" in our hearing, just as our two-eye vision gives us a sense of depth and solidity. Dr. Doolittle substitutes for the single microphone, two microphones. These are placed at a little distance from each other. The

* "With the Inventors," in POPULAR RADIO for April, 1925, page 392.

† "Binaural Broadcasting," by F. M. Doolittle. The Electrical World (New York), vol. 85, pages 867-870 (April 25, 1925).



Mt. Wilson Observatory.

EXPLODING AN IRON WIRE

This picture shows the actual appearance of the explosion when the full charge of the giant condenser is sent through a thin wire of iron.

sound waves received by them will differ slightly, just as do the sound waves received from an orchestra by the two ears of a listener.

The modulations of the two microphones are broadcast separately, on separate channels. They are also picked up and detected separately. One is fed into one ear of the listener; the other into the other ear. The result is said to be a greatly improved "naturalness" of the sound.

As at present operated, the system requires two entirely separate transmitting circuits, two channels and two receivers. It is doubtful if this is within the range of practicable utility. It is suggested, however, that the separate modulations might be impressed on two intermediate frequencies, between the radio and audio ranges, and that these two frequencies might then be combined as a modulation on a single radio-frequency carrier wave. A receiver equipped with properly tuned filter circuits could be made to separate these intermediate frequencies, supplying the audio-frequency modulation of one to one ear and of the other to the other ear. Whether the increased enjoyment of the listener would be worth the trouble and cost is none too certain, but at least it would be worth a careful trial.

The "Radio Detective"

THE possible use of radio devices to prevent thefts from factories and similar establishments has been often mentioned. It remained for the German firm of Wetzel Brothers, in a suburb of Leipzig, to put this apparatus in a practicable and commercially useful form. The radio principles used have been worked out for this firm by two Leipzig physicists, Dr. Geffcken and Dr. Richter.*

* Information for this note is from a statement kindly supplied by Gebr. Wetzel, Leipzig-Plagwitz, Germany, July 11, 1925.

The device consists of a door through which all workmen are compelled to leave the plant and which is surrounded by a wire carrying a radio-frequency current. The frequency of this circuit is carefully tuned. If any workman attempts to carry a bar of copper or any similar metal object through the door, concealed inside his clothes, the induction between this metal object and the surrounding circuit will alter the tuning of that circuit. There will be a resultant squeal in the headphones of the operator who is in charge of the door. The offending workman can be stopped and searched. It is just as though the workmen were compelled to walk through the tuned solenoid of a radio transmitter. Every amateur knows how violently any stray metal inside such coils will upset the tuning of his circuit.

By the use of this device, search of the employees is rendered unnecessary. There is no need to require a change of clothes on entering and leaving, which is sometimes required in American factories. The great majority of honest workmen are not annoyed or delayed by the possibility that a few are dishonest. Of course, the apparatus will detect only metal objects. It would be useless on non-conducting things like glassware or silks or foodstuffs. Furthermore, it must be adjusted, one imagines, so that it will work only on metal objects of substantial size.

A radio detective sensitive to stickpins and suspender buttons would have obvious disadvantages.

Electrification that Lasts for Years

A DISTINGUISHED Japanese physicist, Professor Mototaro Eguchi, of the Higher Naval College at Tokyo, has reported a discovery which promises to have far-reaching effects on electron theory and, quite possibly, on radio technique. He has discovered a way of obtaining what seems to be permanent electrification, analogous to the persistent magnetism of the familiar permanent magnets. Professor Eguchi has named his new invention the "permanent electret." *

The process of making the electret is quite simple. A liquid mixture of melted wax-like substances is allowed to harden (by cooling) in a strong electric field. The wax plates thus produced are found to be permanently electrified. The wax mixture used in most of the experiments contains fifty percent of ordinary resin, presumably from some species of pine tree, mixed with fifty percent of carnauba wax. To this may be added a little beeswax, but this is not essential.

This melted mixture is poured into shallow, flat pans like pie tins. A metal plate is then lowered onto the top of the wax mixture and a strong electrostatic field is created between this metal plate and the metallic bottom of the pan that

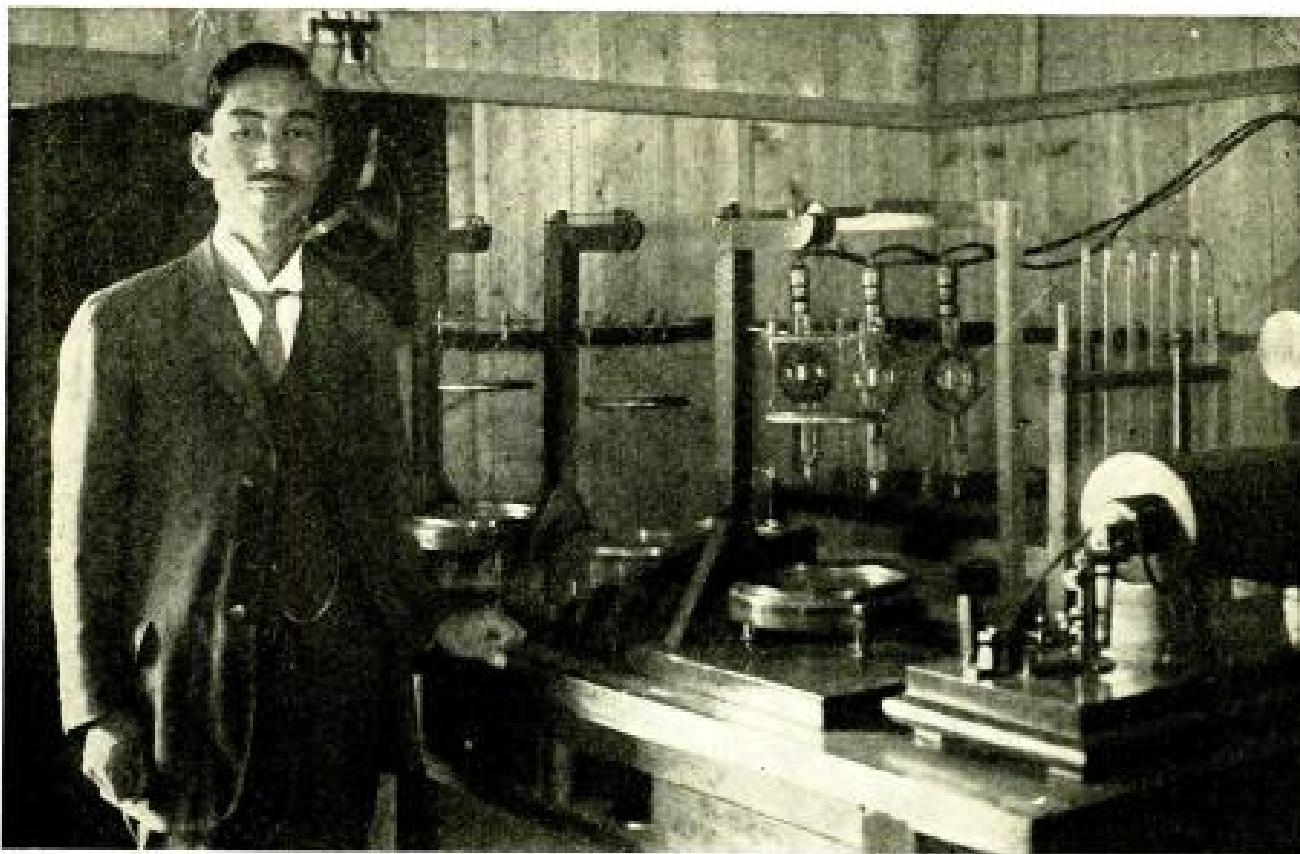
* "On the Permanent Electret," by Mototaro Eguchi. *Philosophical Magazine* (London), vol. 49, pages 178-192 (January, 1925).



Wetzel Brothers.

SUBMITTING TO THE "RADIO DETECTIVE"

Inside the boxed sides of the gate is a coil connected to the oscillator on the window sill. If a workman attempts to carry a concealed piece of metal through the gate, the induction between it and the surrounding coil causes a warning note in the headphones worn by the operator. Metal objects legitimately carried may be stood on the small table while the gate is passed.



From a photograph made especially for POPULAR RADIO by Professor Eguchi, Tokio.

PROFESSOR EGUCHI AND HIS PERMANENT ELECTRET

The horizontal pans at the Professor's left are those in which the wax mixture is allowed to harden under electric stress, so that it becomes permanently electrified. The plates which serve as the upper parts of the condensers may be seen suspended over the pans. The vacuum tubes supply the necessary potential.

holds the wax. The source of charge is a vacuum-tube electrostatic generator. The arrangement of the apparatus is shown clearly in the photograph kindly supplied by Professor Eguchi and which is reproduced herewith.

Essentially, the metal pan and the superposed metal plate act as the two plates of a high-voltage condenser. The wax mixture hardens while it forms the dielectric of this condenser; that is, while it is exposed to enormous electrostatic stress. After it is hard the wax plate is found to be electrified in the reverse sense to the electrification of the condenser. One side of the plate is permanently negative, the other side is permanently positive. These charges last for years. Some have lasted since 1919. The voltage reached by this surface charge may be as high as 20,000 volts per centimeter. The density of the charge on one of the plates was measured as six electrostatic units per square centimeter of the surface.

Scraping of the surface, washing it with acids or other conducting solutions, exposing it to the heat of a gas flame and similar processes destroy the surface charge temporarily, but the charge is restored quickly when the electret is allowed to stand with its surface protected by a metal plate or a sheet of metal foil. Professor Eguchi believes that the electrification is due to a fundamental re-arrangement of the electrons and atoms inside the wax mixture, an electric "polarization" which extends a substantial distance inward from the surface, if not alto-

gether through the plate. The temporary destruction of the charge by solutions, flames and other agencies is ascribed to an accumulation of oppositely-charged ions on the surface. These neutralize temporarily the permanent charge of the electret. On standing, the accumulated ions escape and the permanent charge reappears.

It is obvious that these experiments are of the utmost interest from the viewpoint of atomic theory. If they are confirmed, and especially if they can be detected in plates of pure substances instead of in the mixtures actually used, they will indicate the possibility of creating a lattice structure of atoms in which there is a sufficient distortion of the atom (or electron) positions to cause a great lack of balance between the positive and negative charges. This is a new line of attack on the problems of atomic structure.

To the radio engineer another interest of the work lies in the possibility of procuring permanent electrostatic fields without the necessity of maintaining them. In the vacuum tube, for example, the positive voltage on the plate must be maintained by the "B" battery. This will probably be necessary always, so long as we use the present design of tube, for the positive charge on the plate is continually being neutralized by the arriving electrons of the plate current.

There exist, however, many experimental devices in which one wants merely an electrostatic field or charge, there being no dissipation

of this charge except by leakage. An example is the electrostatic plate of an oscillograph. For such purposes some modification of Professor Eguchi's permanent electret may prove of real value. When the permanent magnet was first investigated by Dr. William Gilbert, back in 1600, no one had any use for it. Yet nowadays we would have difficulty in maintaining civilization at all if the permanent magnets of our compasses, our magnetos and other devices were taken away from us.

A Self-starter for Radio Receivers

AN accessory so convenient that it ought soon to find a commercial place in radio is described in a recent paper by Mr. A. P. Castellain.* This is no less than a relay which automatically stops or starts a radio receiver when the broadcast wave ceases or begins. It is necessary, in reality, to employ two relays. The first is an extremely sensitive one, consisting of a tiny coil mounted between the poles of a permanent magnet. The signal from the antenna is led through a crystal detector and thence through this coil. If any energy is received from the broadcasting station, a current is produced in this coil. The reaction of this current on the magnetic field causes the coil to move. The principle is exactly the same as that of the moving-coil galvanometer.

When the coil of this first relay moves it closes the actuating circuit of an ordinary telegraphic relay. This closes, in turn, the

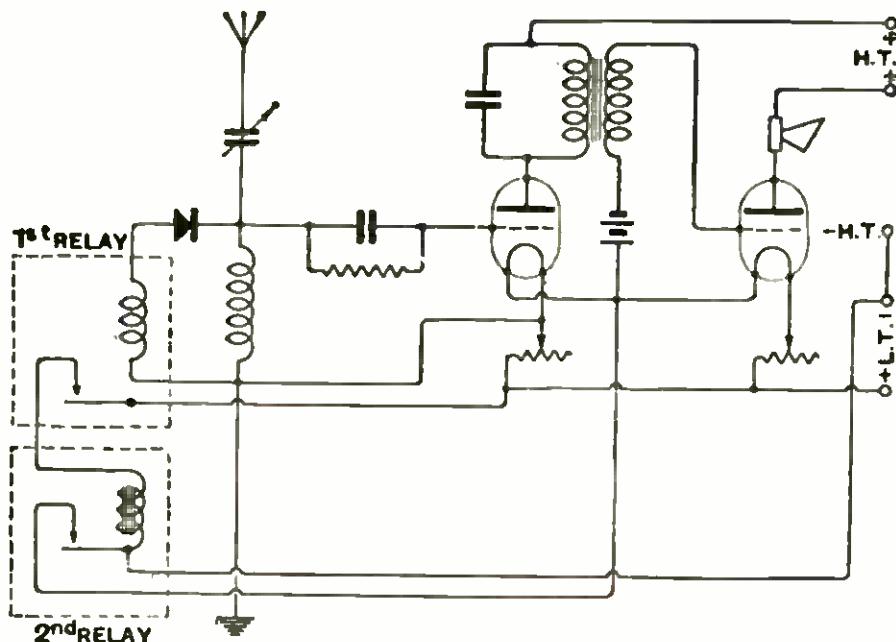
* "A Wireless Self-Starter," by A. P. Castellain. *The Wireless World* (London), vol. 16, pages 564-566 (June 10, 1925).

filament circuit of the receiver. Thus reception starts. If the broadcast wave ceases, a small spring returns the moving coil of the first relay to its neutral position, all the circuits open and reception stops.

For American conditions, where there may be several stations in the same city, it would be necessary for the crystal circuit controlling the first relay to be tuned, so that it would respond only to the station for which it was set. Thus arranged, the device should be useful not only to prevent the frequent accident of leaving the filaments burning all night, but also to turn on the set and wake up each morning those fans who are addicts of the early-morning health and exercise broadcasts now so fashionable from numerous stations. One might anticipate some danger that severe static would actuate the first relay and turn the set on when it was not wanted, but Mr. Castellain mentions no trouble from this source and static is almost as severe in England as here.

Radio Apparatus Helps to Photograph the Human Heart

THE human heart is one of the most difficult things in the world to photograph. X rays permit the physician to see the heart successfully enough but that organ will not stand still to have its portrait taken. Or rather, if it does stand still, the patient will take no further interest in the proceedings. Accordingly, physicians have been searching for years for some method which would permit good heart photography. A snap-shot, made at the instant when the heart is at rest between beats, will not suffice. X rays of the intensity which it is



From the "Wireless World."

HOW RELAYS ARE USED TO MAKE THE SELF-STARTING RECEIVER

By means of the crystal detector, the antenna current itself actuates the first relay. This actuates the second relay, which then turns on the filament current for the receiving tubes. If the antenna current ceases, the first relay opens and stops the filament current. For American conditions a tuned crystal circuit would have to be used for the first relay.

safe to send through the body are not powerful enough to make a detailed photograph so quickly as that.

The problem is important for lung photography, as well as for heart photography. The lungs are in continual motion just as much as the heart is. And many of the lung infections, especially the initial infections of tuberculosis, have a habit of occurring just in that part of the lung tissue which is near the heart and which is moved, therefore, not only by the motions of breathing but by the beating of the heart as well.

There was where the problem stood when Dr. F. M. McPhedran, of the Phipps Institute of the University of Pennsylvania, enlisted the interest of Professor Charles N. Weyl, of the Electrical Engineering Department of the same University. By employing some of the most recent devices of radio engineers, Professor Weyl has succeeded in devising an X-ray photographic apparatus which will make a satisfactory still-picture of either the heart or the lungs without making it necessary to stop the motion of these organs at all.*

The principle is that of taking a succession of short exposures, each one at exactly the same place in the cycle of heart motions. Motion picture fans are familiar with the fact that if the motion of any piece of machinery, for example, a wheel, is timed to fit the exposures of the motion picture film, the wheel will seem to stand still. Each successive exposure finds the wheel in the same position as it occupied during the preceding exposure. Professor Weyl's device does this same thing, except that all the exposures are made, one on top of each other, on the same plate. They are equivalent to a single long exposure.

Where radio comes into the matter is in the way in which the heart itself is made to control these exposures; to operate the shutter, so to speak, for its own portrait. The apparatus begins with a small glass funnel which is held against the neck of the patient, just over the carotid artery. This artery is beating, of course, in exact time with the heart. These beats are communicated to the air inside the funnel and thence, through a rubber tube, to an air-box one end of which is closed by a thin rubber diaphragm. This diaphragm vibrates in time with the air-column behind it; that is, in time with the beats of the heart. Attached to the rubber diaphragm is a small mirror. A beam of light from a lamp strikes this mirror and is reflected off at an angle so that it falls on a sensitive photo-electric cell. With each beat of the heart the mirror moves. The light beam is swung alternately on and off the sensitive portion of the photo-electric cell.

* Information for this note is from a statement issued by the University of Pennsylvania, May 31, 1925.



University of Pennsylvania.

PHOTOGRAPHING THE HEART

The small funnel which the nurse holds against the neck of the patient picks up the impulses of the beating heart. Through a chain of mechanical and electric relays, these impulses control the instant and length of each successive X-ray exposure.

The result is a succession of tiny electric pulses produced by the cell in exact time with the beats of the heart. Although these equal a current strength of not over ten billionths of an ampere, they are amplified by a radio amplifier of standard type until they are strong enough to actuate a relay which turns the X-ray current on or off at the exact instants desired. A lag timer permits the operator to set the instants of the successive X-ray exposures for any desired fraction of a second after the conclusion of each heart beat. Thus set, the apparatus will continue to make flash exposures at that same instant, one for each heart beat, so long as the current is left on and the small funnel is kept pressed to the artery in the patient's neck. This device is sure to play an important part in medical science.

GARTICLE No. 9 of the series "How to Get the Most Out of Your Ready-made Receiver," in which the theory, operation and care of the Garod Neutrodyne, Type V set is treated, was crowded out of this issue of POPULAR RADIO. It will appear in the succeeding—November—number.



IN THE EXPERIMENTER'S LABORATORY

CONDUCTED BY LAURENCE M. COCKADAY

Uses of a Variable Condenser

ONE of the most essential pieces of apparatus for the set builder and experimenter is a standard of capacity. This should have a constant capacity value, fairly accurate calibration, variable capacity and it should be portable. (The requirements are listed roughly in the order of their importance.) The price paid for the apparatus and its importance will vary with the purchaser and his requirements.

The General Radio type No. 247 condensers (see Figure 1) satisfy these requirements very well where ordinary precision is required, and they cost about the same as the usual type of condenser. One of the 1000 mmf. (.001 mf.)



KEEP A CONDENSER FOR
EXPERIMENTAL PURPOSES

FIGURE 1: *A small laboratory condenser is extremely useful to the experimenter. It helps him to measure the capacities necessary in a new circuit and helps him in numerous other important ways.*

types should be used, if possible, as this allows wide variation for measurement work. Where greater capacity is needed a fixed condenser or combination of them with the standard can be used. These can be measured either by the simple method given in this article or by the more complete methods to be given next month.

As a rule the capacity of a by-pass or blocking condenser is not critical. Both of these perform fundamentally the same function of frequency selection. The only receivers which require fairly close adjustment of the by-pass condensers are the reflexes. In these the values must be varied to get best results.

Where the grid-leak is continuously variable or can be changed, the value of the grid condenser is not critical and can be varied over fairly wide limits.

The only type of circuit requiring close adjustment of the capacity is a tuned one such as the input or output circuit of a tuned intermediate-frequency amplifying transformer. Even here extremely close adjustment is not always necessary as the untuned stages generally have a broad enough amplification curve to give good amplification over quite a frequency band.

Due partly to the difficulty of manufacturing condensers of uniform capacity on a large scale cheaply, and partly to the lack of demand for such condensers, most of the condensers now vary 25 percent or so. The more progressive manufacturers are guaranteeing them within 10 percent so as to insure duplication of results in receivers having the same constants.

It will be apparent from the foregoing that a variable condenser which can be used to measure capacities within, say, 5 percent is sufficiently accurate. This is especially true when manufactured condensers varying by 10 percent are used without measuring their capacity with greater precision. Besides measuring capacities, a variable condenser may be used to determine the proper value to use at any point, as a substitute to determine whether or not a condenser is faulty and to measure inductances.

To measure capacities the condenser should

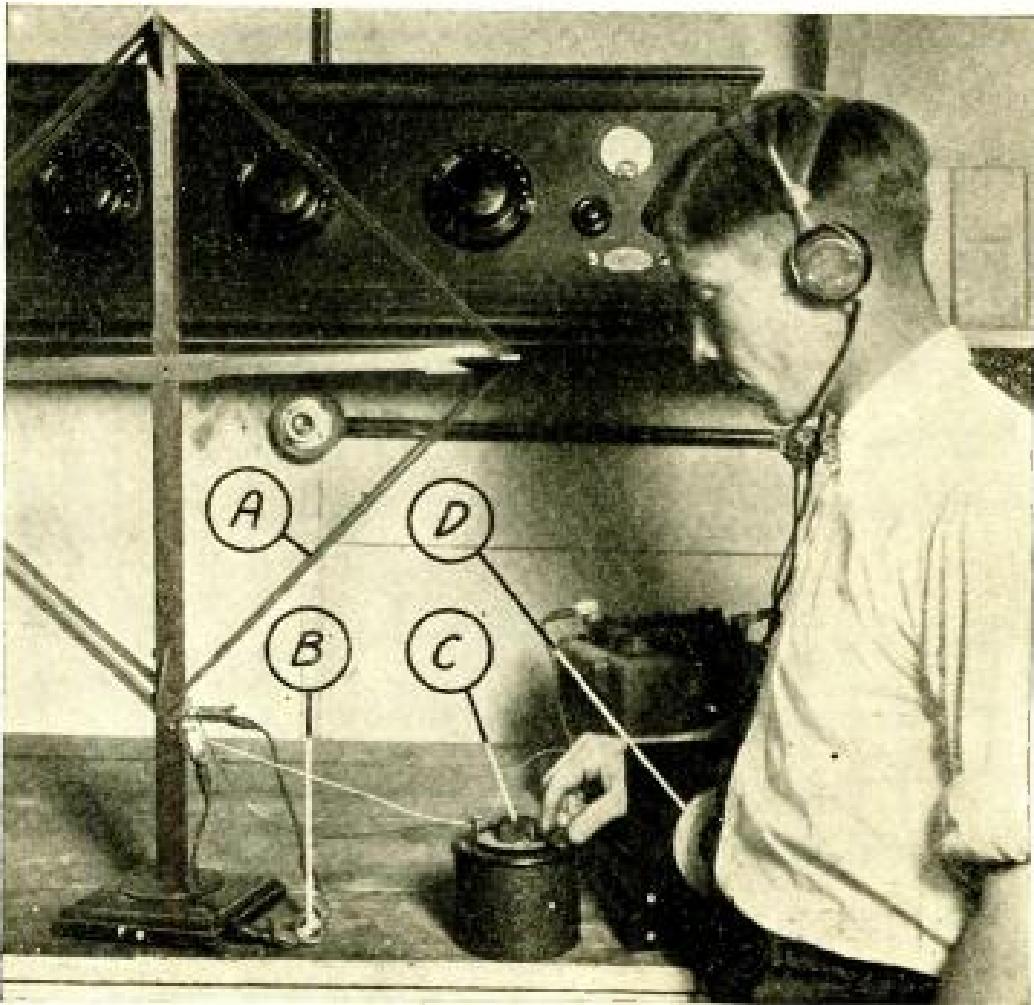
be connected across the loop (or secondary) circuit of a receiving set. Figures 2 and 3 show the connections. A is the loop, B the unknown capacity, C the standard and D the loop turning condenser. The condenser D should be set for minimum value.

Tune in a station as near the highest setting on the variable "standard" C as possible. Then connect the unknown B across it and reduce the standard to the point where the same station is again received. Care should be taken if a superheterodyne is used to see that the new point is not one of the repeat points. The receiver should be adjusted so the loop condenser D tunes sharply otherwise the reading will not be accurate. Where it is rather broad the means of several readings will be more precise than any one reading. This is only satisfactory for measuring capacities of about 900 mmf. (.0009 mf.) or less, depending on how high a setting of the standard is used the first time and the value of the minimum capacity of the set condenser (D). More complete details of capacity measurement will be given next month.

A condenser of this type is always handy when trying out new circuits, particularly of

the reflex type. It should be connected wherever a condenser is needed and tuned until the best value is found. A fixed condenser of that capacity can then be substituted. If the value is fairly critical it may be necessary to measure the capacity of the fixed condenser to be sure it is of the proper value.

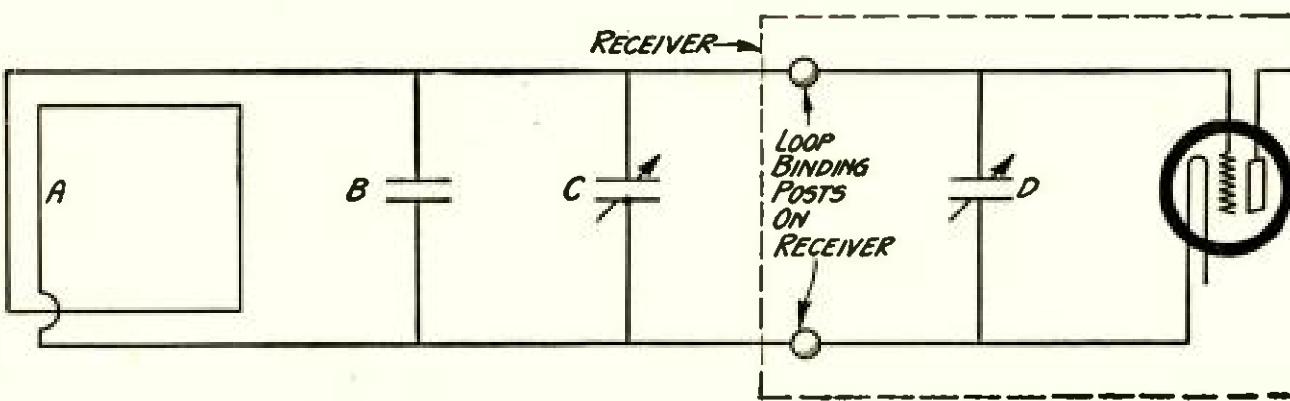
The dials on the type number 247 condensers have divisions every 20 mmf. on the capacity dial. Intermediate points have to be estimated. A valuable aid to more accurate measurement is a capacity curve. This can be made by plotting degrees setting on one side of cross section or graph paper against micro-micro-farads on the other. If, for example, the 1,000 mmf. type is bought the dial reading in degrees should be noted when the condenser is set for 1,000 and 60 mmfs. These two points should then be plotted and a straight line drawn between them. Below 60 mmf. the calibration is not accurate due to the minimum capacity of the condenser. To read the capacity at any setting read the dial setting in degrees and run up or over as the case may be to the curve (the straight line just drawn) then over or down to the capacity reading at the side or bottom of the chart.



From a photograph made for POPULAR RADIO

ONE OF THE USES OF A LABORATORY CONDENSER

FIGURE 2: This picture shows how an ordinary receiving set connected to a loop antenna and the laboratory condenser may be used to determine the capacity of small fixed condensers.



THE CIRCUIT FOR THE EXPERIMENTAL CAPACITY METHOD

FIGURE 3: This diagram gives the external connections for the condenser to be measured, the loop and the calibrated condenser when connected to an ordinary loop receiver for determining fixed capacities.

In trouble shooting in a finished receiver it is frequently hard to test a condenser satisfactorily with a dry-cell and phones. There are some faults that may not be detected with this sort of a test. Where a condenser is thought to be either bad or too low in capacity the standard can be substituted and adjusted for the proper value after which a substitution can be made if necessary. Elimination of faulty condensers will remedy a good portion of the experimenter's troubles.

—H. S. KNOWLES

The primaries of the radio-frequency coils also consist of a like number of turns. The fewer the number of primary turns the less will be the plate inductance and therefore there will be less tendency towards oscillation or regeneration.

This method, although it makes the lower wavelengths easy and efficient to tune, will reduce regeneration on the high wavelengths to such an extent that the tuning may be broad and the signals rather weak.

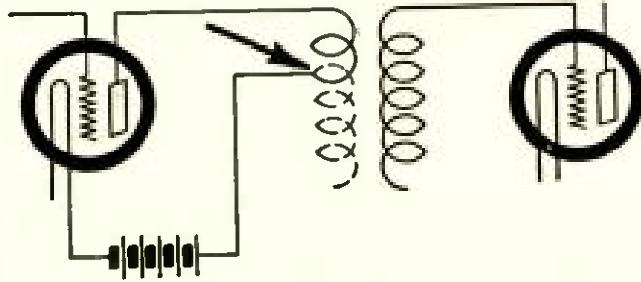
The second method that is used by a num-

The Prevention of Oscillation and Control of Regeneration In Radio-frequency Sets

HOME-MADE tuned-radio-frequency sets sometimes have a discouraging habit of squealing. This is usually more particularly noticeable at the lower wavelengths (high frequencies). There have been various methods devised to overcome this difficulty.

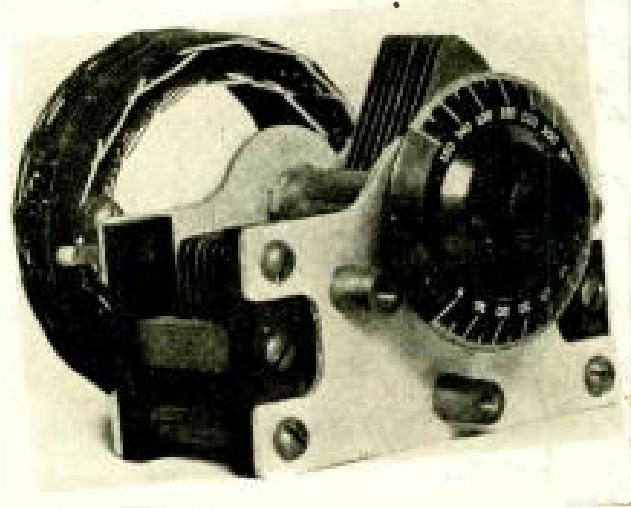
The simplest method used by the manufacturers of low-priced receivers has been to increase the turn ratio of the coupling coils between the radio-frequency tubes by cutting down the number of turns on the primary or plate windings.

By this method the antenna inductance is usually reduced to four or five turns of wire.



TO PREVENT OSCILLATION

FIGURE 4: A method for preventing oscillation in a receiver which consists of cutting down the number of primary turns on the radio-frequency transformer. The arrow shows the cut-away primary.



TO AVOID SQUEALING

FIGURE 5: Another method for preventing squealing in a receiver is to place the inductances near the condenser plates, thereby "lossing" the circuit to prevent oscillation.

ber of set manufacturers is to wind the coil with more turns on the primary but to place the coils in close proximity to the metal end-plates of the variable condensers. This causes a loss in the metal end-plate and in the condenser plates themselves, due to eddy currents induced from the windings. The effect of this loss is to prevent oscillation and also reduce regeneration.

This second method, although it is a simple one and usually produces somewhat louder signals on the higher wavelengths than the first method described, still gives more re-

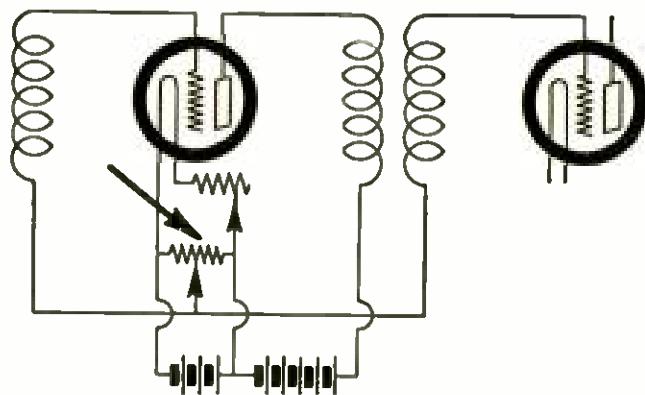
generation and therefore sharper tuning on the lower wavelengths than it does on the higher wavelengths.

The third method which was used to a great extent in the early days of radio-frequency amplification is the use of a grid bias applied through the action of a potentiometer connected across the filament circuit and in series with the grid or input circuits to the tubes.

This method has the advantage that the bias may be increased on the higher wavelengths so that tuning at the higher wavelengths can be made almost as sharp as the lower ones and the volume increased at the same time. However, this method makes the tuned-radio-frequency receiver radiate if not properly handled, and in the ordinary broadcast listener's hands such a set becomes rather a menace. Another trouble with this method is that the amplification obtained by decreasing the bias so that regeneration is prevented or controlled is much less than that obtained by other and better systems.

The fourth method—and a practical one—is the insertion of a resistance in the grid circuits of the radio-frequency tubes.

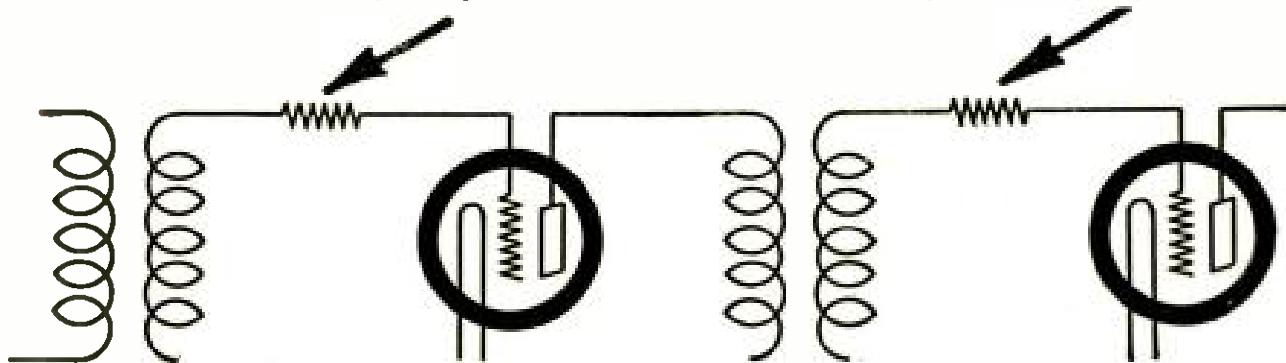
This system does not vary the grid bias but



FOR CONTROLLING OSCILLATION

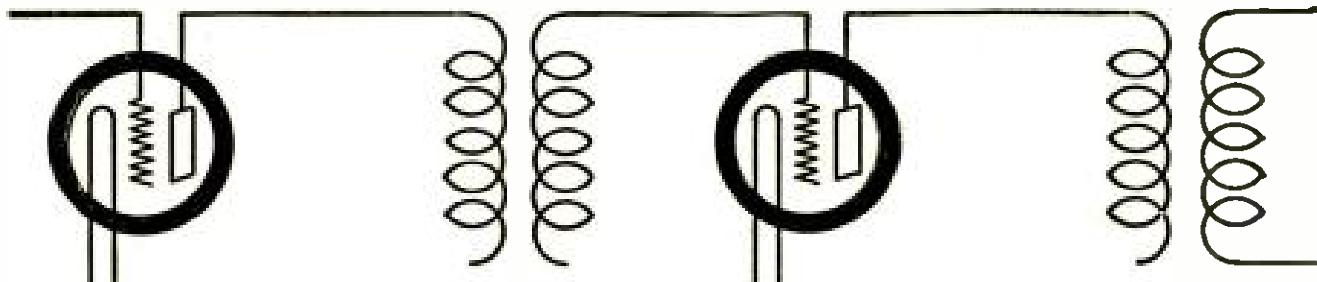
FIGURE 6: *Controlling oscillation in a radio-frequency amplifier by means of a potentiometer for adjusting the grid bias. The arrow points at the potentiometer.*

places a load on the grid circuit just enough to prevent oscillation at the low wavelengths. It gives extremely stable operation at all wavelengths and does not materially affect the amplification obtained through the tube. The method consists merely in a load that absorbs the excess energy produced by regeneration.



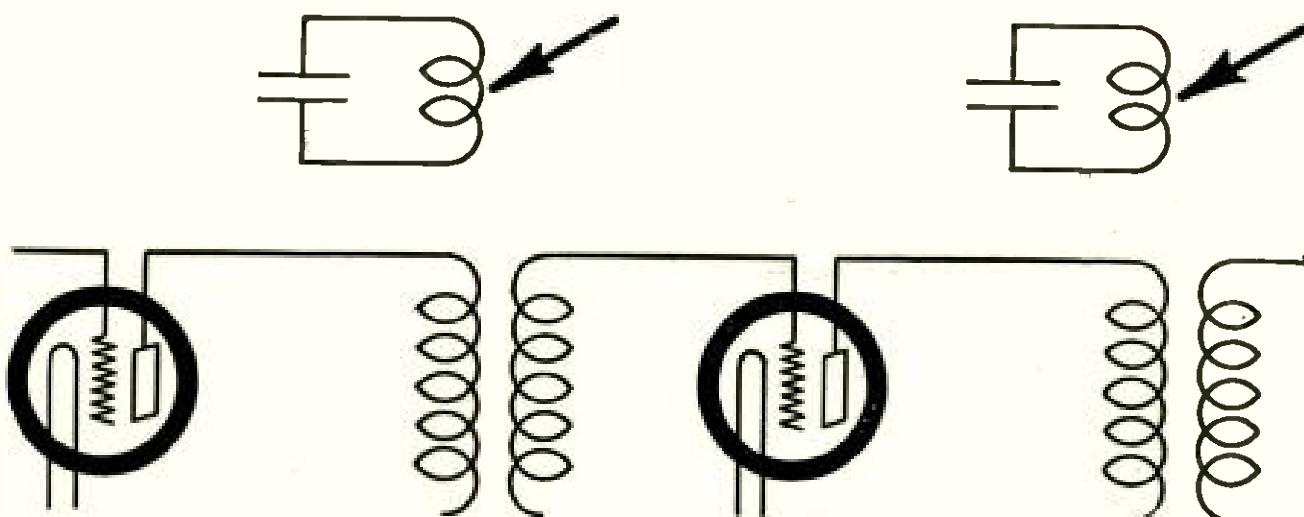
RESISTANCES IN THE GRID CIRCUITS

FIGURE 7: *One other method for preventing oscillation in the radio stages is to insert a critical resistance in series with the grid of the radio-frequency tubes. The extra energy that would cause the circuit to oscillate is absorbed in the resistances, which are indicated by arrows in the diagram.*



A VARIABLE ABSORPTION METHOD FOR PREVENTING OSCILLATION

FIGURE 8: *One or two turns of wire around the primaries and connected in series with a continuously variable rheostat offers exceptionally good control of regeneration in the radio-frequency amplifier.*



THE TUNED ABSORPTION SYSTEM FOR REGENERATION CONTROL

FIGURE 9: Another absorption method consists of an absorption circuit containing an inductance and fixed capacity which is tuned slightly below the lowest wavelength that the receiver operates on. On the higher wavelengths the circuit of such a receiver is only slightly affected by the absorption circuit, but as the tuning is brought lower and lower, the absorption circuit comes gradually into play, thus preventing oscillation and radiation all the way down the scale. This is the same principle as utilized in the four-circuit tuner.

The fifth method, which is also an absorption method, may be called the inductive absorption method. It may consist of an inductively-coupled circuit with a condenser in parallel and in inductive relation to the tuning elements of the radio-frequency tubes. It is usually tuned to a low wavelength, and when the receiver is tuned to a high wavelength little absorption is obtained with the circuit. But as the wavelength is reduced in the tuning circuits, the absorption circuit absorbs more and more energy, thus holding down regeneration at the lower wavelengths and making tuning simple and easy. This is an adaptation of the principle of the four-circuit tuner to radio-frequency circuits. It is extremely efficient and a simple method.

Other absorption methods which come under this heading consist of a single or a number of turns of wire in close inductive relation with the tuning coils which have in series with them a carbon-pile rheostat for controlling the re-

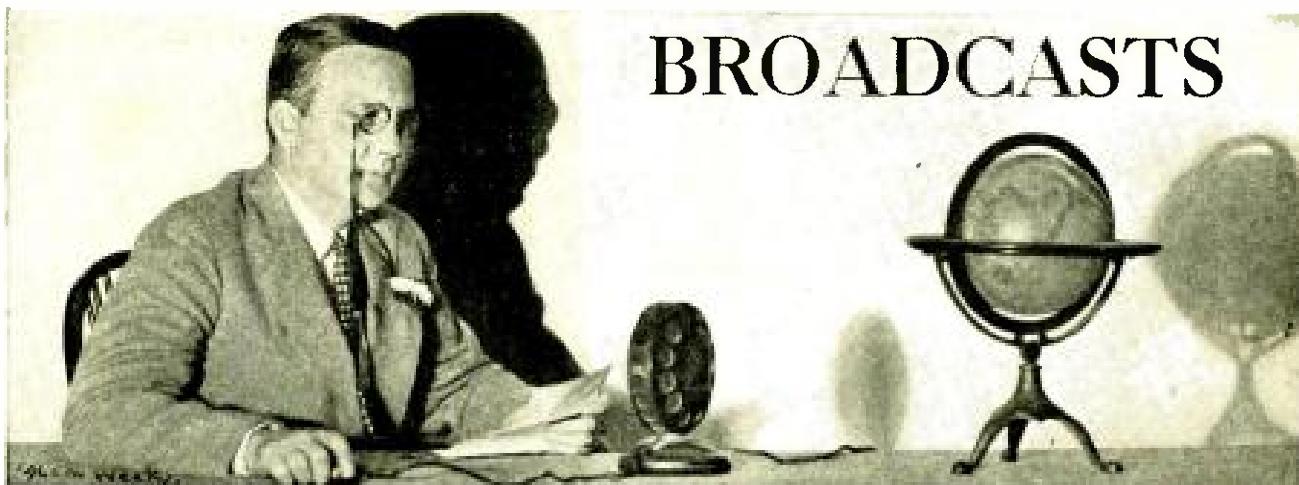
sistance of the circuits and, therefore, the eddy currents that are produced in the inductance loop. This method may be adjusted for any station to increase the amplification and the volume of signals. It is a very simple control and at the same time can be made extremely efficient by critical adjustment.

Neutralization of tube capacity by any of the grid methods, such as the Rice, Hazeltine, Jones or the Scott-Taggart, are usually successful in preventing radiation; the efficiency of a receiver that employs any one of these methods may be increased by slightly upsetting the balance so that regeneration is present to some extent without becoming obnoxious on the lower wavelengths. Perhaps only a single stage may be left unbalanced and thus the selectivity and the distance-getting ability of the receiver may be increased a great many times. This method is very efficient and when once properly adjusted gives very stable operation.

—ROBERT TAIT

Popular Fallacies About Coils

THERE are many misconceptions about the "low loss" feature of coils or inductances. Many of the so-called "low loss" coils that are now so popular among radio fans have less efficiency than some of the older types. Just what constitutes a "low loss" coil and how the characteristics of coils are being studied will be told by D. R. Clemons—in a coming issue of POPULAR RADIO.



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.

"Radio Home-hunting"

PERCEPTIBLE deepening of the furrows of anxiety in the brows of realtors in the vicinity of Spokane is reported as directly due to an increase of what is termed radio home-hunting. One case is cited wherein it required several weeks and the services of many real estate dealers before a satisfactory location could be found for Frank Stoop, well-known sportsman, who looked over house after house in daylight hours but time after time called off what looked like a sure sale upon returning in the evening with his radio set and finding poor reception in each of the successively selected locations. Stoop finally bought a five-room bungalow (paying more than he originally intended incidentally), which suggests the possibility of premium prices for non-static locations.

* * *

Yankee Apparatus in the East

IT would hardly be thought that more American radio sets and parts are going to the Far Eastern countries than to Europe, but the export figures for this year show that, and also that the Latin-Americans are using almost as much of our stuff as the Canadians did last year. Argentina, Brazil, Mexico, Spain and Australia are of markedly increased importance as purchasers.

* * *

Special Programs for Farmers

TWENTY-ONE stations broadcasting programs developed especially for the farmers is the impressive total reported by the National Farm Radio Council. The subjects comprehended in this service of far-reaching economic importance have been expanded beyond the original schedule of daily market reports to embrace talks on poultry, dairy and livestock subjects, the trend of agricultural devel-

opments, marketing of products and even news about meetings of farm organizations. The thoroughness with which the task of supplying these programs is being accomplished is indicated in the Council's announcement that with a string of co-operating stations from the Atlantic to the Pacific programs broadcast from the individual locations are built for the farmers living in the adjacent territory, an analysis of the crops grown in each station serving as the guide to subjects of particular interest in each case.

* * *

A Brindle Cow for a Radio Set

"Of course, we can sell the brindle cow and get another radio," wrote a farmer to KDKA, when that station recently changed its wavelength and could not be received without interference on the set owned by this particular devotee in New Hampshire. Although this man has successfully logged eighty-five other stations, his slogan remains, "Anything to get Pittsburgh." With 571 stations on the air, a neat job is suggested for some tireless investigator—how many are worth the sacrifice of a brindle cow!

* * *

The Meanings of Call Letters

SOMEBOODY is always asking the meaning of the initials W and K which precede the call letters of all our broadcasting stations. These initial letters, along with N (used exclusively by the Navy), were assigned to the United States by the International Bureau at Berne to cover all American radio calls except those designating amateur and experimental stations. In the early days, first convenience governed the selection and issuance of station letters, but recently the K calls have been allotted to stations west of the Mississippi and W to those in the eastern section of the country. The letters following the initial K or W serve in

many instances as a partial identification of the station's owner, an idea which originated in the helpful spirit of accommodation which the Department of Commerce has always shown toward radio.

* * *

No Radio Bootlegging for John Bull

IN a broadcasting controversy centering about the House of Commons recently the principle that the "Englishman's home is his castle" once again emerged triumphant. Beaten down under a storm of protest over a provision granting the right of search for unlicensed receiving sets, Great Britain's wireless bill was withdrawn after it had been properly labeled, "A preposterous piece of bureaucratic tyranny." The bill, it appears, would have empowered Justices of the Peace to search homes where unauthorized apparatus was suspected to be in use, and failure to take out a license carried with it such penalties as imprisonment for a year or a fine not exceeding £500, regulation so severe, one writer insisted, as to make listening-in as dangerous a vice as drug taking or illicit distilling. It is expected that a short substitute bill will be introduced, with a view of establishing the existing license system.

* * *

Communication in Davy Jones' Locker

COMMANDING officers of two submarines will hereafter be able to hold conversations with their craft submerged, through the devel-

opment of a new underwater communication system invented by Dr. H. C Hayes, of the Naval Research Laboratory, at Bellevue, D. C. The heterodyne principle is employed in the new invention, thus making possible the reception of high frequencies above audibility of the human ear; heretofore only the comparatively low frequency sound waves could be utilized, which limited under-water communication to the transmission of code messages.

* * *

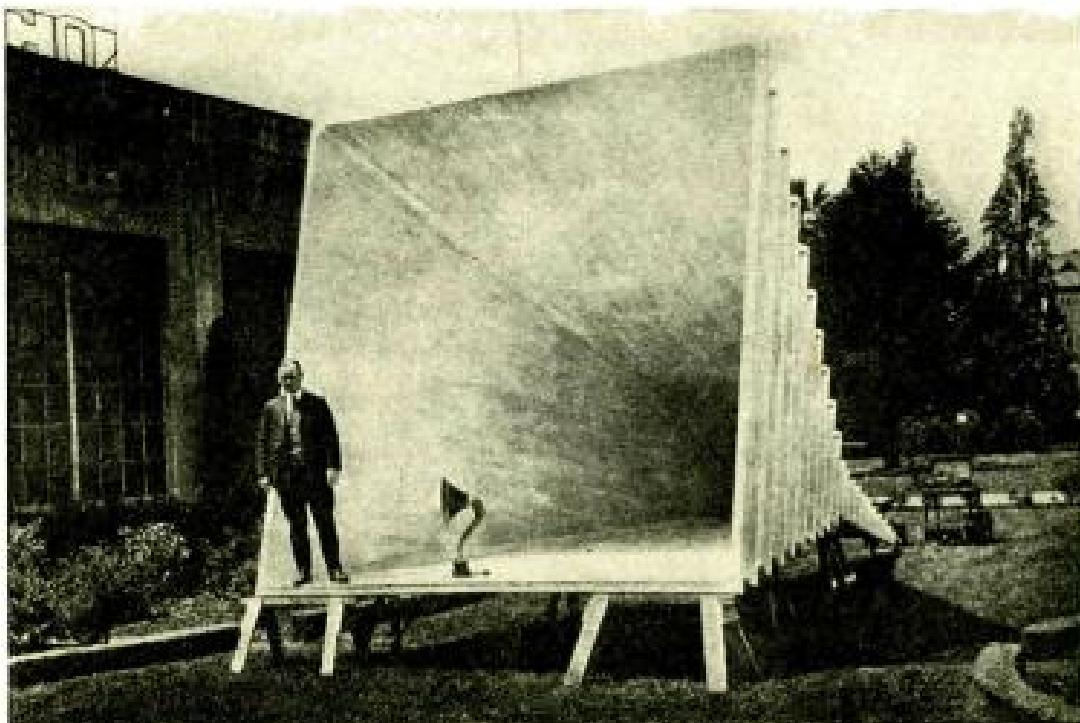
A Novel Radio Fire Alarm

A RADIO fire alarm system which operates automatically whenever an alarm is turned in at the familiar street corner fire box is a matter of civic pride with the city of Dallas, Tex. The alarm signals, which are not disturbing and are only on the air two or three minutes, are broadcast on a wavelength of 146 meters from equipment which includes a new 50-watt tube transmitter. Firemen off duty in their homes can thus be summoned when required to respond on the occasion of a third alarm, apparatus required from distant parts of the city, too, in the event of a stubborn conflagration is quickly made available, as well as recalls sounded for those en route when no longer needed at the point threatened —these are additional refinements of service reported by Superintendent Garrett, out of four years' experience with the system.

* * *

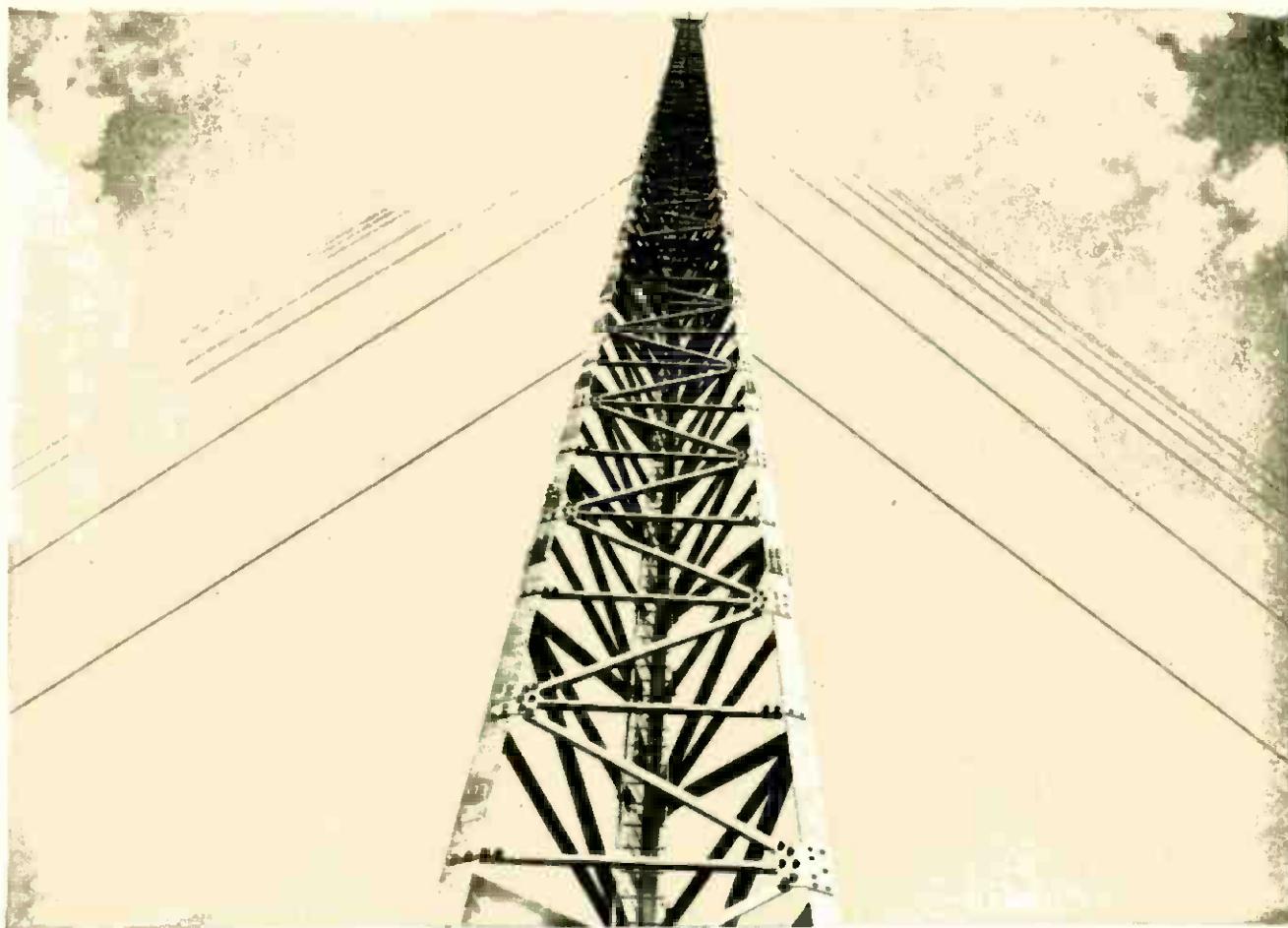
An Amateur Spans 8,000 Miles

ACCEPTANCE seems to be quite general of the record claimed by an English amateur in



THE WORLD'S LARGEST LOUDSPEAKER?

An idea that may eventually be carried out in the city parks as well as the village commons throughout the country has found practical expression in Idora Park, San Francisco. This instrument, thirty feet long, has supplanted bands that the park formerly engaged.



Barratt's, London

A NEW VOICE JOINS THE ETHEREAL THRONG

One of the newest and most powerful of the English super-power broadcasting stations has just been opened at Daventry; one of the huge antenna masts.

spanning 8,000 miles airline in a twenty minute radiophone conversation carried on a wavelength of 45 meters. Gerald Marcuse, of Caterham, Surrey, accomplished this remarkable feat, talking to Lieutenant Schnell aboard the United States cruiser *Seattle* when the vessel was 600 miles east of Australia. The British Marconi Company's beam station had previously conversed by radio with Australians, but used an extremely high-powered commercial set.

* * *

Dad Is the Real Radio Fan

A LONG standing impression that the youngsters bring radio initially into the house is not borne out in a comprehensive survey made in several sections of the country. The husbands or male heads of the homes were found to be the motivating force in more than half of the cases, and the wife's desire for a receiver came second. Only one set out of every five could be checked up to the credit of the younger members of the family. In seven cases out of ten, too, Dad turned out to be the official manipulator of the dials in supplying the evening's entertainment. Two-thirds of the people interviewed were operating their first set, the others having had two or more receivers previously, but practically all were willing to pay more money for a little better set next time.

Only Local Reception in Brazil

THE retarding effect of unfavorable climatic conditions has achieved for Brazil the trailing position in the development of radio, lagging far behind such South American countries as Chile and Argentina. Static at Rio and in the northern sections of Brazil makes anything but local reception an impossibility during the greater part of the year. In the entire country there are only ten broadcast stations, the extremes of power being represented by 500 watts and 10 watts, and an optimistic estimate of the maximum number of receivers in use would be 12,000. Judging by the number of licenses issued, Brazil has nineteen transmitting amateurs, and long distance reception means little or nothing in the life of the average radio devotee, any fishing for United States stations being practically the exclusive pastime of a few Americans resident in the country.

* * *

Are "Municipal Stations" a Menace?

THE municipal station of New York City, WNYC, ran afoul of the prejudices of some of the residents of the metropolis during the warm months of the year, and city officials found themselves answering in the Supreme

Court charges made by the Citizen's Union that installation and operation of such a station was unconstitutional, and furthermore it was being used to spread "political propaganda." Following which there was much pow-wow with the citizen's body insisting upon an injunction to restrain the station from further broadcasting, and the city officials defending principally on the grounds of the importance of the police alarms sent out twice daily and a scheme for future broadcasting of fire alarms, to say nothing of lectures and musical programs as regular features. The tempest in the teapot subsided when Justice Churchill found that he had insufficient legal grounds for granting the injunction and everything ought to be all right anyhow in the future if the officials would carefully delete those things which seemed to be more for the glorification of the Mayor and his associates than for entertainment and edification of the public. Whereupon New Yorkers sat back and wondered what the station could accomplish that the dozen locals were not doing very well and without any increase in the taxpayer's burden. At last reports they were still wondering.

* * *

College Laurels for Radio Research

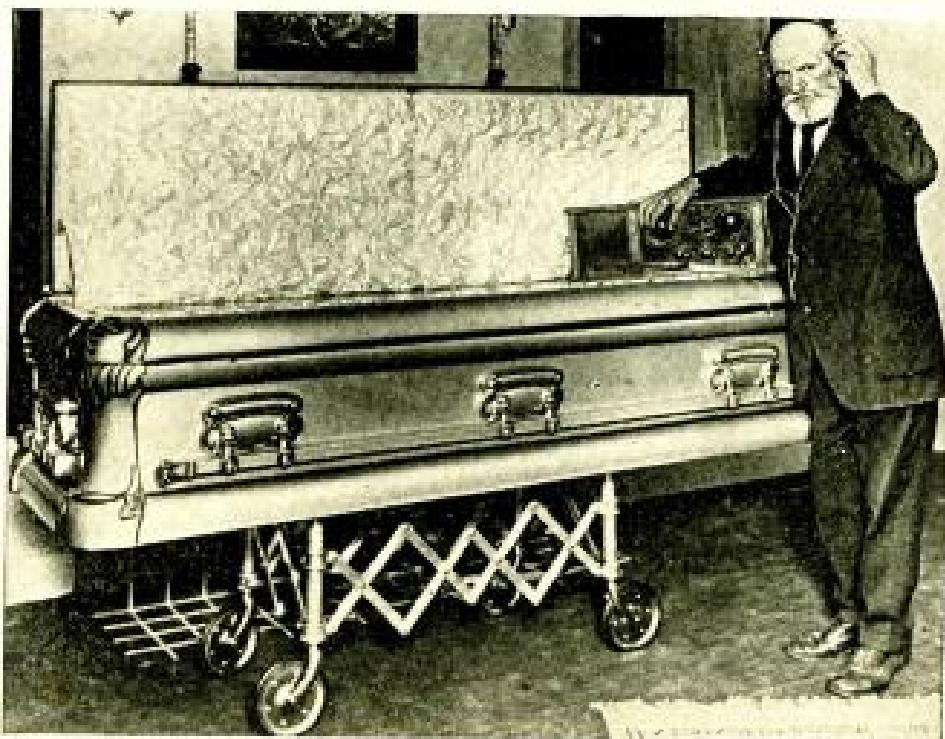
A BIT of radio research was acknowledged the most valuable contribution to the advancement of the college this year, in the award of the Bailey Prize to Edmund B. Redington, of Waverly, N. Y., a senior at Union College.

He received a silver loving cup in recognition of undergraduate research work in making a radio transmitter oscillate on the extremely low wavelength of 3.8 meters. Standard equipment was used, employing two 50-watt tubes. The best previous operation had been on four to five meters, dispensing with tube bases and sockets. It had also been deemed essential to nullify the internal tube capacity, but the new oscillator used this capacity rather than an external condenser, an unusually short oscillatory circuit being obtained by the use of extremely short connections between the tube sockets.

* * *

Kipling Takes Up the Broadcasting Problem

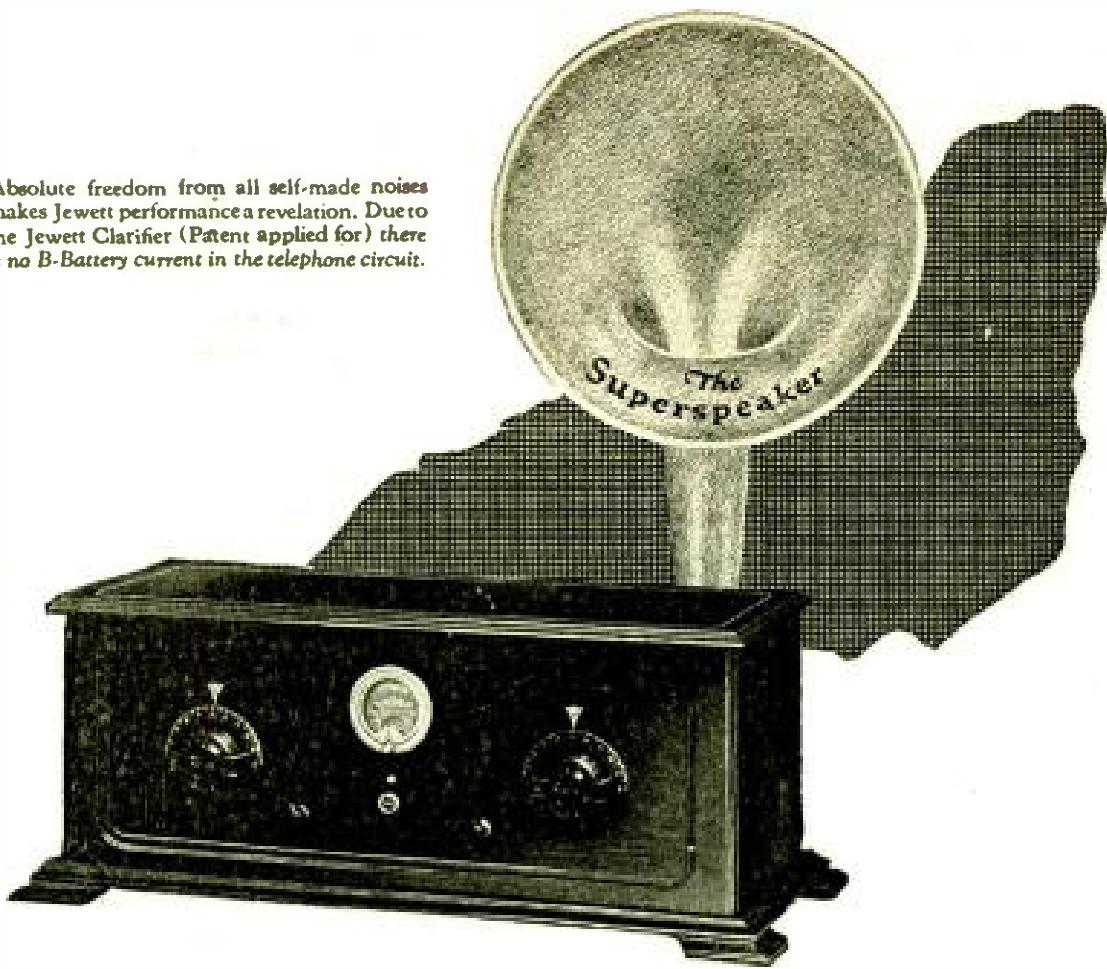
THE radio problem in England is engaging the attention of some of Great Britain's most distinguished persons. Among them is Rudyard Kipling, who has agreed to take up radio in a serious way. He accepted an appointment to the committee of ten which will inquire into the future of broadcasting, its control, financing and management in Great Britain. The British Broadcasting Company, consisting of manufacturers of radio apparatus, has a monopoly of broadcasting, but its license will expire in December next year, and the Government committee will draw up a comprehensive plan for governing broadcasting thereafter. The committee includes prominent business men, politicians, educators and one woman, Dame Meriel Talbot, former adviser to the Minister of Agriculture.



LISTENING IN FROM KINGDOM COME

Sam R. Kimball, an aged San Bernardino Valley rancher, has placed an order with a Los Angeles undertaker for a twelve hundred dollar steel coffin equipped with a radio receiver. Through it he expects to be able to hear what is going on in the world after he dies, being convinced, he says, that the soul lingers near the body until the day of judgment.

Absolute freedom from all self-made noises makes Jewett performance a revelation. Due to the Jewett Clarifier (Patent applied for) there is no B-Battery current in the telephone circuit.



PROCEEDING, step by step, along the path of deliberate and consistent progress, the Jewett Radio & Phonograph Company now offers a Receiver reflecting, in its every detail, that originality and close approach to perfection which you have so thoroughly enjoyed in the Jewett Superspeaker.

Deliveries are being made to pre-arranged schedule. Distribution is through wholesalers and retailers who are under direct contract, with full territorial protection.

JEWETT RADIO & PHONOGRAPH COMPANY

5668 Telegraph Road

Pontiac, Michigan





Whether You Smile or Cuss Depends on the Service Behind Your Radio

WHAT is this radio service which we claim is so necessary?

Do you drive a car?

Do you ever have little things go wrong with it?

You have become so used to minor troubles that you don't condemn the car on which they occasionally occur.

No—

You go right to a service man—a man who knows your make of car. You don't

go to a handy man who claims he can fix any car.

That's automobile service, and is one of the main reasons for the auto being the success it is today.

The same service condition exists in radio—the only difference being that people don't yet understand it.

The radio instrument which never requires service has never been built—it never will be. Like automobile manu-

OZARKA

124 Austin Avenue C,
Chicago, Illinois





facturers, the better radio manufacturers do all within their power to make their instruments mechanically perfect. Nevertheless, like the auto, little things will sometimes go wrong—they are serious to the radio owner but very simple to a factory trained service man.

The handy man who can fix any radio simply experiments until he locates the trouble—such a method was disastrous to the auto in former days—it is disastrous and expensive in radio today. It is not sound. Ozarka instruments are sold only by Ozarka factory representatives, men who are factory trained in sales and service, men who sell no other radios but Ozarka.

These men don't pretend to know all about radio but they do know all there is to know about Ozarka—isn't that the kind of radio service you want?

Ozarka instruments are sold under a very definite plan. An Ozarka representative will gladly set up an Ozarka in your home—he won't tune it—he won't tell you what it will do—you must operate yourself. If the results you receive by your own operating won't convince you that the Ozarka gives you the distance, volume, selectivity, tone and ease of tuning that you demand, then don't buy it.

Ozarka instruments are built to sell themselves but no Ozarka is sold without factory-trained service behind it.

Openings for a Few 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 3,100 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.

There are still openings for the right men in this organization—men who believe in the future of radio—men who are tired of working for some one else—men who want a business of their own. Prove yourself by sales and willingness to learn and exclusive territory will be given you. The man we want has lived in his community for some time. He has the respect of his fellow men because he has never "put anything over" just to make money. He may not have much money, but he is not broke and is, at least, able to purchase one demonstrating instrument.

Send for FREE Book

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 the coupon. If interested in our salesman's plan ask for "Ozarka Plan No. 100."

Ozarka
Incorporated
124 Austin Ave. C.
Chicago, Illinois

Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka Representative.

I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.

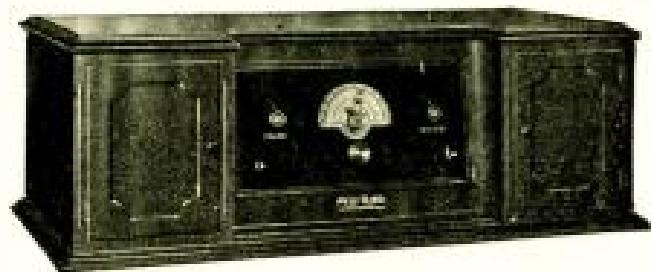
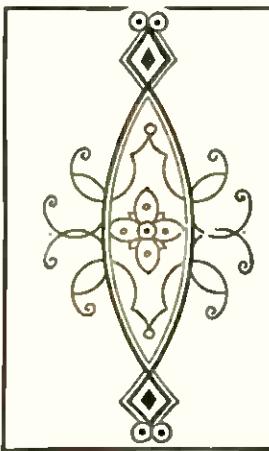
Name.....

Address City

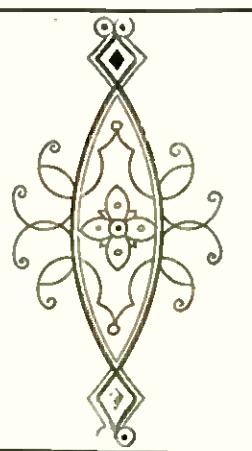
County State

INCORPORATED

124 Austin Avenue C,
Chicago, Illinois



Model A - - Price \$175
Sockets Fit All New Type Tubes



Far Ahead of the Times

The new Mu-Rad Transcontinental Receiver is a distinct advance in the art of Radio Reception. It is the evolution of ten years progress and development in Radio and is the masterpiece of one of Radio's greatest engineers.

One Dial Control

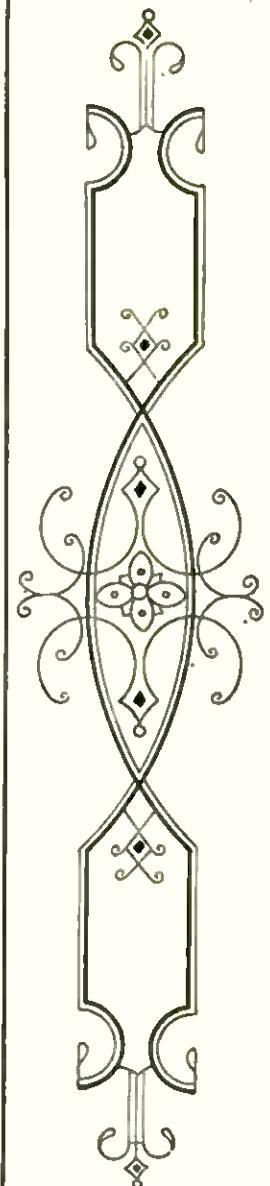
One Dial setting, the turning of One knob brings in local and distant stations with amazing clearness and volume and absolute selectivity. Once a station is logged it will always come in at the same dial setting. It's so simple a child can operate it.

Write Dept. F-2 for Literature

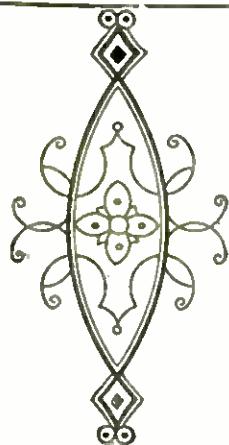
MU-RAD RADIO CORPORATION

Factory:
Asbury Park
New Jersey

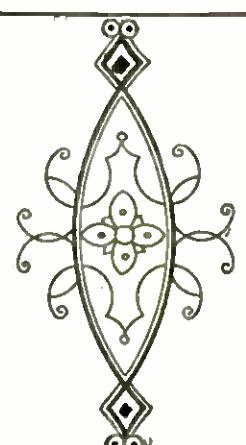
General Sales Offices:
972 Broad Street
Newark, New Jersey



The
MU-RAD
Transcontinental Receiver



Model B - - Price \$125
Sockets Fit All New Type Tubes



A Heart to Heart Talk on Radio Receivers

The Radio Receiver You want must be able to bring in local and distant stations, at will, clearly, and with full, rich volume—and it must be so simple to tune and so reliable in operation that your child can tune it. You also want a Receiver that is so far advanced that it represents a *permanent* value when you buy it.

That is why you want the new Mu-Rad Transcontinental Receiver.

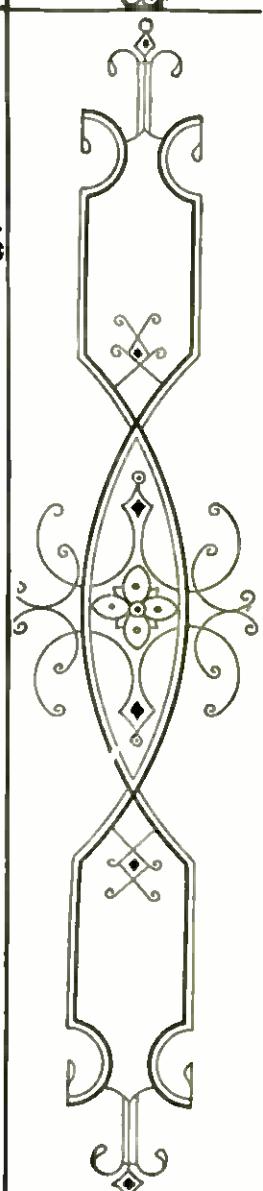
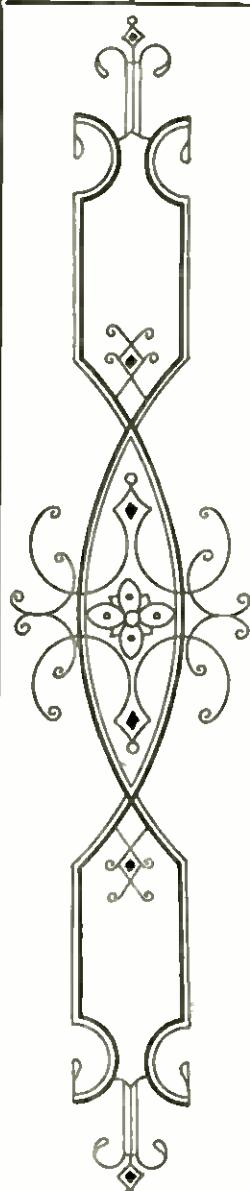
*Go to Your Nearest Dealer—
See this Remarkable Receiver—
Ask Him to Let You Tune It Yourself.*

Write Dept. F-2 for Literature

MU-RAD RADIO CORPORATION

Factory:
Asbury Park
New Jersey

General Sales Offices:
972 Broad Street
Newark, New Jersey



The
MU-RAD
Transcontinental Receiver



Selectivity means more with the Valleytone

Potential Balance exclusive in the Valleytone

The potential balance method of suppressing oscillation and preventing distortion is used for the first time and exclusively in the Valleytone Radio Receiver.

Reception is clear and mellow—free from the thin, hard, metallic sound and the howls and squeaks which have been the plague of radio.

Valley Toroidal Coils

The Valleytone is the first manufactured set to use Toroidal coils. The Valley Toroidal winding allows a greater coupling ratio between primary and secondary. The result is an appreciable increase in volume over the old solenoid winding.

Appearance

The Valleytone is mounted in a solid walnut cabinet, finished in two tones with inlaid gold stripes. It may also be procured in beautiful console models. Special Valley tables with built in loud speaker may be obtained for the cabinet model.

Finer tuning becomes a reality . . . selectivity means more with the Valleytone Radio Receiver.

For instance: The Valleytone has regularly received and separated clearly and distinctly, radio programs broadcasted simultaneously from stations on wave lengths from four to five meters apart.

Such selectivity is attained in the Valleytone because of the Toroidal coils. The Valleytone circuit brings in stations sharply, clearly, and free from distortion.

With the Valleytone, you can enjoy radio as never before. You can get a station if it is on the air and transmitting strongly enough to reach you. You can choose your stations by the clock and hear them with the Valleytone.

The Valleytone is a five-tube set. It is manufactured by an old established company with the experience and the resources to assure you always the utmost in radio value.

Before you buy a radio, see the Valleytone. Hear it. Let an authorized Valley dealer give you a demonstration.

VALLEY ELECTRIC COMPANY, Radio Division, St. Louis, U.S.A.
Branches in Principal Cities

Valleytone
Receiving Sets

Valley
Battery Chargers

Valley
B-Eliminators

Valley Electric

For radio at its best you need these, too



Valley B-Eliminator

The Valley B-Eliminator is made for receiving sets of from one to eight tubes. Binding posts and control rheostats are mounted on Bakelite panel. The unit is enclosed in a handsome black case.

It costs less at the start than wet B batteries and less in the long run than dry cells, too. Much more satisfactory than either.

Like new B batteries every night

Here is a new and better way of supplying B voltage for radio reception.

B batteries wear out. They cannot be the same two nights in succession. As they decrease in strength, volume decreases, too. Furthermore, they become noisy as they wear out. The absolutely ideal B battery current can be obtained only by the use of fresh new B batteries every night. The same ideal results can now be obtained by the use of the Valley B-Eliminator as your source of B voltage.

In its performance, the Valley B-Eliminator is like a new set of B batteries every time you tune in and every second you are tuned in.

The Valley B-Eliminator is more than a substitute for B Batteries. It is a new and better way of supplying B voltage for radio reception. It operates on the house lighting circuit and provides B current at a constant voltage all the time.

Hence reception is always at its best. There is never any decrease in the strength of signals and none of the frying noises or hum which are due to low B batteries. Volume is maintained. Reception is uniformly good.

The charger with ten points of superiority

The Valley Battery Charger has a reputation for results. It is based on principles which were proven successful long before radio became popular. It is the only charger needed for all radio batteries:—6 volt A batteries; 24, 48, 72 or 96 volt B batteries; and 2 volt batteries.

It has ten points of superiority

- | | |
|--|---|
| 1 No bulbs. | 8 Special switch for B Batteries.
Voltages: 24, 48, 72, 96. |
| 2 No liquids. | 9 Has only two wearing parts, the contacts, which can be replaced easily and cheaply. Average life of these contacts about two years. |
| 3 Quiet in operation. | 10 Built in handsome black case with grained and engraved Bakelite panel and clear glass top which shows simple patented working parts. Harmonizes with the finest receiving set. |
| 4 Cannot harm your battery. | |
| 5 Efficient. Takes about a dime's worth of current for a full charge. | |
| 6 Correct 6-ampere charging rate enables you to recharge your battery overnight. | |
| 7 Ammeter mounted flush with panel shows if battery is receiving charge and if charging rate is correct. | |

These features are all essential. Be sure of them by getting only a Valley Battery Charger.



Valley Battery Charger

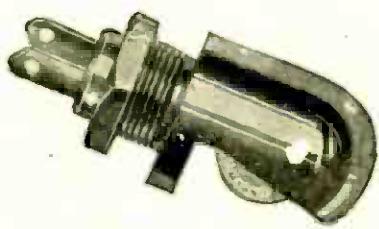
VALLEY ELECTRIC COMPANY, Radio Division, St. Louis, U. S. A.
Branches in Principal Cities

Valleytone
Receiving Sets

Valley
Battery Chargers

Valley
B-Eliminators

Valley Electric



WALBERT PANELITE Dress-up your panel with the original PANELITE. Enjoy the comfort of tuning without eye-strain. Also serves as pilot light. Hooks-up with "A" Battery circuit. Single-hole mounting. Complete with low-current bulb.

Nickel Plated \$1.00
Gold 1.25



WALBERT LOCK SWITCH A sturdy, silent and most efficient filament control with original locking feature. Easily substituted for present switch. Standard single-hole-mounting. Dust and shockproof. Takes minimum panel space. Costs no more.

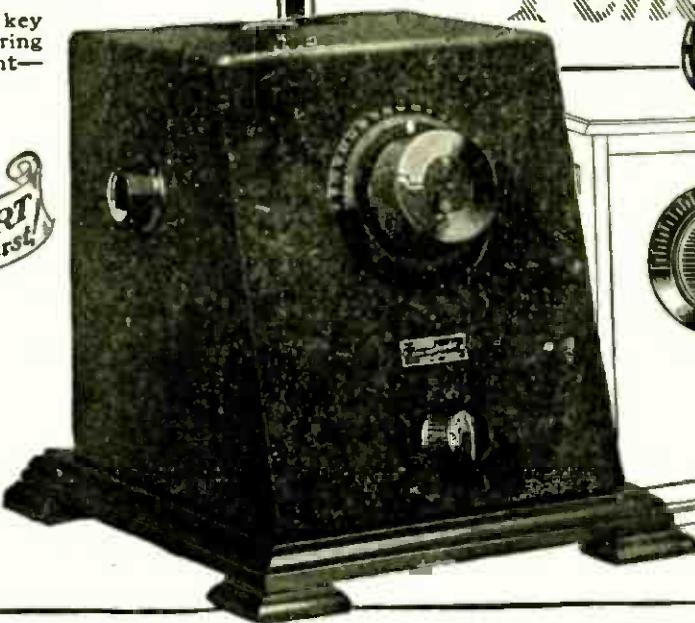
50c.

Extra key with key ring attachment—
20c.



All Walbert products protected by Pats. or Pats. Pend. U. S. and Foreign.

R.M.A.



SLF VERNIER DIAL — UNIVERNIER CONDENSER — SOCKET

Pep Up Your Present Receiver!

Its performance through the use of the Penetrola will astound you!

THE following results are guaranteed on even the finest of receivers.

1. Increase selectivity. A powerful Results of aid in penetrating interference from laboratory local stations. Will positively bring tests sent in stations you can't get without it. on request.
2. Increase range and volume.
3. Reduce static by permitting use of short aerial while actually increasing signal intensity.
4. Improve quality by making it unnecessary for you to operate your set close to the oscillating (howling) point.
5. Positively stop your set from radiating to the annoyance of neighboring fans.

The Penetrola will add more in performance than many times its cost invested in a new set. In most cases your new combination will out-perform the best set on the market. See your best dealer.

Jobbers and Dealers: Write for discounts

WALBERT MANUFACTURING CO.
933 Wrightwood Ave., Chicago, U. S. A.

The new **WALBERT** Penetrola

Two types: (a) for antenna sets. (b) for loop sets. Easily installed—no alterations whatever. Equipped with standard Walbert parts: Univernier, Univernier Condenser, Low-loss Socket, Low-loss Inductance, Isodon, Colored Connection Cords. Finished in black crystalline enamel blending with any cabinet. Price—\$35.00.

FREE Write for laboratory bulletins describing any Walbert product in which you may be interested.

The FIRST Vernier Dial is Still First!

Many new and unique features

OVER three years ago the first UNIVERNIER appeared on the market. Today, more than a million UNIVERNIERS are helping fans "fish" for elusive DX stations. . . . Now comes the 1926 UNIVERNIER—better than ever. With many unique features the original Vernier Dial is unquestionably the best:

1. New simplified mounting
 - a. Takes standard shaft projection without cutting.
 - b. Complete Unit—no separate dial.
 - c. Firm anchorage—no friction anchorage (as in other dials) to endanger instrument bearings and give intermittent action.
 - d. One of the few Vernier Dials that can be mounted with single-hole-mounting condensers.
2. Smooth firm action thru expertly designed gearing. No slipping or jerking.
3. Batelike knob and 4" bakelite dials. Standard clockwise (counter-wise if desired).
4. Removable logging card. The most practical logging method ever devised.

See the new UNIVERNIER at your dealer—or sent postpaid on receipt of \$1.50 (list).

Jobbers and Dealers: Write for discounts

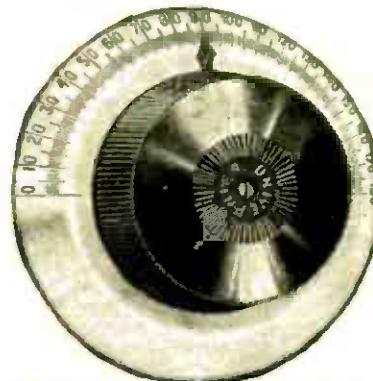
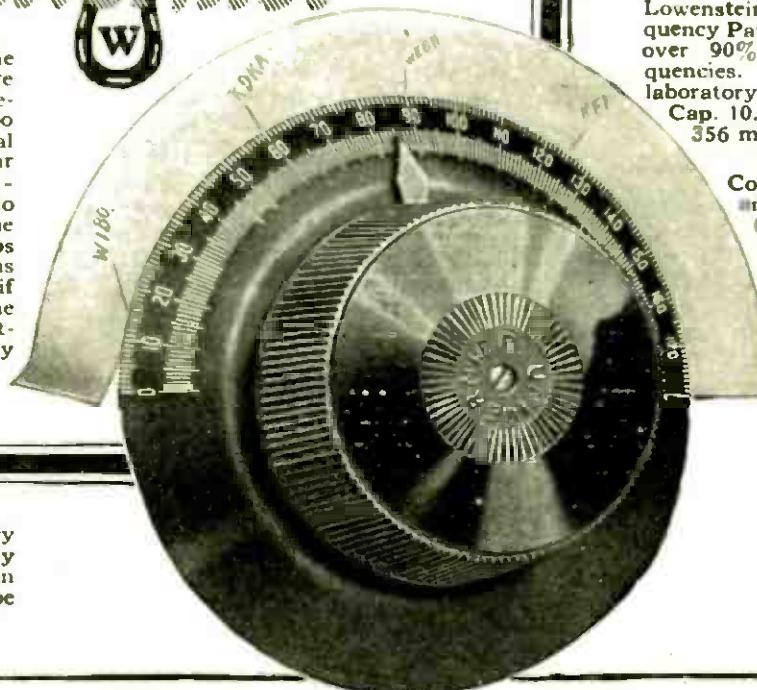
WALBERT MANUFACTURING CO.
933 Wrightwood Ave., Chicago, U. S. A.

The new **WALBERT** Unvernier

Remember how the "slow-motion" picture enabled you to see details which passed too quickly in the usual running? In a similar way, the "slow-motion"—12-to-1 ratio (proven right)—of the UNIVERNIER helps you find many stations that are missed if "searching" is done with the rapid adjustment of an ordinary dial.

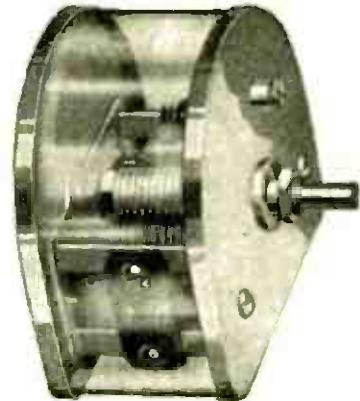
FREE

Write for laboratory bulletins describing any Walbert products in which you may be interested.



WALBERT S.L.F. VERNIER DIAL Convert your old condensers to straight-line-frequency with the Walbert S.L.F. VERNIER Dial. Imparts S.L.F. characteristics to any semi-circular plate condenser plus vernier control. 4" nickel-silver dial. Concentric mounting. For other features see the new UNIVERNIER.

\$2.00



WALBERT UNIVERNIER CONDENSER A remarkably small, compact and easily mounted condenser with dust-proof enclosure. Spring brass plates. Manufactured under Lowenstein Straight-Line-Frequency Patents. Gives S.L.F. over 90% of broadcast frequencies. Lower loss than laboratory standard. Minn. Cap. 10.05 mmf; Max. Cap. 356 mmf.

\$3.50

Combination Unvernier and Condenser, \$5.00 (Unit Mounting)

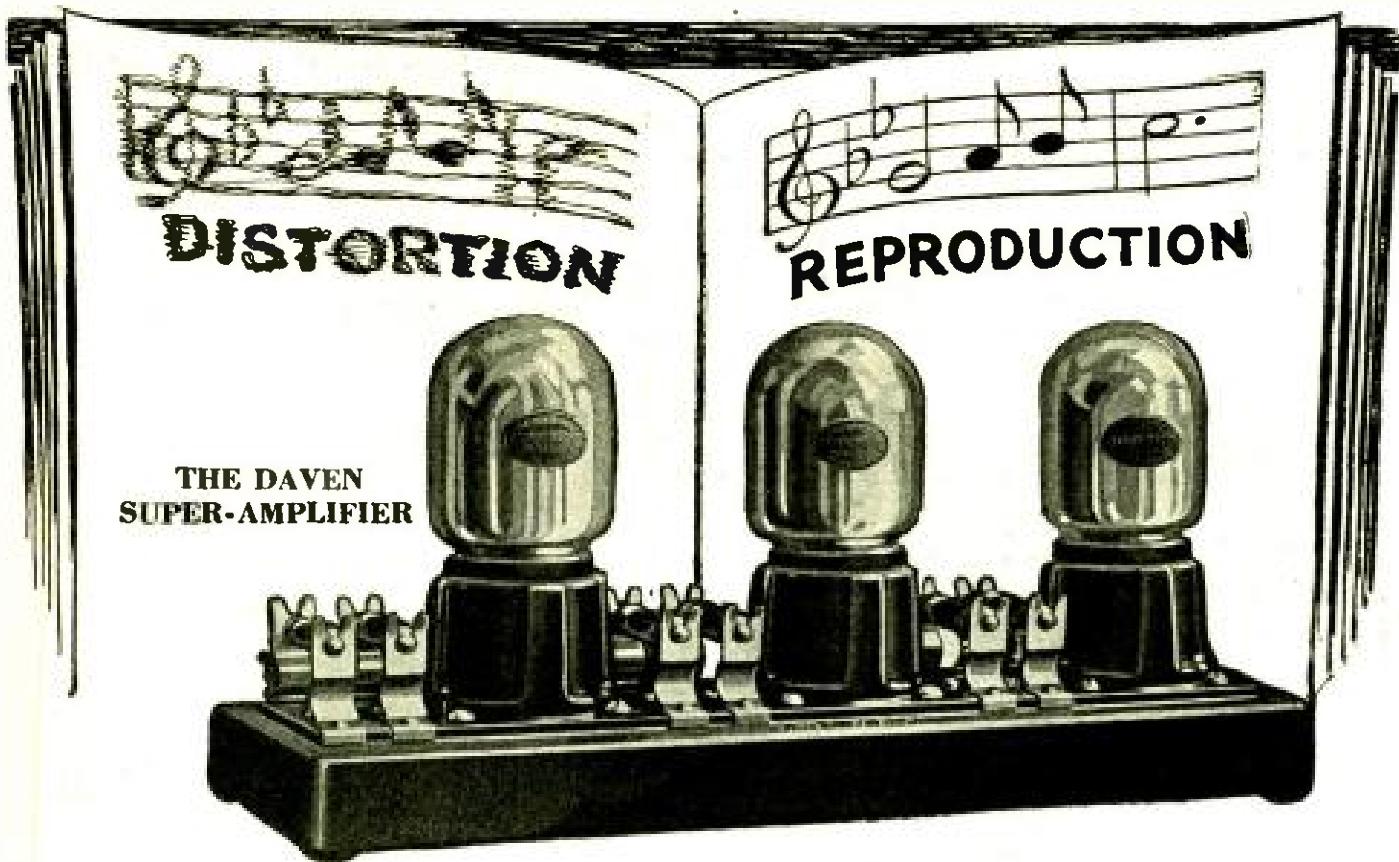
WALBERT made it first!

All Walbert products protected by Pats. or Pats. Pend. U. S. and Foreign.



PANELITE — PENETROLA — LOCKSWITCH — ISODON

TRUE TONE QUALITY



RESISTOR MANUAL
The Handbook of Resistance Coupled Amplification.
At Best Radio Dealers 25c.
Direct by mail, postpaid 30c.

CLIP THIS COUPON

D-10-25

DAVEN RADIO CORPORATION
158-160 Summit St., Newark, N. J.
Please send me the following on Re-
sistance Coupled Amplification:

Check one

- Resistor Manual, 30c is enclosed.
- Complete Catalog (free).

Name.....
Address.....

FOR DEALERS: Send your letterhead or card, or this coupon
and we will have our nearest dis-
tributor communicate with you.

VOLUME was formerly the goal of radio engineers. The blare of discordant trumpets succeeded the tinkling of the harp. The goal had been reached.

But true tone quality is the star we now are shooting at. This explains the phenomenal growth of the demand for resistance coupled amplification. The end of the era of distortion is in sight.

Daven engineers have pioneered in resistance coupled amplification. Daven Resistors and Mountings, Ballasts, Amplifier Kits and Super-Amplifiers are standard everywhere.

The Daven Super-Amplifier is the *aristocrat* of amplifiers. Absolutely no distortion. A revelation to music lovers. It is sold by dealers everywhere, complete, ready to connect with tuner and batteries, for \$15.00.

DAVEN HIGH-MU TUBES

MORE volume of true tone quality is the latest achievement of Daven engineers. The new Daven Tube Type MU-20 increases the amplification of the Daven Super to equal or exceed that obtainable with transformers. 6 volt, $\frac{1}{4}$ ampere—\$4.00 each.

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

DAVEN PRODUCTS ARE SOLD ONLY BY GOOD DEALERS

"The Sine of Merit"

DAVEN RADIO CORPORATION
Resistor Specialists

Newark

Reg. U. S. Pat. Off.

New Jersey

THE BIG LITTLE THINGS OF RADIO

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

"Simplify Radio"

says
Daven



Daven Engineers Blaze Another Trail

THE biggest of all the little things in radio is the grid leak. The Daven Grid Leak is known the world over as the grid leak of permanent, constant value. It is standard.

Almost as important is the condenser. But grid condensers change with temperature and humidity. The mica in condensers lacks uniformity or is impure. The tin foil plates melt or change their capacity.

In their constant efforts always to simplify and to improve, Daven engineers have made a remarkably effective combination of grid leak and condenser.

TWO-IN-ONE!

THE DAVEN LEAKANDENSER is so simple, so effective and so sturdy that you will wonder why it was not thought of before.

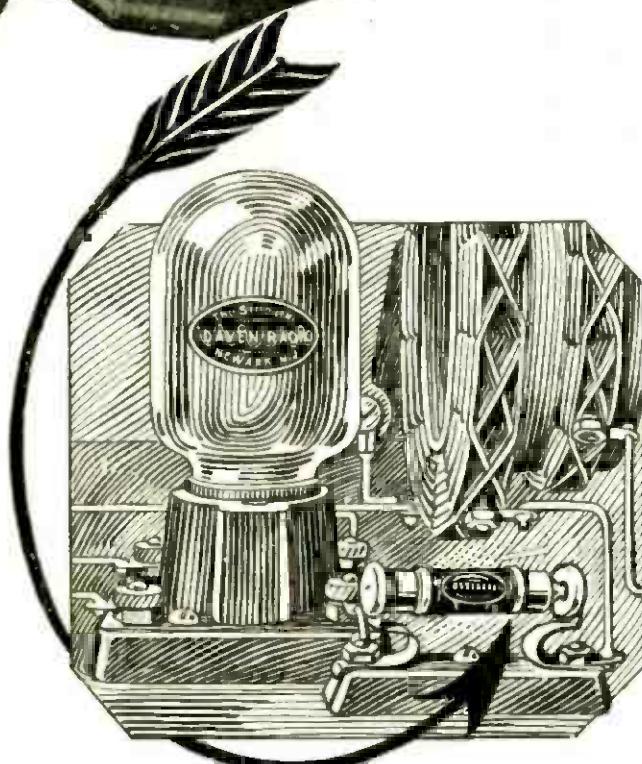
Similar in size to the Daven Grid Leak, it takes the place of the usual grid condenser which has shunted around it the usual grid leak. Made with five different values of grid leak resistance, 2, 3, 4, 5 and 7 megohms. The grid condenser capacity is fixed and correct for all makes of detector tubes.

With every Leakandenser a pair of new fastener clips that do not permit it to shake out. Precision-built. Price \$1.00 each.

Manufacturers are invited to send for a sample.

THE RESISTOR MANUAL is the handbook of Resistance Coupled Amplification. At your dealer's 25c. By mail postpaid 30c.

DAVEN PRODUCTS ARE SOLD ONLY BY GOOD DEALERS



The New Daven Tube

Type MU-20 increases the amplification of the Daven Super-Amplifier to equal or exceed that obtainable with transformer coupling. A one-purpose, three-element tube, 6-volt, $\frac{1}{4}$ ampere—\$4.00 each. Daven Power Tube Type MU-6 is recommended for last or output stage—\$5.00.

The Sine of Merit
DAVEN RADIO CORPORATION
Resistor Specialists

NEWARK

Reg. U. S. Pat. Off.

NEW JERSEY

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

D-10-25

Please send me the following on Resistance Coupled Amplification:

Check one

- Resistor Manual, 30c is enclosed.
 Complete catalogue (free)

Name

Address

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

THE BIG LITTLE THINGS OF RADIO

The Greatest Improvement

For a long time the radio public has been waiting for some revolutionary improvement in variable condensers.

Now it's here!

The Furnell Taper Coil Condenser introduces the first "new-idea" principle offered in condenser design, since Radio became popular.

Heretofore practically all variable condensers have been made up of two series of projecting plates, that intermeshed by the movement of a rotating shaft.

The limitations, as well as the deficiencies of this old style condenser, have long been recognized by the professional.

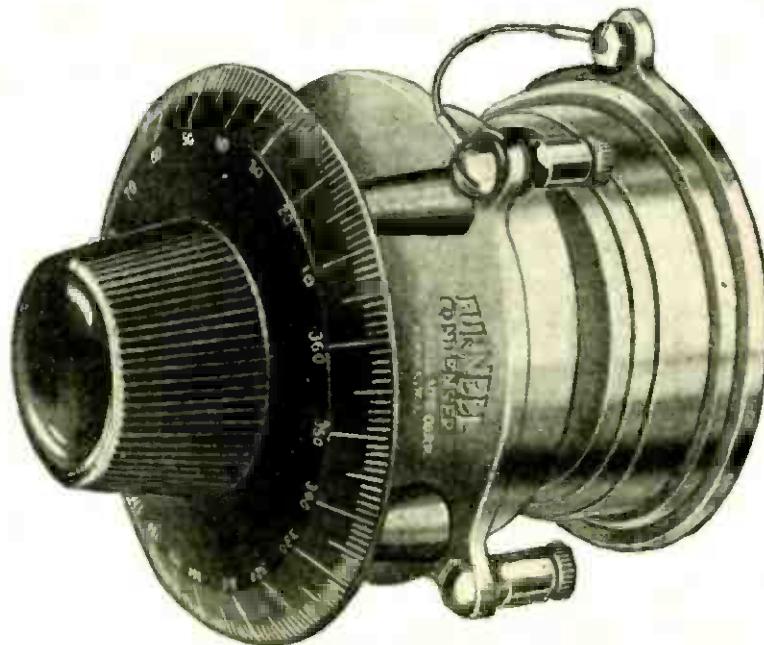
The Furnell Taper Coil Condenser embodies a principle never before used in condensers.

It has no projecting plates, no gears, no racks. No solder. No washers. Nothing to get out of alignment. Nothing to become loosened. Nothing to get out of order.

In every detail, the Furnell Taper Coil Condenser has been designed with one outstanding thought in mind—to afford the highest degree of efficiency ever attained in condenser construction.

And professional tests have proven the Furnell as superior to the old style condenser, as the tube set is to the crystal.

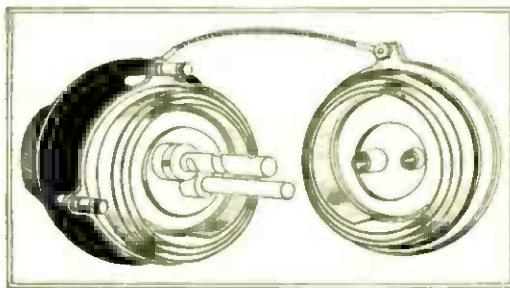
*We are now getting into production, and expect
to begin shipments about October 15th, 1925*



PATENTS
PENDING

in Condenser History!

The Furnell has only two plates, each plate being coiled in the form of an evolute, like an unwound clock spring. The end of each coil is directly connected with the circuit terminal.



This remarkable device has been tested and highly approved by L. M. Cockaday of POPULAR RADIO LABORATORY, and by other well-known authorities.

The Furnell Condenser is a low-loss unit, of the modified straightline frequency type, and uses air for the dielectric.

Due to its improved principle—its simplicity — its permanent alignment under all conditions, the Furnell affords a marvelous smoothness, and a vernier-like accuracy.

And the practical manner in which the Furnell spreads the entire broadcasting range over 360 degrees—one complete revolution of the dial—is a wonderful departure.

Radio experts praise the Furnell Condenser because it gives to radio reception, a degree of tuning perfection heretofore unattainable.

You will experience a new thrill in radio, when you use Furnell Taper Coil Condensers in the set you build—in the set you have—or in the set you buy.

SIZES AND PRICES

Capacity	Prices include 360° Dial, 3 in. or 4 in.	
	3 In. Dial.	4 In. Dial.
.00025 mfd.	\$5.25	\$5.50
.00035 mfd.	5.50	5.75
.0005 mfd.	5.75	6.00

Dimensions—All Capacities

Overall depth (panel to end) $2\frac{3}{4}$ in.
Diameter $2\frac{3}{4}$ in.

New Models to be shown soon will be an Enclosed type (dust-proof) and a Multiple for one-dial controls.

Be sure to visit our exhibits at the Radio Shows.

Write for interesting folder

Manufacturers—Jobbers—Dealers

may expect the Furnell Condenser—in brilliancy of performance and in sales activity—to excel all previous condenser records. Wire or write for plans and discounts.

The FURNELL MANUFACTURING CORPORATION
889F BROAD STREET, NEWARK, N. J.

FURNELL
360° TAPER COIL
CONDENSERS

Amplions chosen to reproduce Papal Ceremonies

throughout Saint Peters, Rome



His Holiness the Pope seated on his throne upon the occasion of the recent canonization of Sister Teresa. The microphone is on the right arm of the throne.

Of ALL loud speakers, Amplions enjoy the honor and high compliment of having been installed throughout the famous Cathedral of Saint Peters, Rome, that important ceremonies conducted by His Holiness the Pope may be clearly audible to great multitudes of people.

Supreme clarity of reproduction was the prime requisite. It is only logical that The Amplion —creation of the actual originators and oldest makers of loud speakers—should have been chosen. Amplions outsell any other loud speaker throughout the world, chiefly because of unrivaled clarity of tone. "The clearness of the reproduction of the Pope's voice was an outstanding feature," writes a witness to the first ceremonies.

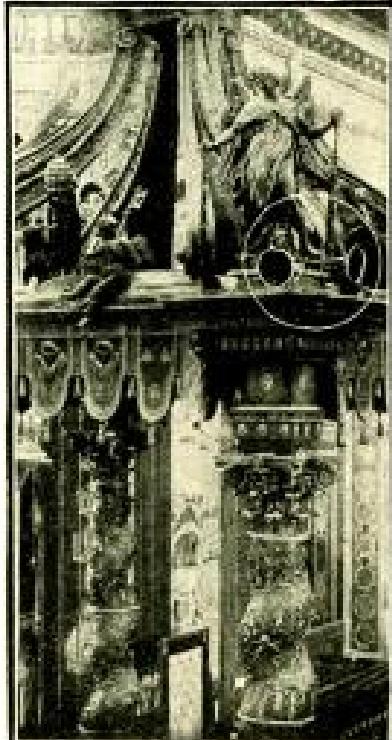
Hear The Amplion in comparison with any or all other reproducers. Prove to your entire satisfaction that it is the world's finest loud speaker. Amplion Loud Speakers, \$12.00 up. Phonograph units in two sizes. Write for interesting literature and dealer's address.

THE AMPLION CORPORATION OF AMERICA

Executive Offices: Suite X, 280 Madison Ave., New York City
Canadian Distributors: Burndepot of Canada, Ltd., Toronto
Alfred Graham & Co., London, Eng., Patentees

AMPLION

The World's Standard Loud Speaker

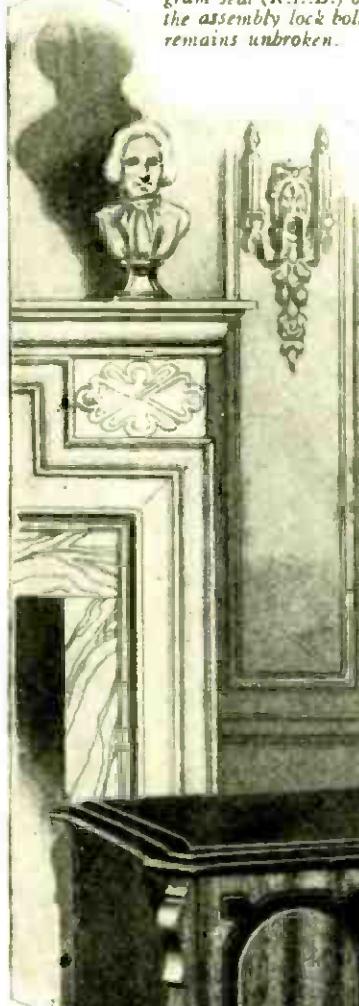


A portion of the magnificent canopy over Saint Peter's Tomb, showing two of many Amplions installed for amplifying Papal services to vast assemblages of pilgrims.

new ULTRADYNE MODEL L-3



All Ultradynes are guaranteed as long as Mr. Lacault's monogram seal (R.F.L.) on the assembly lock bolts remains unbroken.



No Dials-No Panel Built-in Loud Speaker

IF the Ultradyne Model L-3 were merely another new receiver, its influence in the industry would be little felt.

But it is in reality the first step in the general revision of radio receiver design which is bound to follow its advent.

For the new Ultradyne Model L-3 is an entirely new type of receiver—radically different in appearance and method of operation—gives finer results from finer engineering. Employs six tubes—is completely assembled and wired, ready for the tubes and batteries.

It has no dials—no panel—no needless controls. Two levers, an exclusive Ultradyne feature, give you control of the entire broadcast program. Its operation is practically automatic—simply slide the pointer to the station you want and adjust the volume control, soft or loud as you like it.

Loud Speaker and "B" Batteries self enclosed in a beautiful cabinet that is far from mechanical in design and is an ideal mahogany furniture piece for the most charming home.

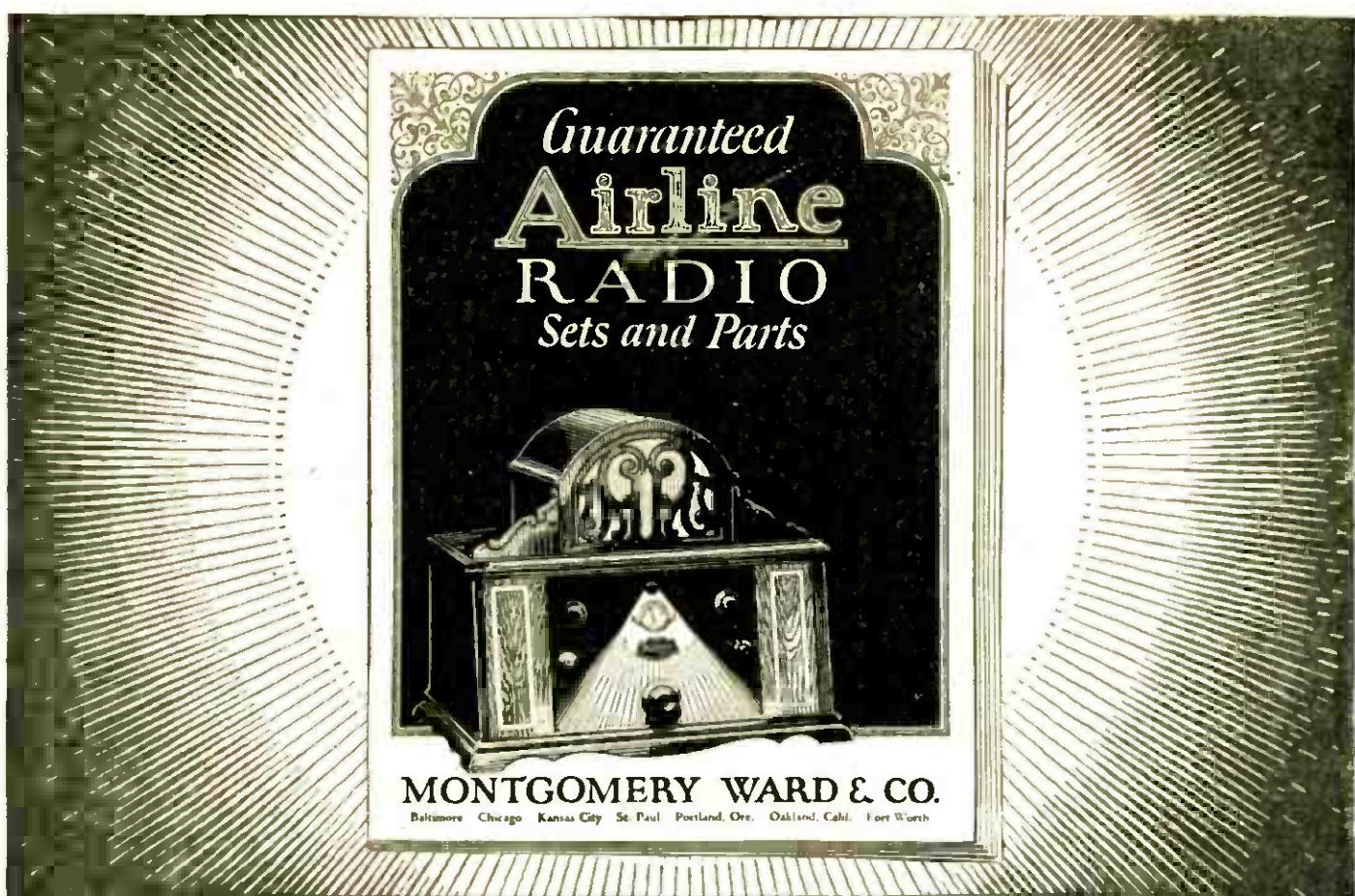
Ask your dealer for a demonstration.

*Write for
descriptive folder*

\$135

PHENIX RADIO
CORPORATION

116 East 25th St.
New York



Ward's New Radio Catalogue Is Yours Free

Yours Free—the newest, most interesting book published on Radio. A book prepared by Radio experts—a complete Radio manual.

52 fully illustrated pages showing what is new in Radio and what has been approved by the best experts.

It shows sets from one tube to five tubes, the new one dial control, parts and supplies, batteries and cabinets. It gives a list of stations, a radio log for recording stations.

Headquarters for Radio

Ward's is today one of the greatest Radio stores in the world—selling

everything in Radio without the usual Radio Profits. And besides, we sell only the tested and approved equipment—selected and tested by our own experts, who are up to the minute in Radio. Thousands of customers write us of their delight and saving on Ward's Radio sets.

Our 53 year old Policy

For 53 years we have sold only quality merchandise under a Golden Rule Policy. You can rely absolutely upon the quality of everything shown in this Radio Catalogue.

**Write for your free copy of Ward's new Radio Catalogue
Address Dept. 38-B**

ESTABLISHED 1872 **Montgomery Ward & Co.**

The Oldest Mail Order House is Today the Most Progressive

Baltimore Chicago Kansas City St. Paul Portland, Ore. Oakland, Calif. Ft. Worth

Send for this RADIO BOOK FREE

The World's Largest Exclusive Radio Mail Order House Will Send You This Wonderful Book FREE

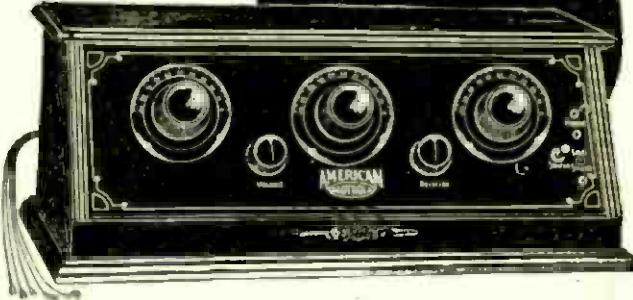
64 illustrated pages containing thousands of bargains in radio sets, semi-finished sets and radio kits of all styles, sizes and approved circuits. 5-tube sets as low as \$29.50. Beautiful models of the very latest designs and types. Elaborate console models with loud speakers built right in cabinets of genuine mahogany and walnut. All sets guaranteed. Coast to coast receiving range. Also contains everything in radio supplies, including batteries, chargers, loud speakers, transformers, condensers, rheostats and any other parts you may want for improving your set or building a new one. Guaranteed saving to you of $\frac{1}{2}$ to $\frac{1}{3}$.



1926 Catalog of RADIO BARGAINS Save $\frac{1}{3}$ to $\frac{1}{2}$

AMERICAN RADYNOLA 5 TUBE SET

\$29.50



The Biggest 5-Tube Value on the Market

Positively the world's greatest 5-tube radio bargains. Regular \$75.00 value. Our large quantity production enables us to sell this set for only \$29.50, fully built and wired in beautiful mahogany cabinet of latest design with sloping Bakelite panel of Satin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, coils and sockets. Bakelite baseboard panel and dials. Price for set only. **\$29.50**

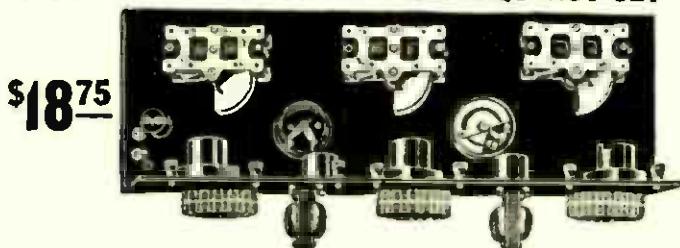
This set with all accessories, including the famous American Bell loud speaker with adjustable unit, 2-45 volt "B" batteries, one guaranteed 100 Ampere Hour, rubber case storage "A" battery, cable for battery connection, 5-201A tubes, Aerial and ground equipment, and everything complete ready to set up and operate. Nothing else to buy. Price **\$59.75**

Transportation charges extra, shipping weight 25 lbs.

Order Direct from This Page! Save About One-Half!

Order direct from this page. Save $\frac{1}{2}$ to $\frac{1}{3}$. Our guarantee protects you. Money cheerfully refunded if you are not satisfied. Write your order and prices plainly. Send post office money order or bank draft for full amount to insure safety. Refer to any bank or commercial agency regarding our reliability. All kits described on this page shipped prepaid East of Rockies (except Canada). American Radynola and the 5-tube Radio Frequency receiver shipped charges collect.

SEMI-FINISHED 5-TUBE RADIO FREQUENCY SET



\$18.75

This special offer is astounding the radio world. Coast to coast reception on loud speaker. Low loss condensers and sockets. Highest quality transformers. Bakelite rheostats. All wiring concealed under Bakelite baseboard. 7x18 panel—fits into any standard 7x18 cabinet. Complete instructions for operating. Guaranteed saving to you of \$50.00. Price of set all mounted, \$18.75. Cabinet of same model as American Radynola pictured above \$5.65 extra.

You must have our catalog no matter what set or kit you want. Our line is complete and includes all popular sets, such as Superheterodyne, Neutrodyne, Ultradyne, Reinartz, Regenerative, Radio Frequency, Browning-Drake, Super-Heterodyne, Reflex and all other latest circuits. Kits, sets and parts manufactured by all well known manufacturers such as Frost, Howard, Baldwin, Brandes, Western Electric, Columbia and others.

Our semi-finished sets come with all parts mounted on panel and baseboard ready for wiring. Do not fail to send for our catalog. Remember—we are the largest exclusive radio mail order dealers in the world and carry the best of everything in radio. We save you $\frac{1}{2}$ to $\frac{1}{3}$ on the following kits. Detailed descriptions appear in our catalog.

Catalog includes list of broadcasting stations, general radio information and facts about our free service division. Write for it today.

NEUTRODYNE

Genuine licensed Neutrodyne kit of parts, come fully assembled on the panel and baseboard with complete instructions. Price. **\$29.75**

COCKADAY

3-tube Cockaday kit of parts, fully assembled on panel and baseboard, ready to wire. Price. **\$15.85**

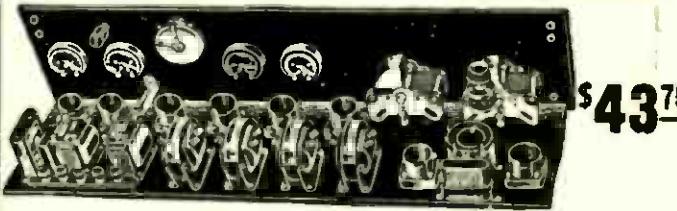
FOUR TUBE BROWNING

DRAKE and also PRESSLEY and REMLER SUPER-HETERODYNE At Bargain Prices.

Genuine Parts for Cockaday

Resistance Coupled and 5-tube set at prices that will astound you. Also complete parts for ACK Kit.

SEMI-FINISHED 8-TUBE SUPER-HETERODYNE



\$43.75

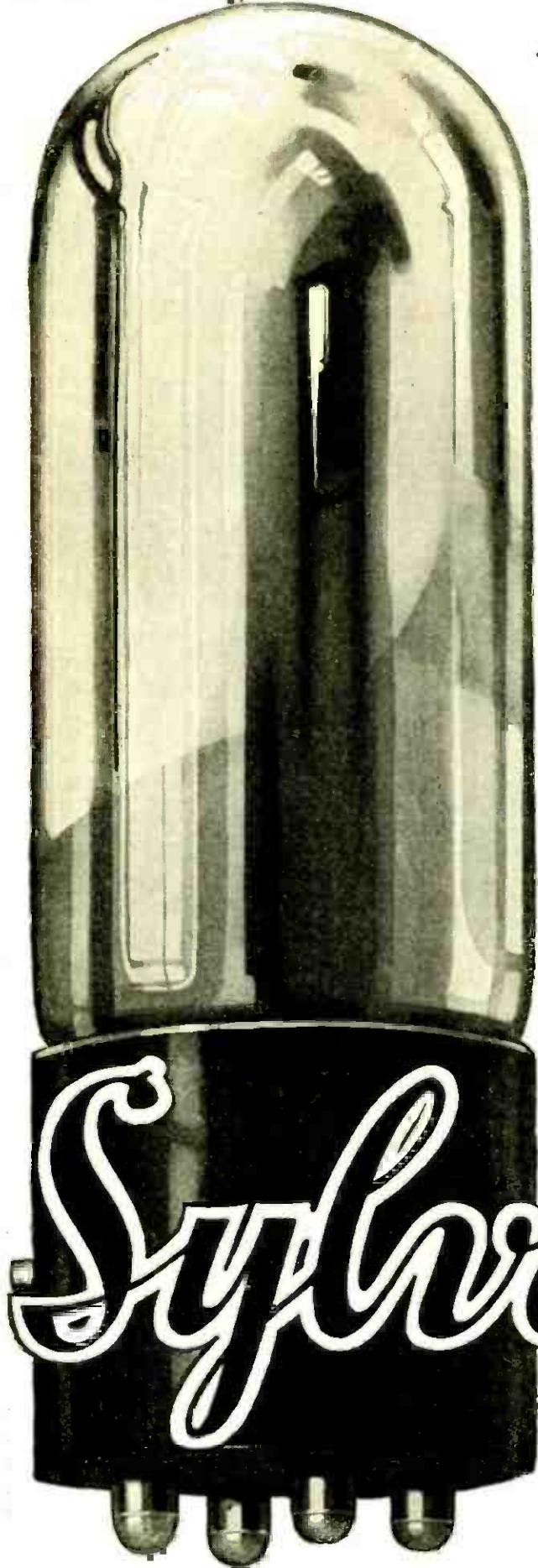
World's Famous 8-tube superheterodyne, Fully mounted on panel and baseboard. Comes completely assembled ready to wire and operate. We have testimonials from thousands of builders of this set. Some have received foreign stations on loop aerial. Unsurpassed in volume and tone quality. Low-loss straight line frequency condensers, vernier dials, finest quality rheostats. Matched Remler or Columbia long wave transformers. Requires only three screws for attaching panel and baseboard and set is ready to operate. 7x30 panel. Price of set only \$43.75.

Requires following accessories to complete this set: 7x30 cabinet, 8-201A tubes for storage battery operation or No. 199 tubes for dry cell operation. 100 Ampere hour storage battery, 2-45X "B" batteries, loud speaker, center tapped loop aerial. All these items are listed in our catalog at a tremendous saving.



RANDOLPH RADIO CORPORATION
159 N. Union Ave. Dept. 29 Chicago, Illinois

A type for every
need or preference:
S 01-A
S-99 Large Base
S-99 Small Base



If you want to get down to bed-rock on the tube situation

THIS tube or that tube—a cheap, questionable product that quickly wears down "B" batteries and gives little that is worth while in return or a downright quality product that brings out the best in your set—it's an important question many fans are asking themselves today.

If you want to quit speculating with radio tubes—if you want to get down to bed-rock and get all out of your set that it's possible for a tube to get—then install Sylvanias. Immediately you will notice a big difference in performance: better tone, greater sensitivity, more volume, longer life.

There is no compromise in Sylvania performance because there is no compromise in Sylvania manufacture. There is one standard only—the best it is humanly possible to produce. Yet the price is no more than you will pay for any other tube.

A Note to Dealers

SYLVANIA tubes are made by a close-knit organization that knows, from long years of experience, the intimate relationship of quality to profits. You should, by all means, get full particulars about the dealer franchise now.

Sylvania

Sylvania Products Company
Emporium, Pa.

Perfect Simplicity!

NO-DIAL

(Patented)



Licensed under Blackmore Patents and Patents Pending. Hogan Patent No. 1,014,002

5-Tube Receiver

A touch of the finger brings 'em in! Think of a receiver *without* dials—so simple that any child can operate it; a set that is fool-proof! That's NO-DIAL, the newest thing in radio!

Features You Have Waited For!

Utmost Simplicity without sacrifice has been attained by NO-DIAL engineers through the most careful correlation of all parts. Adjustments which the listener, himself, in ordinary sets must make are in NO-DIAL completed at the factory.

Better tuning is made possible because the condensers are permanently kept in step. Rotating the cover brings in station after station loud and clear, far and near. The entire edge of the cover is your permanent visible Station Register. Stations always come in at the same places where you locate and mark them. Scrap the log book!

Place your order now with your dealer if you expect to get delivery. The demand is exceeding all expectation. Accept no complicated substitutes.

OUR GUARANTEE

We guarantee NO-DIAL Receivers against defects in workmanship or material.

THE OHIO STAMPING & ENGINEERING COMPANY
Dayton, Ohio U.S.A.

Sensitivity of NO-DIAL is equal to that of higher-priced receivers. In many tests it has received stations from coast-to-coast with loud speaker volume and fine tonal quality. Tube for tube, it recognizes no superior. NO-DIAL does not re-radiate.

Cabinets of NO-DIAL Receivers are of spun aluminum, absolutely shielding it from body capacity. Finished in mahogany brown crystalline, it matches the most beautiful loud speakers and harmonizes with distinctive furniture in any home.

Circuit of the five-tube NO-DIAL is the latest and newest radio hook-up, a most remarkably efficient combination of tuned radio frequency and resistance coupling.

Use this coupon for detailed information

The Ohio Stamping & Engineering Company,
Dayton, Ohio, Dept. P. R. 10

I am a (distributor) _____
(dealer) _____ (agent) _____
(user) _____. Without any obligation
on my part, send me full details of NO-
DIAL Receivers.

Name.....

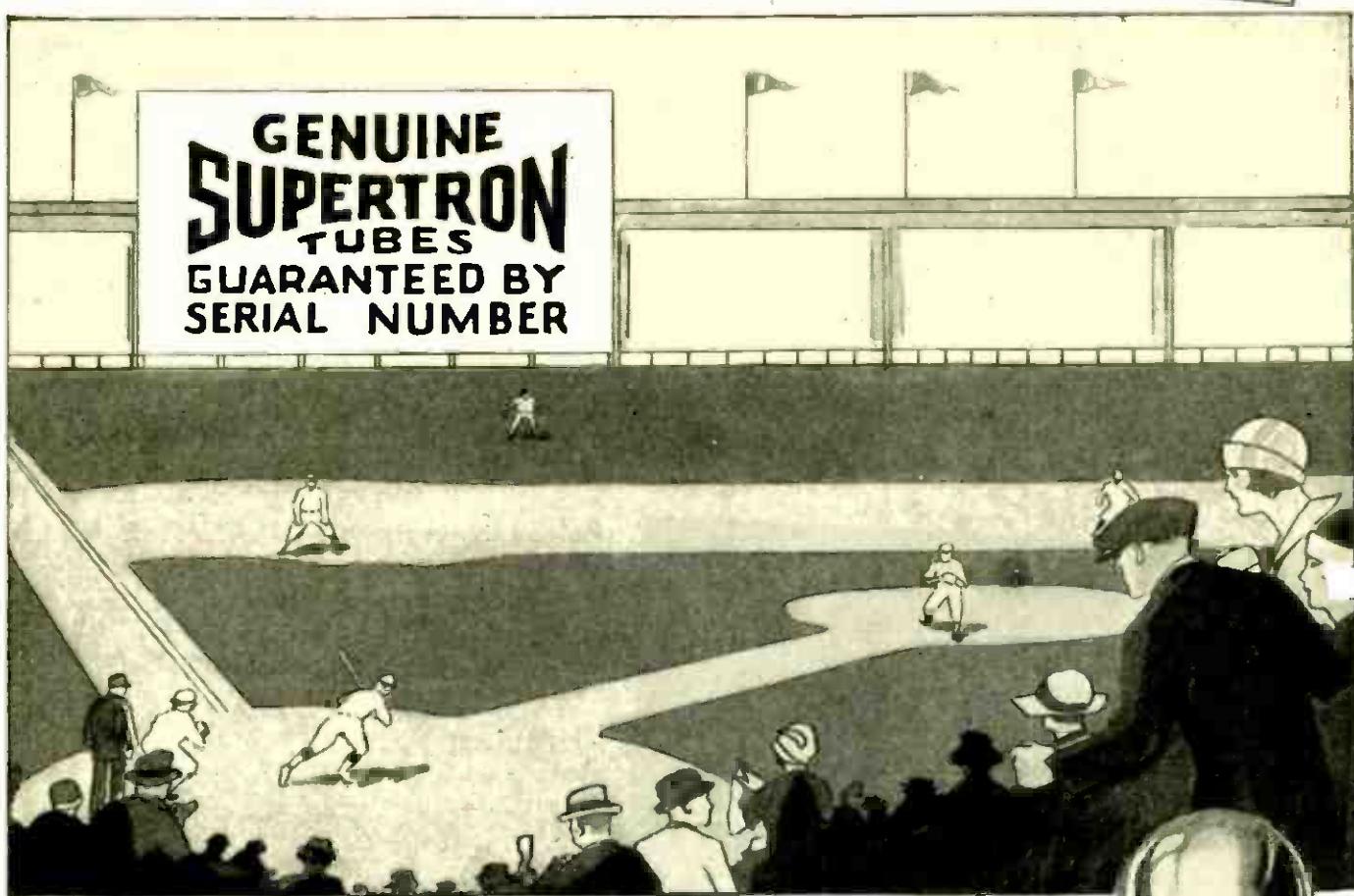
Street and No.

City and State.....

THE TUBE WITH A SENSIBLE GUARANTEE



**GENUINE
SUPERTRON
TUBES
GUARANTEED BY
SERIAL NUMBER**



That moment!

The last inning—tie score—and the bases are full—you hear the crowd yelling!!! —then you hold your breath, for that moment —————— Alas! You are disappointed, reception has ceased due to faulty tubes.

SUPERTRONS PLAY RIGHT THRU TO THE END OF THE GAME
Insist on Supertrons—at your dealer. Each Supertron tube is serial numbered for your protection.

DISTRIBUTORS

FIRESIDE RADIO SET CO.	Chicago	M. H. JOHNSON ELECTRIC CO.	Utica
YAHR & LANGE DRUG CO.	Milwaukee	HINSDILL ELECTRIC CO.	Troy
THE ROYCRAFT CO.	Minneapolis	AMERICAN PHONOGRAPH CO.	Albany
SORENSEN LAMP CO.	Des Moines	ROSEN TALKING MACHINE CO.	Boston
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ORR BROS.	Ceday Rapids	CYCLE AUTO SUPPLY CO.	Buffalo
RADIO DEALERS SUP. CO.	San Francisco	H. D. TAYLOR CO.	Pittsburg
WESTERN LIGHT & FIX. CO.	Los Angeles	HAMBURG BROS.	Denver
FRANKLIN ELEC. SUP. CO.	Philadelphia	REYNOLDS RADIO CO.	Syracuse
KEYSTONE RADIO DIST. CO.	Philadelphia	RADIO SERVICE INC.	Cincinnati
ALLENTOWN RADIO DIST. CO.	Allentown	HURR-FOWLER	Elgin
GOODLIN AUTO SUP. CO.	South Bend	ED. J. GOETZ CO.	Newark
FORT WAYNE IRON STORE.	Ft. Wayne	ELGIN RADIO CORP.	Alberta, Canada
SWANSON ELECTRIC CO.	Evanaville	TURNER-LIPPE	
M. A. BAKER & SON.	Evanaville	ALBERTA RADIO CO.	



ALL TYPES

\$2.00

Canada \$2.75

SUPERTRON MFG. CO., Inc., HOBOKEN, N. J.

Export Dept. 220 Broadway New York

CHICAGO
21 East Van Buren St.
ATLANTA
Ga. Savings Bank Bldg.

DALLAS
2006 1/2 Commerce St.
PHILADELPHIA
369 No. 4th St.

INDIANAPOLIS
19 Ar-Ade
MINNEAPOLIS
229 So. 4th St.

KANSAS CITY
410 East 14th St.
DENVER
1641 Stout St.

SAN FRANCISCO
Rialto Bldg.
BUFFALO
293 So. Elmwood



SUPERTRON

A SERIAL NUMBER GUARANTEE

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

Pfanstiehl Introduces 6-Tube OVERTONE Receiver With Translucent Station Finder

LAST year Pfanstiehl perfected the Overtone Receiver—an accomplishment of the first importance, which radio engineers had vainly attempted hitherto. He did so by eliminating all clashing of radio energy inside the set, thereby insuring a smooth, forward flow of the radio stream from circuit to circuit. The super vibrations of radio energy are thus kept intact, exactly as received, and there is no blurring or marring of the resulting overtones which bring out the beauty of voice and music.

This year he went a step further. He still further protected the overtones by an overtone loudspeaker inbuilt and sympathetically adjusted to the receiver itself. Modulation is made perfect. Even through a detached speaker the tone was far superior to any other obtainable in long distance reception. Now it is supreme.

Single Dial More Efficient Than Any Multiple Control

His single dial control immeasurably simplifies radio. It will give it a new popularity with the great mass of home users who are inexpert and dislike complicated tuning. It has been made possible by the very same mastery of radio energy in and between circuits which perfected overtone reception. With no leakage of energy to disturb the electrical characteristic of the radio stream on its way through each circuit, THERE ARE NO INEQUALITIES. Each circuit is electrically like every other—ALL tuned by one turn of the Pfanstiehl triple unit condenser.

Without the simple, equalized circuit of the Pfanstiehl system, no efficient one dial control is possible in a radio frequency set. Stray energy and the devices employed to neutralize it create inequalities in the circuits which THEN REQUIRE SEPARATE TUNING.

It thus becomes apparent how important an advance Pfanstiehl made in simplifying the radio frequency circuit and eliminating all compensating or neutralizing devices. It made possible perfect overtone reception, simple and dependable operation and now—single dial control.

Actual Wave Length GLOWS from Illuminated Dial—No Scale Necessary

An unique feature of the overtone panel in all models is the illuminated station finder disc which revolves with the tuning knob and registers in actual wave-lengths rather than in arbitrary numbers. The disc is concealed except for a small opening in the panel where the wavelength appears, the disc being translucent and illuminated from behind. Extremely convenient; enables tuning to be done in the dark; shows whether power is on or off; adds a brilliant touch to the panel assembly. Panel is of wood, five ply construction, finished like rest of cabinet. Much handsomer than bakelite or rubber. Control and volume dials of inlaid wood. All exposed metal parts gold plated.

An Exclusive Franchise

The Pfanstiehl line is sold through exclusive dealers and jobbers who are thus protected against unfair competition and price cutting. Whatever good-will the dealer or jobber builds up for Pfanstiehl is his own. He enjoys a liberal profit and is expected in return to push the line aggressively with the co-operation of the maker.

For further details, address

P F A N S T I E H L R A D I O C O M P A N Y

11 South La Salle Street, Chicago, Illinois

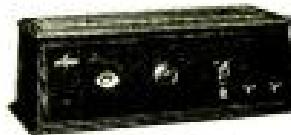
Prices West of the Rockies Slightly Higher



MODEL 10C—A complete 6-Tube Single-dial Console Receiver with Overtone Speaker, Control Board, Battery Charger and Compartments for Battery built in. Price \$450.00 (less tubes and batteries).



MODEL 10S—Overtone Single-dial 6-Tube Receiving Set with demountable Console Stand. Overtone Speaker built in. Price \$200.00 (less tubes and batteries).



MODEL 10—An Overtone Single-dial 6-Tube Receiving Set. Price \$155.00 (less accessories).



MODEL 8—A low priced 2-Dial 5-Tube Receiving Set, Pfanstiehl quality throughout. Price \$85.00 (less accessories).

ALSO

MODEL 8C—Two-dial 5-Tube Receiving Set, demountable from console stand, permitting use on floor or table. Overtone Speaker built in. Price \$135.00 (less tubes and batteries).

ANNOUNCEMENT

To you who are scientifically interested this is of even greater interest than it is to opera-goers, patrons of lectures and concerts, or to the dancing set.

Artistic radio has come with Thorola Islodyne, the only receiver embodying the *Isolated Power* principle made possible by Thorola Low-Loss Doughnut Coils. They conquer the causes of interfering currents, pick-up feed-back, uncontrollable oscillation, complicated and freak wiring, uncertain operation. Radio experimenters know what all this means. Radio listeners no longer need to know!

Islodyne action now keeps every set of radio impulses clear, free, separate. The one station wanted is cleanly selected, even in the broadcasting centers. Utmost power, unscattered, is *isolated—focused*—on this one set of signals only. The impulses do not conflict or neutralize. Full tone, un-

modified—full volume, full distance at last are possible, at all wave lengths.

With the uncontrollable, temperamental factors of radio reception banished, Thorola Islodyne achieves uniformity of results. Every Thorola Islodyne is as good as the best one ever built. The same stations keep coming in the same. The set you inspect tells what every Thorola set does.

Radio reception is unmistakably elevated to a new plane. What you knew would come some day, is now accomplished. There is a complete Thorola receiver leading its field by far, just as Thorola excels in loud speakers and other apparatus.

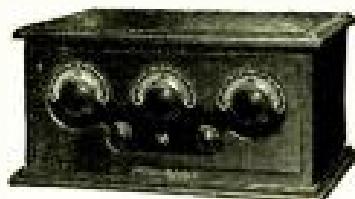
The Thorola name is surety of radio development which nothing will eclipse. The intense interest in the 5-tube Thorola Islodyne receiver at every radio store will tell you where expert opinion centers today. Go and make your own tests.

R E I C H M A N N C O M P A N Y C H I C A G O



Thorola Loud Speakers with new burnished Bakelite horn and gold throat-band are still better in appearance and performance.

Thorola No. 4	\$25
Thorola Junior No. 12	\$15
Thorophone Power Type	\$45
Thorola Junior No. 8	\$7.50
Phonograph Attachment	
Thorola (Large Unit) No. 6	\$15
Phonograph Attachment	



The very proportions of Thorola Cabinets suggest new internal design.

In smart Thoroco Cabinet the 5-tube Thorola Islodyne is.....	\$85
In stunning Burled Walnut Cabinet with Circassian top the 5-tube Thorola Islodyne is.....	\$115



Thorola Low-Loss Doughnut Coils installed in other sets as recommended will provide many of the greatest Thorola advantages. For the complete set of three..... \$12
Coupler and transformer coils, each \$4

Thorola

I S L O D Y N E



The Rectigon recharges BOTH "A" and "B" batteries easily and quickly. There's no muss or fuss; no acids or chemicals to bother with—

No moving parts, and no noise.

No storage-battery radio is complete without a
RECTIGON!

Westinghouse Rectigon Battery Charger

WESTINGHOUSE ELECTRIC & MFG. COMPANY
South Bend, Indiana



© 1925.
W. E. & M. Co.

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

From the Listener's Point of View



Type 285
Audio Amplifying
Transformers
6 to 1 ratio for first stage
2 to 1 ratio for second stage

\$6 each



General Radio transformers are True Mirrors of Tone Quality. They reproduce instrumental and vocal music as pure, full, and natural as it enters the microphone at the studio of the broadcasting station.

Due to the special design of the core and adjustment of the coil turns these transformers are capable of unusually high and even amplification of all tones common to speech and music.

In spite of their recognized superiority over other transformers they sell at a popular price.

Enjoy the programs of radio artists in unmodified form—use a General Radio 6 to 1 ratio transformer in the first stage and a 2 to 1 ratio in the second.

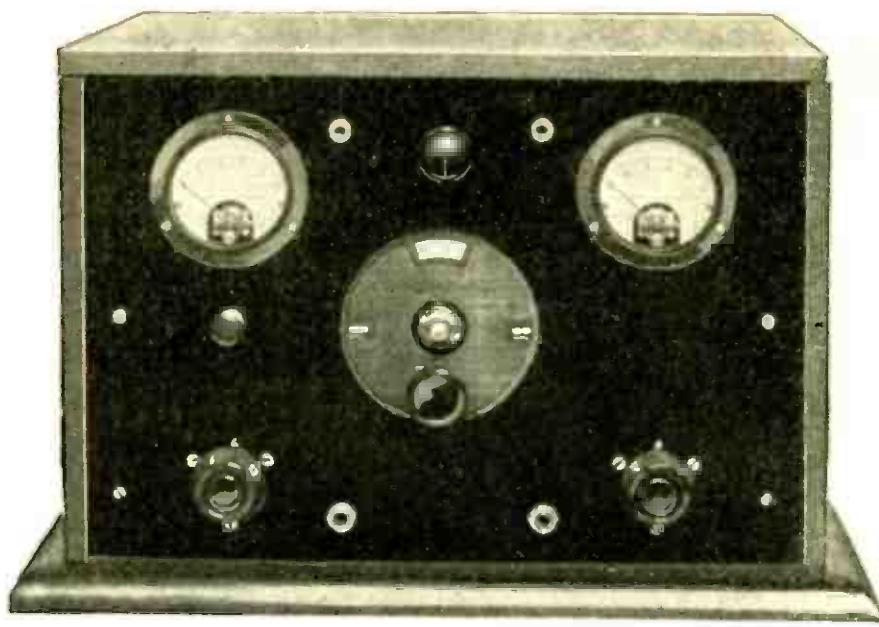
Ask to see them at your local dealers or write for our descriptive folder No. 285-P showing amplification curves and wiring diagrams.

GENERAL RADIO COMPANY
Cambridge, Mass.

GENERAL RADIO

"Behind the Panels of Better-Built Sets"

WESTON EQUIPPED!



McLAUGHLIN *Single Control* SUPERHETERODYNE

Weston Instruments—the logical choice for the new McLaughlin Single Control Superheterodyne.

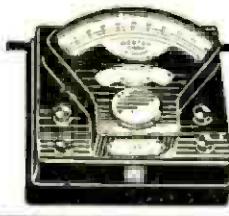
Leading radio engineers and manufacturers recommend the use of Weston Instruments because they know and are familiar with their dependable performance and their long life service.

To the radio enthusiast Weston means the utmost reliability, accuracy and value that unequalled experience, skilled personnel and a great modern plant can give.

*Weston Products are carried by
Representative Dealers*

For further information address

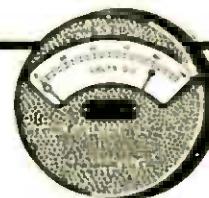
WESTON ELECTRICAL INSTRUMENT CORP.
115 WESTON AVENUE, NEWARK, N. J.



STANDARD THE WORLD OVER

WESTON

Pioneers since 1888



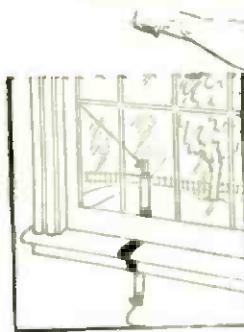


Plays
No
Favorites



"ELECTRAD" 3-STEP RESISTANCE COUPLED AMPLIFIER KIT No. 1-C—A big \$6.75 value. Contains the necessary Resistor Couplers, Certified Mica Condensers, Condenser Mounting, Certified Grid Leaks, and Resistors. Nothing else needed except sockets, rheostat and busbar.

Ask your dealer or write for FREE
Resistance Coupled Amplification Folder



"ELECTRAD" LEAD-IN—
Price 40c.—Fits under locked windows. No holes to bore. Extra waterproofing. Made to meet "Electrad's" high standard—there is a difference.

ELECTRAD

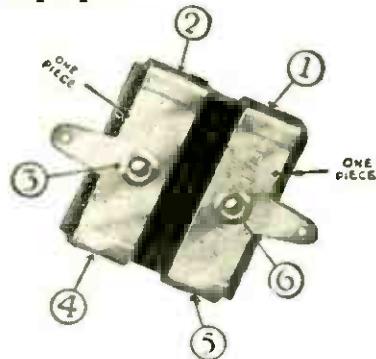
INC.
428 BROADWAY
NEW YORK CITY

All good dealers sell other "Electrad" Radio Devices—Audios, Variohms, Lamp Socket Antenna and Certified Grid Leaks

Amplifies Both Low and High Tones

YOU want pure tones, clear and mellow, whether high, low or of medium pitch. You expect faithful reproduction from your loud speaker.

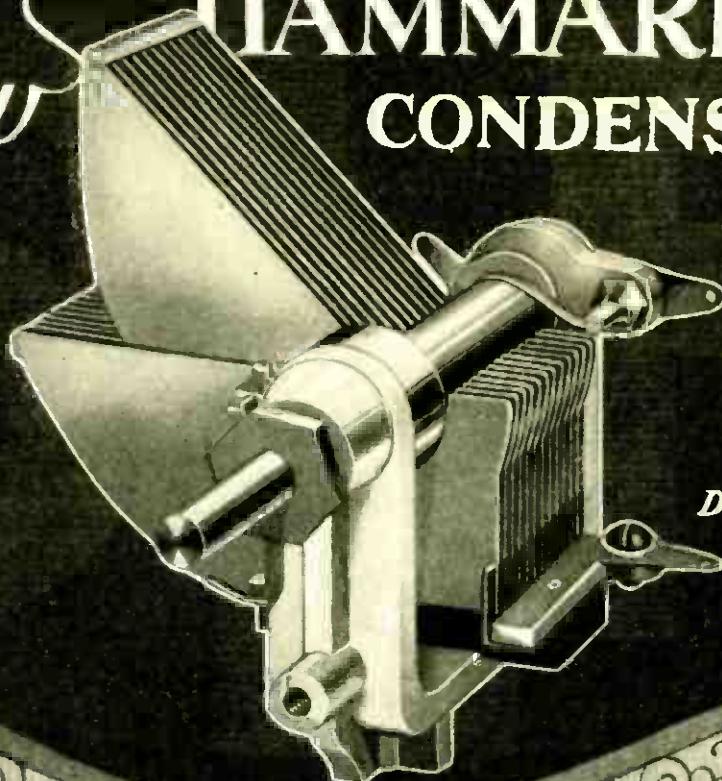
Such reproduction is made possible by resistance coupled amplification. Lower initial and operating costs, simpler assembly, and superior results makes this method of amplification most popular.



"The Six Point Pressure Condenser"

The "Electrad" Certified Fixed Mica Condenser is a revelation in accuracy and design. 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. In sealed dust and moisture proof packages. List 30c to 75c.

The New HAMMARLUND CONDENSER



*Distributes
Stations
Equally*

A STRAIGHT-LINE FREQUENCY ACHIEVEMENT

RUGGED, compact, sublimely efficient, with all the refinements of 15 years' experience comes the latest Hammarlund achievement—the variable condenser that distributes stations equally over your dials and solves the problem of critical tuning for all time.

You will recognize many distinctive "HAMMARLUND" features that have won world renown. Others are new—the result of advanced engineering and the natural progress of the radio art.

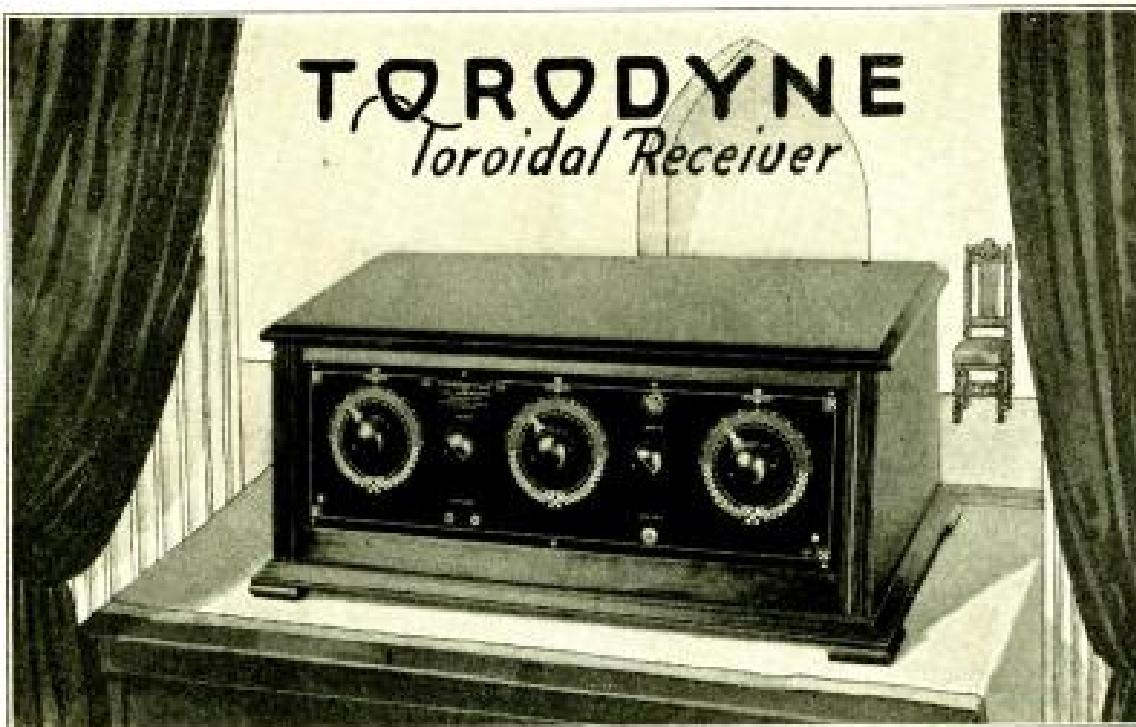
Soldered, non-corrosive brass plates, with sturdy tie-bars that insure permanent alignment; one small piece of insulation placed outside of the electro-static field; strong aluminum frame that cannot warp, grounded to rotor; adjustable ball bearings at both ends of rotor shaft; bronze clock-spring pigtail; single hole mounting; a separate "hand-capacity" shield for use if desired. Made in all standard capacities; a quality product at an attractive price.

At the Better Dealers, October 1st. Write for Descriptive Folder

HAMMARLUND MANUFACTURING COMPANY
424-438 West 33rd Street

New York City

For Better Radio
Hammarlund
PRECISION
PRODUCTS



58 Stations in One Evening

Improved Radio Frequency Amplification

One of the leading features that place the TORODYNE ahead of the field is 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 as it must come through the antenna. *Toroidal transformers will not pick up signals themselves.*
2. MORE VOLUME without oscillations. These coils permit this by minimizing interstage coupling.
3. DISTANCE. The greater amplification increases the sensitivity bringing in distant stations with more volume. This naturally increases the range of the set.
4. SUPERIOR TONE QUALITY is secured through the elimination of distortion and foreign noises by preventing stray feed-backs.

IN ONE EVENING (two and one half hours actual time) 58 stations from Los Angeles to Boston, Calgary, Alberta to Ft. Worth and from Ottawa to Miami, Florida, were received with good volume and equal clarity of tone through a loud speaker. The time includes waiting for the announcement of call letters.

This is but one of the records of the TORODYNE, the latest AINSWORTH Receiver. It is a five-tube, tuned radio frequency receiver with Toroidal (doughnut type) transformers, which greatly increase the scope of radio frequency amplification. The TORODYNE will bear comparison favorably with any set and the difference can be quickly and easily distinguished.

An attractive, silver engraved sub-panel leaves only the condensers and tube sockets visible on the inside of the cabinet. All terminals are mounted on this panel and plainly marked to insure correct connections. The entire construction is simple, compact and efficient. The TORODYNE is easy to tune and its accuracy permits consistent logging.

The refined beauty of the TORODYNE harmonizes with any period furniture. The black, sloping panel is silver engraved by a patented process and mounted in an Adam brown mahogany cabinet. Pointers on Bakelite knobs operate over scales engraved on the panel.

In every way the TORODYNE is a set you will be proud to display to your friends—beauty, exceptional performance and the latest improvements in radio.

The TORODYNE will give genuine satisfaction. Ask your dealer for a demonstration and judge for yourself. (If your dealer is not showing the TORODYNE, write us.)

Price \$100.00

The Ainsworth Radio Company

308 Main Street

Cincinnati, Ohio

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

The latest developments in low-loss parts

*Built of this special insulation
made to order for radio*



Ask for Radion Panels by name; look for the stamp on the panel and the name on the envelope.



This is the Radion No. 2 Socket, designed for both old and new tubes. Equipped with binding posts.

NOW you can get a complete line of low-loss parts made of Radion, the special insulation which our engineers created for radio purposes exclusively.

These parts embody the very latest developments in radio. They are as efficient as the well-known Radion Panels and have the same high-resistant characteristics.

Radion Panels, made in black and Mahoganite, come cut in 18 standard sizes for whatever set you wish to build. And in addition, you can have Radion Sockets, Radion Loud Speaker Horns, Radion Tubing, Radion Binding Post Strips, Insulators, etc.

New sockets for both new and old tubes

OF PARTICULAR interest are the new Radion Sockets. Nos. 4 and 5 are for the new-style UX tubes exclusively. Nos. 2 and 3 are designed to take both new and old-style tubes.

All Radion Sockets are highly efficient, due to the principle of their construction and the low-loss characteristics of Radion. Ask your dealer to show them to you.

Send for Booklet

OUR booklet, "Building Your Own Set," gives clear, complete directions for building the most popular circuits. Mailed for 10 cents (stamps). Send the coupon today.

AMERICAN HARD RUBBER COMPANY
Dept. B10, 11 Mercer St., New York City
Chicago Office, Conway Building
Pacific Coast Agent: Goodyear Rubber Co.
San Francisco, Portland

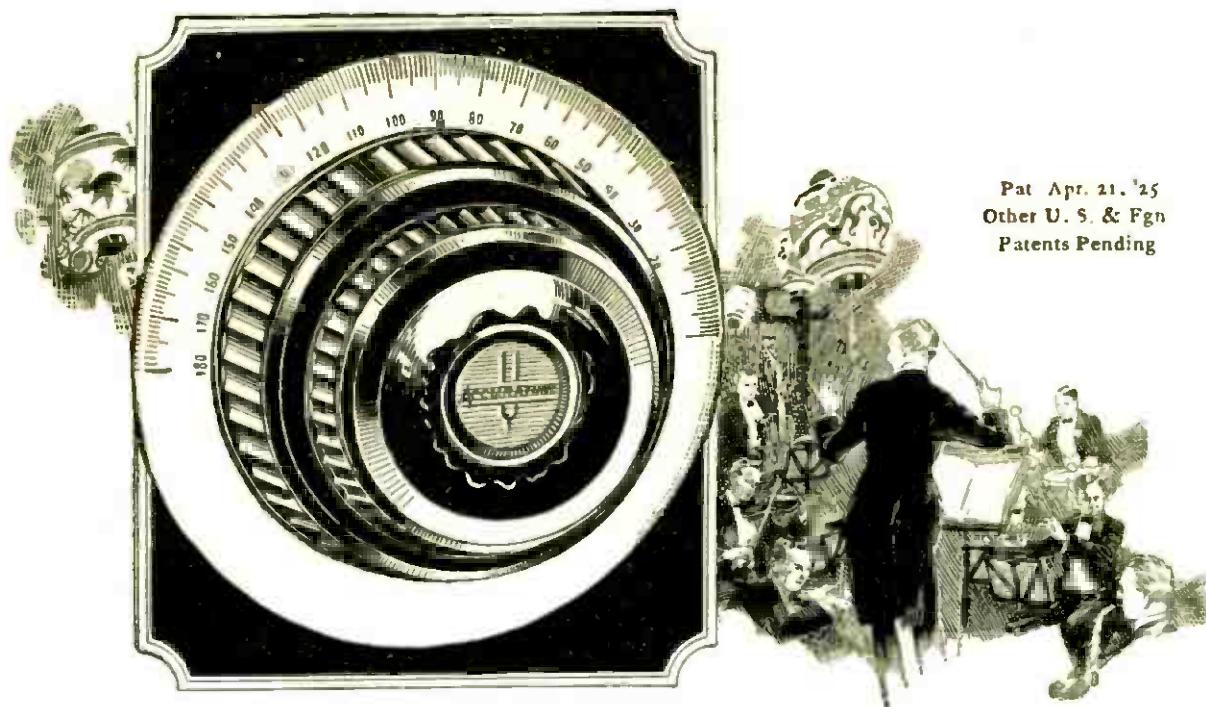
AMERICAN HARD RUBBER COMPANY
Dept. B10, 11 Mercer St., New York City
Please send me your booklet, "Building Your Own Set," for which I enclose 10 cents, in stamps.

Name.....

Address.....

RADION
The Supreme Insulation

AN ESSENTIAL ACCESSORY



When accuracy tuning counts-

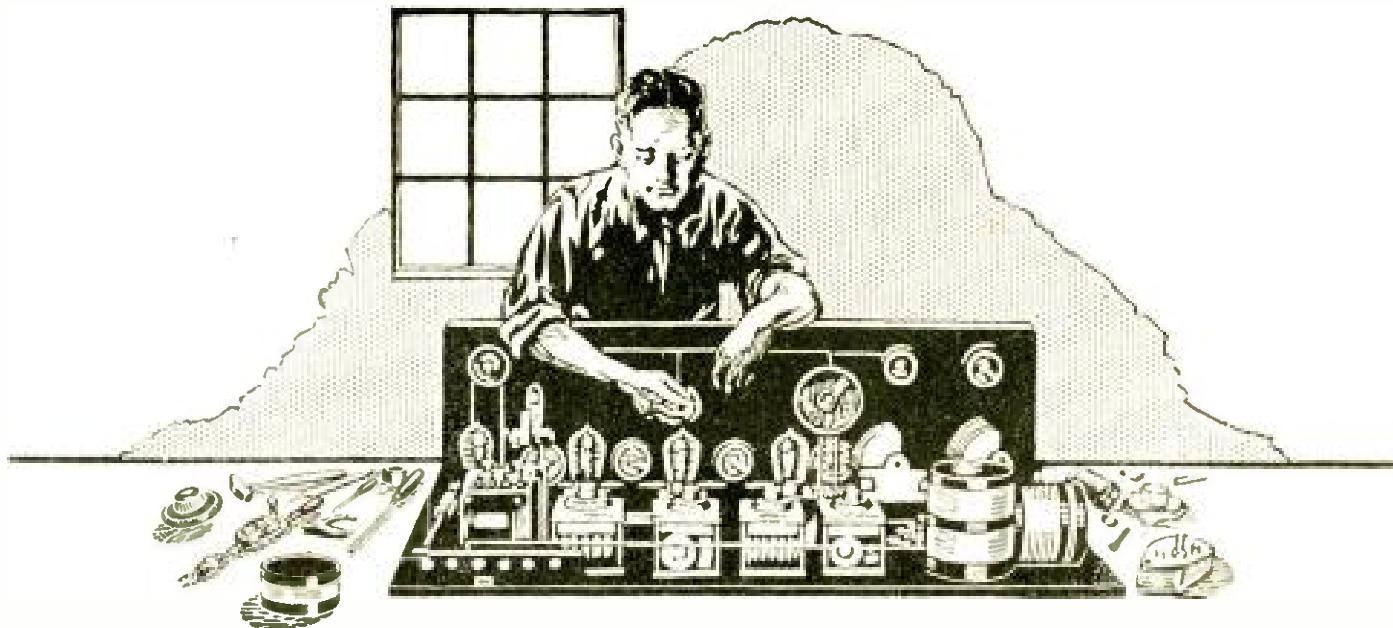
ACCURATUNE



WHEN there's a particularly fine program at one of the stations within the scope of your set, then if ever do you yearn for precision, and that's exactly what you can be assured of if your set is equipped with the Accuratune.

Geared on an 80-to-1 ratio for coarse or infinitely fine tuning, the Accuratune performs with uncanny precision at all times. Moreover, it's easily substituted for ordinary dials without altering your set.

MYDAR RADIO COMPANY
5 CAMPBELL ST., NEWARK, N. J.



Good Radio Requires Good Material

VERI-CRONGE 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 sub-titling pointers instead. The reduction in cost is large. Write for prices on complete panels finished in this way in quantity.

IT is just as impossible to build dependable radio with poor material as it is to build a good automobile or a good locomotive that way.

Formica panels, base panels, winding tubes, insulating bushings and washers have the qualities that make lasting durability possible.

They have electrical qualities that are more than sufficient for any need—and they combine with them equally essential mechanical strength, resistance to warping, and cold flowing. They never distort in use so that instruments are displaced.

The Formica finish is unequalled in richness and gloss. And that finish is one of the most permanent in the world. It does not discolor, grow dull, check or craze. No ordinary varnish or lacquer can equal it.

These are all things that count. They make or break the satisfaction a radio set will give. And that is why for years the great majority of radio manufacturers have used Formica.

Dealers: Formica panels in individual envelopes furnish a line on which dealers make a very satisfactory profit.

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

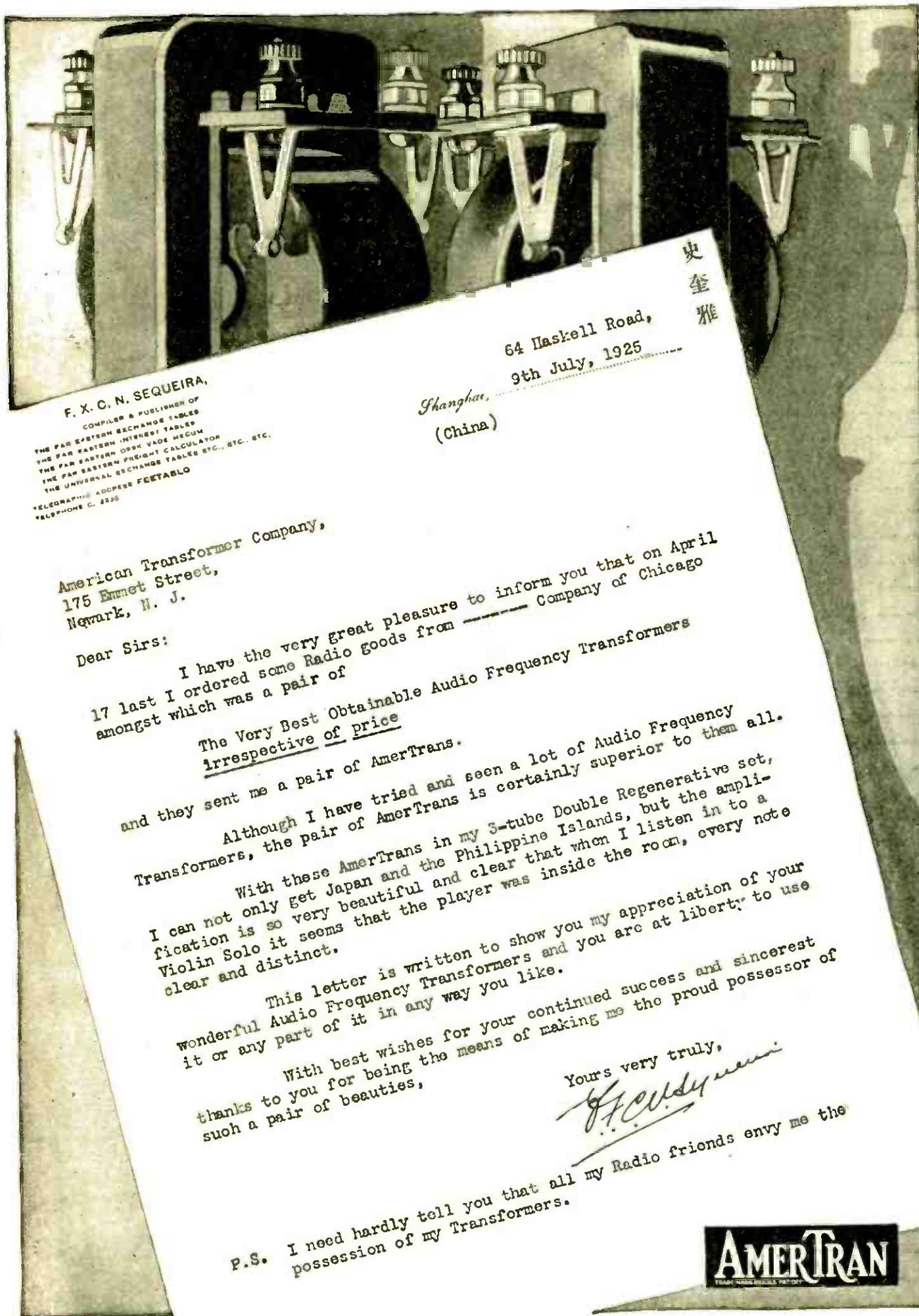
50 Church Street	New York, N. Y.
9 South Clinton St	Chicago, Ill.
516 Caxton Bldg.	Cleveland, Ohio
327 Cutler Bldg.	Rochester, N. Y.
422 First Avenue	Pittsburg, Pa.
6 Beacon Street	Boston, Mass.
55 Calle Obispo	Habana, Cuba

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 WLB every Tuesday evening from 9 to 10 Central Standard Time.



KODEL RADIO

The Emblem of  Worth in Radio

Setting a New Radio Standard



LOGODYNE
"BIG FIVE" \$90⁰⁰

Five tubes, self-balanced tuned radio frequency; sloping panel gold engraved; beautiful, massive. Adam brown mahogany cabinet; compartment for batteries; stations already logged for easy tuning.

Radio for years to come will not offer a better receiver than the LOGODYNE Big Five. Combining the utmost in performance with striking beauty of cabinet design, the LOGODYNE Big Five represents a triumph in radio engineering and artistry of manufacture.

No receiver could better express or exemplify the high standard to which the entire KODEL RADIO line is built—for KODEL RADIO is, without a doubt, the best that radio offers.

Free

Send for the new edition of our free booklet "The Secret of Distance and Volume in Radio". Gives helpful interesting information on radio operation.

THE KODEL RADIO CORPORATION
504 East Pearl Street Cincinnati, Ohio

WKRC

Owners of Kodel Broadcasting Station WKRC
on the Alms Hotel. Send for program.



LOGODYNE "Big Five" Console Model—the Aristocrat of Radio; built-in loud speaker; compartment for batteries and charger a masterpiece in furniture design. \$275



LOGODYNE "Standard Five" Console Model—beautiful brown mahogany; built-in loud speaker; compartment for A and B batteries and charger..... \$165



LOGODYNE "Standard Five"—five tubes self-balanced tuned radio frequency; gold engraved panel and sub-panel; battery compartment; handsome brown mahogany cabinet..... \$70

KODEL "Gold Star" Models— Radio's greatest set values; Three Tube "Gold Star" Model.	\$30
Two Tube "Gold Star" Model..	\$20
One Tube "Gold Star" Model...	\$12
"Gold Star" Crystal Set.....	\$ 6



Mr. Radio Fan:

Mr. Dealer:

Mr. Jobber:

Mr. Set Manufacturer:

To each of you we have a message.

In the New Timbretone we have succeeded in accomplishing what seemed impossible, namely, Quality and Volume in the same horn, "Without Adjustments!" It is still made entirely of wood and lives up to its name—

TIMBRETONE

REG. U. S. PAT. OFF.

We would like to write you all an individual letter and will, if you will send us your name and address.

Manufacturers of radio sets can obtain a blue print showing dimensions small enough to build the Speaker in the radio cabinet.

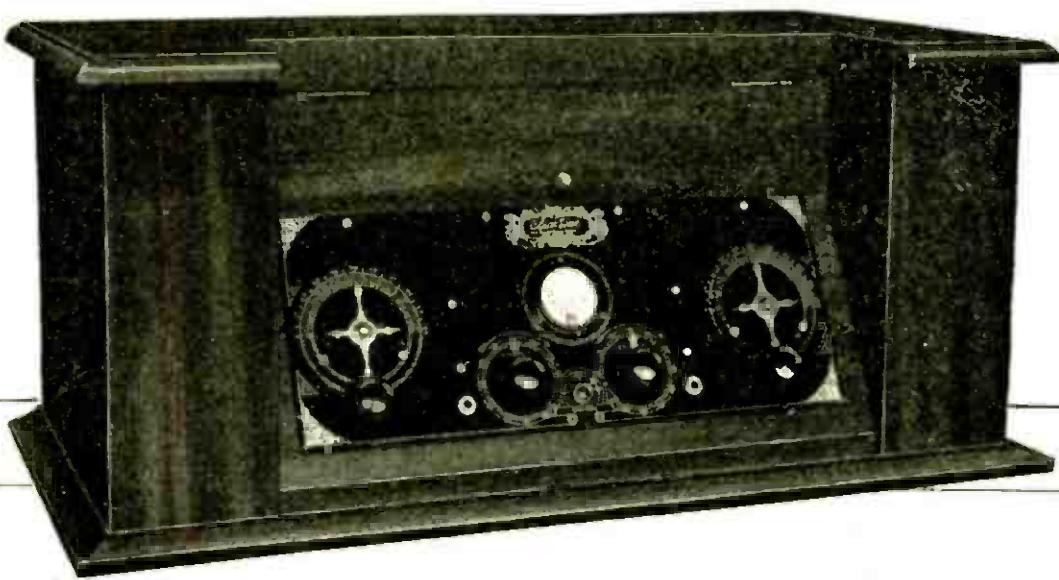
We would like to hear from Dealers and Jobbers before the Radio Shows take place.

Write now!

(Price east of Mississippi) Cabinet \$30.00



**Made in Hoosick Falls, N. Y.
by the TIMBRETONE MFG. CO.**



A Revolutionary NEW Set!

Here is a set produced by a reliable manufacturer complete with tested tubes, batteries, loop and loud speaker. There is nothing extra to buy! Price \$185.00

Beautiful finish and workmanship, at a moderate price, that will operate anywhere without aerial or ground—and equal or excel the performance of many sets using an outdoor antenna. The Cleartone "90" gives you exceptionally strong loud speaker volume over big distances. This is a seven tube, completely self-contained set using dry cell equipment.

Beautiful cabinet work, the finest material—mellow, clear, and beautiful tone. Every detail

THE CLEARTONE RADIO COMPANY, 2427 Gilbert Ave., Cincinnati, Ohio

of workmanship and construction stamps it as high grade. This set solves the problem of the apartment dweller who can't erect an antenna. It is the ideal outfit for the farmer who has no charging equipment. You can demonstrate this set anywhere—in ten minutes—and it sells itself!

Dealers and Distributors: Easy to demonstrate. Easy to sell. The perfect proposition for the great apartment building and farm markets. Our new sales plan eliminates most of the troubles you have encountered in selling the ordinary set. Write for it.

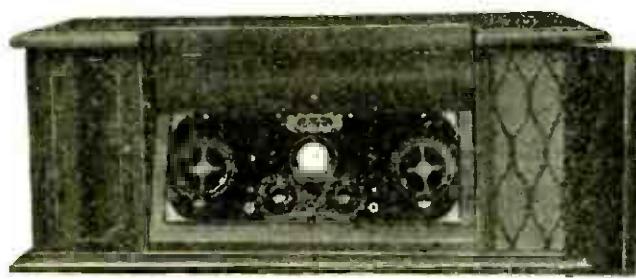
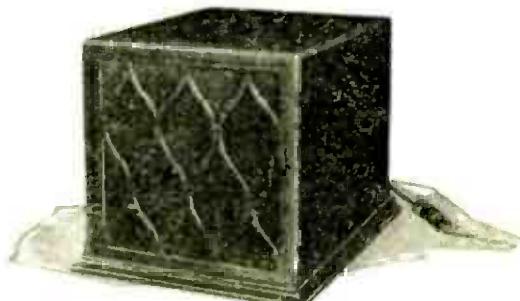


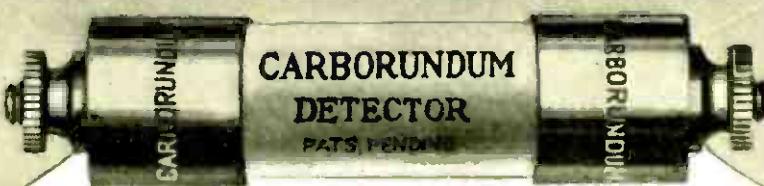
Table Model 91, Loud Speaker Built in \$200.00

Console Type Loud Speaker Built in \$275.00



The Cleartone Detached Loud Speaker is a handsome cabinet type of the finest appearance and workmanship and wonderful distortionless tone for only \$25.00

CLEARTONE Complete RADIO SETS

\$1.50
IN U.S.\$1.50
IN U.S.

A Detector that Gives Perfect Rectification

THE perfect rectification of Radio signals on any Crystal or Reflex Set of course means clear, true, tones and tonal effects.

Such reception is possible with the Carborundum Detector Unit. It is a cartridge type unit carrying a Carborundum especially created for Radio purposes and one of the inherent qualities of Carborundum is perfect rectification.

The Carborundum Detector Unit is fixed, permanent—no adjustments—it retains its sensitivity indefinitely and will not burn out. It will increase volume, distance and selectivity.

Backed by our guarantee. From your dealer or direct

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

New York - Chicago - Boston - Philadelphia - Cleveland - Detroit - Cincinnati
Pittsburgh - Milwaukee - Grand Rapids

Carborundum Detector Unit

More Pep for Old Tubes!

Why throw away your old tubes—The Rhamstine★ Tube Booster will make them new again, just like they were when you bought them. It makes no difference whether you use 201-A or 199 type tubes, the Rhamstine★ Tube Booster will make them new and they will have the same snap and pep as the day they left the factory.

Works equally well on alternating current 110-120 volts, 50 to 133 cycles—the ordinary electric light circuit. You can pay for this Booster in a short time by boosting old tubes for your friends. Send no money, just sign the coupon and mail it.



Rhamstine★ B RECTIFIER
Only \$25

J. THOS. RHAMSTINE★

Radio and Electrical Products

Woodbridge at Beaubien Detroit, Michigan

"B" Rectifier for your "B" Power Service

gives you the finest, sweetest, most natural reproduction of any tone, always. Low in cost of operation, wonderful in results. attractive in appearance, a money saver and happy home producer. It's better than a "B" Battery. Operates on any 110 volt AC circuit. For use on any tube set. Send no money, pay when you get it, use it 5 days. If you're not entirely satisfied, purchase price will be refunded.



Rhamstine★
Tube Booster

Only **\$6**

Mail this Coupon Today

J. THOS. RHAMSTINE★
Woodbridge at Beaubien (10)
Detroit, Mich.

Please send me your () Tube

BOOSTER at \$6; () "B"

RECTIFIER at \$25 by express

C. O. D. subject to inspection. If I am

not entirely satisfied with the "B"

RECTIFIER I will return it to you in five

days and receive a refund of the full purchase

price.

Name.....

Address.....

Build with the New Models of **U.S. TOOL CONDENSERS**

Better Condensers Make Better Receivers



THE same superiorities that have induced many reputable manufacturers to adopt U. S. Tool Condensers for their receivers are the points that will greatly improve your set. Chosen by these manufacturers after careful testing; you can use them with the same confidence and satisfaction.

Model 8

An efficient condenser made with new and patented one-piece stator, guaranteed to give sharp tuning at the lower broadcasting wave lengths.

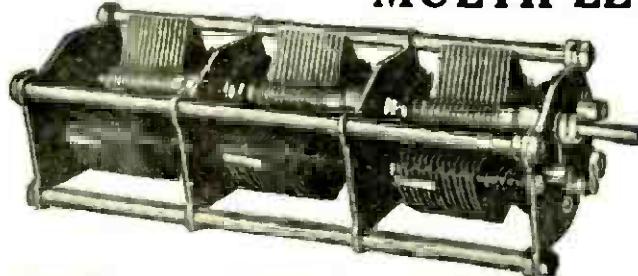
Capacity.	Max. .00025,	Min. .0000076,	\$2.70
	Max. .00030,	Min. .000008,	2.85
	Max. .00035,	Min. .0000086,	2.95
	Max. .00050,	Min. .000011,	3.75



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*



Made under
Hogan Patents,
Jan. 9, 1912
Pat. No. 1,014,002

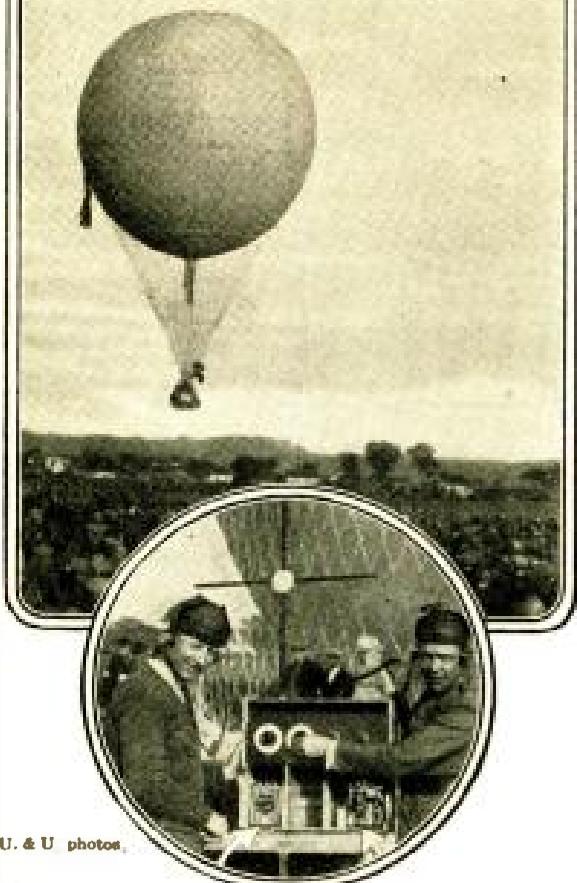
WRITE FOR LITERATURE

SEE THESE NEW MODELS AT YOUR DEALER'S

U.S. TOOL CO., INC. AMPERE, N.J.

BURGESS RADIO BATTERIES

Win Again



The illustration pictures the take-off of the winning flight and the insert is the radio equipment carried. (Burgess 'A,' 'B' and 'C' Batteries furnished the electrical energy to operate the set.)

When the Goodyear III won the right to represent the United States at Belgium, Burgess Radio Batteries supplied the electrical energy for the operation of the balloon's radio equipment.

Almost every day from some where in the world news comes to us of new Burgess adventures.

And that Burgess Batteries have contributed their bit in so many interesting events of sport, commerce and science reflects the esteem in which they are held.

"Ask Any Radio Engineer"

Your own radio dealer down the street sells Burgess Batteries. He probably sells the famous Burgess Flashlights, too.

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO
Canadian Factories and Offices:
Niagara Falls and Winnipeg

with the \$100 Guarantee



Absolutely warranted to protect your set from lightning, with a guarantee to pay you \$100 or replace your set, should it be damaged through any fault of the

FIL-KO-ARRESTER.

Listed as standard under the re-examination service of National Board of Fire Underwriters.

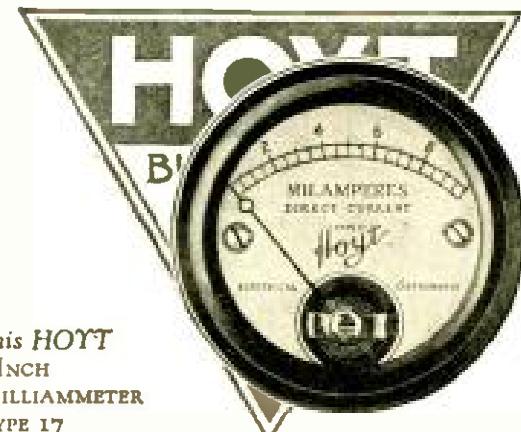
If your dealer has none, send his name with remittance to Dept. PR-1685

DX Instrument Co.
Harrisburg, Pa.

FIL-KO
LIGHTNING
ARRESTER

TRADE MARK REGISTERED

HOYT METERS Insure Reliable Radio Reception



This HOYT
2 INCH
MILLIAMMETER
TYPE 17

with accurate moving-coil action attached to your radio set will save its cost in B batteries many times over. It will give a continuous check on your B battery current consumption. It will aid you in reducing this by the use of C batteries. It will detect instantly any short circuit. Write for our complete booklet, "Hoyt Meters for Radio."

Burton-Rogers Company
26 Brighton Ave. :: :: Boston, Mass.
National Distributors

DISTON

AN ELECTRICAL INSTRUMENT
REPLACING "B" PLATE TUBE
using ALTERNATING CURRENT



For better reception with your present receiver—

Diston makes good set operation better, more simple, reliable and satisfactory, adding tone quality and volume.

You will never know real radio until you have used Diston on your receiver under your own local receiving conditions. You can confirm Diston Advantages in your own home without obligation. See your dealer or write us.

Diston Kits for Set
Builders
60-50-25 cycle
\$28.50 to \$42.75

RADIO PRODUCTS, INC.
Dept. PR Richmond, Ind.

Dealers: Write for the Diston User Judgment Sales Policy

Diston Ready for
Operation
60-50-25 cycle
\$40 to \$60

The Heart of the Set

FIXED CONDENSERS

GRID CONDENSERS

RESISTOR MOUNTINGS

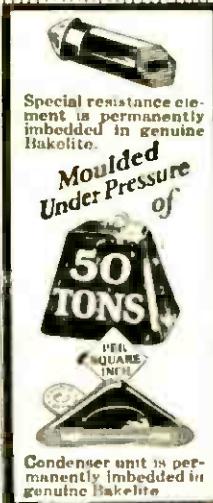
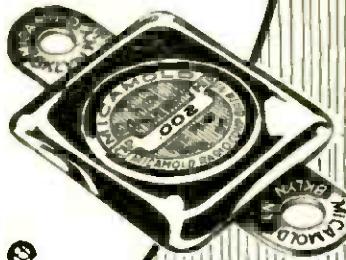
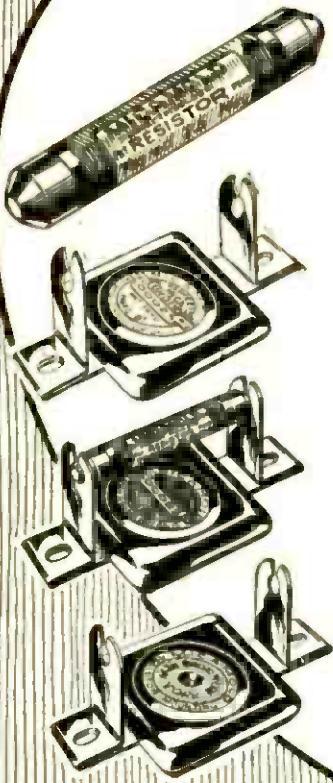
FIXED RESISTORS

*Made of Mica and
Moulded in Genuine Bakelite*

Not affected by extreme heat or cold. Eliminate all losses. Accuracy and capacities never vary. Unbreakable. Absolutely guaranteed.

At all dealers

Write for free folder, listing capacities and prices.



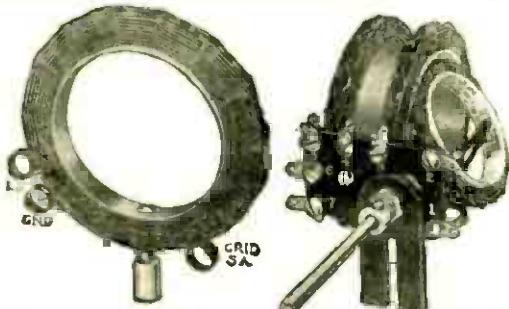
Micamold

REG

MICAMOLD RADIO CORPORATION

Flushing and Porter Avenues

Brooklyn, New York



Sickles Coil Set No. 24 for Browning-Drake Circuit. Price \$7.50.

An entirely new system of
Radio Reception

Sickles Diamond-Weave Coils have been specified for use in the Hoyt System of Signal Augmentation, by the inventor, Francis R. Hoyt. We have a limited number of blue printed copies of Mr. Hoyt's original laboratory notes on this new system of radio reception, together with nine circuit sketches, which will be sent free to you upon receipt of this coupon and four cents for postage.

The F. W. Sickles Co.
Springfield, Mass.

Please send information of Hoyt System

Name.....

Address.....

Popular Radio

SICKLES

DIAMOND-WEAVE COILS

(Trade Mark registered Aug. 4, 1925)

For Browning-Drake, Roberts, Craig,
and Hoyt Circuits

(Patented Aug. 21, 1923)

Sickles Coils for the famous Browning-Drake Circuit are the latest Sickles achievement in efficient design for a particular use. They are priced at \$7.50 a set.

The New No. 18A Coils for any Roberts Circuit are absolutely standard equipment. They are priced at \$8.00 per set.

Coil Set No. 20, at \$4.50, is for use specifically with the New Reflex Receiver designed by Albert G. Craig using the Sodium detector.

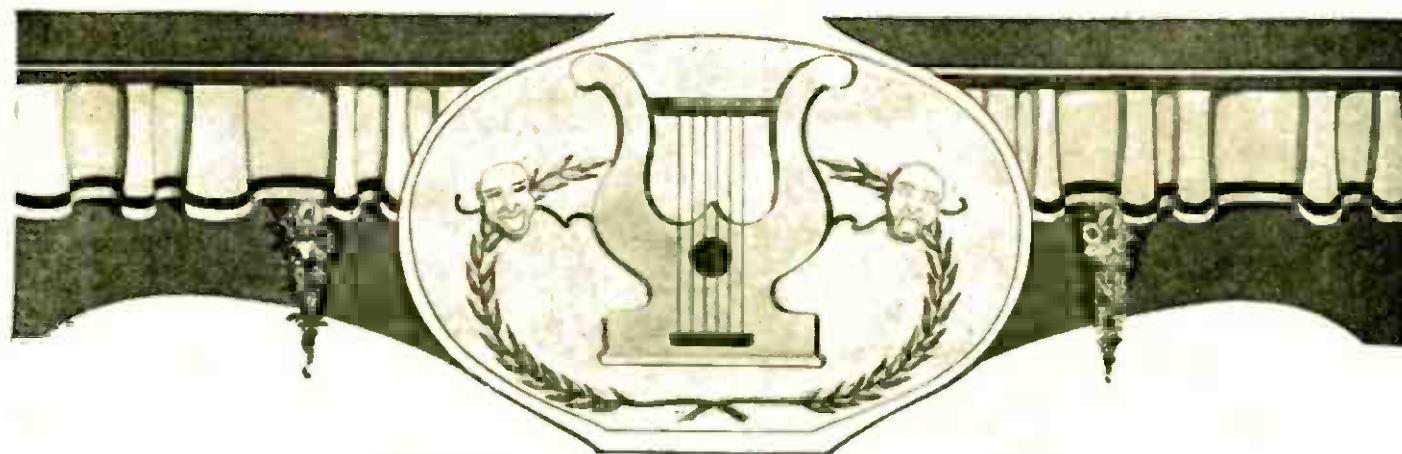
Coils for the Hoyt Circuit at \$10.00 a set, for the Knock-out Reflex Circuit at \$4.00 a pair, and the Tuned Radio Frequency coils at \$2.00 each are other standard Sickles Coils. We manufacture also for manufacturers' special requirements.

Send for descriptive catalog

The F. W. Sickles Co.

134 Union Street

SPRINGFIELD, MASS.



Without Exaggeration!

You can buy radio on the strength of exaggerated statements or you can be guided in your purchase by the reputation of the manufacturer and the actual performance of the article itself.

The Holtzer-Cabot Electric Co. has just celebrated its fiftieth anniversary. A half century spent in building a reputation for quality electrical products, equalled by few, and surpassed by none. The experience gained through this period has enabled us to produce a remarkable loud speaker about which we could say much without exaggeration. We prefer, however, to let the instrument speak for itself, knowing that its performance will convince you of its merits. Before you buy a loud speaker at any price, ask your dealer to demonstrate the Holtzer-Cabot National.

National
Loud Speaker

\$12.00

Adjustable
Control



1875-1925

For Fifty Years
Manufacturers
of Quality
Electrical
Apparatus

The Holtzer-Cabot
Electric Co.
125 Amory Street
Boston, Mass.



Holtzer-Cabot

New!

The biggest little thing in radio

this season

DURHAM Variables

Bring control of high resistance to the panel

Panel Mount
\$1.00

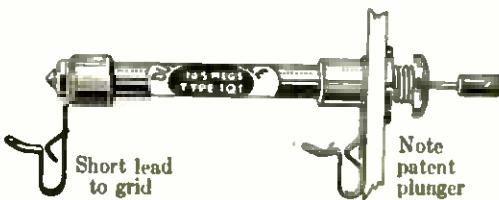
Standard Type
75c

Both types in three sizes:

* 100—1000 to 100,000 ohms

* 101—0.1 mgs. to 5 mgs.

* 201A — 2 mgs to 10 mgs.



Always a one-finger control and now at your finger-ends—that's the new DURHAM Variable. The familiar ease and accuracy of these standard high resistance units in their latest form may be placed anywhere on your panel, preferably near the tube they control. Only a $\frac{1}{4}$ " hole required.

For most hook-ups, you'll need two DURHAMS—detector and audio.

Look for the plunger

The patented DURHAM combination of sliding plunger and non-wear compound is your protection and guarantee for accurate, high resistance control.

DEALERS: Get this

Order from jobber now specifying type, panel mount and standard.

This style fits any clipped condenser 75c

or DURHAM Bases, 30c-45c

DURHAM & CO., INC.
1936 Market St., Philadelphia

The Red Stripe
A Radio Guide Line

For your protection, throughout the center of every Dilecto radio panel is a Red Stripe. You can see it along the edge of every panel.

If you buy or build a set Look for the Red Stripe—and you'll be sure of the finest, strongest radio panel that can be made. Dilecto is a Phenolic condensation material.

THE CONTINENTAL FIBRE COMPANY
Factory: Newark, Delaware

Service on Dilecto, Conite, Contex and Vulcanized Fibre from:

New York, 250 Park Ave.	Chicago, Wrigley Bldg.
San Francisco, 75 Fremont St.	Los Angeles, 307 S. Hill St.
Seattle, 1041 Sixth Ave., South	Pittsburgh, Farmers Bank Bldg.

Dilecto



12-Cell—24 Volt Storage 'B' Battery

Positively given free with each purchase of a WORLD "A" Storage Battery. You must send this ad. with your order. WORLD Batteries are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with Solid Rubber Case, an insurance against acid and leakage. You save 50 per cent and get it.

2-Year Guaranteed Bond in Writing

WORLD Battery owners "tell their friends." That's our best proof of performance. Send your order in today.

Solid Rubber Case Radio Batteries

6-Volt, 100-Ampères	\$11.25
6-Volt, 120-Ampères	13.25
6-Volt, 140-Ampères	14.00

Solid Rubber Case Auto Batteries

6-Volt, 11-Plate	\$11.25
6-Volt, 13-Plate	13.25
12-Volt, 7-Plate	16.00

Send NO MONEY

Just state battery wanted and we will ship day order is received, by Express C. O. D. subject to your examination on arrival. FREE "B" Battery included. Extra Offer: 5 per cent discount for cash in full with order. Buy now and get a guaranteed battery at 50 per cent saving to you.

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 3

Approved and Listed as Standard by Leading Authorities including Radio News Laboratories; Popular Science Institute of Standards, Popular Radio Laboratories, Radio Broadcast Laboratories, Radio in the Home, and Lexicon, Inc.

Set your Radio Dials at 210
and listen for the new 1,000 Watt
World Storage Battery Station, WSHL, Chicago. Watch
for announcements.

World
STORAGE BATTERIES

GOLD SEAL TUBES

**One Man
Tells Another!**

*Actual performance has
built Gold Seal's popularity*

They last twice as long . . . they reach the peak of perfection in reception . . . That consensus of opinion has given Gold Seals the call wherever perfect reception, without excuses, is demanded. We have watched them operate under some of the most exacting test conditions, where other tubes failed. But Gold Seals performed in true Gold Seal style.

Winning national recognition purely on their merits is surely proof of the worth of Gold Seal Tubes. It shows, too, that when radio fans find a superior tube, they're quick to tell others. Nothing else could account for the splendid demand for Gold Seals.

. . . Engineered and Guaranteed . . .

Gold Seal filament is a tube engineering accomplishment destined to revise the radio world's estimate of what fine reception is. And in a splendidly equipped plant, Gold Seal's standards and exhaustive double-tests send each tube out—perfect.

If you use a tube rejuvenator, Gold Seals will help you get longer tube life. They can actually be rejuvenated!

A no-argument guarantee goes with every Gold Seal Tube. Your dealer in giving you this guarantee knows it means what it says because he knows the resources of the Gold Seal organization.

Just say Gold Seal to your dealer. You'll get the tube you have waited for. If your dealer is not yet supplied, write us direct.



*Everywhere
\$250
and
Guaranteed*

TYPES

G.S. 201-A

G.S. 199

G.S. 199 ~

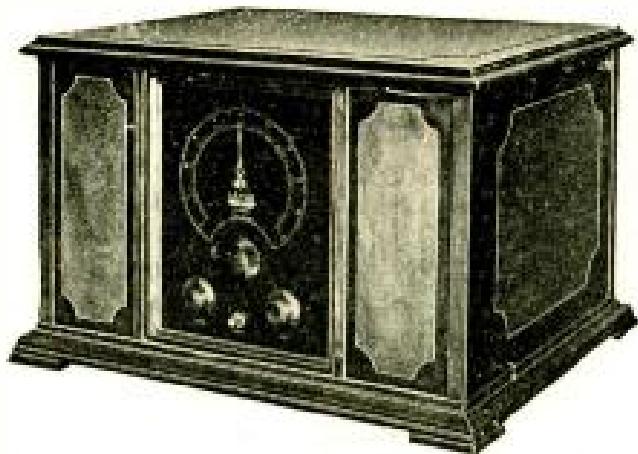
Standard Base

Facts About Tubes

- 1—A tube and its guarantee are only as good as the intentions of the organization behind them.
- 2—Gold Seals are winning on tested merit.
- 3—Dealers stand back of them because we stand back of the dealers.
- 4—Gold Seal's engineers are radio experts; the Gold Seal plant is a reality and a model of efficiency.
- 5—There were six months of exhaustive experiment before Gold Seal engineers would permit a single tube to be offered to the public.
- 6—Gold Seals are here to stay because they do perform.

GOLD SEAL PRODUCTS COMPANY, Inc.

250 PARK AVENUE, NEW YORK



List Price, \$145.00



announce

The UNI-CONTROL Receiver With "Pretuned Radio Frequency"

PRETUNING—an exclusive Le Mor feature will stand as the great radio advance of this year. PRETUNING—means actually tuning the radio stages at the factory, matching them identically over the broadcast range. PRETUNING thus assures perfect peak value operation of all stages with but a single dial. There are no vernier or subsequent adjustments. Besides this innovation the UNI-CONTROL has the advantages of equal frequency spacing, velvet slow-motion accuracy, and minimum current consumption. The five tubes are cushion mounted; the panel is antique bronze framed in an attractive walnut cabinet with ample battery space.

LE MOR RADIO INC., Asbury Park, N. J.

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



**\$3.25
3 C.O.D.**

RADIO Storage "B" Battery

**12 Cells
24 Volts Lasts Indefinitely—Pays for Itself**

Economy and performance unheard of before. Recharged at a negligible cost. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other important institutions. Equipped with Solid Rubber Case, an insurance against acid and leakage. Extra heavy glass jars. Heavy, rugged plates. Order yours today!

SEND NO MONEY Just state number of batteries wanted and we will ship day order is received. Extra Offer: 4 batteries in series (36 volts), \$12.75. Pay expressman after examining batteries. 6 per cent discount for cash with order. Mail your order now!

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 77 Chicago, Ill.
Makers of the famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp., \$11.25; 120 Amp., \$13.25; 140 Amp., \$14.00
All equipped with Solid Rubber Case.

**World
STORAGE BATTERIES**

KDKA - WEAF - WOR - WJS - HML - HGO - KFAF - WUY - KOP

Set your Radio Dials at 210 meters for the new 1000 watt World Storage Battery Station, WSHC, Chicago. Watch for announcements.

Fine Radio

Apparatus

D.T.W. LOOP

The beginning of another radio year finds the DTW Tobe Deutschmann collapsible loop still in its well-earned position of leadership.

In its well-earned position of leadership.

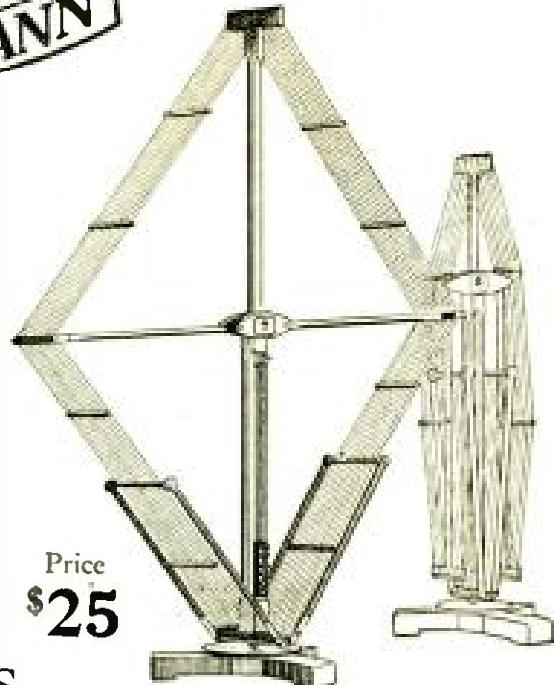
Unequalled in design and operation, the loop has won and retained the admiration of technicians in all parts of the world. A unique arrangement makes it readily adaptable to all forms of receiving sets employing loop reception. It is found to be ideal when used with receivers of the center-tap, or loop regeneration type.

The one loop in all America selected by McLaughlin for his single control set.



Precision Condensers

Price
\$25



Following our success with DTW loop we are bringing to the public a complete line of by-pass and filter condensers—the product of years of research.

A truly precision device, each TOBE Deutschmann condenser is thoroughly guaranteed. Only the best quality materials enter into its construction.

Whether for by-passing stray radio frequency impulses or smoothing out annoying ripples in a battery eliminator, TOBLE Deutschmann condensers will prove more than adequate.

Type 708. Price \$1.25 Features of TOBE Condensers

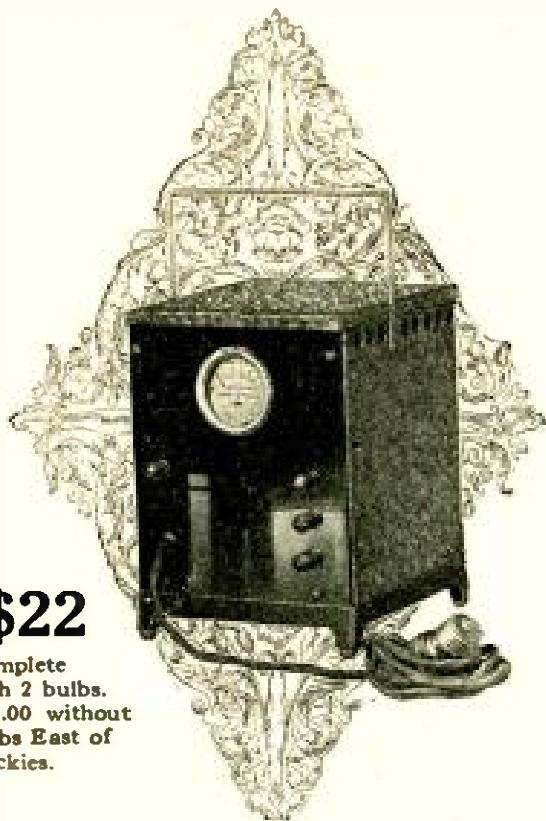
1. They will operate at 700 volts D.C. without breaking down or overheating.
 2. High megohm resistance indicates perfect insulation. The TOBE Deutschmann 1 MFD condenser has a guaranteed resistance of 150 megohms. The other capacities have correspondingly high resistances.
 3. The capacity of each condenser is guaranteed to be accurate within five per cent.
 4. Extreme heat or cold has no effect on TOBE Deutschmann condensers. They maintain their capacity through all changes in temperature.

TOBE condensers are distinguished by their silver finished case.

"A better condenser"

Dealers sheets furnished to jobbers on request. Manufacturers and jobbers write for full description of this line of better condensers.

Tobe Deutschmann Co.



\$22

Complete
with 2 bulbs.
\$14.00 without
bulbs East of
Rockies.

The New TWIN BULB HANDY CHARGER

Truly a wonder. Charges at a fast economical rate and is absolutely noiseless. It cannot overcharge or discharge your battery so it is particularly adapted to overnight charging. You always know just what the rate of charge is as the New Twin Bulb HANDY is equipped with a special ammeter.

The "push-pull" method is employed, using both halves of the AC wave. This accounts for the economy and speed of the charge. The New Twin Bulb HANDY CHARGER charges them all; "A" Batteries 4-5 amperes to 6 volt batteries; "B" Batteries up to 120 volts in series. Ask your dealer or write for additional information.

INTERSTATE ELECTRIC CO.

4337 DUNCAN AVE.
ST. LOUIS



COILS & 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 unequalled 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.



SOMETHING decidedly new, different and better has been perfected in radio. Interesting information is ready for you. Write us at once.

PREMIER ELECTRIC CO.

Dept. L19, 1800 Grace St., Chicago, Ill.

PREMIER ELECTRIC CO..

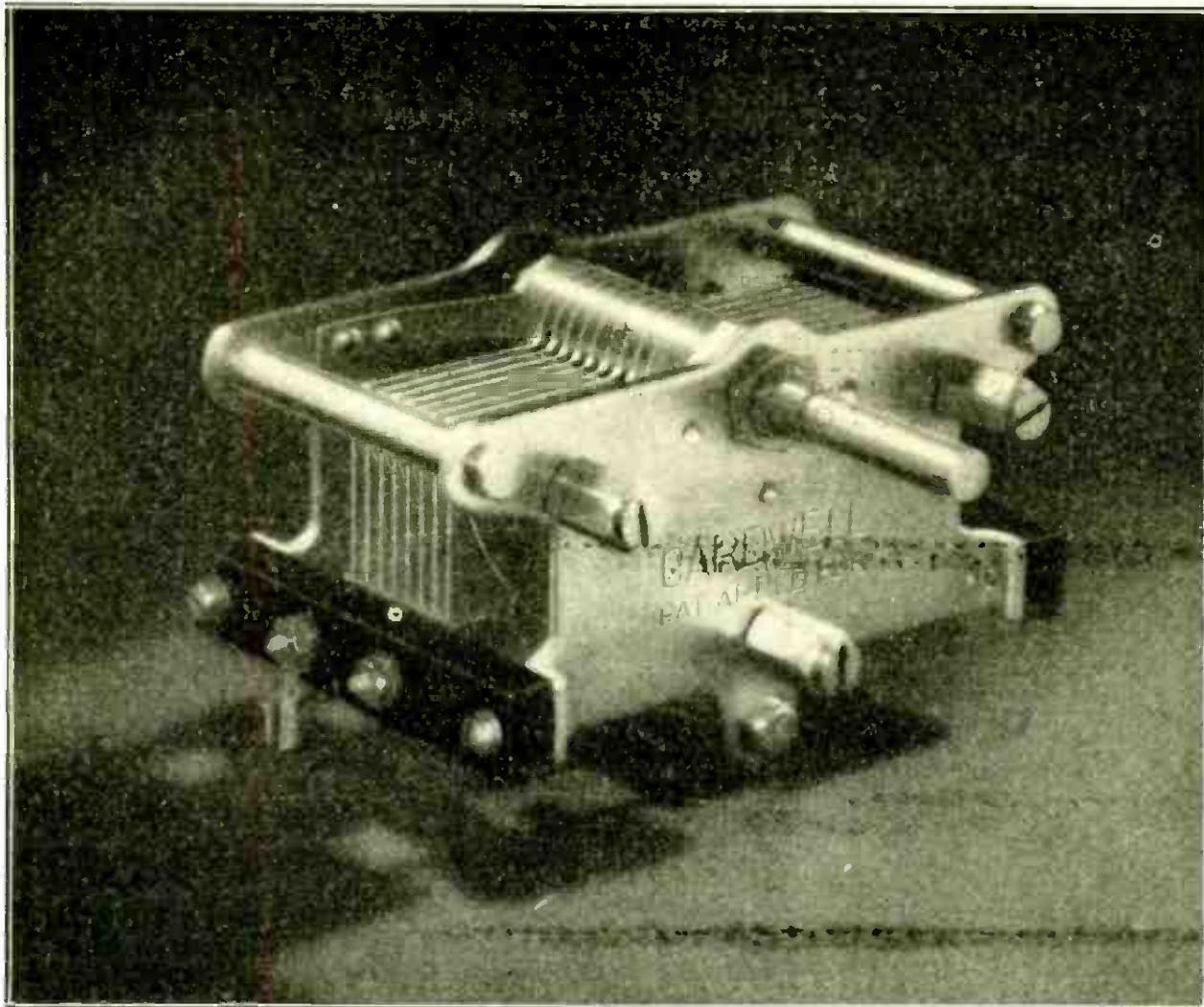
Dept. L19, 1800 Grace St., Chicago, Ill.

Send me immediately full information about the New Premier Ensemble. This does not obligate me.

Name

Address

City State



Insist on CARDWELLS The *first* "low-loss" condensers

CARDWELL invented the original *low-loss* condenser, using metal end plates and a grounded rotor. The phrase "low-loss" was in fact first applied to Cardwell Condensers by engineers to distinguish these highly efficient condensers from the ordinary varieties.

Cardwell Condensers have been universally adopted by radio editors, experts, and professionals. Cardwells have become the standard of comparison.

Performance is the only real test of a condenser. And Cardwell Condensers have proved their superiority because of their scientifically correct

design—small area of contact between insulation and stator supports, rigid three-point frame, permanent alignment, accurate adjustment, etc.

Such details permit exceptional distance records, smooth tuning free from noise, and prevent changes in capacity at given settings.

Use Cardwell Condensers in all receivers. There's a Cardwell Condenser for every requirement—seventy-six different types. A post-card brings you an education on condensers.

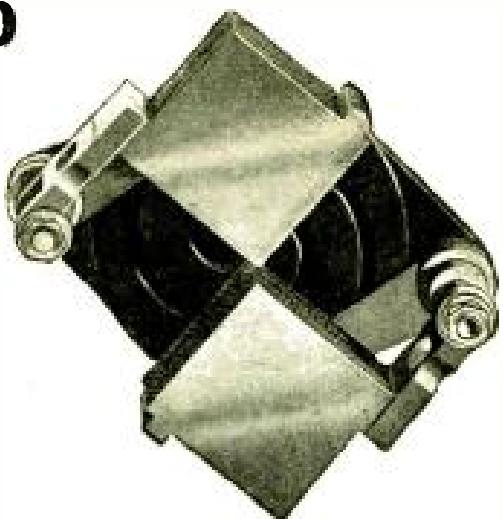
Allen D. Cardwell
Manufacturing Corporation
81 Prospect St., Brooklyn, N. Y.

No More "Bunched-Up" Stations!

The Signal Spiral Cam Condenser Distributes Them Evenly Over the 360 Degrees of Your Dial

Yes, sir, you get absolutely even distribution with this condenser. Other types may simplify tuning. But the Signal Spiral Cam Condenser is perfect insurance against conflicting stations. It separates them all.

The Signal Spiral Cam Condenser uses the full 360 degrees on the dial—yet is so compactly designed that it needs no more space than the old type semicircular unit. There is no backlash. The perfectly balanced assembly accounts for the smooth action. See one at your dealers—then you'll understand why thousands of



fans will use no other condensers. Built in three capacities for single or three-hole mounting and all one price.

We have an interesting chart showing the efficiency of this condenser. Write us for it today—also for literature on the new Signal Bracket Type Loop Aerial, the ideal loop for close quarters.

"Where Millions of Good Radio Parts Come From"



Signal Electric Manufacturing Co.

Dept. 10J

Menominee, Mich.

Branch Offices In All Principal Cities

Buy direct from the Manufacturer

DYN-A-BLUE

Consumes .23 A. Battery current and .4 Mills. B Battery current. Operates as detector radio or audio amplifier. Powerful and sensitive.

\$1.75



DYNETRON

A real good tube for all around use. .35 Amperes. Will operate with any other make of tubes.

\$1.25

Send cash, money order or certified check

Sold on a money back basis

MAGNITE LABORATORIES
P. O. Box 472 Newark, N. J.



Burns
SPEAKER
WITH
CONCERT
UNIT

The Heart of the Speaker

Large size and scientific construction of the Concert Unit gives the remarkable tone values which, combined with the special amplifying properties of the BURNS horn, produce remarkable results.

BURNS horn is of distinctive design with pyralin flare in several handsome finishes.

Manufacturers
American Electric Company

State and 64th Streets
CHICAGO, U. S. A.



Mohawk

Manufactured by Mohawk Corporation of Illinois
Independently Organized in 1924

You can now buy, in knock-down form, the famous one-dial Mohawk Radio, "five tubes, just one dial to tune." Or, if you prefer, you can obtain, separately, the splendid Mohawk parts used in this remarkable set.

If you buy a new radio, do not fail to hear the one-dial Mohawk with its super-selective three-in-line, balanced condenser. To test the Mohawk is to want one.

Manufacturers
MOHAWK CORPORATION OF ILLINOIS
Independently Organized in 1924
Chicago, Ill.



Mohawk No. 143 Kit. Includes Mohawk Three-in-line balanced condenser; Mohawk Selectune Dial; three standard Mohawk radio-frequency transformers. With this kit you can convert any three-dial, five-tube tuned radio-frequency radio into a one-dial set. \$23.50.

Mohawk
Three-in-line
balanced conden-
ser—"the heart of the
Mohawk Radio."
\$15.



Radios Kits Parts

If you intend to build a set, by all means get a Mohawk kit. Or if you rebuild your present radio, modernize it—convert it into a one-dial set with the patented Mohawk condenser and other Mohawk parts.

For quality in all radio parts insist on Mohawk. Sold by leading dealers.

Sales Department
THE ZINKE COMPANY
1323 S. Michigan Ave.
Chicago, Ill.

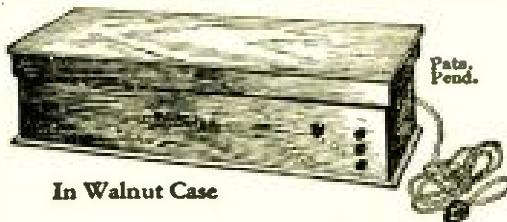
Mohawk No. KU51
Kit, including all
parts, with cabinet,
ready for quick as-
sembly. Price, \$75.



Mohawk Radio, "5 tubes,
just one-dial to tune." [Ac-
cessories extra]. \$100.



The Wilson "B"
Radiopower Unit



In Walnut Case

Operates from light socket. Supplies the uniform voltage necessary for perfect reception. Absolutely noiseless. *Guaranteed not to set up the slightest hum.* No acid to spill. No moving parts to get out of order. Requires no attention. As easy to operate as switching on a light. Convenient and dependable. The least expensive plate current supply because of its long life. In handsome walnut case. Price complete, \$35. Your dealer can supply you.

The Andrews
Paddlewheel-Coil



Pats. Pend.

Price \$3.00

Improves tone quality. Increases selectivity, range and volume. Losses are negligible. Has exceptionally high ratio of inductance to resistance with minimum distributed capacity.

Used in well-known receivers such as the Deresnadyne and Buckingham. Can be used in any standard hook-up. Ask your dealer for blueprints of circuits employing this coil.

Our Technical Dept. will answer inquiries.

**Duo-Spiral
Folding Loop**

Highly directional and very selective. Reduces static and helps to cut out interfering stations.



Price \$8.50

Pats. Pend.

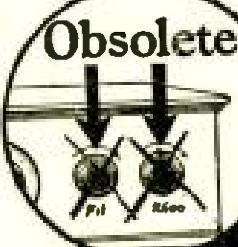
Handsome finished in silver and mahogany. Easily portable. Has long handle and graduated dial. A special model for every circuit.

See these standard units at your dealer's or write for complete information.

Radio Units Inc.

1301 FIRST AVE., MAYWOOD, ILL.

Perkins Elect. Ltd., Montreal, Toronto, Winnipeg



**Take the
"GUESS"
Out of Tube
Control**

\$1.10
Everywhere

Amperite automatically controls tube current, eliminates hand rheostats, filament meters, guessing and all tube worry. Simplifies wiring, tuning and operation. Permits the use of any type of tube or any combination of tubes. Tested and used by more than 50 set manufacturers and in every popular construction set.

RADIALL COMPANY

Dept. P.R.-13, 50 Franklin St., New York City

Write for
FREE
Hook-ups

AMPERITE
REG. U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat

Our Midget By-Pass Condensers

In Capacities of .005 to .1

will effect a saving of more than half of what you are now paying.



Of Course

Our Precision Mica Fixed Condensers
In Capacities of .0001 to .006
are still the Standard of Comparison.



NEW YORK COIL COMPANY
338 Pearl St. New York City

Pacific Coast Representative: Marshank Sales Co.
926 Ins. Exch. Bldg., Los Angeles, Calif.

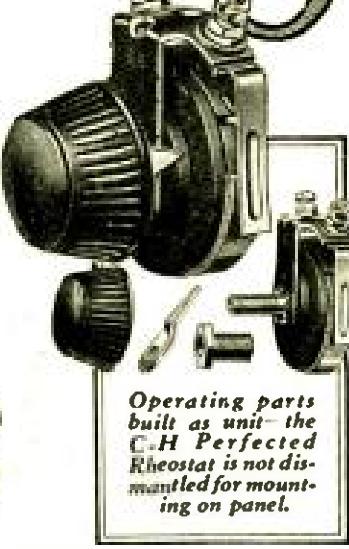
Now! C-H Quality at a New Low Price

The Perfected C-H Rheostat

Revolving drum type with one hole mounting. All spring tensions adjusted at factory and undisturbed by mounting. Instrument cannot turn on panel. Very small size. Operation smooth and quiet. 6 ohms, 15 ohms, and 30 ohms—perfect control for all tubes and their combinations.

C-H Radio Potentiometer

Similar in construction to the perfected rheostat. 400 ohms and only a little larger than a silver dollar. Perfect, smooth operation—no back lash or sticking. Price \$1.00.



C-H Radio Toggle Switch

The newest idea in panel switches. ON or OFF with a flip of the finger. Beautiful appearance and simple one hole mounting—neat etched plate for panel provides definite indication. Quiet, easy operating switch mechanism.



The C-H Radio Switch

The original radio switch. Millions in use. One hole mounting—high capacity mechanism. The only radio switch approved for 110 volt circuits by Underwriters Laboratories.

75 The name Cutler-Hammer has held an enviable position in radio. Consistently from the earliest days has the C-H trade mark been synonymous with proper design and unequalled precision. Radio builders everywhere justly had faith in these foremost engineers and millions of their radio parts in the orange and blue boxes have helped build receiving sets of quality.

Better Sets at Lower Cost

These millions of sales have brought down manufacturing costs and today this quality carries no premium. Demanding the C-H trade mark now not only insures satisfaction, but provides a saving. Dealers everywhere are ready to serve you. If yours has not yet stocked any C-H part you desire, send us his name and we will see that you are supplied.

THE CUTLER-HAMMER MFG. CO.

Member Radio Section, Associated Manufacturers
of Electrical Supplies

MILWAUKEE and NEW YORK



CUTLER-HAMMER

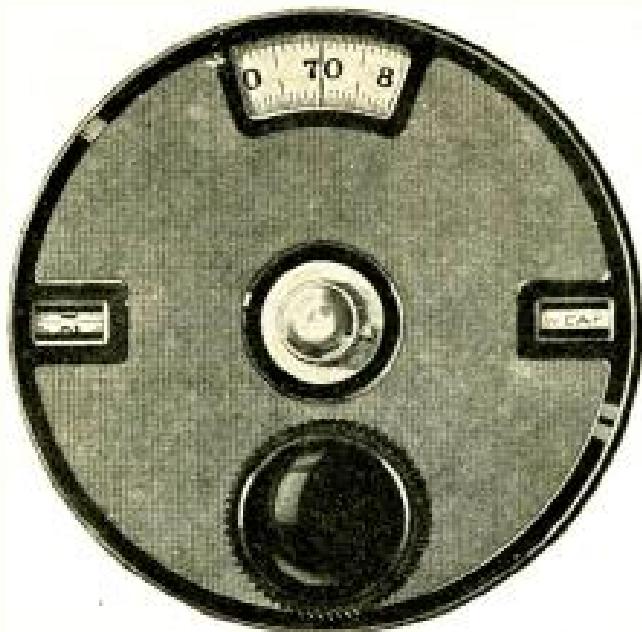
Buy Your Radio Parts by Name

Splits a Single Degree Into Hair's Breadth Divisions!

You'll never know how much difference a dial can make until you get this new MARCO dial on your set. Without the least suggestion of backlash, it responds instantly to your slightest touch. Smooth-working, handsome, supremely accurate, it's typical of MARCO. And you keep a record of dial settings in the two slots—right on the dial itself!

Nickel Plated \$2.50 Gold Plated \$3.00

Martin-Copeland Company
Providence, Rhode Island



This is the dial specified in the McLaughlin single-control superheterodyne, described in this issue.

MAR-CO RADIO PRODUCTS Vernier Dial

FREE HOOK-UPS AND BIG RADIO GUIDE

RADIO GUIDE THE BARAWIK CO.
103-104 S. Canal St., Chicago, U. S. A.

Free, big Radio Catalog and Guide brimful of newest ideas, over 100 special hook-ups and illustrations. You save as much as 50% on sets and parts. Be sure to get this thrifty book before you buy. It puts money in your pocket. Shows standard radio parts, sets, kits, all reliable, guaranteed goods. Please include name of radio fan to whom we may send copy also. Write letter or postal now.

LOWEST PRICES ON KITS

McLaughlin One Control, 8-tube Super, as described in POPULAR RADIO, with loop...	\$95.00
Cockaday 5-tube A. C. Receiver.....	49.00
Cockaday 8-tube Superhetrodyne.....	74.50
Cockaday 5-tube 4 Circuit.....	67.00
4-Tube Browning Drake.....	35.00
Bess Superhetrodyne-Remler parts.....	62.50
Model 12 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
103-104 S. Canal St., Dept. PR.. Chicago, Ill.



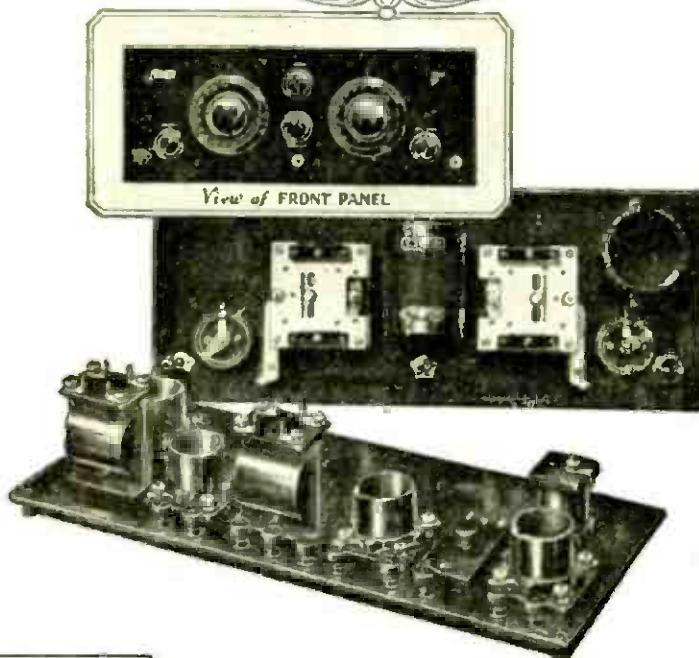
The TOWN CRIER Radio's Most Beautiful Speaker

You will be delighted with the gorgeous colors . . . the handsome, stippled finish, and the novel design of the Town Crier—the Speaker with the voice that thrills.

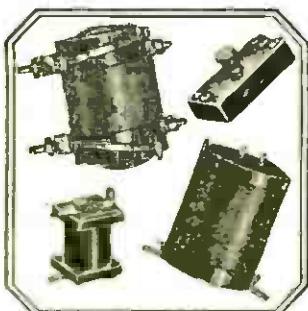
Ask your dealer to show you a Town Crier Speaker. Write today for beautifully illustrated circular describing the Golden Polychrome and Green Polychrome models.

List Price \$17.50
West of the Rockies \$18.50
GALE RADIO LABS.
2512 Irving Park Blvd. CHICAGO

Samson & Assembly



View of FRONT PANEL



Rebuild Your Present Set

The new and vital parts of the SAMSON TC Assembly are included in the SAMSON Transcript Kit and may be combined with the parts you have. Kit Price \$14.75

Your Confidence is Deserved

In a space of but 18 x 7 x 7 inches SAMSON Engineers, by combining new and vital parts of SAMSON manufacture with other fine standard parts, have created this improved assembly based on a fundamental and successful circuit. Easily wired in a few hours. An independent Radio Testing Laboratory reports: "A high power set designed to cut thru locals and to bring in distant stations with perfect quality and volume." A copy of the complete article will be mailed on **SAMSON T. C. \$65.00**

SAMSON ELECTRIC CO.

Manufacturers since 1882

Canton, Mass.

Sales Representatives in Principal Cities

MEMBER
R.M.A.

Samson Radio Products



ACME WIRE RADIO PRODUCTS

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. Adds greatly to the appearance of your set.



Enamelled Antenna Stranded

The best outdoor antenna you can put up. 7 strands of enamelled 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 of fine copper wire, green silk covered. Flexible; non-stretching, neat.

The New Celatsite Wire

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.



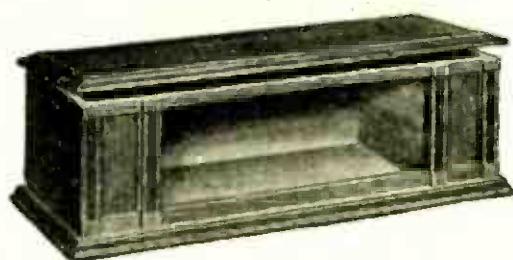
Flexible Varnished "Spaghetti"
A perfect insulation tube for all danger points in set wiring. Costs little more and is worth a lot more than the cheaper substitutes offered. Black, yellow, red, green, brown, for wires No. 10 to No. 18. 30 inch lengths.

Send for Folder

THE ACME WIRE COMPANY Dept. P New Haven, Conn.

Also makers of fine enamelled magnet wire and coil windings for Audio Transformers, Battery chargers, "B" Battery Eliminators.

Premier B Battery Cabinet



Our Premier B Battery Cabinet is a beautiful piece of furniture. The B battery compartment will take any type B battery. The space of each B battery compartment is 4 1/2" wide, 8 1/2" high and 10" deep.

No.	For Panel	Deep	Genuine Walnut
718-10	7 x 18	10"	\$18.50
721-10	7 x 21	10"	19.00
724-10	7 x 24	10"	19.50
726-10	7 x 26	10"	20.00
728-10	7 x 28	10"	21.00
730-10	7 x 30	10"	22.00

F.O.B. Waukesha, Wis.

The tops of these cabinets are figured walnut, the ends and B battery panels are select walnut, all 5 ply veneer. The bases are built up of massive molding. Nickel plated piano hinges and lid holders. The material and finish in these cabinets will equal the best furniture obtainable.

WE MAKE 9 STYLES OF CABINETS FOR 14 SIZES OF PANELS. Send for our 1925-26 line of cabinets at "Factory to User" prices.

Utility Cabinet Company

Phone 721

Waukesha, Wisconsin

Two WONDERS of the NIGHT!

AND THE
ARAGAIN RADIO RECEIVER
AUTOMETAL CORPORATION
NIAGARA FALLS

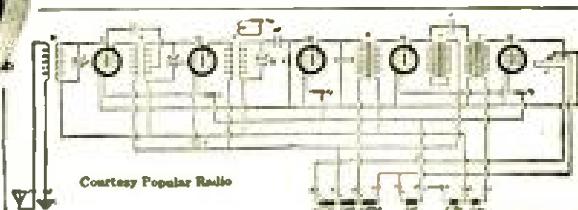
Tuned
Radio
Frequency
Kit
\$12.00
Complete
with
Brackets



The complete Low Loss Inductance System, comprising two tuned circuit transformers and an antennae coupler with a uniquely constructed variable primary for governing the selectivity of the antennae circuit.

NOW—All the world can have it!

The sensational favor which Chicago and New York showered upon the AERO COIL has prompted its designers to make it available to every fan in the Nation. Vigorous plans are, therefore, under way to place the Aero Coil where every city and village can see it and witness its markedly superior performance.



Courtesy Popular Radio

Declared by Chicago and New York the most SELECTIVE, most POWERFUL Inductance Ever Designed!

Enjoy the "knife-edge" selectivity with which Aero Coils cut through the tangled mass of Chicago and New York broadcasting at will! Enjoy the uncanny sensitivity with which sets built of Aero Coils pick up the far off, small, low-wattage stations that you never thought existed! Be thrilled by the amazing volume with which Aero Coils amplify for the loud speaker, reception which you have always had to listen to on the head phones! Build a 5-Tube Tuned Radio Frequency Set with Aero Coils the true low loss inductance system.

PATENTS PROTECT ITS SUPER-EFFICIENCY

Its lower circuit resistance, its lower high frequency resistance, its lower distributed capacity, and the fact that its dielectric is 95% air are the reasons why the Aero Coil tunes so sharply into resonance—and why it actually uses the energy which other types of inductances waste. Hence, Aero Coil is the inductance of today—and tomorrow, and you can be assured that it is—for the construction which makes it the ideal inductance is patented, and no inductance can be made so good as Aero Coil unless in violation of these patents!

If your dealer has not yet obtained his stock of Aero Coils, order direct, enclosing price with your order.

Free Booklet showing new circuits and giving full constructional information of help to any fan or set builder—mailed on request. Write for the Aero Booklet.

95% Air dielectric
—No dope on windings — All turns air-spaced—Solonoid (cylindrical) windings
—Variable primary
Engineers recognize cylindrical winding to be superior to any other. The Aero Coil is the only Air dielectric cylindrical inductance with a variable primary. Aero Coil patents prevent imitation.

Build Your Set Now!
The construction which makes possible the far superior results obtained from Aero Coils also makes them cost a bit more—but, performance considered, their price is low. \$12.00 for a set of three, complete with nickel plated mounting brackets which fit any condenser. Go to your dealer's today and obtain a set of three. A circular containing complete hookups for building the most selective, most sensitive, most powerful five-tube receivers ever designed is enclosed in each package.

Use AERO COILS

Wherever An Inductance Is Required

[THE ONLY AIR DIELECTRIC COILS HAVING VARIABLE PRIMARIES IN ANTENNAE CIRCUITS]

The Aero Coil 3-Circuit Tuner

Another adaptation of the patented protected Aero-Coil construction and for that reason the most efficient three-circuit tuner ever offered. More than covers the broadcast wave band when shunted with a good .0005 condenser. This is the tuner whirr in a 3-tube set brought in Havana, Cuba, in the day-time in Chicago. Price.....\$8.00

The Aero Coil Radio Frequency Regenerative Kit

Consists of one AERO COIL 3-Circuit Tuner and one AERO COIL Antennae Coupling Transformer. Makes the most powerful, most selective 4-tube, non-radiating set possible to build. Price\$11.00

The Aero Coil Wave Trap Unit Also for Crystal Sets

By reason of the characteristics made possible by the Aero Coil construction, this unit makes a very efficient wave trap or crystal set. Price \$4.00.

The Aero Coil Oscillator for Super Heterodynes

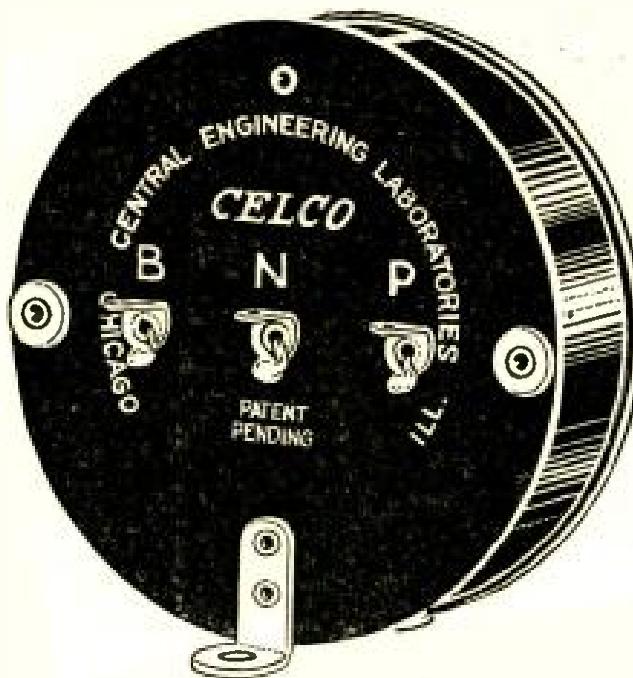
The characteristics achieved through the use of the Aero Coil principle make of this instrument the ready means to tremendously increase the efficiency of the oscillator circuit in any Super Heterodyne receiver. Pr. \$5.50

AERO PRODUCTS, Inc.
217 North Desplaines Street, Chicago, Illinois

Successors to
HENNINGER RADIO MFG. CO.

AERO COIL
All Aero Coils embrace a patent-protected method of construction which makes possible a far more efficient inductance performance than is possible with any other type of coil.

Prepared by KIRTLAND-ENGEL ADVERTISING COMPANY - CHICAGO



CELCO Indicating Battery Switch

There need be no more annoyance over tubes burning all night if a Celco Battery Switch is in your set. The jeweled pilot light emits a soft golden glow that makes it as hard to forget to turn off as it is easy to turn on. Simple to install—only two holes to be drilled in panel, one for pilot light and one for switch.

Agent Representatives
wanted
Some Good Territory Still Open

CENTRAL ENGINEERING LABORATORIES
3345 No. Lincoln St. Chicago, Ill.

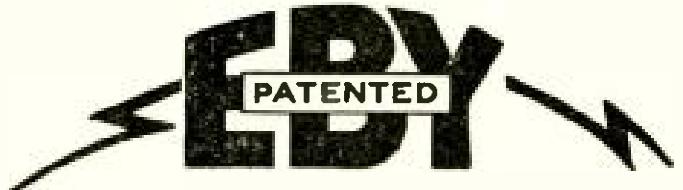
CELCO

Double "D" Coil

Intermediate Frequency Transformers

have aroused a tremendous interest among laboratory engineers and many other experts and experimenters in radio. These transformers have made possible a new standard of super-heterodyne performance and have demonstrated conclusively the remarkable possibilities of a satisfactory super-heterodyne. They are of the popular air-core type, accurately and uniformly peaked for maximum efficiency.

Volume
Super-
Selectivity
Quality
Reception



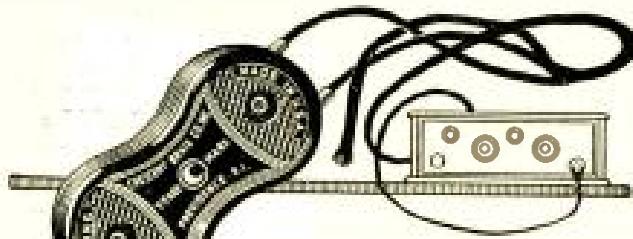
BINDING POSTS

After you have put time, money and labor into the building of your set, don't jeopardize its efficiency with doubtful binding posts.

Ask your dealer to show you why EBY Quality Posts are the choice of over 150 radio manufacturers.

6 types—25 different markings—and the tops don't come off!

The H. H. EBY MFG. CO.
Philadelphia, Pa.



Quick as
a Wink!

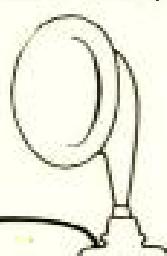
PREMIER 20-ft. Extension Cord (for loudspeakers) now comes with the handiest connecting plug you ever saw. Holds terminal pins securely. Releases instantly. Automatic—with no tiny screws to fuss with or lose.

PREMIER Cord, \$1.75
with Plug

At your dealer's or write us.

CRESCENT BRAID CO., Inc.

Makers of Extension
Cords and Batter
Cables for Radios
Providence, R. I.



Better reception this season than last!

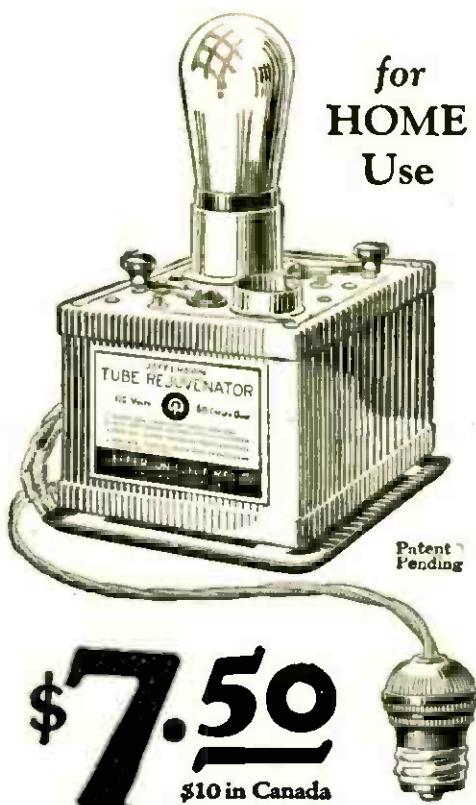
WOULD you like better reception this fall and winter than last? Better distance? Better volume? Better tone? You will enjoy better results in every way, this season, if you keep your tubes at full efficiency with the Jefferson Home Tube Rejuvenator.

All tubes deteriorate rapidly with use. The Jefferson Tube Rejuvenator "brings them back" in 10 minutes! Use it once a month—keep your tubes like new. Completely restores paralyzed or exhausted tubes. Doubles and trebles tube life, quickly paying for itself through this great saving.

Takes large or small tubes—types 201-A, 301-A, UV-199, C-299, 5-VA. Attach to any alternating current electric light socket in your home. The Jefferson Home Rejuvenator for tubes is as essential to satisfactory radio reception as a charger for storage batteries. Get one now; start the season with your tubes in perfect condition. Sold by leading dealers in radio supplies, and fully guaranteed.

Jefferson Electric Manufacturing Co.
501 S. Green St., Chicago, Ill.

Makers of Jefferson Radio, Bell Ringing and Toy Transformers; Jefferson Spark Coils for Automobile, Stationary and Marine Engines; Jefferson Oil Burner Ignition Coils and Transformers.



JEFFERSON TUBE REJUVENATOR

Keeps radio tubes like new

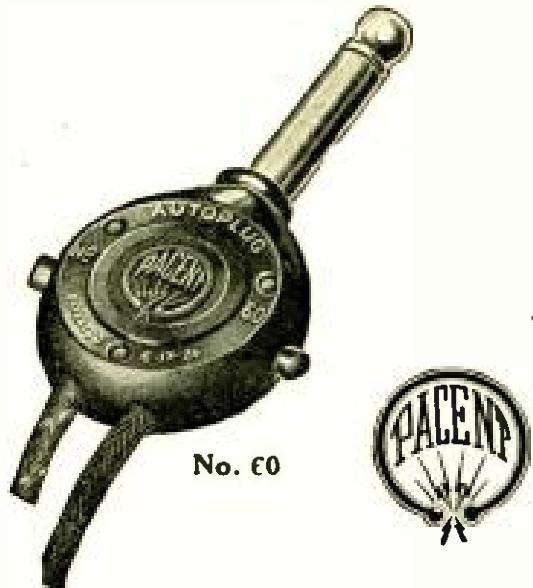


JEFFERSON RADIO TRANSFORMERS

Your radio, no matter how costly, can be no better than its transformers. Our experience as the world's largest manufacturers of small transformers is everywhere recognized by leading radio engineers who carefully specify "Jefferson". If you want amplification without distortion—clear, pure, sweet, natural tones from your radio—make sure it is equipped with Jefferson Transformers. Sold by the better radio dealers, used by leading set manufacturers.



The Best Plug at a Better Price!



The Pacent Autoplug Now 60c

THIS plug is entirely shock-proof, for the entire length of the cord tips is encased by the plug shell and no metal parts are exposed. The shell is made of genuine Bakelite. No screws are used in its assembly, and there is nothing to work loose or cause trouble.

Pacent parts are used by 40 leading manufacturers in the construction of their sets. It will profit you to get in touch with us.

See your dealer, and write us for the new Pacent Catalog of complete line of Pacent Essentials.

PACENT ELECTRIC COMPANY, INC.
91 Seventh Avenue, New York City

Washington	Chicago	Buffalo
Minneapolis	Birmingham	Jacksonville
Boston	Philadelphia	Detroit
San Francisco	St. Louis	Pittsburgh

Canadian Licensees: White Radio Limited
Hamilton, Ont.

Pacent RADIO ESSENTIALS

"DON'T IMPROVISE - PACENTIZE!"

New **AIR COOLED** **Rheostat**

Air
Cooled
Coil

Adjustab'e
Contact
Sliding
Lever



Bakelite
Base
Coil
Exposed on
All Sides
No Vernier
Required

Operates without temperature rise and at constant coefficient of conductivity. The many turns, with an unusually long contact surface permits filament voltage to be built up slowly and held at just the right point to facilitate tuning and develop perfect reproduction. Quarter inch shaft fits same size hole as jack and requires a single nut mounting.

At the best radio dealers \$1.35
Dial Plate, 15c extra.

YAXLEY

APPROVED RADIO PRODUCTS

YAXLEY MFG. CO. Dept. P
217 N. Desplaines St., Chicago, Ill.

DUPLEX

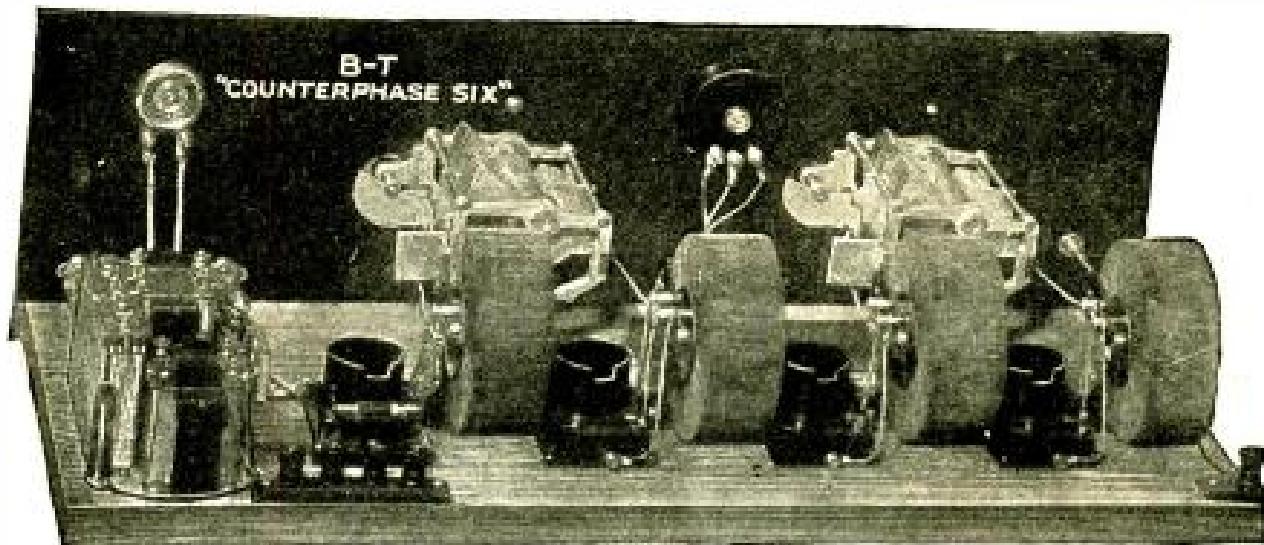
Straight Line Frequency
CONDENSERS

Made according to Bureau of Standards specifications for lowest losses and best electrical characteristics.

Specially shaped-out stator plates space the stations over the dial, while keeping the condenser as small as a straight-line capacity model.

Aluminum stator plate, exactly the same as used in the new DUPLEX Straight Line Frequency condenser, sent on request. Write for one today. Learn the secret of DUPLEX superior construction.

DUPLEX CONDENSER & RADIO CORP.
50 Flatbush Avenue Extension
Brooklyn, N. Y.



Another Forward Stride—

Another forward stride in radio—the B-T "COUNTERPHASE." Builders of quality apparatus since broadcasting began, Bremer-Tully regard the "COUNTERPIASE" and the parts that go into it, as the best thing they have ever done.

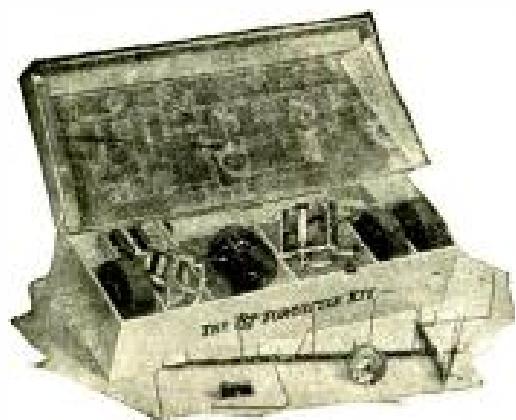
A sixth tube where it will do the most good—as a third stage of radio frequency gives sensitivity that requires only a short indoor antenna for distant reception. Selectivity to the point where further sharpness would be impractical. And withal a tone quality of surpassing beauty and clearness.

Anyone Can Build This Master Set

B-T Kits contain essential parts and B-T instructions and color-diagrams make the job easy. A typical B-T ingenuity is the wiring form which quickly and correctly hooks up all radio frequency leads.

Those who desire to build a five tube set may also build the "COUNTERPHASE Five" which employs two stages of radio frequency amplification and gives surpassing results on an outdoor antenna.

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BREMER-TULLY Mfg. Co.

*First in the Field
Specializing in
Cockaday Kits*

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

**Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan
50% of Your Time, Work and Worry SAVED!**

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved; in a solid Mahogany Cabinet. Genuine parts used as listed below; exactly as specified by Mr. L. M. Cockaday. COMPARE OUR OFFER!

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UNASSEMBLED KIT PRICE, Write Us
WIRED COMPLETE \$120.00**

In Genuine Mahogany Cabinet Including D. T. W. Loop

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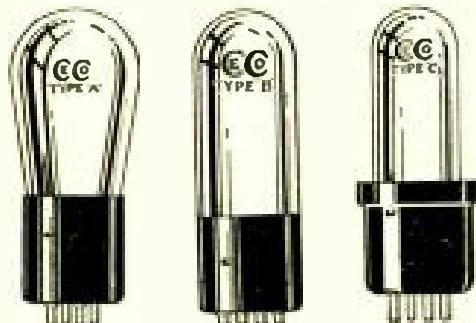
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Filament Volts "A" 5.0 "B" 3.0 "C" 3.0
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Plate Voltage 20 to 120 20 to 80 20 to 80
Made with Brass and Bakelite Bases

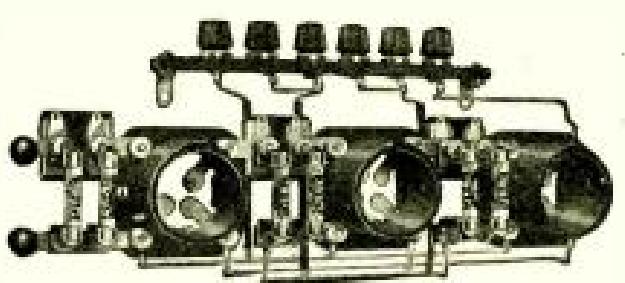
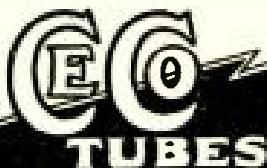
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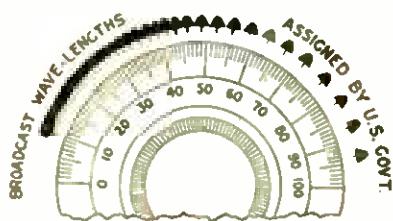
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QUALITY RESISTORS
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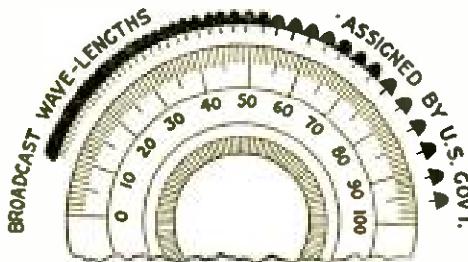
NEWARK

NEW JERSEY

Last Year—
Bad Crowding of Shorter-Wave Stations



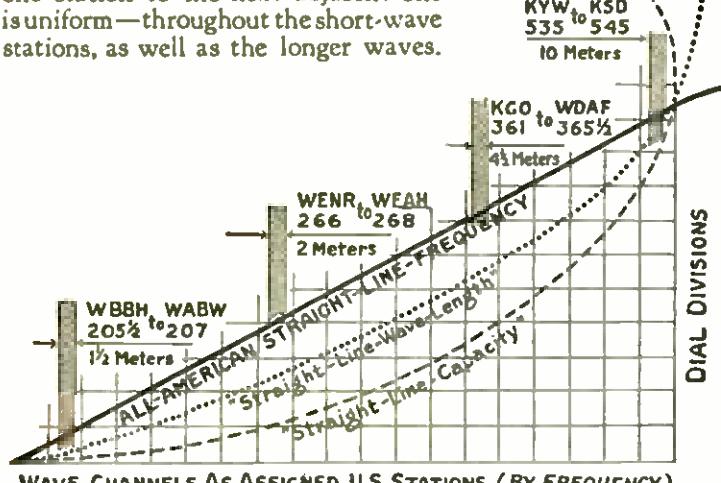
This Year—
Better, But Crowding Still Troublesome



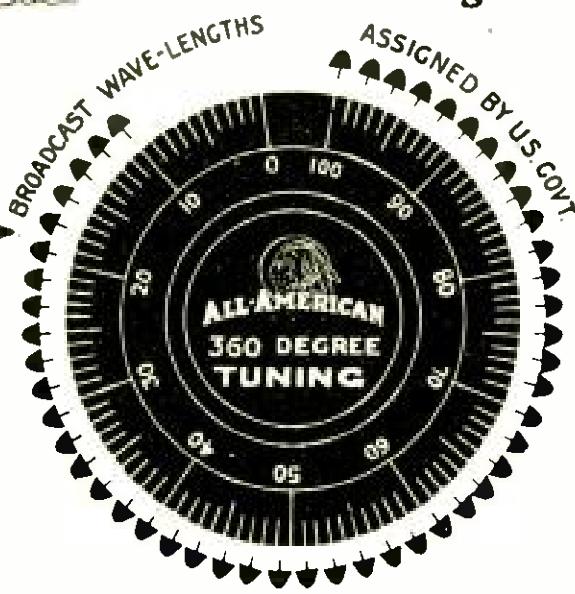
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No Crowding!

Straight-Line Frequency Means—

That the distance on your dials from one station to the next adjacent one is uniform—throughout the short-wave stations, as well as the longer waves.



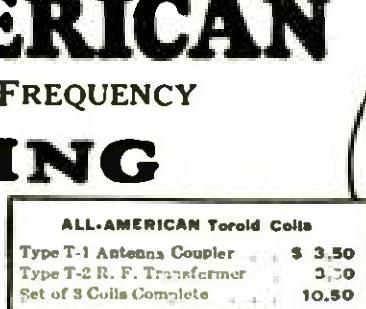
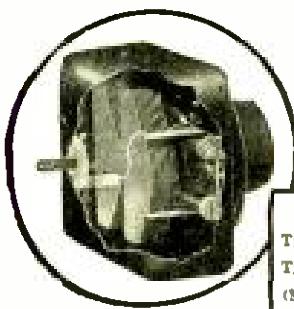
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20-KILOCYCLE INTERVALS ARE SHOWN:
ALTERNATE CHANNELS OMITTED
FOR CLEARNESS

ALL-AMERICAN

STRAIGHT-LINE-FREQUENCY
TUNING



ALL-AMERICAN Straight-Line-Frequency Condensers
Type C-36 Max. .350 Micromicrofarads
(Min. 10.5 mmf.) \$4.50
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(Min. 11.8 mmf.) \$5.00
(Min. Capacity is measured at 400 meters)

ALL-AMERICAN Toroid Coils
Type T-1 Antenna Coupler \$ 3.50
Type T-2 R. F. Transformer 3.50
Set of 3 Coils Complete 10.50

Ease and certainty in tuning—no more crowding of short-wave stations—no need to buy vernier dials—no gears or other back-lash makers—body capacity absolutely not distinguishable—electrical efficiency unsurpassed—on one-half the panel space: that is the ALL-AMERICAN Straight-Line-Frequency Condensers.

New power for distance reception through close coupling—tuning of arrow-like sharpness—elimination of all oscillation worries through the self-enclosed endless magnetic field—non-radiating reception: that is ALL-AMERICAN Toroid Coils—Antenna Coupler and Radio Frequency Transformers. See them at your dealer's.

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



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Owners of Super-Heterodynes or any other sets receiving their A and B current supply from dry batteries should have a Nagel combination Voltmeter and Ammeter. Accuracy in readings under any condition and safety against battery drainage are two important features that are embodied in all Nagel pocket-type battery measuring instruments. See your dealer or write The W. G. Nagel Electric Co., 513 Hamilton Street, Toledo, Ohio.

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True Blues*

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TO those who hold quality above price in making a purchase True Blue Radio Tubes tell a story of values which continue to mark them The Finest Radio Tube in the World. Evidence of their value is given in their remarkably rapid increase in sales to thousands of radio fans, amateurs and engineers whose friends use and recommend True Blue Tubes.

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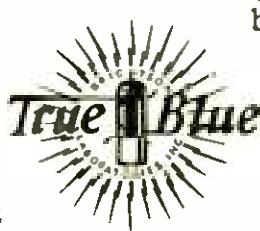
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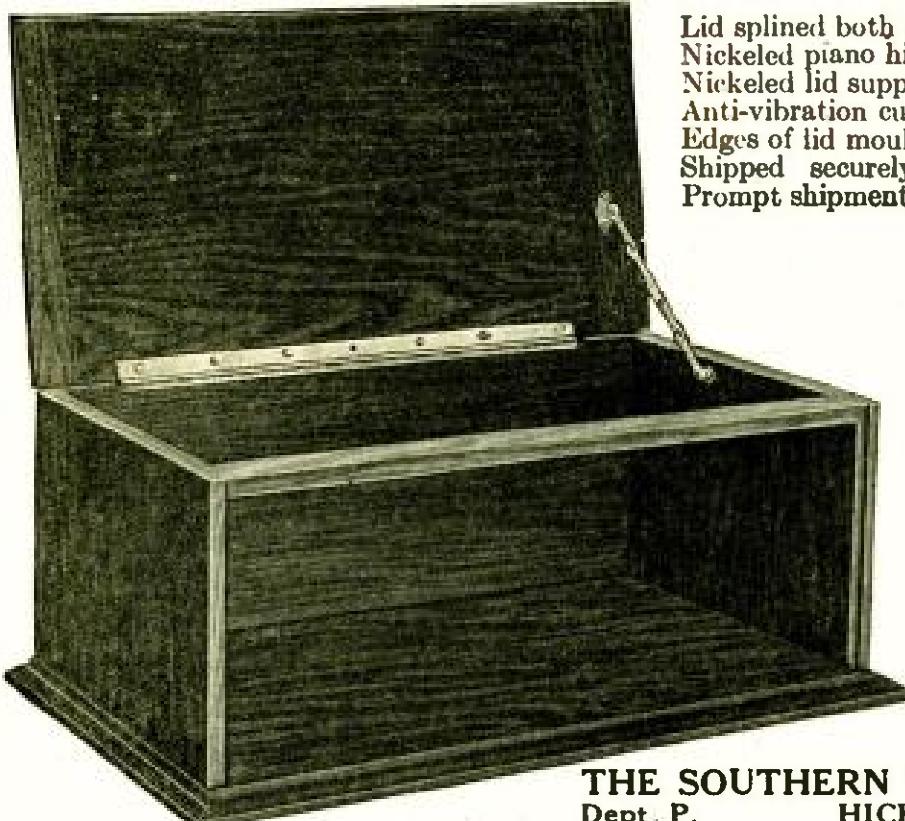
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THE FINEST RADIO TUBE



LABORATORIES, Inc.
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A RADIO CABINET OF BEAUTY AND ELEGANCE DIRECT TO YOU AT LOWEST COST



Lid splined both ends to prevent warping.
Nickel piano hinge.
Nickel lid support of artistic design.
Anti-vibration cushion feet (not visible in cut).
Edges of lid moulded to match bottom.
Shipped securely packed in strong carton.
Prompt shipment.

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7 x 18 x 7 $\frac{1}{2}$ or 10 in. deep	\$3.50	\$5.00	
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Prices F. O. B. Hickory, N. C.
Order express shipment, often
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from damage.

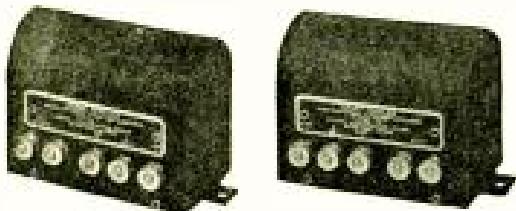
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a glued-up stock non-warping $\frac{1}{2}$ -
inch BASEBOARD.

Free Catalogue.

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"Take No Chances—Use Como" **COMO DUPLEX**

The World's Standard Push Pull
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PRICE \$12.50 per pair

For maximum volume without distortion

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NU-WAY BATTERY CABLES

Are Equipped with **NU-WAY** Connectors

No need to remember colors of cables or trace wires as each connector is marked: Ant., A-, etc.

The Battery Adapter slips over the threaded post or through the spring clip.

No more fussing to get the cable through the clip or around the post. Simply SNAP the connector to the NU-WAY stud.

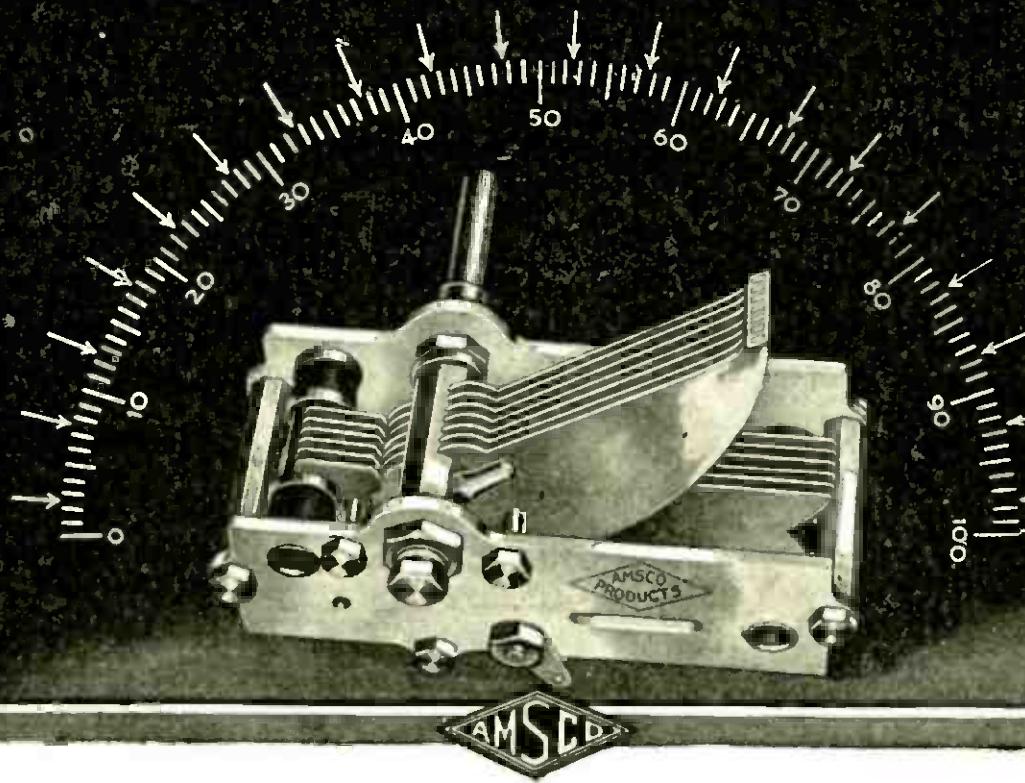
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THE HATHEWAY MFG. COMPANY

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The AMSCO ALLOCATING CONDENSER (STRAIGHT LINE FREQUENCY)



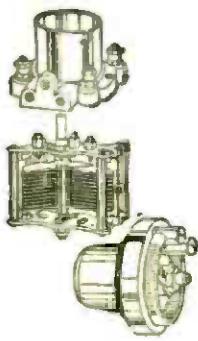
AMSCO

Spreads the Stations Over the Dial—

The new AMSCO Allocating Condenser is the triumphant combination of electrical engineering and mechanical ingenuity. Electrically efficient in unscrambling the stations on your dials. Each dial degree from 1 to 100 will be found to represent 10 broadcasting kilocycles accurately over the entire scale—"a station for every degree." Mechanically ingenious in correcting the fault of other S. L. F. Condensers—it conserves space! Scientific low-loss construction. Rigidity with light weight.

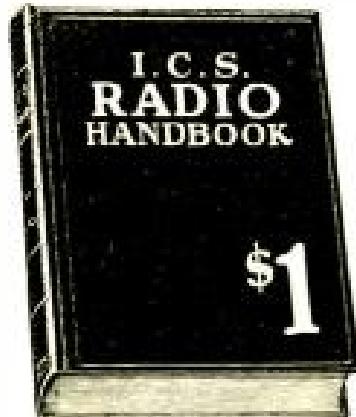
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"Dialite"



\$1.75

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Gives you light right over your dial, where you need it. Complete with snap switch. Single hole mounting.

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Perfect precision in every part reduces loss of energy —makes it possible to pick up, and build up, weak signals from far distant stations, and to reproduce such signals with amazing volume, perfect clarity and and fidelity to tone.



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A demonstration proves the superiority of this 5-tube, tuned radio frequency receiver Enclosed in rich mahogany cabinet. Price, without accessories, \$75

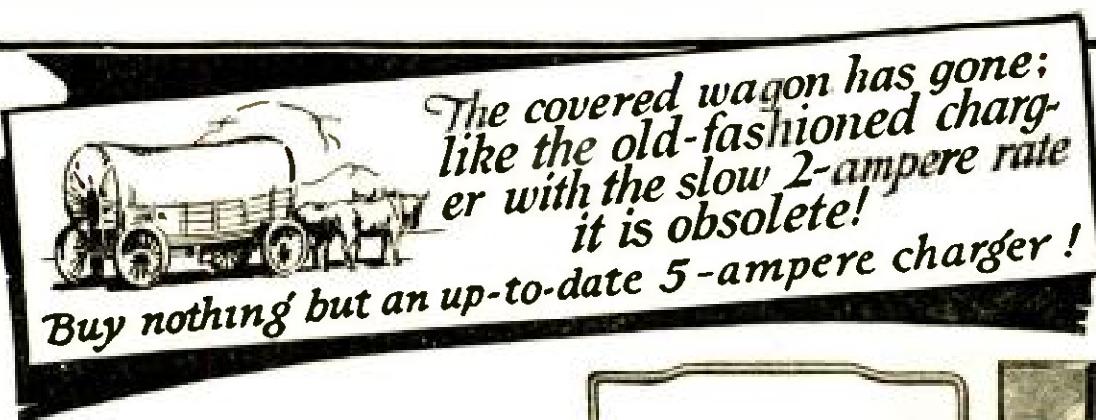
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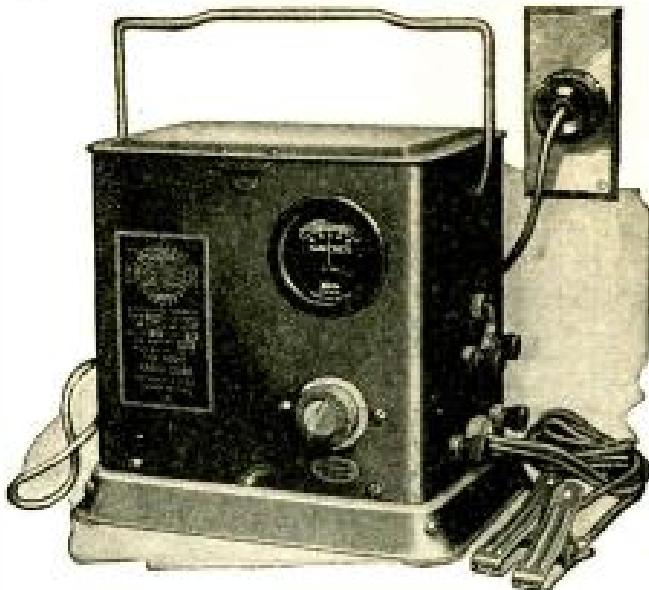
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The New Improved
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Over 500,000 already in use

Get This Modern Fast Charger!

Better Because:—

New micrometer adjustment,
hinged lid, and carrying handle.

No bulbs to buy or break.

Can be used anywhere—contains no acids or other harmful liquids to spill.

Approved by underwriters—
trouble-proof, shock-proof and
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Beautiful cabinet in maroon
and gold.

When you buy a charger don't let anybody sell
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The New Improved GOLD SEAL HOMCHARGER,
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that were necessary when the slow inefficient chargers
of last year were the best that radio offered.

And the New Improved GOLD SEAL HOM-
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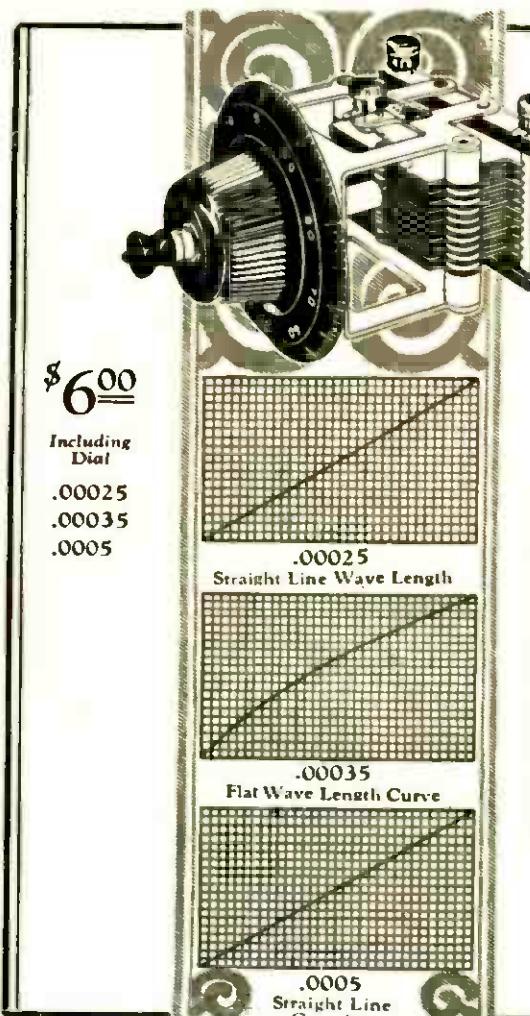
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our instructive booklet on
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WKRC

Owners of Kodel Broadcasting Station WKRC
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Positively— More Stations if you use a **BARRETT & PADEN** Micrometer Condenser

(For any type of Set)

A RECEIVER cannot bring in a station unless it is tuned into resonance with that station. There are many stations which you have not been able to receive because the condensers in your set did not have a sufficiently wide range of minute capacity variations to enable you to tune enough separate and distinct resonance points. No matter how finely you try to tune with your present condensers you skip these signals—because their tuning range is limited.

Install Barrett & Paden Micrometer Type Condensers and bring in the weak distant stations with loud

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At your dealers or direct

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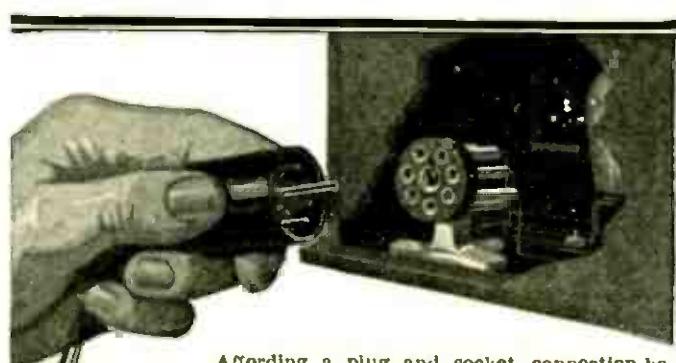
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No. 248
E-5841
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"Little Joe"
Lightning Arrester

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

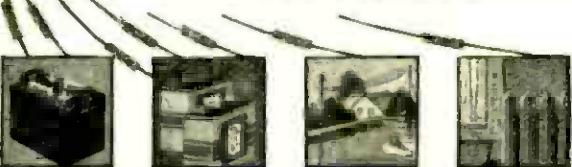
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M'f'd by CIRCLE F MFG. CO.
Trenton, New Jersey



Affording a plug and socket connection between the radio set and all outside connections. Jones Multi-Plug is as essential to the radio as a cord and socket to the electric iron. For safety and convenience leading set manufacturers have adopted this item as standard equipment. You too need a Multi-Plug for the set you are building or the set you now have. See your dealer or write direct for descriptive folder C.

TYPE BM For set Building \$4.50
TYPE BP Adaptable to any Set \$5.00

HOWARD B. JONES CHICAGO, ILL.
618 S. Canal St.



Jones
MULTI-PLUG
THE STANDARD SET CONNECTOR

Greater selectivity, range, power, beauty and simplicity~at lower cost! *

Built like—
looks like—
performs
like a \$200
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***NOTICE!** Enormous demand for the celebrated Miraco Ultra-5 (resulting from its many enthusiastic users so highly recommending it to their friends) has enabled us to add hosts of costly new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on the newest sets selling at much higher prices. So the Improved New Ultra-5 for 1926 is even a better set—more beautiful set—a more selective and more powerful set—incredible as this may sound!—for less money than ever before. Mail coupon today!



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daily.

HEARS CALIFORNIA TO EUROPE
Enclosed is a partial list of the stations I received with the Miraco Ultra-5: KSD, WBBU, WBAV, WBAF, WLW, WCRD, WIIB, WOR, WJAZ, WOU, WHAS, WWJ, CKAC, KFKX, WCK, WIAZ, KFAK, WHAA, WASI, WCAP, WTAS, WQJ, KFKX, WAAS, WTAM, WOAI, WSOE, WCO, KDKA, WHAP, WMC, CNRO, WLS, WIU, WBZ, WMH, KFNE, KPL, WEEL, WBL, WFAA, WAF, WGY, CKY, WRK, WCAE, WEAO, WRC, FFDM, WJJD, WGR, WABN, WCAL, WER, WHIN, WMAQ, WJZ, WLS, WOAW, WIO, WOS, CPAC, Sheffield, Eng.; Paris, France; Carl H., Waukesha, Wis.

MONTANA HEARS CALIFORNIA TO IRELAND

I am more than pleased with the Ultra-5 receiver. I have 90 stations on my feed-in in 30 days time, including KDKA, WCAI, KFLE, WFC, WCC, WIAN, WEAF, WEM, WGM, WCAL, WLW, CAM, CFCE, WJJ, WAE, KAKB, KOOW, WCCO, WOC, WOAZ, WIO, WCGA, WOAW, CKAC, WOAL, WOS, WCKE, KFPP, KBB, KPO, KFPA, WMCR, CKY, WOOF, WMAQ, WRAF, WGN, KJR, WIU, WOS, WMC, WJJ, WGAN, KGU, WGW, WLW, WOOL, WHB, WFAJ, WIAZ, KGO, WCAF, KSAC, WTAI, KSKJ, KFKA. On February 16th at 12:45 o'clock received Ireland—the distance between seven thousand miles. Richard.... Comertown, Mont.

WEST VIRGINIA HEARS AUSTRALIA
Got 2-XB Wellington, Australia, plain last night at 12:45 A.M. over the Ultra-5 Miraco you sold me. I am delighted and would not trade for any instrument in town. Geo.... Glen Ferris, West Va.

WINS IN DISTANCE AND TONE

The Miraco five-tube has all the other five tube radios beat by a mile. All my friends have radios but they can't get distance or clear tone as I can with mine. I have about 65 stations now and I get them as far as Oakland, Los Angeles, Calgary, Miami, Fort Worth, Omaha, and a lot more. Leon J..... Buffalo, N.Y.

UTAH HEARS COAST TO COAST
My Miraco Ultra-5 is a marvel. Directly I got it hooked up I got Zion, Ill., loud and clear on loudspeaker, and had been a great number of stations coast to coast since, all coming in on loudspeaker very clear. I consider it one of the best sets I have heard and am greatly pleased with it. John R..... St. George, Utah.

GREENHORN HEARS STATIONS EVERWHERE

To date have had about fifty stations on the Ultra-5 including Los Angeles, Havana, Winnipeg, Boston, etc., which is quite some for a greenhorn I think. Lynn C..... Bowling Green, O.

**GETS COAST TO COAST AND
CANADA**
I received my Ultra-5 radio from you and I can say it is a wonder. We have received stations from coast to coast and also Canada. Orie E..... Lacombe, Iowa.

now only **\$59.50** retail

SEND FOR SPECIAL OFFER!

The Powerful New **MIRACO** **Ultra-5**

[FIVE TUBE OUTFIT IN BEAUTIFUL MAHOGANY CASE]

The amazing coast to coast reception (on the loudspeaker) and International revolving range of the famous Miraco Ultra-5 in the hands of its multitudes of pleased users—as voluntarily reported by them to us in writing—offers proof of performance which makes claims by us superfluous. Send for plenty of this proof—and our remarkable Special Offer—at once.

Remember that one of America's oldest and most reliable manufacturers of quality sets completely builds, thoroughly tests and factory guarantees each Miraco. That longer experience and immense production make possible such money-saving prices. Bear in mind that this big, beautiful, powerful and clear-toned Miraco Ultra-5 is the latest, improved model. That it has a beautifully gold-etched genuine Formica panel with large Bakelite knobs equipped with gold filled indicators for very fine tuning.

ing. That it is even more selective, more powerful and is capable of getting greater distances due to exclusive use of "Duoformers" (ultra low-loss inductance coils—the newest achievement in radio engineering). "B" battery consumption is minimized and oscillations are controlled on all wavelengths by a new patented feature, the "Counter-Balancer." Flexibly wired (to prevent broken connections). Has an adjustment for different length aerials, only two rheostats, a cut-out switch, concealed wiring and other features of costliest sets.

Comes in a handsome hand-rubbed mahogany cabinet. An instrument thoroughly tested and approved by radio's highest authorities and one which anyone can easily connect, operate and "log." Works on storage or dry batteries. Literature describes other latest improvements—use coupon.

Other Miraco Long Distance Sets \$13.75 up
retail

Wonderfully improved new models in one-tube and three-tube Miraco Long Distance Sets also ready at lower prices! Powerful new Miraco R-3 at only \$27.50 (retail) operates loudspeaker on distant stations.

All Miraco sets work on storage or dry batteries. Approved by Radio's highest authorities. Unmatched values! Let testimony of users convince you. Write for literature and Special Offer—use coupon.

All the Proof you want is waiting for You!

Reports from their hosts of users in every state prove Miraco sets—at rock-bottom factory prices—outperform sets costing much more money. Send for latest literature, SPECIAL OFFER and plenty of additional testimony from users leaving no doubt that "Miraco Radio Gets 'em Coast to Coast."

SEND COUPON FOR SPECIAL OFFER!

Dealers! Jobbers!

Write for the new Miraco proposition.

Agents!

The wonderful tone, volume and distance-setting ability of Miraco Sets makes them easy to sell. Send coupon for proposition; good territory open.

Send coupon
for free bulletins!
[or order
direct from
this ad]

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets, 479 E. Eighth St., Cincinnati, O.
Send free literature, SPECIAL OFFER and all particulars regarding
Miraco Sets.

NAME.....
ADDRESS.....

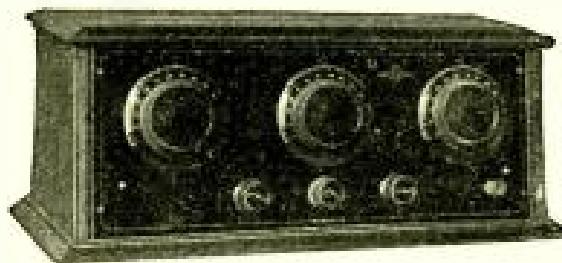


TRIMM
Home Speaker

TRIMM Home Speaker is the only \$10 speaker with a scientifically designed, goose-neck type, Volconite horn having a bell measuring 12 in. Every Home Speaker performs alike. Absolute uniformity insures everybody's satisfaction—and we guarantee that. Be sure to hear the Home Speaker.

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.



New!
Simplex SR 8
\$65

In this 1926 5-tube model you get the highest development of the noted Simplex radio frequency circuit. Amazing selectivity. Dependable on distance. Exceptionally easy tuning. New tone modulator gives complete control of volume.

Simplex SR 5, Five Tubes \$57

Simplex superiority has caused our name to be widely copied. In fairness to yourself, be sure to get genuine Simplex products made in Phila. by the original manufacturers.

If you can't see Simplex at your dealer's, write direct.

SIMPLEX RADIO COMPANY

Main and Rector Sts.

Manayunk

Phila., Pa.

This  means
HILCO

Five HILCO Condensers, installed in 18 minutes, will make a 3-tube circuit equal a 5-tube reflex—and then some!

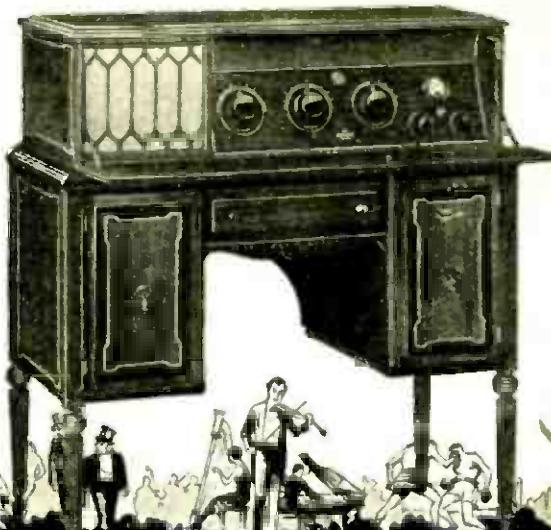
But don't expect it from any other make. It takes the dynamo - tested, watch - built HILCO thus to clear frequency paths, stop battery clack and make low-loss a verity. You never knew a fixed condenser like it—yet HILCO Condensers cost no more than makeshifts.



Bearable dealers and jobbers will get HILCO Condensers for you from

A.E.HILL Mfg Co. ATLANTA

KING IN RADIO



"King In Radio" meets every radio taste with three beautiful, distinctive models.

Table type
Built-in Loudspeaker
Magnificent Console.
These are furnished
in two-tone. Mahogany and Walnut.

KING In Radio" stands for reception of regal worth—the royalty of radio. To Neutrodyne's proven advantages have been added 15 years of experience in radio, King-Hinners design, plus the accuracy of workmanship, the fine limits, the high standards by which King products have held public confidence for 20 years.

The King-Hinners Neutrodyne Receiver gives you faultless tone, the ability to select stations easily and quickly, simple and accurate operation plus dignified beauty—truly "King In Radio."

Double metal panel plus condenser shields eliminate whistling.

Antenna coil switch affords greater selectivity on short waves, and increases volume on long waves.

A voltmeter warns you of rundown batteries, prolongs the life of batteries and tubes. It insures proper connections and makes it impossible to reverse "A" battery wires.

Rheoswitch does away with the need of resetting the rheostat. A slight turn and receiver is put in operation or shut off.

Stationary dial with moving pointers lessens eye strain and does away with moving numbers.

Three separate tuning controls insure exact tuning, and the utmost in selectivity.

By these and many other practical advantages the King-Hinners Receiver offers the features exclusive to Neutrodyne at their best—unfailing selectivity, simple tuning, perfect tone and greater distance.

Write for booklet "The Quest of 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.

**KING
NEUTRODYN
HINNERS**

Experts in acoustics and radio combined their efforts to produce the loudspeaker built into King - Hinners Receivers.

The horn is scientifically matched to harmonize with the loudspeaker unit. The result is a loudspeaker which faultlessly reproduces the full, rich tones.



MODEL 25S



MODEL 25



NAVY MODEL C-10 Super-Heterodyne

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
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Federal	Kellogg

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.

AEROVOX

CONDENSERS YOU'VE HEARD OF

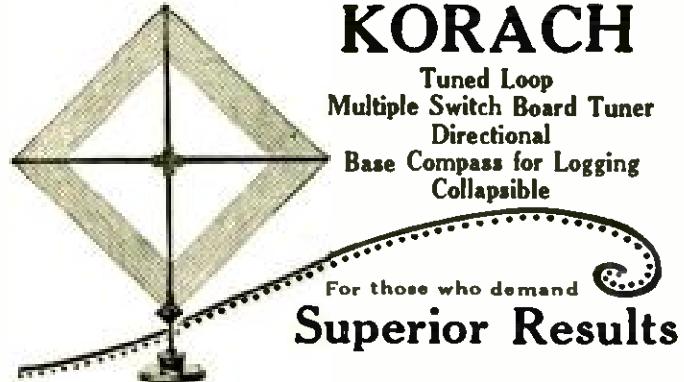
.5 MFD
AEROVOX
BY-PASS
CONDENSER

Manufactured by
AEROVOX WIRELESS CORP.
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A structural superiority that insures accuracy and permanence. Demand Aerovox Standard in size, they are interchangeable.

Write for our catalogue including resistances, grid leaks, resistoformers and rheostats.

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Leads the march toward perfect radio reception under all conditions. Not merely a "loop" but an ingenuous arrangement of mechanical skill designed for superior results. L. M. Cockaday, using this loop, reached out across the Atlantic to audibly hear many trans-continental Stations.

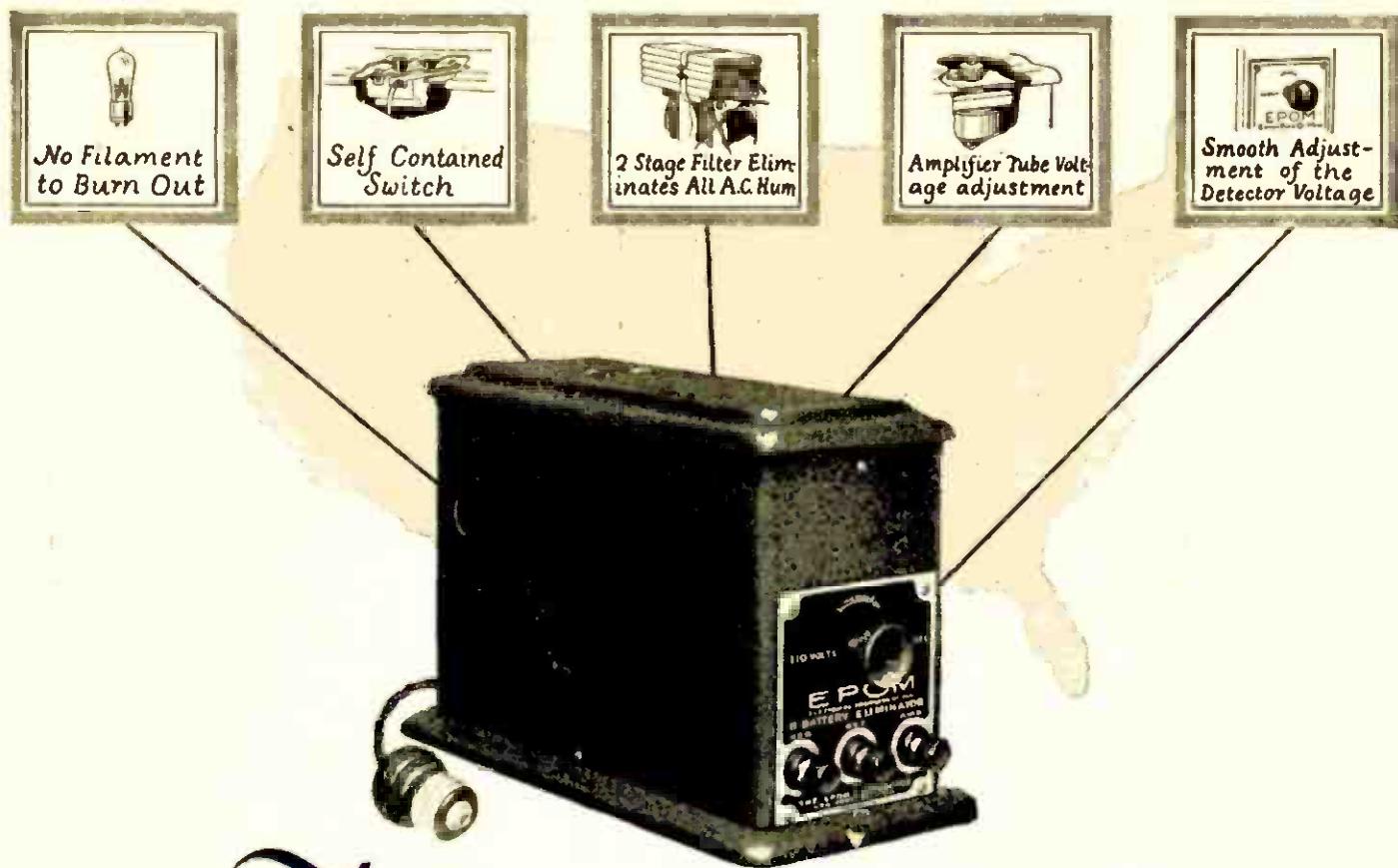
Selectivity Plus Distance

unheard of with common loop aerials. The Korach excels on all sets designed for loop reception. Priced at \$16.50 and for sale by all good dealers. Full particulars sent for 2c stamp and name of local dealer.

KORACH RADIO CO.
20 E. JACKSON BLVD. Dept. 10 CHICAGO, ILL.
Dealers and Jobbers: Write today for attractive proposition

THE KORACH JUNIOR

A modification of the "Senior" but possessing all its important features - - - \$12.50



The UNITING of the BEST PRINCIPLES

By the uniting of the best electrical and mechanical principles, their untiring efforts and refusal to accept defeat, the EPOM Engineers have overcome the obstacles that have beset all the pioneers of the industry and have added a noteworthy achievement to radio.

The elimination of inefficient, temporary "B" Batteries and the assurance of permanent, noiseless "B" power direct from a convenient lighting socket is possible now in the EPOM "B" Battery Eliminator. The following Distributors have the EPOM "B" Battery Eliminator in stock:

New York	E. B. Latham & Co.	Springfield, Mass.	Wetmore-Savage Co.
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Newark	Tri-City Elec. Co.	Milwaukee	J. Andrea & Sons Co.
Newark	E. M. Wilson & Son.	Detroit	Electrical Specialties Co.
Hartford	So. New England Elec. Co.	Cleveland	Erner Electric Company
Boston	Pettengell & Andrews	Cleveland	Republie Electric Co.
Boston	Wetmore-Savage Co.	Columbus	Erner & Hopkins
Philadelphia	Jones-Beach & Co.	Cincinnati	Post-Glover Elec. Co.
Philadelphia	F. H. Stewart Elec. Co.	Kansas City	B-R Electric Company
Baltimore	Southern Electric Co.	Dallas	Southwest G. E. Company
Pittsburgh	Union Electric Co.	Indianapolis	Indianapolis Elec. Supply Co.
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ELECTRICAL PRODUCTS OF MERIT

"B" Battery Eliminator

EPOM CORPORATION

114 E. 47th St., N. Y. City

EARN \$50 to \$200 A WEEK!

Become a Radio Expert

This is the time to get into Radio—the new fast growing uncrowned profession. Stop working long hours for small pay at work that is drudgery. Men from all walks of life are taking advantage of the big opportunities now open in this wonderful new industry. Salaries of \$100 a week—and more—not at all uncommon!

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Almost every day we get urgent calls for our graduates. The big jobs hunt you when you are a Radio Expert. Radio offers you more money than you ever dreamed possible—a chance to travel or to take any one of the many Radio positions all around you at home. And Radio offers you a glorious future!

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Write today for free book "Rich Rewards in Radio." Tells all about this great new money-making field—and describes our amazing practical method which gets you the bigger paying jobs in Radio. No obligation mail coupon NOW. National

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D. C.**



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Grecian Model

Pathé

CONE LOUD SPEAKER

Exquisite in tone
Exquisite in design
Exquisite in workmanship

Some territories for both jobbers and retailers still open. Write

PATHE PHONOGRAPH AND RADIO CORPORATION
Dept. 4357 20 Grand Avenue, Brooklyn, N. Y.

"WINDHAM" WIRE FORMER

(Patent Pending)



A complete and handy tool for electricians, radio set builders and mechanics. It will accurately form loops or eyes for No. 4, 6, 8 and 10 screws, make easy radius and sharp right angle bends, has flat jaws and wire cutters. This tool is made of the best quality steel, dropped forged and carefully tempered in oil.

Price \$1.25 Each

Manufactured by

THE GOYER COMPANY
Willimantic Connecticut

Radio drafted Bakelite *so all could listen-in*



To make available for everyone, everywhere, the marvel of radio reception, radio engineers required an insulating material possessing a unique combination of properties.

Bakelite alone met the need. It combines high insulation value with strength and light weight. It is easily formed into the many shapes required and will not warp, shrink nor swell. It will not absorb moisture and is unaffected by extremes of heat and cold.

All of these properties and the beautiful color and finish of Bakelite are permanent—unaffected by time, use or climate. So "Radio drafted Bakelite," and today it is used by over 95% of radio set and parts manufacturers.

Make sure that the radio set or parts that you buy are Bakelite insulated, for good insulation is essential to clear reception.

Write for Booklet 28

BAKELITE CORPORATION

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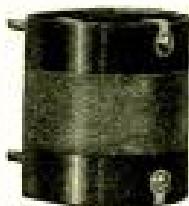
Bakelite is a registered trade mark and can be used only on products made from materials manufactured by the Bakelite Corporation. It is the only material which may bear this famous mark of excellence.

BAKELITE

THE MATERIAL OF A THOUSAND USES

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A PRECISION COIL for McLAUGHLIN ONE CONTROL SUPER



Price,
\$1.85

Precision
Inducto
Coupler

James L. McLaughlin, an authority on superheterodyne design, says, "Your Inducto Coupler may be used wherever an oscillator is needed—and is peculiarly adapted for use in my new One Control Superheterodyne. It is the only coil I recommend for use in my new circuit."



Precision R-F Couplers
Price, \$2.50 each

This highly efficient coil is one of the finest radio frequency coils on the market. The hard rubber core is octagonal in shape, with the sides concave, permitting the wire to touch at only eight points. This gives a coil that is 90% air core and yet it has the rigidity of one wound on a solid surface cylinder.

Because the success of his 4-circuit tuner so largely depended on the efficiency of the coil, Cockaday in specifying the Precision Cockaday Coil paid a great compliment to the marked accuracy and efficiency of Precision Coils.

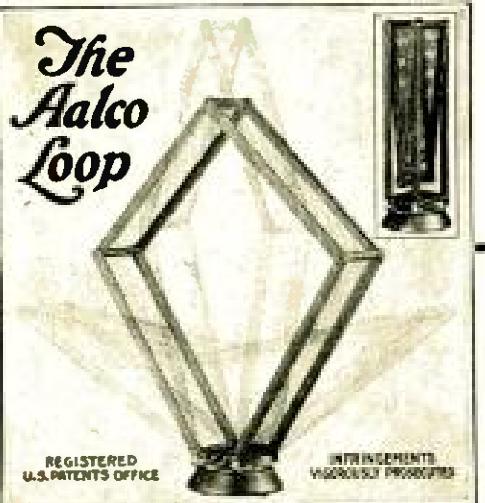


Cockaday Coil
Price, \$5.50

PRECISION COIL CO., Inc.

209 Centre Street

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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.

LIST PRICE \$15.00

JOBBERS: Write for our proposition

AALCO RADIO LABS.
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RADIO NEVER HAD A TUBE EQUAL TO EMPIRE-TRONS

Does 1200 hours continuous operation mean anything to you? Does perfect radio reception; clarity and sensitivity appeal to your trade? Satisfied customers pay big profits. Make a comparative test and convince yourself.



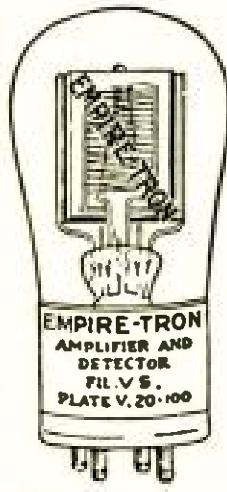
Each tube is
a model of
perfection.

Finest
mechanical
construction.

Bakelite
bases

Type '99
also
supplied
with
'01A base.

Tested in our
Factory
Made in
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Satisfactory Performance Guaranteed

Any tube showing mechanical defects may be returned to us within 60 days of purchase. Can you ask for more?

Superior Quality Priced Right Larger Profits to Dealers
Ask Your Jobber for EMPIRE-TRONS. Write us for Folders
—also for EMPIRE LINE OF SPEAKERS AND UNITS

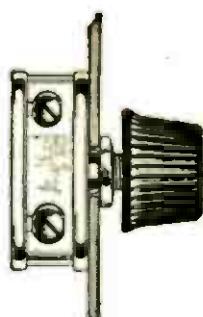
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There's a Real Thrill in trying a New Hook-Up!



Bradleystat—Perfect
Filament Control for
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EVERYONE in the family is eagerly waiting to hear the new set! After hours and hours of drilling and soldering, the set is nearly ready for its first crucial test. Will it meet with your expectations or will it be a disappointment? That depends upon two things—first your workmanship, and second, the quality of the parts used. Good workmanship is the result of patience, but good parts are assured only by demanding well-known, guaranteed products, such as Allen-Bradley Perfect Radio Devices. Allen-Bradley Products are known the world over for exceptional performance and fine appearance. They eliminate the hazard and disappointment that follows the use of inferior radio products.

Ask your dealer for Allen-Bradley Perfect Radio Devices if you value your time and labor. They always work!

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Electric Controlling Apparatus

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Milwaukee,
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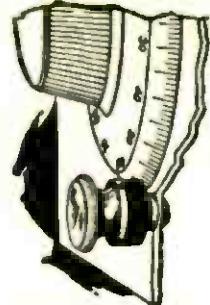
Mfrs. of Graphite Disc Rheostats for
Over 20 Years

ALLEN-BRADLEY CO.,
276 Greenfield Ave., Milwaukee, Wis.

Please send me your latest liter-
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Leak $\frac{1}{2}$ to 10 Megohms.



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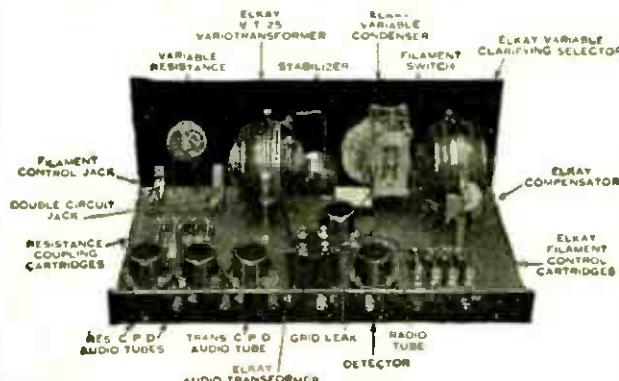
5-Tube Super-Selector RESISTANCE COUPLED - \$80!

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 mahogany cabinet. A genuine triumph, based on the fundamental ELKAY circuit.

Also built for 4 tubes at \$70. Write for folder. Amateur set builders, write for kit prices on ELKAY sets.

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



The Langbein-Kaufman Radio Company
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An LK Product



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

YOUR
THREE
BEST BETS



X-L RADIO PRODUCTS

Just install them in your receiver and leave them speak for themselves

Endorsed by LAURENCE M. COCKADAY and other leading radio authorities and publications

Model "N" Vario Denser

Capacity range 1.8 to 20 micro-micro-farads, for balance in Roberts two tube, Browning-Drake, McMurdo Silver's Knockout, Neutrodyne and tuned radio frequency circuits. Price \$1.00

Model "G" Vario Denser

Two capacity ranges, .00016 to .00055 and .0003 to .001 Microfarada, for the Cockaday circuits, filter and intermediate frequency tuning in super-heterodyne and positive grid bias in all sets with grid-leak clips. Price \$1.50



X-L Push Post

A binding post that really does excel in looks, action, service and convenience. Just push it down—insert wire—cannot jar loose from vibration. No screwing or danger of shearing off wires. Furnished attractively plated with soldering lug and necessary markings.

Price Each 15 Cents

X-L RADIO LABORATORIES
2422 Lincoln Ave. **CHICAGO**



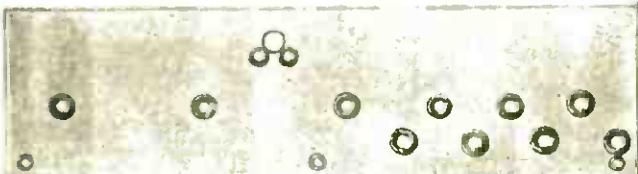
Something New

Hornig Glass Insulated Terminal Strips

Samples sent postpaid on receipt of following prices:

2 connections	\$.50	Each includes a glass lube, two mounting brackets and all necessary machine screws and nuts
3 connections65	
4 connections80	
5 connections95	
6 connections	1.10	
7 connections	1.25	
8 connections	1.40	

Write for Dealer and Jobber Discount



Hornig Glass Panels and Cabinets
(equipped with Safety Bushings Pat. App.)

Ask for our Bulletins

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3921 Dickens Avenue, Chicago, Ill.
Tel. Spaulding 3156

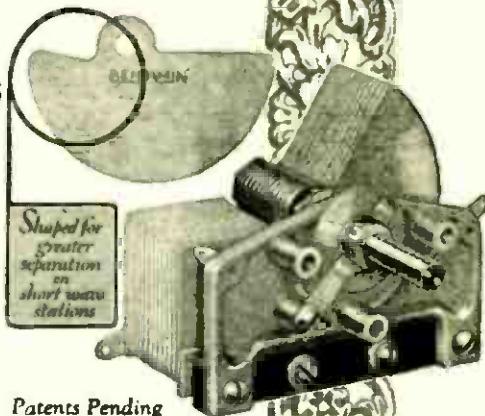
Perfect Results

in Radio Reception

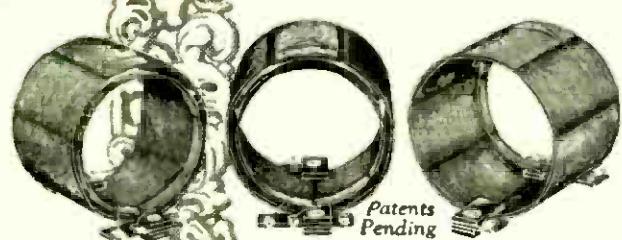
In reproducing the bewitching melody of some famous orchestra, all working parts in the radio set must co-ordinate and harmonize with each other to develop perfect reception. Individually or in combination, Benjamin Super Radio Parts achieve this beautiful tonal perfection by banishing disturbances and distortions, stopping radio losses, properly balancing the tuning range, increasing selectivity, and in making the set neater and better looking.

Benjamin Low Loss Long Range Condensers

Spreads the broadcast range, eliminating bunching of stations on the lower side of the dial. The cut-away shape of the rotor blades aids sharp tuning and makes tuning much easier. Unpolished silver plate finish. Small size of condenser makes it adaptable to any set, regardless of crowding of apparatus on subpanel. Friction disc on rotor shaft adjusts turning tension without throwing rotor plates out of alignment. In three sizes: 13 plate for .00025 Mfd., 17 plate for .00035 Mfd., and 25 plate for .0005 Mfd.



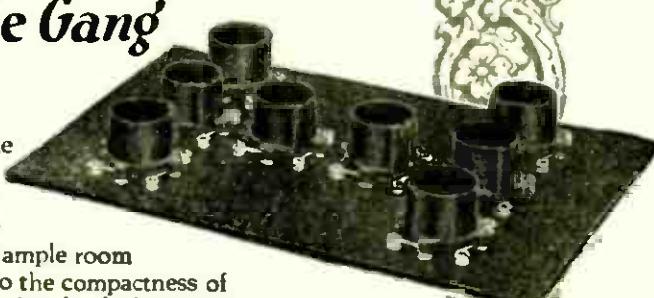
Patents Pending



more selective by enlarging the tuning range. Coils are coupled so as to reduce capacity of coupling to a minimum. Green double silk covering provides high insulation and gives a fine appearance to the coil.

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. Makes any set



Benjamin Cle-Ra-Tone Gang Sockets

A step toward greater simplicity in the construction of Radio Receiving Sets. A number of Spring Suspended Shock-Absorbing Cle-Ra-Tone Sockets are mounted on a single Bakelite base, with ample room for other equipment. They add greatly to the compactness of the set and preserve the advantages found with individual Cle-Ra-Tone Sockets. This 8-tube Gang Socket is particularly adaptable for the McLaughlin circuit and is also made in other sizes to fit into any type of circuit. Now ready. Your dealer can secure these gang sockets from all radio jobbers.

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ALL SPECIFIED PARTS FOR McLAUGHLIN ONE CONTROL RECEIVER

2 Precise No. 750 Syncrodensers	Each \$4.50	\$9.00
1 Precise No. 744 Connector		.60
1 Marco 4" Vernier Dial (clockwise)		2.50
1 Hammarlund, Jr. Midger Condenser		1.80
2 Carter "Imp" Jacks with plugs for loop wires. Each	50	1.00
1 Benjamin No. 9050 8 gang socket shelf		11.00
1 Drilled Bakelite Panel 10" x 14 1/2" x 3/16"		4.50
1 pair Precise Aluminum Brackets		2.00
1 Weston No. 301 Voltmeter 0 to 7 volts.		8.00
1 Weston No. 301 Milliammeter 0 to 25 milli- amperes.		8.00
1 Benjamin Battery Switch		.35
1 New York Coil mica fixed Condenser .006 mfd.		.75
2 Dubilier 1 mfd. by-pass Condensers. Each \$1.25		2.50
1 Dubilier No. 640 mica fixed Condenser .00025 mfd. with grid leak clips.		.45
1 Daven 2 megohm grid leak		.50
1 Precision Inducto Coupler No. 260		1.85
1 Precise No. 1900 Filtoformer		4.50

1 Precise No. 1700 Super-Multiformer	\$20.00
1 General Radio Rheostat type 214A 2 ohm. 2 1/2 amperes.		2.25
1 General Radio Potentiometer type 214A 400 ohm		3.00
1 Precise Audio Frequency Transformer No. 480 5 to 1 ratio.		7.50
1 Precise Audio Frequency Transformer No. 480 2 1/2 to 1 ratio.		7.50
1 Carter double circuit "Holdrite" Jack		1.00
1 Carter single circuit "Holdrite" Jack		.70
18" stranded wire for oscillator circuit		.10
1 N. Y. Coil mica fixed Condenser .00025 mfd.		.35
28' Celatsite Wire		1.40
Bus bar, screws, lugs		.75
1 Mahogany finished cabinet		9.60
Total		\$113.30
1 D T W Loop		\$25.00
8 True Blue Tubes at \$3.50		28.00

Ask for any Parts you can't get

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We Carry All Standard
Radio Receivers. Also
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Representing Reputable
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Establish connections
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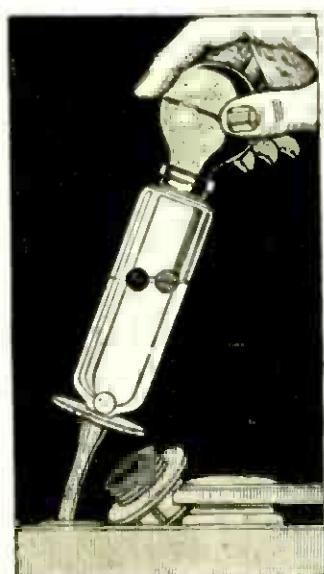
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Simple - Durable - Accurate



Easy to Read and
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BALLS are used as
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These Patented Balls
show the condition
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Swim all Three,
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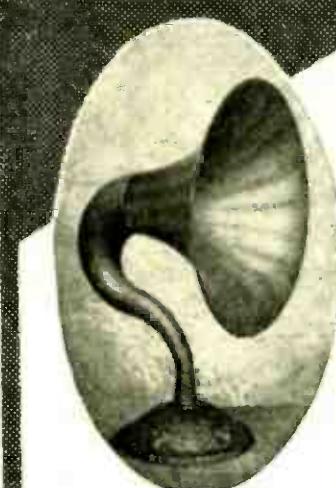
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Acknowledges No
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Perfect reproduction
with volume, without
distortion. The se-
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lies in this loud-
speaker. You must
hear it to be con-
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will arrange this
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The Remola Concert Cabinet

The same tone quality as the Remo Trumpet, but even sweeter. A mahogany cabi-
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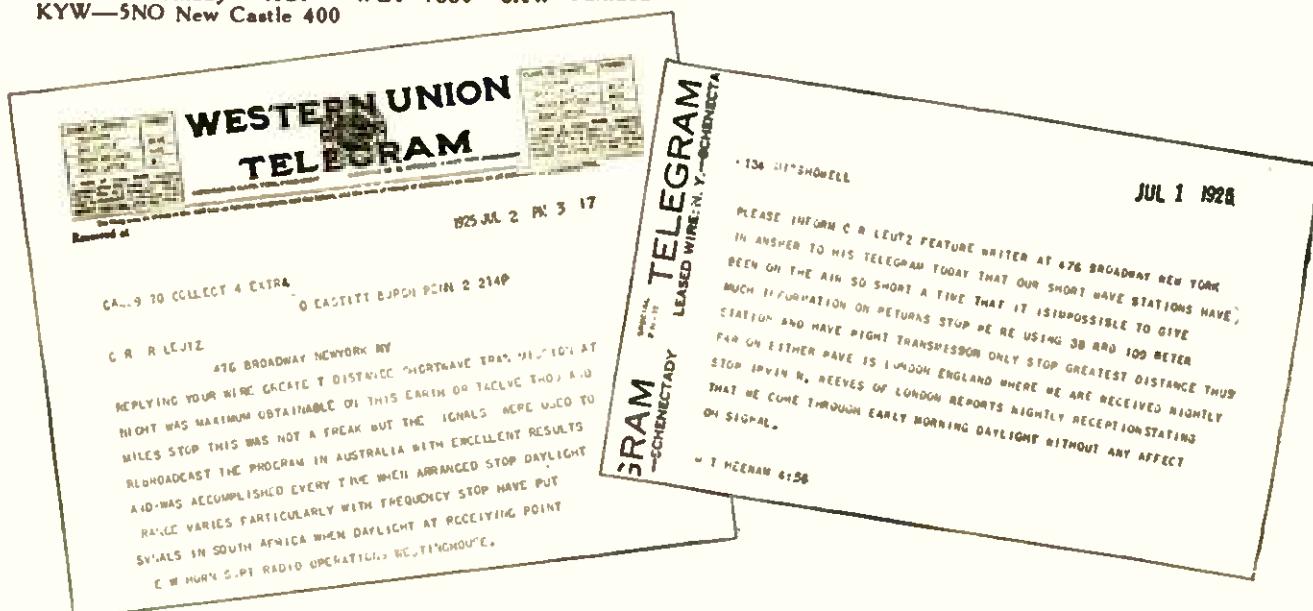
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*The Only Set That Tunes All Wave Lengths Within Distance Range
35 TO 3600 METERS*

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3LO Melbourne
1720

6BM Bourne-
mouth 385

5WA Cardiff
350

PRC Prague
1800

2ZY Manches-
ter 375

HB2 Lausanne
850

JJC Funabashi

JSB Chemulpo

3FL Mel-
bourne 400

6VL Liverpool
318

HBI Geneva
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KDKA 64

POZ Berlin
2800

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325

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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.

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McLaughlin De Luxe One Control RECEIVER

We can make immediate delivery on any or all parts specified by James L. McLaughlin, R.E., for his remarkable one control receiver. Check the parts you want on the list below and send with your money order. Write today!

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1 Precise No. 744 Connector	.60	1 General Radio Potentiometer type 214A 400 ohm	3.00
1 Hammarlund Jr. Midget Condenser	1.80	1 Precise Audio Frequency Transformer No. 480 5 to 1 ratio	7.50
2 Carter "Imp" Jacks with plugs for loop wires at 50¢ each	1.00	1 Precise Audio Frequency Transformer No. 480 $2\frac{1}{2}$ to 1 ratio	7.50
1 Benjamin No. 9050 8 gang socket shelf	10.80	1 Carter double circuit "Holdtite" Jack	1.00
1 Drilled Bakelite Panel 10" x $14\frac{1}{2}$ " x $\frac{1}{8}$ "	4.35	1 Carter single circuit "Holdtite" Jack	.70
1 Pair Precise Aluminum Brackets	2.00	18" stranded wire for oscillator circuit	.10
1 Benjamin Battery Switch	.35	1 N. Y. Coil mica fixed Condenser .00025 mfd.	.35
1 New York Coil mica fixed Condenser .000 mfd	.75		
2 Dubilier 1 mfd. by-pass Condensers at \$1.25	2.50		
1 Dubilier No. 640 mica fixed Condenser .00025 mfd. with grid leak clips	1.50	1 Weston No. 301 Voltmeter 0 to 7 volts	8.00
1 Daven 2 megohm grid leak	1.50	1 Weston No. 301 Milliammeter 0 to 25 milliamperes	8.00
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A Shielded Radio Frequency Transformer

Lowest resistance of any shielded radio frequency transformer, effective electromagnetic and electrostatic shielding, reduces interference from strong local signals, permits compact construction; eliminates inter-stage coupling, which prevents stray feed-back and allows better control of regeneration. Space wound solenoid inductance. Mechanical precision in construction insures perfect matching. **No critical angle for mounting.** Primary tapped for all tubes. Easily substituted in your present set. Mounting base $3\frac{1}{2} \times 4\frac{1}{2}$ inches.



From dealers or sent direct postpaid. Free technical circular especially prepared by W. W. Harper, designer of the Metaloid.

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It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently, look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35¢ a copy.

July, 1925

Contains a regular Handbook of the Best 101 Hook-ups, also

- "What Set Shall I Buy?"
- Second Installment.
- Broadcast Stations in the United States.
- What's New in Radio Apparatus.

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- "Motion Pictures" by Ether Waves.
- A New Type of Hornless Loudspeaker.
- How to Build a 5-Tube Radio-Frequency Set with Simplified Control.
- Trouble Shooting.
- Hints for Amateurs.

September, 1925

- How the Air Affects Radio.
- When You Turn Your Dials.
- Useful Charts for Amateurs.
- Call Letters That Have a Past.
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Balkite Radio Power Units

the ideal power supply for any radio set



**Balkite
Battery Charger**

This popular battery charger is entirely noiseless. 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. Also for 25-40 cycles with 1.5 ampere charging rate.

Price \$19.50

West of Rockies, \$20
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**Balkite
Trickle Charger**

Charges both 4 and 6 volt radio "A" batteries. Will furnish more current than is used for 6 dry cell or 2 storage battery tubes, if used only while the set is in operation. If allowed to "trickle" charge continuously will also furnish enough current for as many as 8 dry cell or storage battery tubes. Size 5½ in. long, 2½ in. wide, 5 in. high. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles. Price \$10

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Balkite Radio Power Units are the ideal power supply for any radio set. They simplify and improve radio reception. They reduce the amount of attention you must give your set. With their use your current supply is always exactly what is required for each circuit.

For the "A" circuit there are the Balkite Chargers. The popular Balkite Battery Charger is entirely noiseless and can be used while the set is in operation.

For sets of smaller "A" current requirements there is the Balkite Trickle Charger. With a low capacity storage battery it enables owners of sets now using dry cells to make a most economical installation.

For the "B" circuit there is Balkite "B". It eliminates "B" batteries entirely and supplies plate current from the light socket. It fits any set of 6 tubes or less. For sets of 6 tubes or more there is Balkite "B" II.

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 wear out or replace. They require no other attention than the infrequent addition of water. They require no changes or additions to your set.

Manufactured by

FANSTEEL PRODUCTS COMPANY, Inc.
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FANSTEEL
Balkite
Radio Power Units

BALKITE BATTERY CHARGER · BALKITE TRICKLE CHARGER · BALKITE "B" · BALKITE "B" II



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 twice a year.

Will serve any set of 6 tubes or less. Occupies about same space as 45 volt dry "B" battery. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

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Same as the new Balkite "B" but will fit any set including those of 8 tubes or more. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

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The Gould Unipower is equipped with a special Balkite Radio Power Unit

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MAGNATRONS have achieved supremacy in the vacuum tube field, but the constant vigilance which has brought these tubes to the fore has not for one moment been lessened. Every part, from contacts to filament, is tested, constantly tested.



Magnatrons are made by the oldest exclusive manufacturer of thermionic valves. The Connewey plant has been turning out vacuum tubes long enough to know how—and rigid inspection makes certain that that knowledge is always being used.

*The Magnatron DC-201A, DC-199
and DC-199 (large base) now list
for only \$2.50 each.*



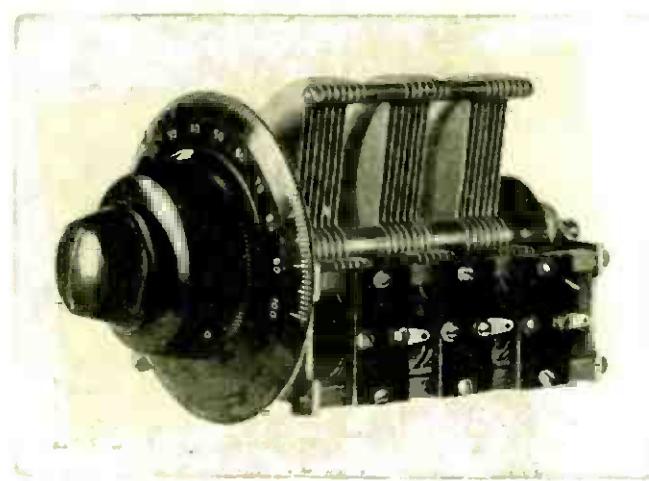
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MAGNATRONS

LOMBARDI



Shaft Construction
Pat. May 13, 1924



STRAIGHT-LINE-FREQUENCY CONDENSER

"LOMBARDI JUNIOR"
Midget Condenser for Balancing Stages of Multiple Controlled Radio Frequency, for Capacity Antenna Coupling and Tuned Tickler Regeneration

Lombardi Straight-Line-Frequency Condensers give sharp tuning and separation of low wave stations not possible with any other type. Made with highest mechanical and electrical precision. Absolute minimum of loss and variation from rated capacity. Patented adjustable ball and taper shaft bearings eliminate all play in rotor. Watch-spring pigtail makes positive contact. Made in single or multiple units. Multiple Condensers licensed under Hogan Patents.

Recommended in August Popular Radio for use in Craig Tuned Radio Frequency Set

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M&M Low Loss INSULATORS

Storm, Weather and Water Proof.

PERFECT your entire insulation by insulating your antenna and ground system. Your set is not responsible for energy lost through insulated aerial. M & M Low Loss and Lead-in Wall Insulators will give your set insulation.



4" Lead-in Insulators 50c.
10" Lead-in Insulators 80c.



20" Lead-in Insulators for heavy walls \$1.50.

WALL INSULATORS

The 5" Wall Insulator illustrated here is made to hold all sizes of wire from 4 to 14. Meets Underwriters' requirements and makes your antenna insulation perfect.

Price, 60c.

Dealers: If your jobber cannot supply you, write us direct giving your jobber's name.

Send for our catalog.

The M&M Co.
CLEVELAND, OHIO.



*You'll Like
This Duplex*

One cabinet—

Any panel size, 7x26, 7x24, 7x21 or 7x18". Depth 10". Room for all dry batteries. Either straight or sloping panel—grooves, no screws.

Solid mahogany. Latest lacquer hand-rubbed finish. Entire lid raises. Full length piano hinge. Folding lid supports. Felt covered feet. Extra $\frac{1}{2}$ " mounting board.

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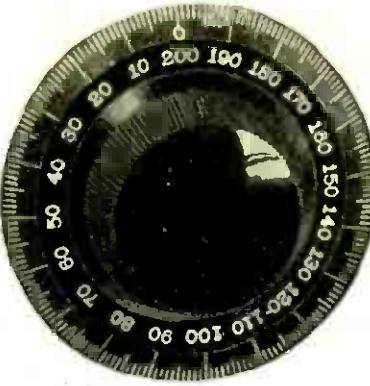
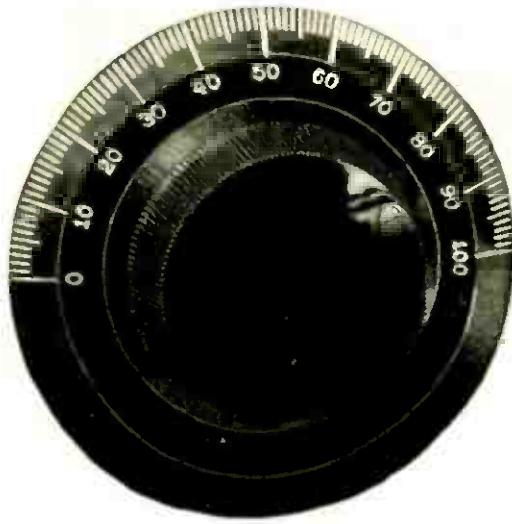
The new Blandin Console is ready for you.

Blandin
TRIPLE A Radio Cabinets

Built by
BLANDIN
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"Align right—Hold tite"



THE NEW KURZ-KASCH Aristocrats

Never before has beauty been combined with efficiency as in these New Kurz-Kasch products.

The clear-cut markings, the smooth edges, the large "comfy" knobs all add to the beauty of a set.

The Kurz-Kasch split bushing method of mounting gives you a sure grip and "aligns rite."

Send for illustrated booklet giving complete information and prices.

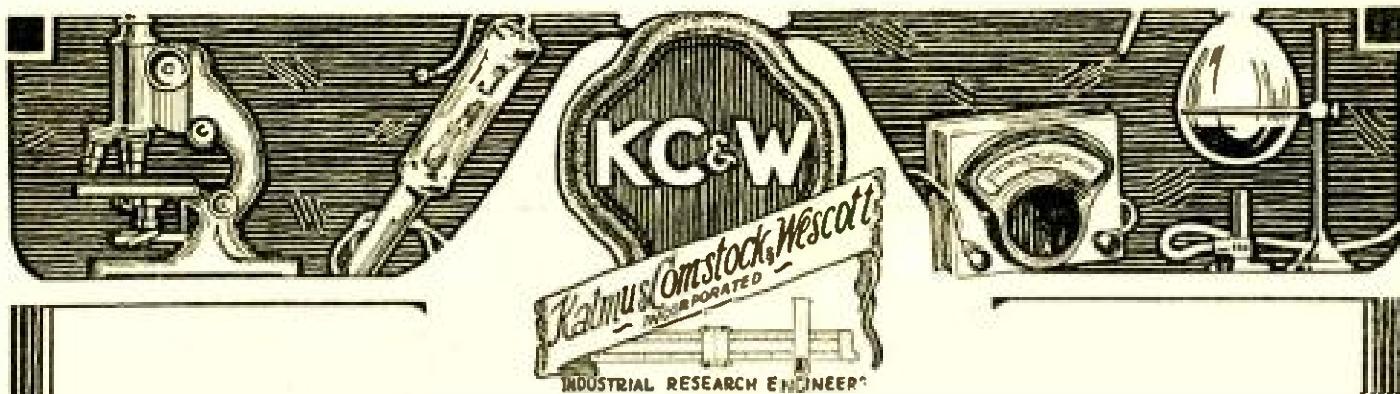
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Radio Manufacturers are constantly faced with scientific problems due to the discovery of new principles and the necessity for keeping their product in the front rank in Radio's rapid advance.

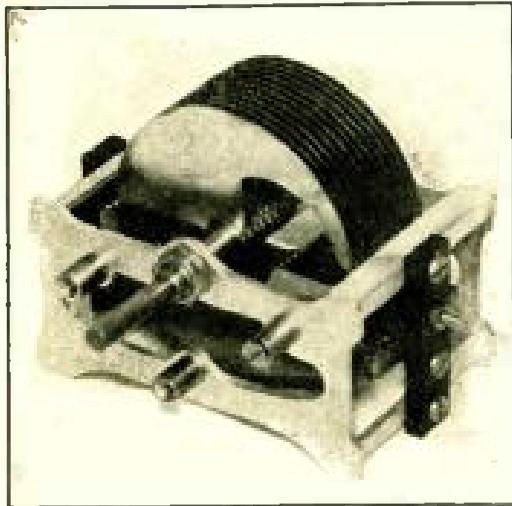
Kalmus, Comstock & Wescott, Inc., offers to the Radio Industry resources, equipment, and trained scientific skill necessary to solve these problems.

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Announcing the Chelten Straight-line Frequency Condenser (Modified)



Chelten Straight-line Frequency Condenser
(Modified) Made with standard frame.

At last! A condenser that spreads low-wave stations and that also overcomes the vital defect of ordinary straight-line frequency condensers—the crowding of high wave lengths. Insures uniform separations over the entire tuning range. Not mere claims or theory—but a scientific design, proved by severe tests under actual operating conditions.

GET THE FACTS!

Fans! Dealers! Separate the wheat from the chaff. Save yourselves trouble and disappointment by getting the truth about straight-line frequency tuning. This booklet gives you the facts—clearly, fully, impartially. And it's free!

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AUDIO FREQUENCY

AMPLIFYING TRANSFORMER



The Triumph of a Masterpiece!

—A Marvel of Transformers that Brought Real Musical Quality to Radio Reception

JUST one year ago the Karas Harmonik Audio Frequency Transformer took the radio world by storm.

Nothing like it had ever been known before. For the first time, scientific study had been devoted to perfecting an audio transformer for the reception of broadcast music. The problem of amplifying high, low and medium frequencies to equal degree was finally solved. Bass notes were poured from the speaker in full strength and rich tone quality. The vital harmonics in rich overtones, formerly lost, were brought out in their full beauty by this marvel of audio transformers.

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Prominent radio engineers subjected Karas Harmoniks to exhaustive laboratory tests—and pronounced it a technical masterpiece. Technical editors who promoted the season's most successful hook-ups specified Karas Harmoniks in their circuits. The triumph of the Karas Harmonik was complete.

But, for all of this, the enjoyment of Karas Harmonik amplification was too greatly confined to one class of radio enthusiasts. Home set builders bought Karas Harmoniks by the tens of thousands. They were free to pick and choose. They were most exacting in their demands for the newest and best developments.

It was the owners of factory-built sets who missed the delightful pleasure of real, true radio music in their homes. Set manufac-

turers were prevented by price from adopting Karas Harmoniks for their sets. So the ready-made set-buyer unless he undertook to switch transformers, had to do without Karas Transformers.

Today there are in use, hundreds of thousands of sets—good sets—which could be vastly improved in musical quality by the simple operation of replacing the old transformers with Karas Harmoniks. Perhaps you own one of these sets. It may be all you desire from the standpoint of selectivity of range, and other tuning qualities. But, if it is not equipped with Karas Harmonik Audio Frequency Transformers, you are NOT getting *nearly* the musical quality you can just as well enjoy. Are you going to be content with anything short of the best?

You can install Karas Harmoniks yourself. It's a short, easy job. Or, any radio repair man can do it for you. Make up your mind to do it now—at once. Get a pair of Karas Harmoniks TODAY!

In large cities, most good dealers carry Karas Harmoniks—and in many small towns. If your dealer is out of them, order direct from us. Send no money. Just send the coupon now!

Karas Electric Co.,
4044 N. Rockwell St.,
Chicago, Ill.

The Distinctive Features that Elevate Karas Harmonik Transformers to the Highest Pinnacle of Success in the Radio World.

1. Many thousands of turns of wire
2. Low ratio of turns
3. Extra large quantity of special formula iron in core
4. Controlled air gap
5. No core saturation
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10. Very High Primary Impedance
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12. High and Even Amplification of all Audio Frequencies.

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Please send me _____ pairs of Karas Harmonik Audio Frequency Transformers. I will pay the postman \$7 apiece, plus postage, on delivery. It is understood that I am privileged to return the transformers any time within 30 days if they do not prove entirely satisfactory to me, and my money will be refunded at once.

Name _____

Address _____



This Is the Panel to Buy—It's a FIBROC-BAKELITE

You've invested close to a hundred dollars in the finest parts money can buy. Now you want the best panel on which to mount them—and that's a FIBROC-BAKELITE. You see, the efficient operation of your entire set depends upon the panel and you can't afford to use any but the best.

Then, too, a FIBROC-BAKELITE panel will make your set equal in appearance to the finest manufactured sets.

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, cirschian 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

For winding coils use FIBROC-BAKELITE Tubes



No backlash is possible in the new Fynur Vernier Control. There are no gears to mesh, so there can be no lost motion, and the movement is always smooth and free.

If you want the utmost accuracy in reception, and unless you have it you cannot expect the best results from your set, use Fynur dials.

If your dealer cannot supply you, write to us.

AUGUST GOERTZ & CO., INC.
270-286 Morris Ave. Newark, N. J.

FYNUR VERNIER CONTROL

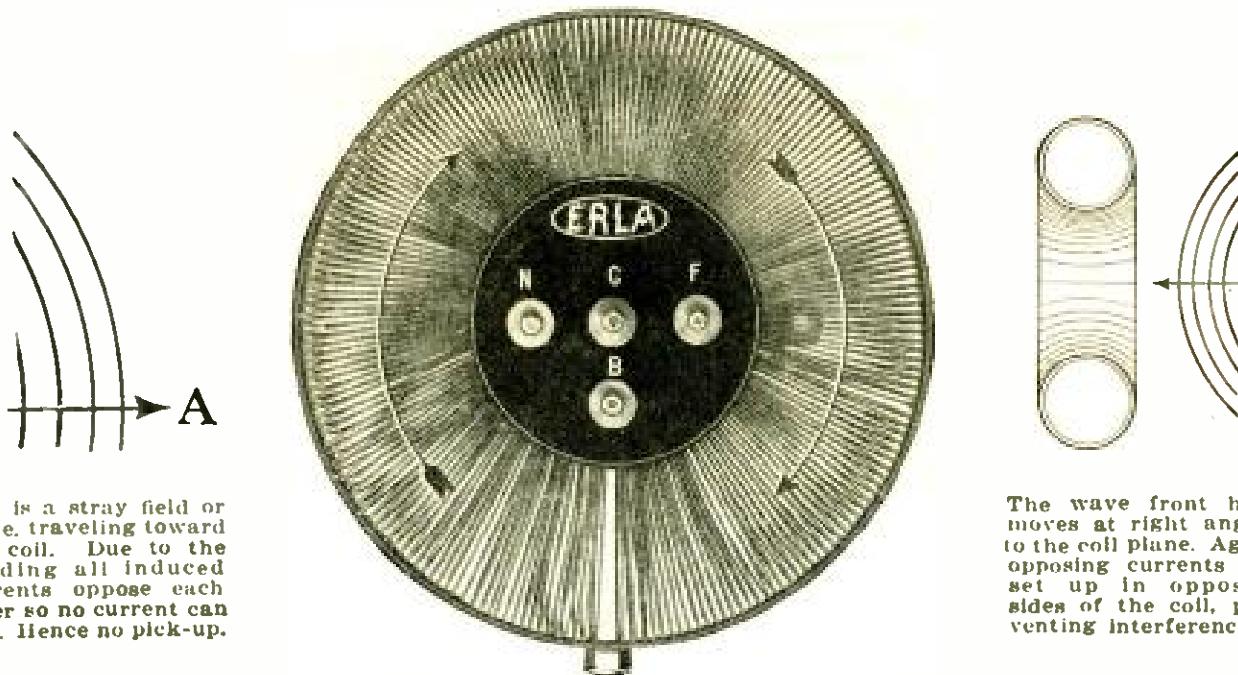


for radio dealers

—our big new catalog; fully illustrates the best in radio. Write on letterhead for copy — ask for C1004.

We Ship Fast

Wakem & McLaughlin, Inc.
225 E. ILLINOIS STREET CHICAGO, ILL.



New kind of coil

Instantly brings four amazing improvements to your present set—greater distance, more volume, increased selectivity, finer tone quality. Send for remarkable new book, *Better Radio Reception*.

SCIENCE has discovered a new inductance principle that is bringing astounding results. Now you can apply it to your present set through new type coils known as Erla *Balloon *Circloids.

Thousands of tests and experiments were necessary before the circloid was finally perfected. Leading radio engineers worked night and day in order to develop a coil that would correct the four vital weaknesses of present sets. At last they were successful.

When circloids are used, results you think impossible are obtained with surprising ease. Note especially the four that follow:

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. (See diagram above.) This explains the almost total absence of static.

Dealers—Exclusive franchises are available to high-class dealers in localities still open. Write or wire immediately.

4. **Finer tone quality.** The self-enclosed field positively prevents stray feed-backs between coils. Hence no blurring or distortion. Tones are crystal clear.

Write for new book, "Better Radio Reception"

You will be amazed at the difference circloids will make in your present receiver. Get a set and test them out today. Go to your Erla dealer or write direct.

Also send for remarkable new book just published. It explains the Circloid principle with diagrams and drawings and tells you many things you ought to know about reception. Send 10c to cover postage and cost of mailing.

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Send me free information on the Circloid. I enclose 10c for postage for book, "Better Radio Reception."

This sign identifies authorized Erla distributors. All are equipped to give complete radio service.



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Address _____

City _____ State _____

FUL-**Uses the full A.C. current—not half of it!****WAVE****The Perfect Charger for
Radio Batteries**

Model "A"—for radio "A" Batteries only. Rate 6-8 Amperes..... \$18.00

Model "A-B"—for charging "A" and "B" Batteries SEPARATELY or to charge BOTH AT THE SAME TIME \$22.00



No overheating—no blowing of fuses—no bulb—no water—no acids—the perfected radio battery charger built for radio—the Ful-Wave Charger.

It should be a part of every radio outfit. It keeps batteries fit and makes them last longer.

In two models. Model "A-B" charges both "A" and "B" storage batteries simultaneously. Model "A" for "A" batteries operates in almost half the time other chargers take.

Sealed at the factory—because they are built right, stay right.

The manufacturers guarantee is packed with each Ful-Wave.

SIMPLE TO OPERATE: JUST PLUG IN YOUR ELECTRIC SOCKET

SOLD BY THE BETTER CLASS OF DEALERS
Write for Booklet

LIBERTY ELECTRIC CORP. of NEW YORK - 342 Madison Ave., New York



Where you see these signs
— in circuits—use —

Potter BY-PASS Condensers

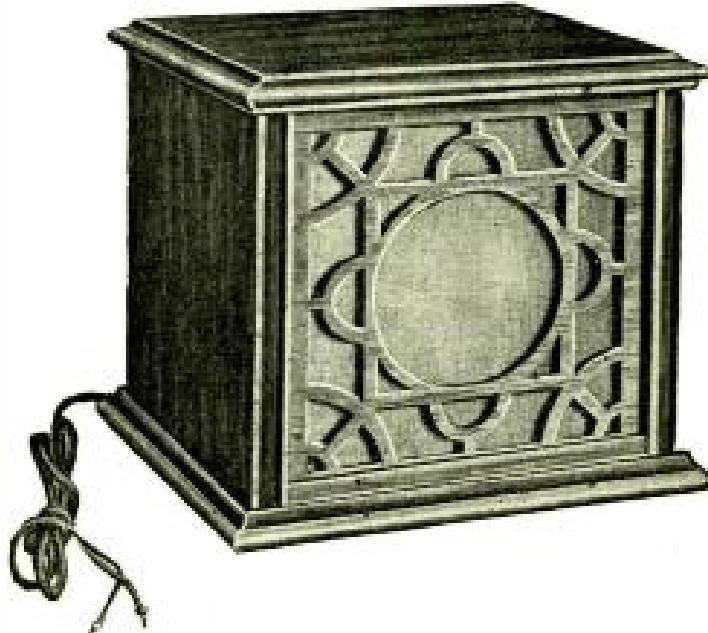
- They prevent "B" voltage fluctuation
- Allow undistorted amplification
- Make possible full bass tones at all frequencies
- Improve reception with "B" Supply Units
- Essential for building the new Autoformer Amplifier

As easily attached as the "B" battery

Made in 1/10, 1/8, 1/6, 1, 2, 3 and 4 Microfarad sizes

At your Dealer's

POTTER MANUFACTURING COMPANY
North Chicago, Illinois



YOU HAVE BEEN WAITING for a really efficient medium sized Cabinet Loud Speaker at a reasonable price. But you want first an up-to-date reproducer of speech and music, and then a piece of nice furniture that will harmonize with the finish of your set.

THE IVEY LOUD SPEAKER IS ALL OF THAT.

SPECIFICATIONS

A powerful high-pitched telephone Unit that has just been perfected in the laboratory. A Horn developed by experts. A highly finished Cabinet of pleasing design, size 8 x 9½ x 8¼. Your choice of rich mahogany finish or solid walnut. Price \$15.00 F. O. B. Hickory. Cash with order. Shipped in a strong WOODEN BOX, with 5-foot cord all ready to use. Dept. P, THE SOUTHERN TOY CO., Inc., Hickory, N. C.



And now the final radio set —the Deresnadyne operating from the light socket

See it at the Radio World's Fair, New York City

FOR those who want a radio receiver second to none the Deresnadyne will settle the question of which set to buy. It is a complete set installed by merely plugging in the light socket, requiring no attention and always ready to operate at full power. A set which does not choose between tone quality and volume, nor between selectivity and distance.

The Deresnadyne employs no batteries. A power unit furnishes all necessary current from the light socket. This unit is entirely noiseless—a permanent piece of equipment, with no bulbs and nothing to adjust, wear out, replace, re-

charge or renew. It performs at all times exactly as do batteries when these are new and fully charged.

The Deresnadyne includes all accessories except tubes. There is nothing more to buy and no further expense other than household current (110-120 AC 60 cycle). The only connection you need make is the ground wire. Price \$365.

See the Deresnadyne at the Radio World's Fair, 258th Field Artillery Armory, New York City, September 14-19. See also the Deresnadyne II at \$125 and III at \$165, receivers employing the Deresnadyne circuit but requiring the usual battery and aerial equipment.

Andrews
Deresnadyne
Radio Receiving Set

ANDREWS RADIO CORPORATION, 1414-20 SOUTH WABASH AVE., CHICAGO

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

Guglielmo Marconi as he appears today. Signor Marconi is Honorary Chairman of the Radio Institute of America.



There's a Position for YOU in RADIO

THE Radio Industry today holds forth more and better opportunities than ever before. Radio operating and manufacturing companies are constantly employing new radio operators, mechanics, assemblers, testers, repairmen and designers.

Are you neglecting these opportunities?

Start to prepare now for an interesting and profitable career in radio. The instruction offered by the Radio Institute of America has in the last sixteen years enabled 7,000 graduates to obtain lucrative positions in radio. A competent staff gives special attention to the requirements of each student.

Our Home Study Department permits those who cannot attend classes to study radio at home in spare time. Check the course in which you are most interested and mail the coupon to the

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(Formerly Marconi Institute) Established in 1909
322a Broadway New York City

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RADIO INSTITUTE OF AMERICA,
322a Broadway, New York City.

Please send me full information about your Home Study Course of radio instruction.

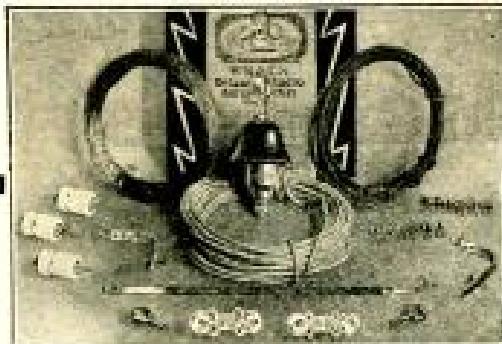
I am interested in the complete course, including code instruction, which qualifies for the U. S. Government Commercial or Amateur Radio License.

I am interested in the technical course for radio dealers, jobbers and salesmen.

Name.....

Address.....

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



The Highest Form of Aerial Obtainable

BRACH

Complete Aerial Outfits

Here you have every needed part to the last screw for an antenna—all in one package—in one purchase—everything of the highest class, including

Brach Lightning Arrester \$4 to \$5.50
At All Reliable Dealers

L. S. Brach Mfg. Co.
Newark, N. J.



KIC-O

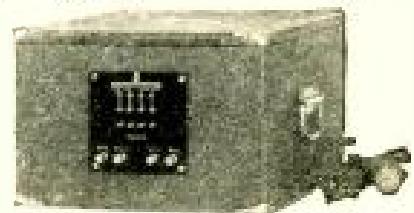
**"B" ELIMINATOR
SIMPLICITY
PERMANENT
ALKALINE STORAGE
BATTERY RECEPTION**

KIC-O MULTI-POWER UNITS operate from your lighting line and eliminate the replacing of dry cell "B" batteries—usually saving their cost in the first six to twelve months of service on Neutral-dyne and Super Heterodyne sets.

Guaranteed Two Years

PRICES
MULTI-POWER UNITS
(Complete)

90 Volt MX.. \$26.50



Permanent—**E**conomical—**P**ower
Shipped charged and ready to use.
No costly bulbs! No acid fumes!

Units for 110 volt A. C., D. C. or farm plants.
Write for special offer! Distributors! Everybody!

Kimley Electric Company, Inc.
2667 Main Street Buffalo, N. Y.

ANNOUNCING

the new

RATHBUN STRAIGHT LINE FREQUENCY CONVERTER

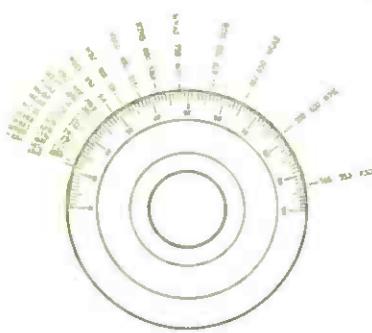
THE modern radio receiver has abundant tone, volume and power—now it may have *perfect, simplified control*.

The Rathbun Straight Line Frequency Converter is adapted for use on your receiver

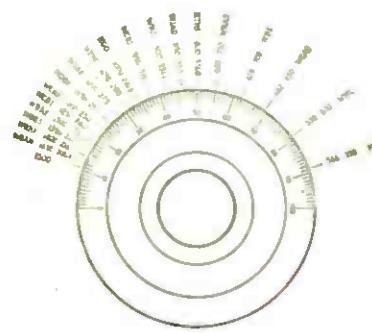
— every receiver — without change of equipment — except the condenser dials. Each station is given a distinct reading at a uniform distance from the next. Real logging becomes a fact. The stations are distributed with flawless precision over 360° —one complete revolution of the Dial. There is no limitation or crowding as on controls using only half a dial. Radio control is simplified.

The Rathbun Straight Line Frequency Converter provides straight line frequency tuning with ordinary capacity condensers. It is interchangeable with any condenser—on any receiver. It is sold with the guarantee of reliability and satisfaction attached to all Rathbun Radio Apparatus.

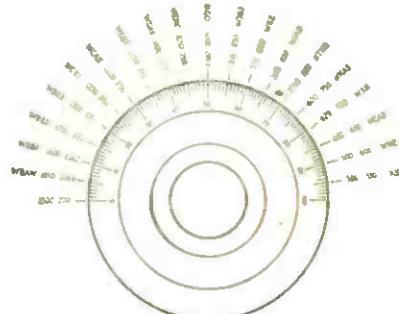
See and Try it - at Your Dealer's
If your dealer cannot supply you, send Money Order (\$3.50 each) and your order will be shipped promptly by Parcel Post prepaid.



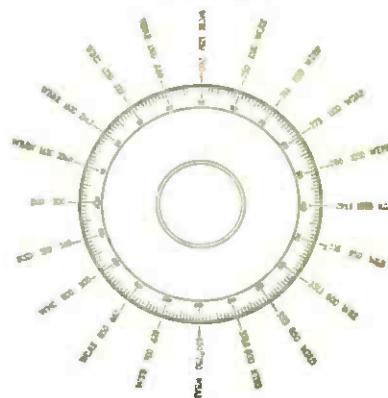
Stations indicated in kilocycles and wavelengths showing crowding with an ordinary capacity condenser.



Stations partially separated and tuning slightly improved with a Straight Line Wave Length Condenser.



Practically even separation over half the dial with a Straight Line Frequency Condenser.



Complete and equal separation of stations over the entire dial with the Rathbun Straight Line Frequency Converter.

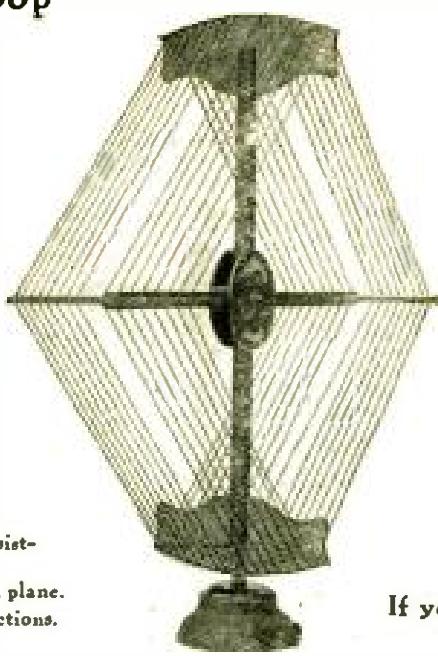
Rathbun Manufacturing Co. Inc.
Jamestown New York

Berling

An efficient loop
for
The Present Day
Superheterodynes
and
Tuned-Radio
Frequency Receivers

The Berling Loop incorporates the following features:

1. High ratio of inductances to resistance.
2. Low distributed capacity.
3. Maximum practical inductance.
4. Extremely low radio-frequency resistance.
5. Easily adjustable to rotating vertical plane.
6. Perfect electrical contact and connections.
7. Collapsible.



MADE BY

BERLING MAGNETO CO., Inc.
Buffalo, N. Y., U. S. A.

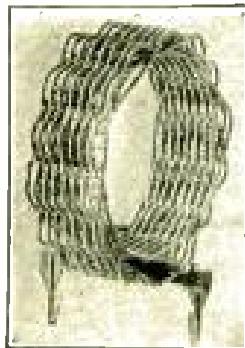
To win more
friends

WORTH MORE
DOES MORE

FINISH:
Brown Mahogany
Instrument Black
Gold Plated Parts

\$12.50

If your dealer can not supply you we will ship direct.



Correct Tuning With the Right LOW REL LOSS PLUG-IN COILS

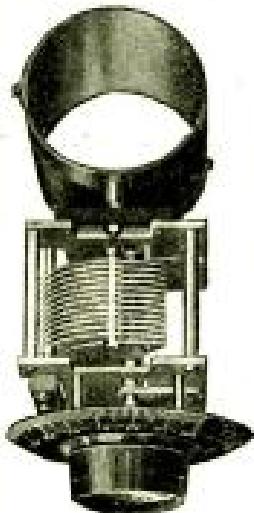
"REL" Coils are right. Their basket weave winding, triple-covered paraffined wire, low-loss plug-in mounting represents the best and highest in technical design.

"REL" low-loss coils can be used wherever coils are used in circuits, interchangeably—for a range of 10 to 1000 meters!

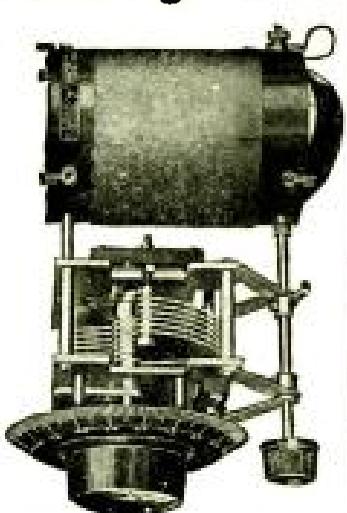
The "REL" Coil Chart tells you which size coil to use with a given size condenser, or vice versa, to get maximum results. If you are building, or intend to build a set, you will need the "REL" Coil Chart to tell you what type coils are best. Write for it and price list.

Radio Engineering Laboratories
27 Thames Street, New York, N. Y.
"The Low-Loss Coil Pioneers"

NATIONAL Tuning Units



BD1



BD2

Combining the Genuine
BROWNING-DRAKE TRANSFORMER
NATIONAL CONDENSER
VELVET VERNIER DIAL

These two well-balanced units cover the broadcast map with radio satisfaction. Write for Bulletin 105PR.

National Company, Inc.
W. A. Ready, President
Engineers and Manufacturers Cambridge, Mass.

Why does a good radio set "go bad"?

Nine times out of ten, weak signals on distant stations and poor volume on locals can be traced to weakened tubes or to low batteries.

By the use of these new, yet inexpensive, Sterling Radio Specialties, you can have permanent test and service instruments for tubes and batteries in your home. More important, you will get permanent first-class reception, at its lowest cost.

Tube Reactivator

Tube Tester

Pocket Meter

Battery Charger

STERLING POCKET METERS

Quickly determine whether your dry batteries are "up" or getting low. Also, when to recharge both "A" and "B" storage batteries. There is a type for every battery testing requirement. Sterling is the standard. See your dealer. Prices \$1.00 to \$4.00.

Ask for detailed booklet on any of the service devices.

RADIO

Sterling

The result of 20 years of progress in the

STERLING BATTERY CHARGER

The favorite Sterling Model 19 Rectifier charges 6 volt "A" Batteries; also "B" Batteries up to 96 volts (in series). Absolutely no drain on "A" Battery when charging the "B", and the meter indicates the charging rate for either "A" or "B" Batteries. Sterling Chargers are as easy to use as an electric iron—simply hook on leads, plug in and turn the selector switch. No upkeep and are good to look at. Made in enclosed and open models. Prices \$16.00 to \$25.00 at your dealers. Write for folder.

STERLING TUBE TESTER

No radio set is better than its weakest tube. You cannot tell the tube's condition by the glow nor by its service record. The scientific Sterling Home Tube Tester tells whether tubes are good, fair, or poor. Results obtained quickly, accurately and easily. Testing table furnished with the instrument. Also helpful to locate transformer, wiring, and socket troubles. Price \$8.50.

THE STERLING MANUFACTURING CO.

2831-53 Prospect Ave.
Dept. G Cleveland, Ohio

EQUIPMENT

electrical instrument field

Sangamo Mica Condensers



Accuracy guaranteed
within 10 per cent. of
marked capacity.
Resistor clips 10c extra.

In reflexing -- *where accuracy brings results*

BECAUSE of their high accuracy, Sangamo Mica Condensers give perfect results in reflex circuits, where exact capacity is necessary to success. Any receiver, whatever the circuit, is improved by the use of Sangamo Condensers.

They are accurate, and they stay accurate. All nationally recognized radio laboratories have approved Sangamo Condensers.

The accuracy of these condensers is not affected by heat or cold, moisture or acid fumes, soldering or electrical surges. They are solidly molded in smooth brown bakelite which will not chip or crack even if dropped several feet to a hard cement floor. The edges are rounded, and substantial ribs increase their mechanical strength.

All in all, Sangamo Condensers are as fine condensers as money will buy, not only on account of their sustained precision, but because their workmanship and finish is in harmony with the beautiful construction of the highest quality of radio parts on the market. Yet they are not expensive. Quite otherwise, in fact.



All standard capacities. Your dealer should have Sangamo Condensers. If not, INSIST and he'll get them for you.

Sangamo Electric Company
1320-10 Springfield, Illinois

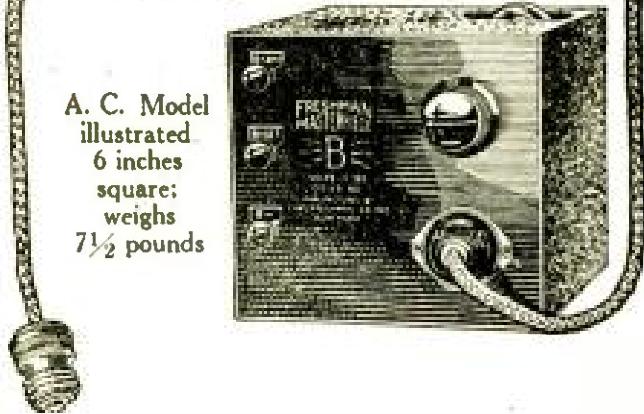
RADIO DIVISION, 50 Church Street, New York

SALES OFFICES—PRINCIPAL CITIES

For Canada—Sangamo Electric Co. of Canada, Ltd., Toronto.
For Europe—British Sangamo Co., Ponders End, Middlesex, Eng.
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**You
don't need
"B" Batteries
if you use the
FRESHMAN MASTER "B"
Battery Eliminator**

A. C. Model
illustrated
6 inches
square;
weighs
7½ pounds



Connects from any electric light socket right to your radio set;—that's all there is to it.

With the Freshman Master "B" Eliminator your set will always be supplied with constant and uniform power. Noiseless in operation; your reception will not be marred by the snap and crackle due to chemical action in "B" batteries.

Costs less than one-tenth of a cent per hour to operate

A. C. Model **\$20.00**
For Alternating Current

Freshman Rectifying Tube is required for
operation of the A. C. Model. Price . . . **\$2.50**

D. C. Model **\$17.50**
For Direct Current

Sold by AUTHORIZED FRESHMAN DEALERS Only

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Radio Receivers and Parts
FRESHMAN BUILDING
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CHICAGO OFFICE — 327 S. LA SALLE ST.

CLARITY

THE OBEDIENT SLAVE TO YOUR DESIRES

FROM the mellow depth to the highest pitch of harmony—the improved APEX Receiving Sets bring in, with startling clarity and naturalness, all of the delicate gradations of the entire range of sound—whether the highest soprano or the deepest of bassos profundo.

The charm of naturalness, combined with greater distance getting ability, positive selectivity and full volume, plus the enchanting elegance of design and finish, present radio receiving sets that are most satisfactory in every element of operation and a real delight to all whose choice of home furnishings is guided by true appreciation of artistic and refined beauty.

Only a dependable merchant is given the APEX dealer franchise. Your APEX dealer will gladly make personal demonstration of APEX Quality Radio Apparatus.

APEX ELECTRIC MFG. CO.
1410 W. 59th St. Dept. 1002
Chicago

Also makers of the famous APEX Vernier Dials and APEX Rheostat Dials, which are sold by every good dealer in Radio.



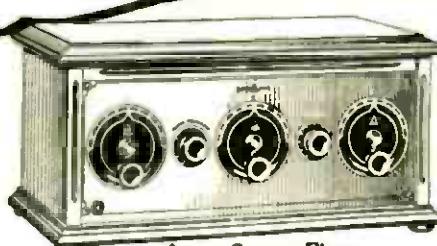
Upon request, we will gladly mail you descriptive folder.



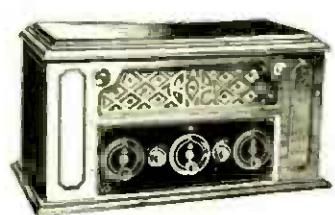
Quality Radio Apparatus



Apex Utility
Radio Table
Price \$75



Apex Super Five
Price \$95
without accessories



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Price \$135



Apex Baby
Grand Console
Price \$225



Apex
Entertainer
Price
\$22.50

Apex Console
Entertainer
Price \$27.50

Prices West of Rockies slightly higher.
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Our New
96 Page
RADIO GUIDE**

"Chockful" of Data and
Valuable Information
for RADIO Enthusiasts
Trouble Shooting Chart
Latest Released List of
Broadcasting Stations and
Hundreds of
RADIO VALUES

WRS Prices Are Lower
WRS Service Is
Prompt—Efficient
Complete
Everything in Radio

GET OUR PRICES FIRST
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FAN'S LIBRARY
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FREE YOUR BOOK NOW**

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KITS—SETS—PARTS
For All Circuits Approved by
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POPULAR RADIO

**McLAUGHLIN'S LATEST
SINGLE CONTROL
SUPERHETERODYNE**

ALSO
5 TUBE AC RECEIVER
ULTRADYNE
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All Parts Exactly As Specified By Mr. Cockaday and Inventors

We specialize in parts, kits and sets approved by Mr. Cockaday, Popular Radio and other leading radio authorities!

WHOLESALE
RADIO SERVICE CO.

**6 CHURCH ST.
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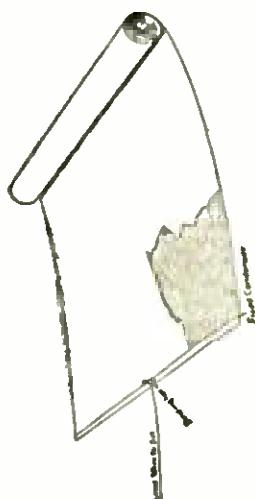
**An indoor aerial
that works even better
than an outside wire!**

Effarsee
ANTENNAE
REG. U. S. TRADE MARK
PATENT PENDING

Add hundreds of miles to your best distance with this scientifically designed antenna. Consists of 100 wire strands insulated from one another and from moisture—covered with parchment, it rolls up.

*Cuts Down Static!
Gives Louder Signals!
Greater Selectivity!*

Equipped with special fixed condensers, EFFARSEE gives range and volume of long aerial—selectivity and freedom from interference of short aerial. Write for testimonials of enthusiastic users.



Type 1XL
(Large) . . . \$4.00
Type BXL
(Small) . . . \$2.50
At any radio dealer,
or write direct.

FISHWICK RADIO CO.

503 Edwards Bldg.,

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**"HOW TO BUILD YOUR
RADIO RECEIVER"**
FREE
with POPULAR RADIO

Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO, have compiled a book that will prove to any one that he can build a set which will give distance, selectivity and tone volume, and at the same time a very definite basic knowledge of radio.

Build Your Own Set and Save Money

In "How to Build Your Radio Receiver," you will find complete specifications, constructional diagrams, photographs and instructions for building all of the following sets:

A \$5 Crystal Set
The Haynes Single Tube Receiver
A Two-Stage Audio-frequency Amplifier
The Cockaday 4-Circuit Tuner
A 5-Tube Tuned Radio-frequency Receiver
The "Improved" Cockaday 4-Circuit Tuner
The Regenerative Super-Heterodyne Receiver

30 DAY OFFER

You can secure a copy of "How to Build Your Radio Receiver" FREE, and have all the privileges of the Technical Service Bureau without additional expense, if you will send a remittance of \$3.00 in full payment of 12 months' subscription for POPULAR RADIO. (Or as an alternative, you may have the book and privileges of the Technical Service Bureau with POPULAR RADIO for 7 months only—for \$2.00. A two dollar bill will do.)

**POPULAR RADIO, Dept. 105
627 West 43d St., New York City, N. Y.**

Enclosed remittance of \$3.00 is payment in full for a 12 months' subscription for POPULAR RADIO, with advisory service and copy of "How to Build Your Radio Receiver" FREE.

Name.

Address.

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Check here if you want the \$2.00 offer of POPULAR RADIO with "How to Build Your Radio Receiver" and Technical Service Bureau privileges for 7 months only.

One Tuning Control— Calibrated in Meters!

THIS, the fondly sought, generally abandoned dream of every radio engineer has, at last, found fulfillment in the Ferguson "Eight," and without a sacrifice of any of the sensitivity, selectivity, tone quality or volume that have, since the pioneer days, been outstanding characteristics of every Ferguson Receiver.

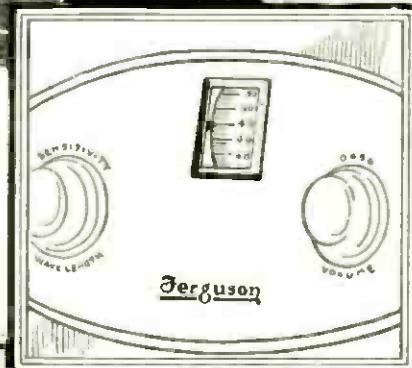
Milady will acclaim the Ferguson "Eight" for its graceful beauty, its unequalled simplicity, its full, crystal-clear reproduction. The man who knows radio will choose it because he appreciates excellence, permanence and dependability in design and craftsmanship.

*Authorized Ferguson Dealers sell
Ferguson Receivers. If there
is none in your locality, write us.*

J. B. FERGUSON, Inc.
41 East 42nd Street, New York

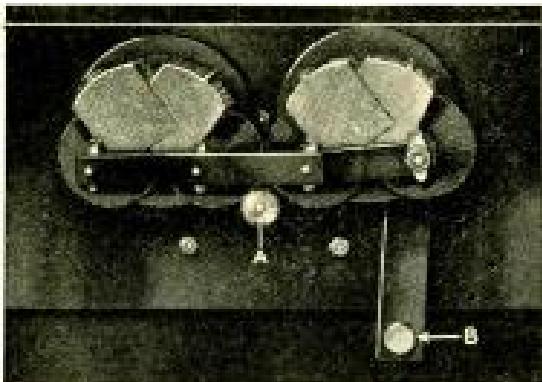
The Ferguson
"Eight"
is a six-tube tuned
radio frequency
Receiver.
Cabinet Model (illustrated) . . . \$226
De Luxe Console Model
with built-in Amplifier
& Loudspeaker . . . \$348

To operate, simply light the
tubes; select your program,
noting its wavelength; set in-
dicator and adjust vernier and
volume. Simplicity itself!



Ferguson
J. B. INCORPORATED
The Gold Standard of Radio Receivers

Brighton



The S-C Capacity Element

Offers an easy means of obtaining simple tuning.

Be up-to-date!

Make your set a single control.

This device can be easily applied to Roberts, Browning - Drakes, Superheterodynes or any set with two controls.

Furnished complete with instructions, template and Martin-Copeland vernier dial, \$15.00. Without dial \$13.50.

4 TUBE "SUPERUNIT" with loop and S-C Capacity Element, \$55.00. Three styles. Type A for standard base, Type B for 199's, Type C for UX tubes.

Hanscom Radio Devices

Woonsocket, R. I.

U. S. A.

MUTER

DEPENDABLE RADIO PRODUCTS



Lightning Arresters — approved by Fire Underwriters. Retail **50c**

Complete Aerial Kits — everything for complete installation with instructions. Retail **\$3.50**

Resistance Amplifiers — all assembled and ready for use. Retail **\$8.00**



Audio Frequency Transformers — tests have proven the quality. Retail **\$2.25**

Automatic Shock Proof Phone Plugs — a real value at this price **50c**

Sold by
All Leading Radio Dealers

Get This Big Western Radio Catalog

NEW
1925-1926
EDITION

Contains nationally advertised High Quality Sets, Parts and Kits.



Western Radio co. ^{MFG}
134 W. Lake St. Chicago, Ill.

Continuous, unfailing "A" Power

—in a single compact unit . . . that automatically replenishes itself

THE new Gould Unipower asks for a place in your set on this basis—that it will contribute more than anything else to the convenience, perfection and economy of operating your set—that it will give you the most that your money can buy—that it will banish "A" battery failure, the most frequent cause of poor radio reception.

Unipower is a single compact "A" power unit that fits inside most radio cabinets. Unipower is not a battery eliminator, and should not be confused with any other power device. Unipower is a scientifically designed "A" current supply which automatically converts house lighting current into radio power.

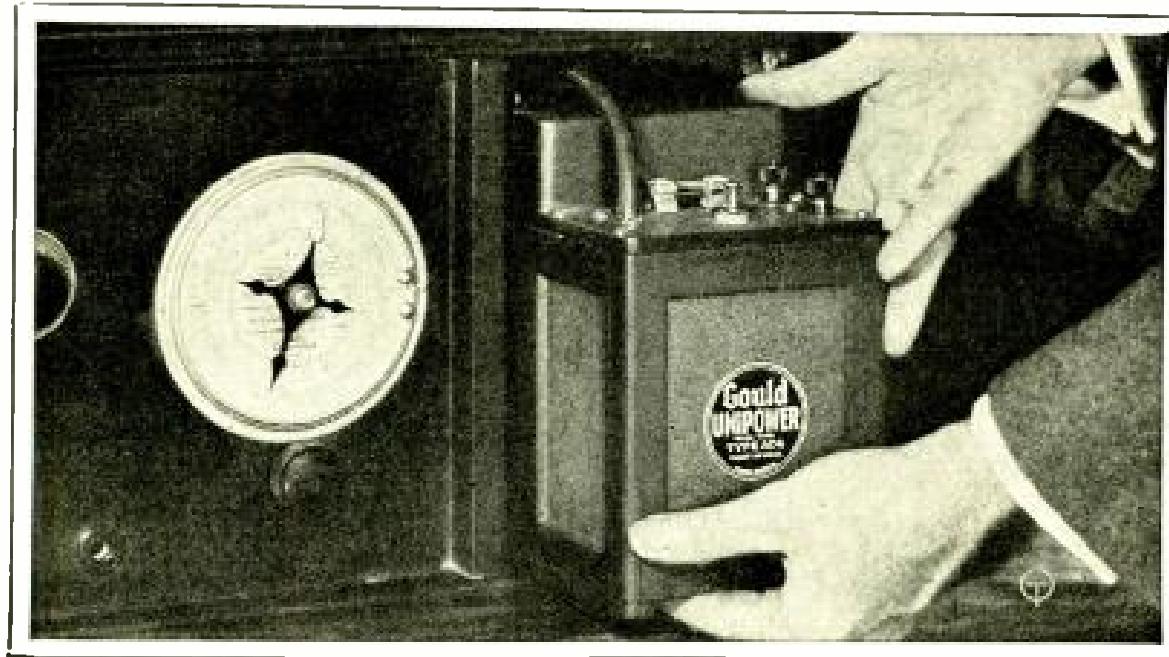
Unipower is quickly and easily installed. Just connect two wires to your house set, plug in on your light current, and the job is done! Unipower is equipped with an exclusive Balkite

charger of special design. Unipower will last you for years, and there are no tubes, bulbs, lamps or working parts that require frequent and expensive replacement.

A unique feature of Unipower is the single 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 lighting current.

Decide to see the new Unipower today. The nearest radio dealer has it. The Gould Storage Battery Co., Inc., 250 Park Ave., New York.

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 it's on—On when it's off

**The Sun
SECTION TWO
RADIO SECTION**

NEW YORK, SATURDAY, JANUARY 24, 1925. 50 PAGES.

The Three-Tube Rasla Receiver

How to Build This Remarkable Set, which Functions So Successfully That Many Stations Receive "Locals" Night After Night

Volume Selectivity and DX

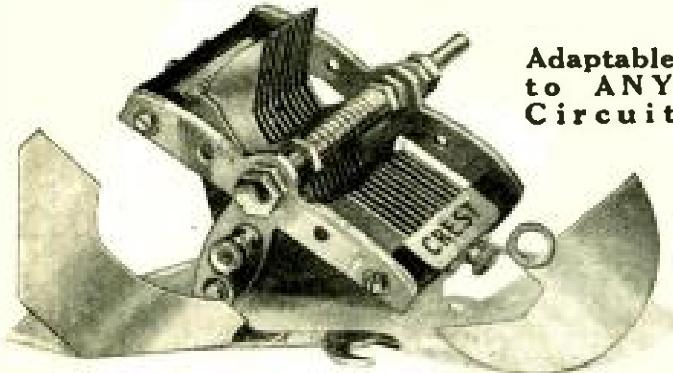
The Radio Sun sponsored the one tube Rasla and the two tube Rasla. The receiver was tested by the SUN staff. The receiver for tube this three bulb receiver surpasses any home built set and suffices for the volume far too sufficient for the locations fifty miles from the broadcasting station. **The Editors.**

RASLA REFLEX

EDITORS are notoriously "hard-boiled." Before they go into ecstasies over a circuit, it must really be exceptional. You can draw your own conclusions from the fact that the Rasla Reflex was editorially boosted by The N. Y. Sun and by many others. Write at once for FREE picture diagram

Davidson Radio Corp.
Dept. "A" 222 Fulton St.
NEW YORK CITY

The Crest Convertible Condenser



Is adaptable to ANY circuit, for the number of plates may be changed at will from 23 plates down to 2 plates. It will balance your circuit perfectly. Plates can be removed and cleaned plate for plate. This is semi-straight line frequency condenser. Made of solid brass—workmanship and materials guaranteed.

Armour Institute Tests Showed:

Maximum capacity .000522 mfd. or .22 mfd. above rated capacity. Minimum capacity of 23 plates .00011. Ohmic resistance .18 ohm over laboratory standard due to special construction features.

23 Plate—\$5.00

Two finishes: Nickel Silver or Natural Brass

If dealer cannot supply you, send his name with your remittance and we will supply you direct. Inquiries invited from dealers, jobbers and manufacturers.

CREST RADIO CORPORATION
5 N. Wabash Ave., Chicago

BLUEPRINTS—FREE

You can have your choice of any one of seven POPULAR RADIO Simplified Blueprints with your new or renewal subscription for POPULAR RADIO, accompanied by remittance of \$3.00.

You, as a reader of POPULAR RADIO, know the many entertaining, interesting and instructive articles that are published each month. Every issue some new item is sure to attract your attention.

Ease, Economy and Accuracy in Construction
Simplified Blueprints were prepared under the personal supervision of Laurence M. Cockaday. They make it possible for anyone, without previous knowledge of radio, to construct a highly efficient radio receiver. Each set of Blueprints consists of 3 prints as follows:

Panel Pattern
This Blueprint is the EXACT size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. You can readily appreciate the convenience of this Blueprint. No scaling or measuring to do, no danger of ruining the panel through faulty calculation.

Instrument Layout
Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet. Even the cabinet structure is clearly shown.

Wiring Diagram
The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

POPULAR RADIO, 627 West 43d St., New York

POPULAR RADIO, Dept. 100,
627 West 43rd Street, New York City.

Enclosed is my remittance of \$3.00, in full payment for subscription, with Blueprints as checked below, FREE.

- | | |
|---|--|
| <input type="checkbox"/> Set No. 4—Cockaday Four-circuit Tuner with Resistance-coupled Amplifier. | <input type="checkbox"/> Set No. 8—Cockaday Improved DX Regenerative Receiver. |
| <input type="checkbox"/> Set No. 6—Cockaday 8-Tube Super-heterodyne Reflex Receiver. | <input type="checkbox"/> Set No. 9—"The Portable Town and Country Receiver." |
| <input type="checkbox"/> Set No. 7—Craig 4-Tube Reflex Receiver with Sodium Detector Tube. | <input type="checkbox"/> Set No. 11—5-Tube Tuned Radio-Frequency Receiver with Simplified Control. |
| <input type="checkbox"/> Set No. 12—8-Tube Superheterodyne with Single Control. | |

Name.....

Street.....

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



\$25

*West of Rockies,
\$26.50
In Canada, \$35*

The SAAL Soft SPEAKER

combines volume with a velvet tone

SAAL Jr.

The same in every respect as the Saal Soft Speaker, except it measures 18½ instead of 21½ inches in height.

\$20

*West of Rockies, \$21.00
In Canada, \$27.50*



The Saal Soft Speaker Unit is an example of the care with which the entire speaker is manufactured. The diaphragm is connected to the armature by a pin which transmits the action of the armature to the diaphragm as a push and pull movement. There are no springs to snap the diaphragm back into place. This explains why the unit cannot be blasted and cannot get out of order. In attaching the pin to the diaphragm it is threaded for a nut. These threads, 200 to the inch, are finer than a jewelers' standard.

IN buying a radio reproducer you need no longer choose between volume and tone quality. You can now buy a speaker with both. The Saal Soft Speaker combines volume with a velvet tone.

The Saal has no blare, no blast, no metallic ring. It is not a fad. It is a faithful reproducer of radio programs. It is properly constructed for the accurate reproduction of sound. It is not straight-necked like a trumpet. The neck is curved like a saxophone, the most melodious of all instruments.

The reproducing unit of the Saal Soft Speaker is of all-metal construction, and cannot be harmed or "blasted" by

the loudest receiver. It maintains its tone with any volume. There is no adjustment knob to complicate tuning.

The Saal Soft Speaker is made to last a lifetime. The neck is of aluminum. The bell is of genuine Bakelite. There is no wood, no tin, no composition. It has nothing to warp, crack, wear out or deteriorate. It is guaranteed to give you satisfaction.

In appearance the Saal, with its large black bell, black crackle throat and graceful lines, is the aristocrat of horns. Also furnished with a brown bell and gold or silver stippled throat at \$5 extra. Hear it at your dealer's today.

SAAL *Soft* **SPEAKER**
VOLUME WITH TONE QUALITY

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

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

*The Loud Speaker
Sensation...*



The KODEL MICROPHONE LOUD SPEAKER

You can't tell the KODEL MICROPHONE LOUD SPEAKER from the microphone the broadcasting stations use—they are exactly alike in size and appearance.

The efficient Kodel Sound Unit, with a ingenious new snail-shell horn, mounted inside the microphone case, produces a remarkably clear, full-toned volume. Non-vibrating tone chamber absolutely eliminates distortion.

\$15 model incorporates Kodel, Jr. unit; equipped with large Kodel unit \$20

\$15⁰⁰

Radio dealers everywhere have them.

THE KODEL RADIO CORP.
504 E. Pearl St. Cincinnati, O.

RECEIVERS :: SPEAKERS
HOMCHARGERS

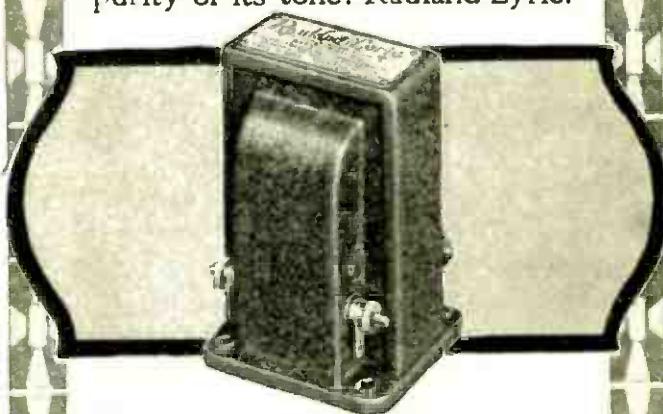
WKRC

Owners of Kodel Broadcasting Station WKRC. Send for program



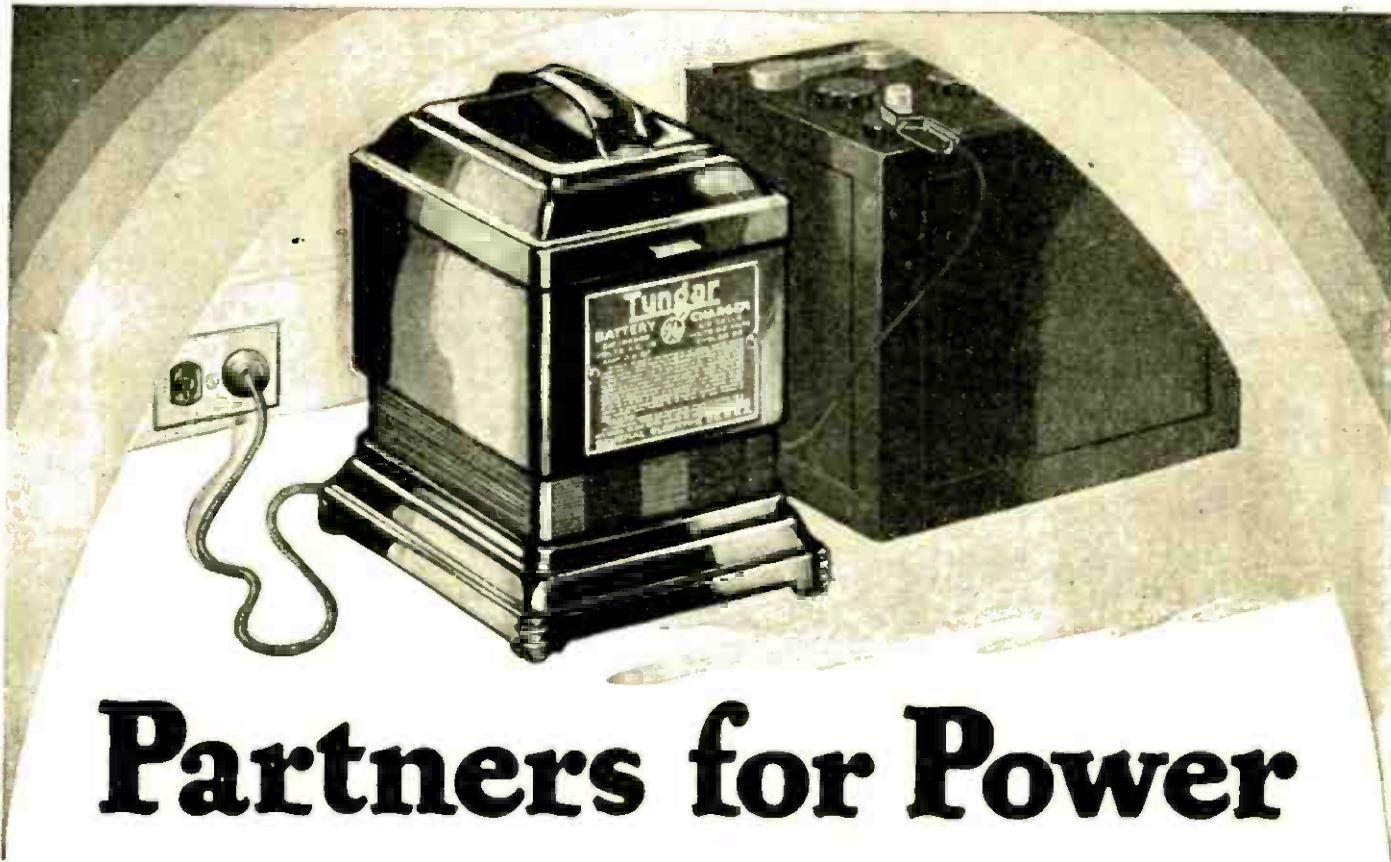
Lullaby

Through the air of the evening, calm and sweet comes a cradle song from a distant city. Then, as never before, we feel the need of radio amplifiers which will bring out, strong and clear, just the pure beauty of music. For such moments is the joy of owning the one amplifying instrument selected by world-famed musical authorities for the purity of its tone: 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



Partners for Power

If you want distance and clear tone from your radio set, your storage battery must have its partner—the Tungar Battery Charger.

Two clips and a plug to connect to the house current. That's all there is to it. Or you can make permanent connection and just throw a switch.

The Tungar charges while you sleep—it makes no disturbing noise—keeps your batteries at top notch. For power there is nothing like a good storage battery—with a tungar to keep it good.



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

The new Tungar charges 2, 4, 6 volt "A" batteries, 24 to 96 volt "B" batteries; in series; and auto batteries, too. No extra attachments needed.

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

60 cycles—110 volts

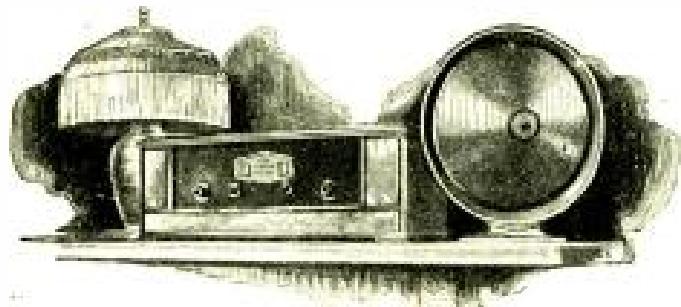
Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

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

BOSCH BUILDS RADIO

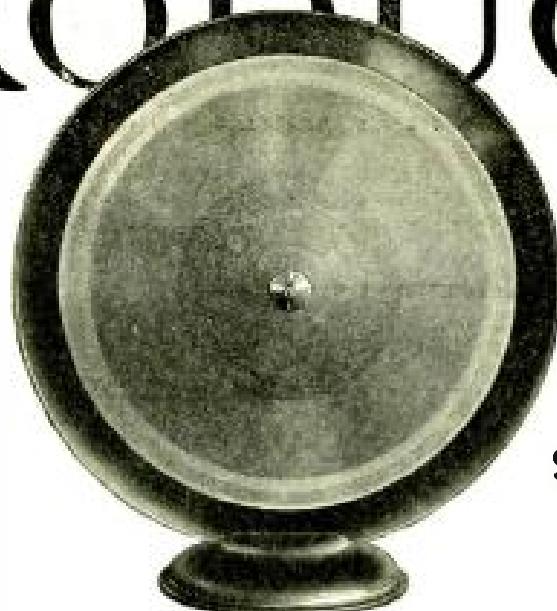


THE AMERICAN BOSCH MAGNETO CORPORATION PRESENTS "THE AMBOROLA," THE BOSCH RECEIVING SET AND "THE AMBOTONE," THE BOSCH REPRODUCER. THESE INSTRUMENTS HAVE BEEN BUILT TO THE FAMOUS BOSCH LINE OF PRECISION AND ALL THE EXPERIMENTATION ON THEM HAS BEEN ACCOMPLISHED IN THE BOSCH LABORATORIES RATHER THAN IN THE HOMES OF THEIR PURCHASERS.



THE AMERICAN BOSCH MAGNETO CORPORATION
SPRINGFIELD, MASS.

Another BOSCH RADIO PRODUCT



PRICE
\$14⁵⁰

The Junior AMBOTONE

Another Bosch triumph. Having announced the Bosch Radio Receiver, the Amborola and the deLuxe Bosch Reproducer, the Ambotone, the Junior Ambotone is now announced by Bosch.

The Junior Ambotone is a radio reproducer with an unusual tonal quality built to the famous Bosch standard of precision. Following the Ambotone principles of reproduction, the Junior Ambotone gets its mellowness from wood.

The Bosch ability to manufacture to precision standards, accounts for the tone quality. The Bosch ability to build with accuracy in quantities accounts for the remarkably low price. The greatest value in radio—The Junior Ambotone at \$14.50.



THE AMERICAN BOSCH MAGNETO CORPORATION
SPRINGFIELD, MASS.

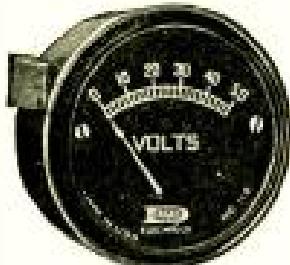


Audio Transformers and Voltmeters

42 Set Manufacturers Use Them



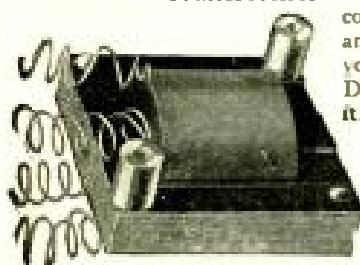
Type S
[Audio Transformer
Special quality in this
handsome mounted
transformer
Attractive Prices



Type N
Voltmeter
One of 5 types. Range
0-7, 0-50, 0-100 volts
A guaranteed, high-
grade instrument



Type B
A.C. Tube Transformer



Type CSB—Audio Transformer
One of 35 types exclusively for set
mftrs. Performance equal to any

DONGAN ELECTRIC MANUFACTURING CO.
2983 Franklin St. Detroit, Mich.

"Transformers of Merit for 15 years"

It is only natural that Dongan can continue to manufacture Audio Transformers that suit the requirements of the great majority of receiving set manufacturers. Many of the men in today's organization have been designing and building Dongan Transformers for 15 years.

Better Audio Transformers priced specially for set manufacturers; a reputation for quality always maintained; deliveries when you need them—all are assured Dongan customers.

This year many sets achieve a new sales appeal by the use of Dongan Voltmeters. Built into the set Dongan Voltmeters become most essential to fans who like to keep performance up to par. Accuracy throughout the scale is a dependable feature of Dongan Voltmeters.

Jobbers Dealers

The Radio Public is demanding reliable merchandise like Dongan Transformers and Voltmeters. You will find Dongan parts the last word in design, construction and appearance. Our discounts allow you a generous profit—Dongan Repeat Sales assure it.

For B-
Eliminators
Use Dongan
Transformers
and Chokes

\$5.00

CAP.
.0005
Mfd.

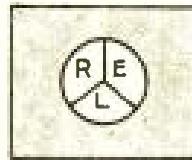
ULTRA-LOWLOSS
CONDENSER



*Positive
as Big Ben*



Cutlass Stator
Plate exclusively
an Ultra-
Lowloss feature



A guarantee
of satisfaction
and Lacault
design

SET Big Ben at seven and at
seven o'clock you're bound to
get the alarm.

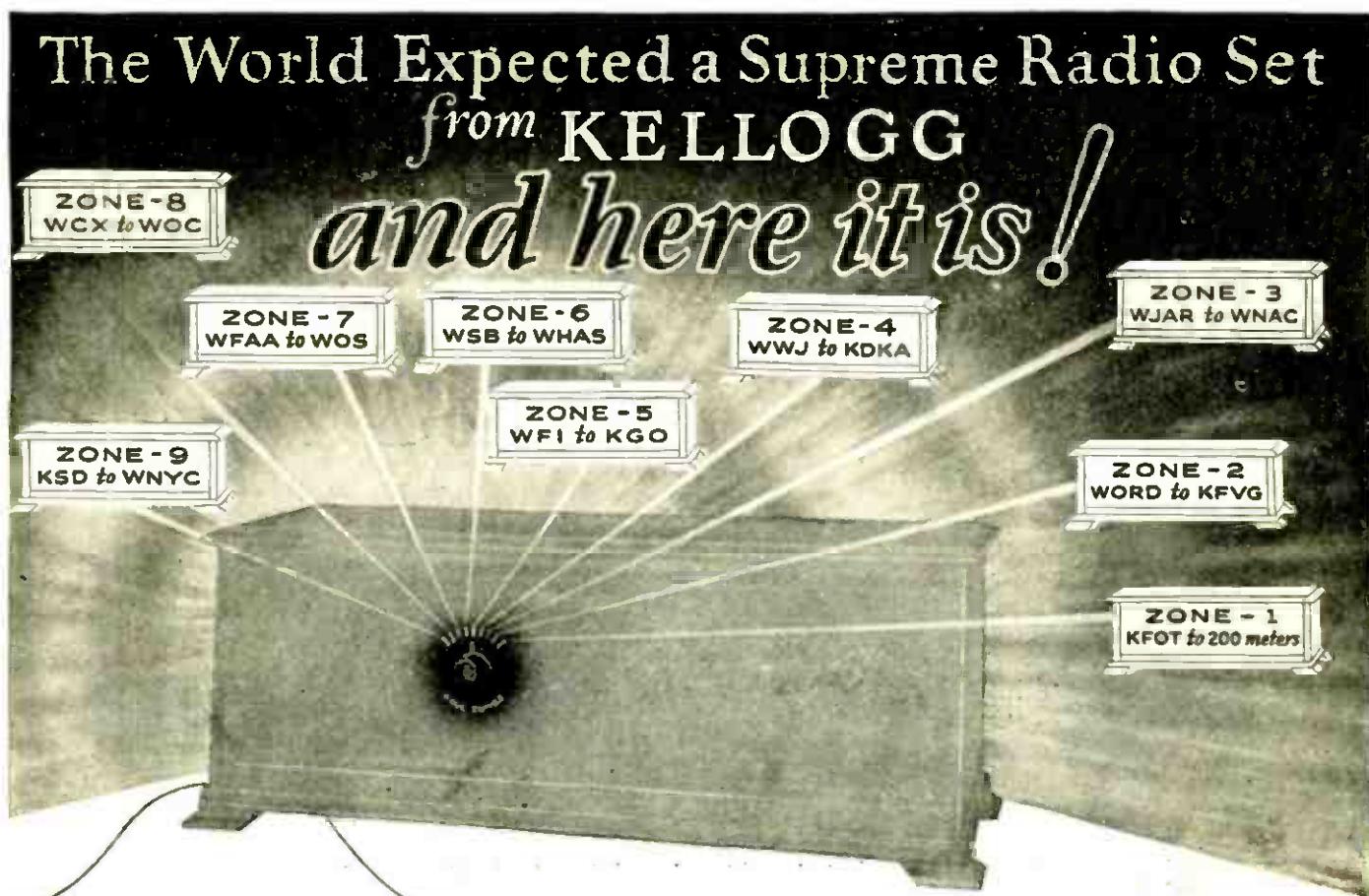
Just so, the Ultra-Lowloss condenser can be set at any wavelength—the corresponding station will come in clear and sharp. You know instantly where to turn, once a station of known wavelength is located. Makes tuning easy—direct—positive. Special Cutlass Stator Plates spread wavelengths evenly over a 100 degree scale dial so that each degree represents approximately 3½ meters.

Ultra-Lowloss condensers are designed by R. E. Lacault, originator of the famous Ultradyne Receivers, and built upon scientific principles which overcome losses usually experienced in other condensers.

At your dealers, otherwise send purchase price and you will be supplied postpaid.

Design of lowloss coils furnished free with each condenser for amateur and broadcast wavelengths showing which will function most efficiently with the condenser.

ULTRA-LOWLOSS
CONDENSER
PHENIX RADIO CORPORATION
116 East 25th St. New York



A Separate Circuit for Each 40 Meter Wavelength Band!

KELLOGG — for 28 years makers of precision telephone instruments — producers of quality parts since radio began — Kellogg has perfected a radio receiver worthy to bear the Kellogg name.

In the new WAVE-MASTER there are nine separate circuits—one for each 40 meter wavelength band. Each circuit gives that maximum efficiency heretofore found only in one short section of the dials of ordinary radio frequency sets. Each circuit brings within the range of the tuning dial a different group of stations.

Merely set the pointer to the wave zone in which you are interested and tune in with the one dial.

This dial actually has a tuning

range of 540 degrees — over three times the range of any other set.

All other radio frequency sets have variable capacity which must be tuned, usually with three different dials, to balance with their inductance coils.

The WAVE-MASTER'S inductance is not fixed but variable and is easily and quickly tuned, with the one dial, to balance the fixed capacities.

Write for full description. Please mention your radio dealer's name.

Kellogg Switchboard & Supply Company
1033 W. Adams St., Dept. J, Chicago, Ill.

KELLOGG
WAVE MASTER
SWITCHBOARD & SUPPLY CO.

Radio Dealers and Jobbers

The WAVE-MASTER franchise, backed by Kellogg resources and our powerful advertising campaign, is most valuable. Wire, or get into Chicago, quick, and see us.

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

McLaughlin specifies // Precise!

IN his new one control 8-tube receiver the well-known radio authority, Mr J. L. McLaughlin, specifies Precise Syncrodensers and Transformers.

The Precise No. 750 Syncrodenser used in this remarkable receiver is a scientific combination of straight line frequency where it is vital with straight line capacity where that is superior. The Syncrodenser permits ideal separation on the dial. The lower half of the dial which normally is crowded, has fewer stations, while on the upper half of the dial the stations are uniformly separated. The Syncrodenser can be mounted on panel or sub-panel in any position.

The two Precise No. 480 Supersize Audio Transformers faithfully reproduce all broadcasts with magnificent amplification. Their supersize permits immense overload.

Other Precise instruments used in this receiver are: the Super-Multiformer which contains four matched radio frequency transformers in one unit; the Filtoformer which is a choke coil and a by-pass condenser in a single unit; the No. 99 Bracket which is made of solid cast aluminum and is neat and sturdy; and the Connector Unit No. 744 which permits two or more Syncrodensers to be tuned with one dial.

Ask your dealer to show you the complete Precise line.

**PRECISE MANUFACTURING CORP.
ROCHESTER, NEW YORK**

BRANCHES:

126 Liberty St., New York City 53 W. Jackson Blvd., Chicago, Ill. 821 Market St., San Francisco, Cal. 454 Builders Exchange, Minneapolis, Minn.

CANADIAN DISTRIBUTORS: Perkins Electric, Ltd.
Toronto, Montreal, Winnipeg.



**No. 480 Precise Supersize
Audio Transformer**

In two ratios, 5 to 1 and 2½ to 1.
Price for either ratio, \$7.50.

Every Precise Instrument is a Laboratory Product

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

Adapto

RADIO CABINETS

BY DONEHUE



Obtainable in
Walnut and Mahogany

Make your present receiver into one of the popular new console art models. Your present panel assembly, intact, drops right into the artistic, convenient ADAPTO CABINET without disturbing a wire. Everything concealed. Makes your receiver the equal of the

most costly models.

Two styles in walnut or mahogany finish. Exclusive features—sliding compartment for storage battery and charger; built in loud speaker horn with new improved resonance. Superior cabinet work!

Write for name of the nearest ADAPTO dealer and illustrated literature.

LR. DONEHUE CO.

PERTH AMBOY N.J.

Music Master
Resonant Wood
Insures Natural
Tone Quality



Model VI, \$30
14" Wood Bell
Model VII, \$35
21" Wood Bell

(Canadian Prices
Slightly Higher)

Ten Models—\$50 to \$460
Guaranteed Unconditionally



TYPE 60

Five Tubes. Two stages of radio frequency, detector
and two stages audio frequency. Selective, good
volume and distance. Brown mahogany art
finish cabinet. Price \$60



TYPE 100

Five Tubes. New Music Master Circuit, involving special
adaptation to radio frequency. Very selective, good vol-
ume and distance. Solid mahogany cabinet in \$100
brown mahogany art satin finish. Price

MUSIC MASTER
RADIO PRODUCTS

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



Radio, too, is Now Standardized

PIONEER owners of automobiles had to try out all sorts of accessories to get motoring satisfaction. Pioneer owners of radio receiving sets likewise experimented with tubes, batteries, condensers and "loud speakers" to balance the power of the set with the quality of the amplifier. And they found that MUSIC MASTER Reproducer—the *Musical Instrument of Radio*—made any good set better.

MUSIC MASTER Receivers embody the demonstrated features of standardized radio and assure efficiency of radio reception equal to the world-famous quality of MUSIC MASTER reproduction.

An authorized MUSIC MASTER dealer will demonstrate—in your home—MUSIC MASTER's power of distance, clarity and volume, ease of operation, faithful reproduction and superb musical tone quality.

See MUSIC MASTER—hear—com-
pare—before you buy any radio set.

Music Master Corporation

Makers and Distributors of High-Grade Radio Apparatus

128-130 N. Tenth Street, Philadelphia

NEW YORK CHICAGO PITTSBURGH MONTREAL
Canadian Factory: Kitchener, Ontario

NINETY CENTS May Solve the Problem of Your Set

IF you use leaky insulators on your antenna most of the signal never reaches the set. Start without a handicap—a pair of genuine PYREX Antenna Insulators (45c each) will eliminate antenna losses.



The sending and receiving antennae of the MacMillan Arctic Expedition are PYREX insulated. 34 broadcasting stations have recently replaced other insulators with PYREX. The Navy, Coast Guard, Lighthouse and Air Mail Services specify and use genuine PYREX.

Be sure you get PYREX and not something "just as good"

Several makes of variable condensers can now be obtained insulated with PYREX.

PYREX is Real Insulation

Corning Glass Works

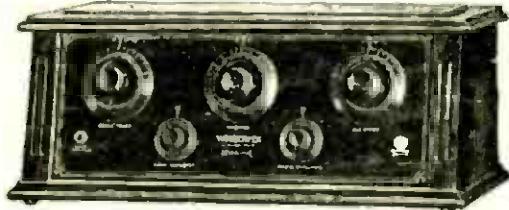
Industrial Division

Corning New York

WORKRITE Radio

1925-1926 Models

This famous line of neutrodyne receivers is known everywhere for three things:
 1. Unbeatable value. 2. Mechanical superiority. 3. Beauty.

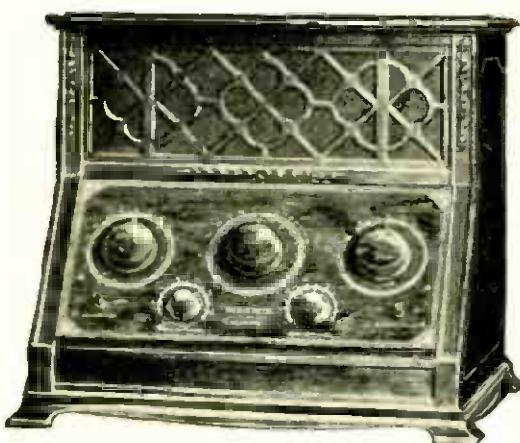


WorkRite Winner Five

Has great volume and pulls in stations at unbelievable distances. Quality of tone will compare with many sets selling for twice the amount. Very attractive in appearance and its performance will surprise you. Cabinet finished in dark walnut, size 22 inches long, 11½ inches wide, 9 inches high. Price \$80.00.

WorkRite Winner Six

Exactly the same as the Winner Five except that six tubes are used instead of five. Price \$90.00.



WorkRite Radio King Six

Produces voice and all notes of music without the slightest distortion. Resistance Coupled Amplification. Brings in the distant stations with good volume, still the outstanding feature is pure tone quality. Price with built-in loud speaker \$170.00.

WorkRite Air Master Six

Exactly the same set as contained in the Radio King, except does not have built-in loud speaker. Price \$125.00.

WorkRite Air Master Five

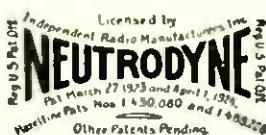
Same as Air Master except employs only five tubes. Price \$120.00.

THESE receivers have won a reputation for their selectivity, long range reception and freedom from whistles and other distracting noises. All sets use either UV 201A or C 301A tubes throughout and each set is equipped with a special cable carrying all wires to the batteries.

The panels and dials are mahogany in color to match the attractive cabinets and are engraved in gold. Any of these superb instruments harmonizes perfectly with the furnishings of any room.

Remember that only the best material and workmanship go into the WorkRite radio receiver and each instrument has the backing of one of the oldest and largest radio manufacturers in the country. This assures each WorkRite customer of the latest and finest receiver it is possible to build. Each set is unconditionally guaranteed against defects.

Dealers—If you don't know the WorkRite distributor in your territory, write direct to us.



THE WORKRITE MFG. CO.
Cleveland, Ohio

Branches: Chicago, Los Angeles, San Francisco,
Seattle, Portland

WORKRITE

SUPER NEUTRODYNE RADIO SETS



The House Behind the Catalog

YOU'VE seen this slogan in our advertisements: "The Largest Radio Store in America." Of course, there are larger concerns handling radio—but not exclusively. Perhaps we should say: "The Largest Exclusively Radio Store in America." Every square foot of floor space in our building (shown in this advertisement) is devoted to storing our enormous Radio Stock. We employ more than 60 experienced radio men to serve you and our million other radio customers. Ever since 1915, when we started, our policy has been: real service backed by an iron-clad guarantee of satisfaction.

Salvage means:
Save! Service: Satisfaction

FREE

This Super of Radio Catalogs

NOTHING but the latest—and the best, too! Browning-Drake, Cockaday, Superheterodyne, Ultradyne, Reflex—you'll find the best kits for all these latest hook-ups fully described and illustrated in our new 96 page "Super" Radio Catalog.

We save you money, too! Our enormous

buying power permits us to pay spot cash and get rock-bottom prices—even way below manufacturer's cost. Lowest prices for standard, fully guaranteed parts and accessories such as Acme, All-American, Bremer-Tully, Carter, Freshman, Frost, General Instrument, Howard, Remler, Thordarson, Walbert, etc.

Send for your FREE copy, today!

CHICAGO SALVAGE STOCK STORES
509 S. STATE ST., Dept. P. R. CHICAGO, U. S. A.

Approved by ~ ten leading manufacturers

THE new Hammarlund-Roberts receiver is the united achievement of ten leading engineers, endorsed by ten of the best-known radio manufacturers. No one man's or one group's conception of five tube possibilities but the composite of the leaders' convictions.

This concentration of the leaders upon one purpose—the perfection and intense application of tried and proven radio principles—has produced new results. Results so vital and so valuable that they put the Hammarlund-Roberts far beyond your expectations of performance.

In designing this new standard of efficiency, the consulting engineers had at their disposal the finest parts the market affords—regardless of cost. They were not handicapped by having to build to a price.

The outstanding merit of the original Roberts Circuit was its use of regeneration (the equivalent of two stages of radio frequency) in combination with proper tube neutralization. This hitherto unattainable combination provided maximum range, sensitivity, perfect tone and easy, non-critical tuning. It banished the former bugbears of radiation. Ten of the country's leading engineers collaborated on still further refinements and elaborations of this popular circuit. This union of principles, opinions and experiences has clarified hitherto cloudy points. The ideals of all these experts have been pooled in this one model radio receiver.

These ten leading manufacturers offer to the American public greater value than ever before. A radio receiver constructed throughout of the latest, most efficient part designs at a price within the means of every one. A five-tube receiver that equals the Super-Heterodyne in selectivity and volume. A receiver so simple in design that anyone can build it from the instructions in the "Hammarlund-Roberts Construction Book." You will wonder at this new simplicity; this new efficiency; this new saving.

Write for this most complete book.

ASSOCIATE MANUFACTURERS

All-American Radio Corp.	Dubilier Condensers
Alden Manufacturing Co.	Union Radio Corp.
Rediall Company	International Resistance Co.
Carter Radio Company	Hammarlund Mfg. Co., Inc.

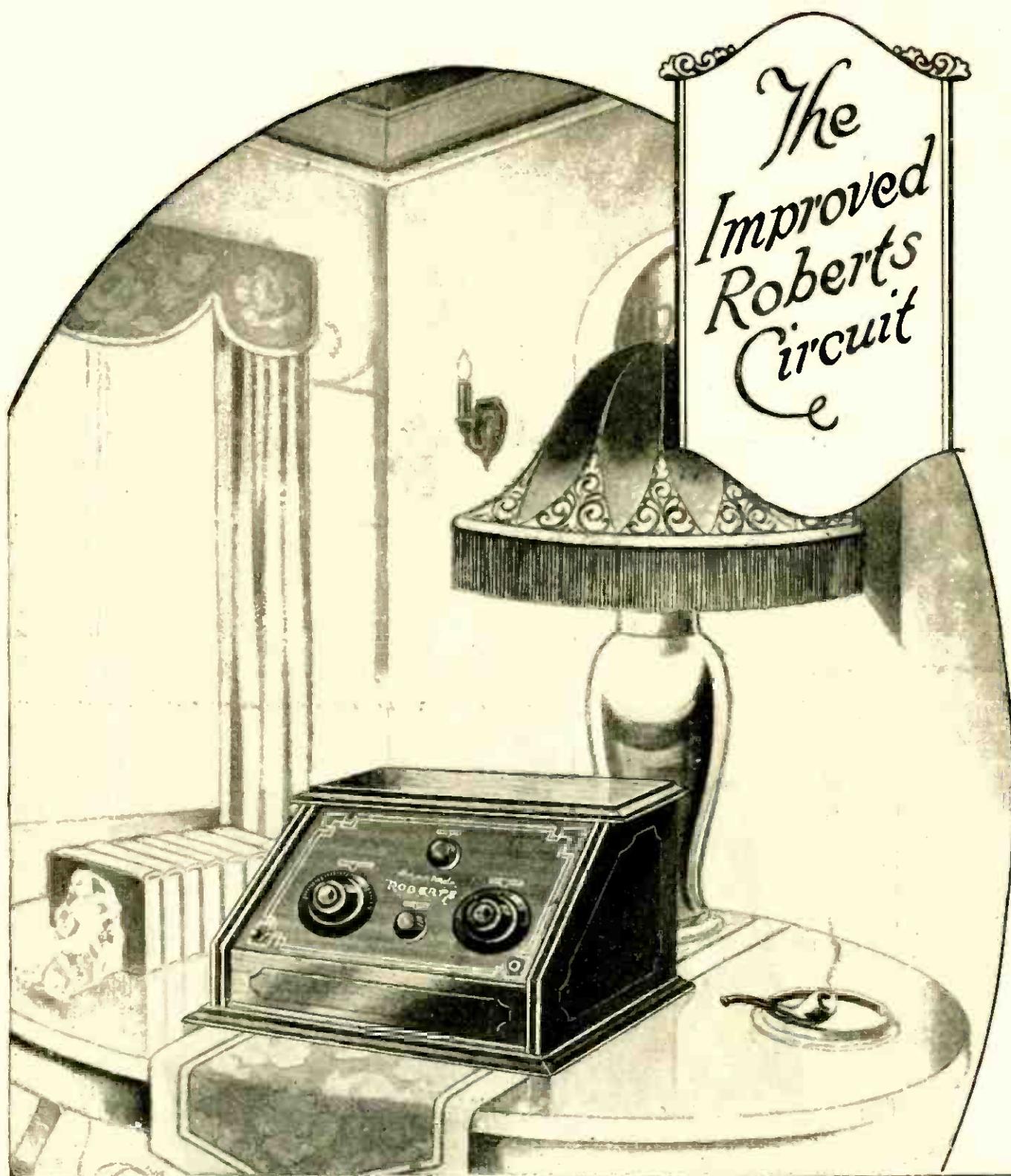
Hammarlund-Roberts, 1182-B Broadway, New York

Hammarlund- **ROBERTS**

Write for this illustrated book, giving complete details on assembling, wiring and operating the Hammarlund-Roberts receiver.

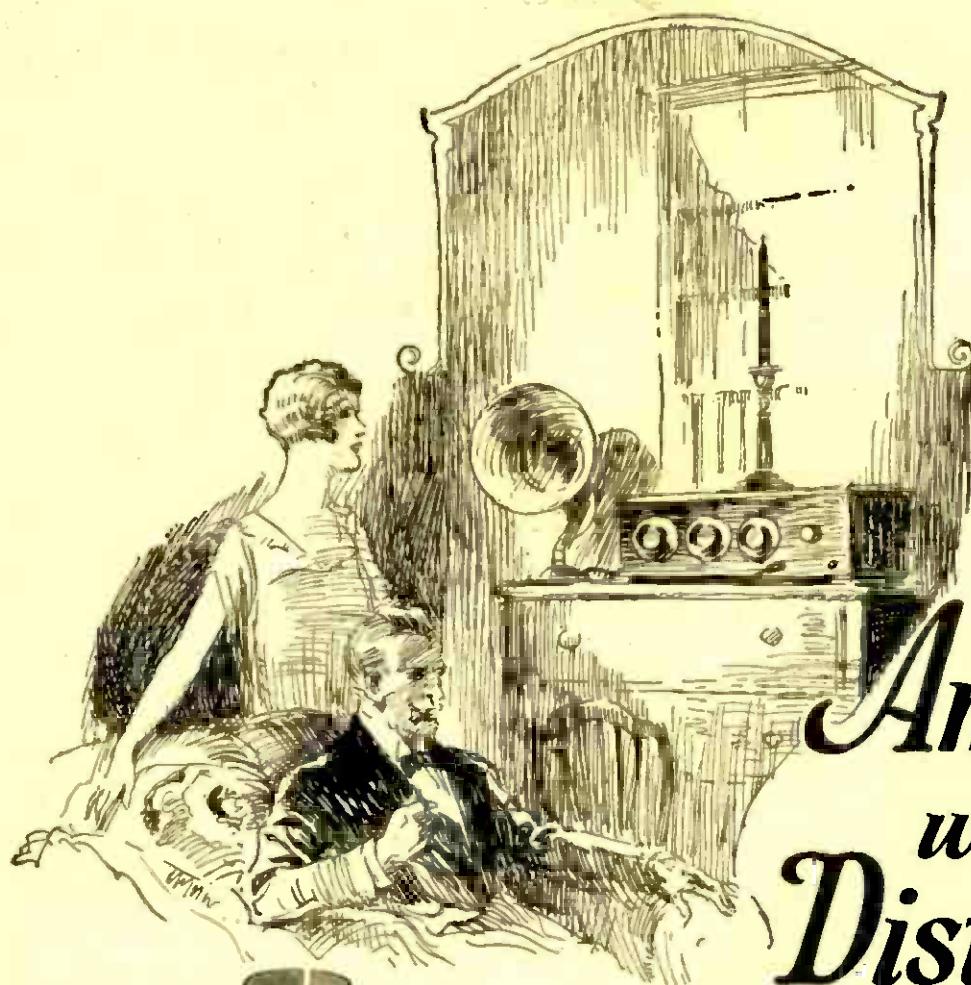


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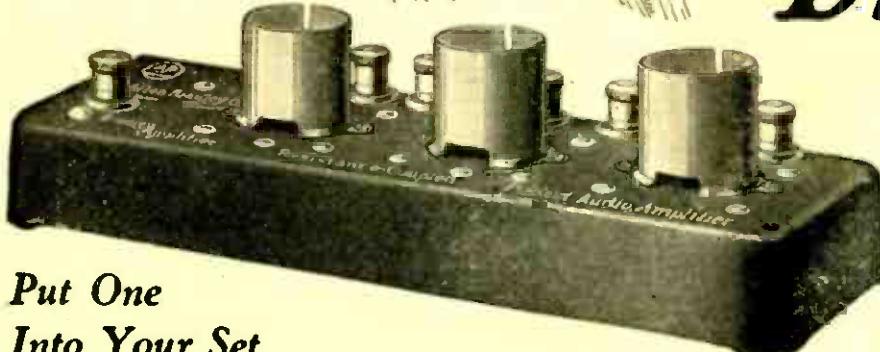


\$60.85
Cabinet Extra

The All-American Radio Corp. contribute
the Rauland Lyric Transformer to the
efficiency of this new receiver.



Amplifies without Distortion



**Put One
Into Your Set**

HAVE you been troubled with distortion, due to faulty audio-frequency transformers? If so, slip a Bradley-Amplifier into your set and experience a new thrill in radio reproduction. No special wiring is necessary, because the Bradley-Amplifier is wired, ready for instant use. Send for new booklet "Amplifies without Distortion" today! It explains, fully, the principles of audio frequency amplification and how to improve tone quality.

ALLEN-BRADLEY CO., 276 Greenfield Ave., Milwaukee, Wis.

THE latest Allen-Bradley contribution to better radio is the new Bradley-Amplifier, a marvellously compact three-tube audio amplifier of the resistance coupled type.

Aside from its faultless tone quality and perfect reproduction, the Bradley-Amplifier is amazingly small in size. All circuits, resistors, and condensers are securely soldered within the base, leaving no exposed parts.

Another outstanding feature is the use of Bradleyunits (Molded Resistors) which do not deteriorate with age, nor are they affected by temperature and moisture. The Bradley-Amplifier requires no attention or adjustment.

Bradley-Amplifier

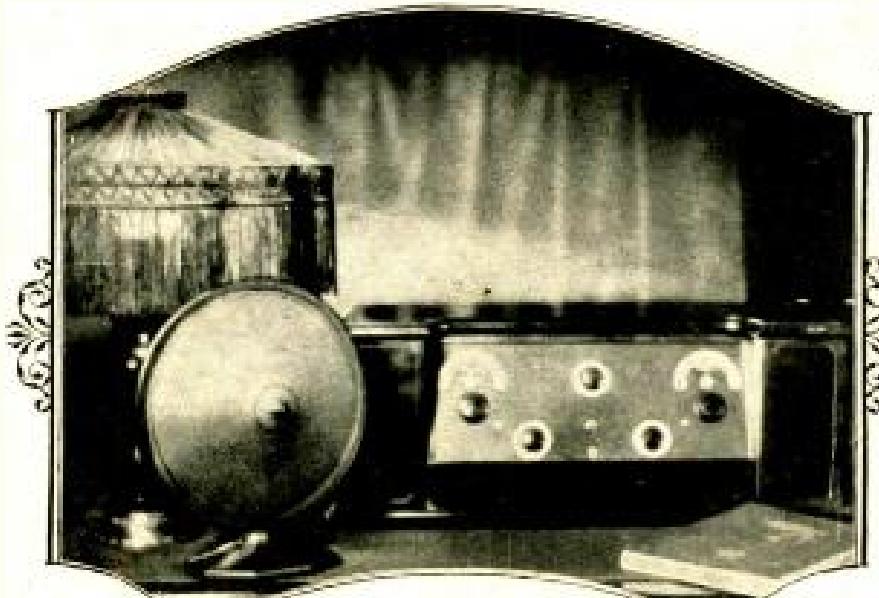
Resistance-Coupled

PERFECT AUDIO AMPLIFIER

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



Crosley
2 Tube \$1 S. D.
Mahogany finished cabinet holds all batteries . . . \$23.50



Crosley Super Trirdyn Special \$60⁰⁰
Crosley Musicone \$17⁵⁰



Crosley Pup
A genuine long range receiving set \$9.75



Crosley De Luxe Combination
Musicone De Luxe \$27.50
Super-Trirdyn Special 60.00
Console Table 25.00
Complete \$112.50



Crosley
3 Tube 52 S. D.
Highly selective; unusual range, mahogany finished cabinet \$32.50

"Better Results From 3 Tubes Than From 5"

Instead of passing the incoming signal once through each of 5 tubes, Crosley design, in the Super-Trirdyn, passes it through two of the three tubes several times, each time building up its strength and adding to its volume.

Even the technically uninitiated can see the advantages: simplicity instead of complexity; fewer dials to adjust; sharper accuracy in selecting stations; greater clarity; greater volume, greater ease in logging stations.

This simplicity of design, combined with the economies of gigantic production, makes possible a price of \$60.00 on the Super-Trirdyn Special, the most efficient and

beautiful of all Crosley receiving sets. For Crosley is the world's largest builder of radio sets—owning and operating parts factories, cabinet woodworking and assembly plants.

Listen to a Crosley Super-Trirdyn under the most exacting conditions and you will understand why it represents a genuine achievement in radio performance and value which all America was quick to recognize and reward with increasing sales.

Write for an illustrated catalogue of the complete Crosley line or see them at your Crosley dealer's. Authorized sales and service stations everywhere.

Crosley manufactures receiving sets which are licensed under Armstrong U. S. patent No. 1,113,149 and priced from \$9.75 to \$60.00 without accessories.

Add 10% to all prices West of Rocky Mountains. Crosley owns and operates WLW first remote control super-power broadcasting station.

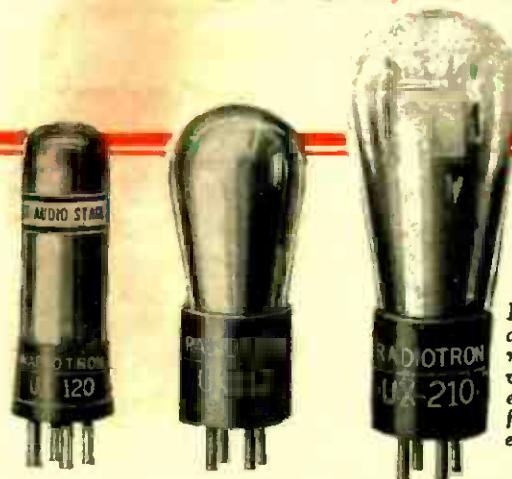
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B E T T E R · C O S T S L E S S

THE CROSLEY RADIO CORPORATION, CINCINNATI, OHIO

RCA *announces* three new power tubes *for greater volume*

RCA announces three important new Radiotrons. Their contribution to radio progress is *greater power*. They mean greater volume on dry batteries — and greater volume on storage batteries. They mean better tone, because they mean volume of sound without distortion.



For technical description of the new Radiotrons, write to the nearest RCA office for the illustrated booklet.

- A—New Radiotron UX-120—for great volume on dry batteries \$2.50
- B—New Radiotron UX-112—Similar to Radiotron UV-201-A, but several times as powerful \$6.50
- C—New Radiotron UX-210—A super-power tube several times as powerful as UX-120 \$9.00



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