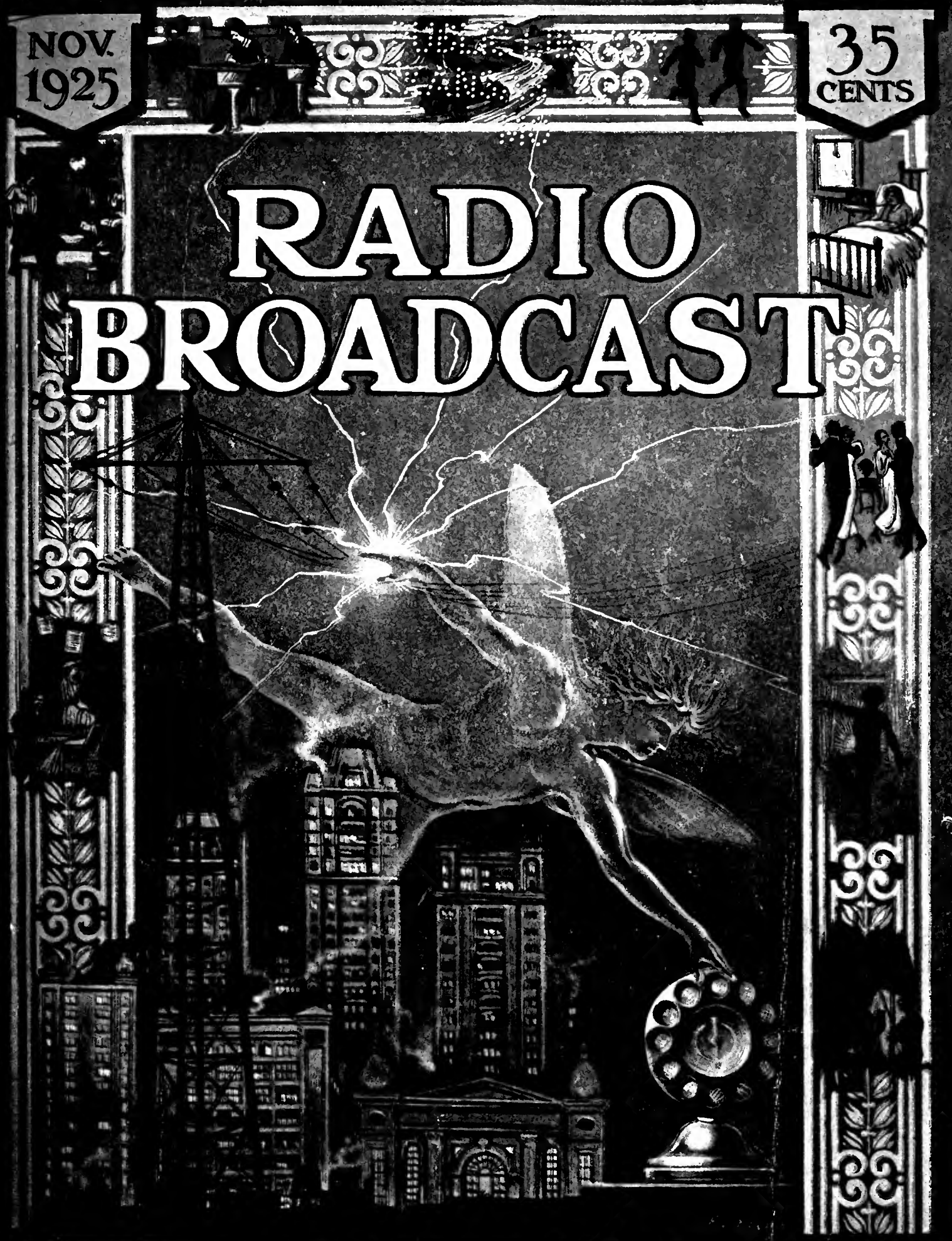


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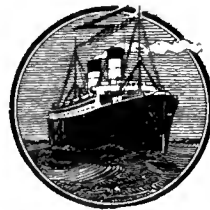
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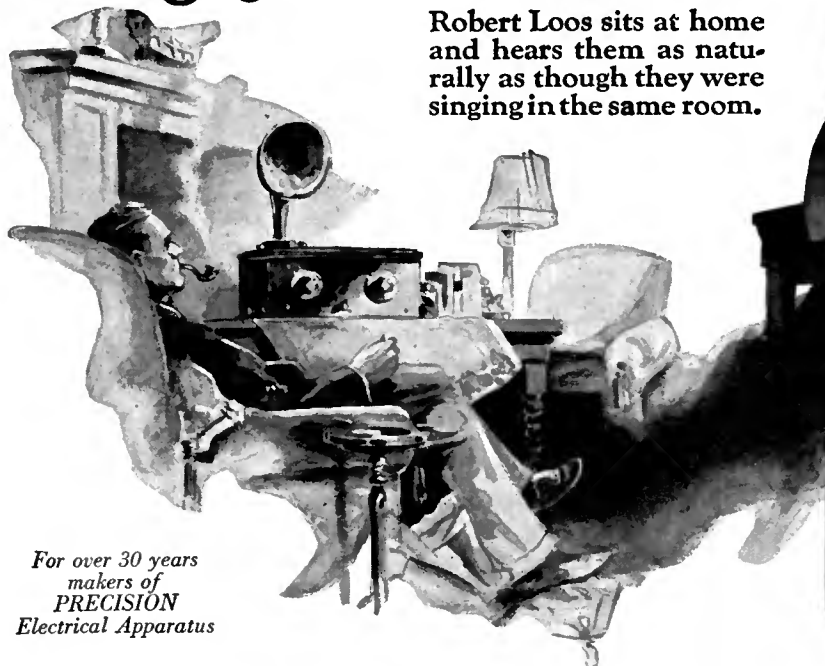
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RADIO BROADCAST

ARTHUR H. LYNCH, Editor
WILLIS K. WING, Associate Editor
JOHN B. BRENNAN, Technical Editor

NOVEMBER, 1925
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BEHIND THE EDITORIAL SCENES

WE ARE proud to present the new RADIO BROADCAST which in quality of appearance and contents speaks for itself, and we are confident that all our readers will feel the same as one enthusiastic subscriber who was in the office the other day and to whom we showed the plans of the new RADIO BROADCAST. "Why," said he, "there is nothing in the radio field to equal RADIO BROADCAST now that you have increased its size and succeeded in turning out a magazine of the splendid quality of this November number."

In this issue are described four complete receivers, any or all of them good enough to please the heart of the most discriminating of constructors. The RADIO BROADCAST "Aristocrat" is a single-control set with resistance coupling; Mr. Millen's receiver and power amplifier is the first one to be described employing important new developments with a.c. audio power amplifiers for the home constructor. The other articles are worthy of distinct attention each on its own merits.

MR. C. S. THOMPSON, the author of the interesting piece about Doctor DeForest, was for many years closely associated with him and knows whereof he speaks. Mr. Fred Turner, whose "Radio Central"—Conqueror of Time and Distance" appears in this number, is a broadcast speaker whose "Trips and Adventures" are familiar to WEAf and WJZ listeners. Readers who have been following the interesting discussion in Carl Dreher's department regarding the merits of so-called "super power" will read with great interest the concluding arguments in this word-battle. Those who have been curious about the internal human machinery of a great broadcasting station should read Mr. Dreher's leading article on page 45.

In the following numbers of the magazine, there will be articles of great interest to every one who follows radio. To make a confession, because of lack of space for many months, the editors have had to leave out almost as much material as appeared in the magazine. That embarrassment of riches means that the reader can be confident of some mighty good material in every number. One of the most interesting of the articles due to appear as soon as space can be made is by Roland F. Beers on "How to Build an Improved Plate Supply Unit" employing the new Raytheon tube, an improved "S" tube. The article is very complete constructionally and every part of the B supply unit is fully described. And Glenn H. Browning has developed an improved Browning-Drake receiver using impedance-coupled amplification which will be described soon.

Write and tell us how you like RADIO BROADCAST with its new cover and in its new form.

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"Quality Is Season's Watchword"

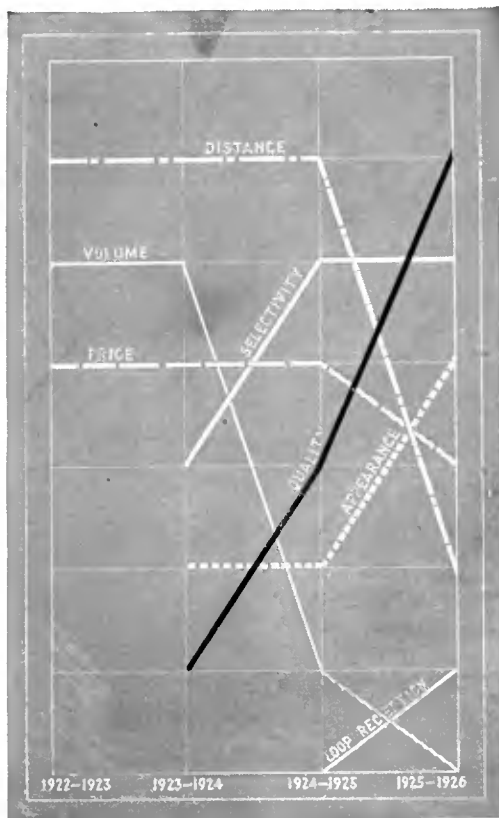
"Fidelity of Tone Production Will Be Greatest Public Demand this Fall"—*Radio Retailing*, issue of August, 1925.

Radio Retailing asked one hundred dealers in ten states what was the most important thing in Radio today.

They all said "Tonal quality is the first requisite."

For years Daven has pioneered quality. It is gratifying to see our vision come true and our judgment substantiated.

Daven engineers have long recognized that the present day receiving set needed to be greatly improved from a quality standpoint. They worked



A graph from August issue of *Radio Retailing*, showing the most important selling point of Radio from 1922 to date.

and perfected Resistance Coupled Amplification, the only existing method known whereby you can procure amplification without distortion and no distortion means simply quality.

The Daven Resistance Coupled Amplifier shown below can be conveniently added to any existing set owned by the public. Manufacturers and amateur set builders should also investigate Daven Resistance Coupled Amplification. Your set will not be 1926 Model unless it is Daven Resistance Coupled.

DAVEN RESISTANCE COUPLED AMPLIFICATION

To the public—Daven Resistance Coupled Super Amplifier in a genuine Bakelite base complete with all resistors, grid leaks and condensers inserted—\$15. In kit form, for those who like to build their own, including special Type A Daven Condensers, \$9.00.

To radio dealers—Send for our complete catalog and the name of our nearest established distributor.

To set manufacturers—The facilities of our Engineering Department are yours to command. Call upon

us at any time. We can offer you constructive advice on how to improve the audio end of your set.

THE RESISTOR MANUAL is the handbook of Resistance Coupled Amplification. At your dealer's 25c. By mail postpaid 30c. Dealers, write for a free copy.

"The Sine of Merit"

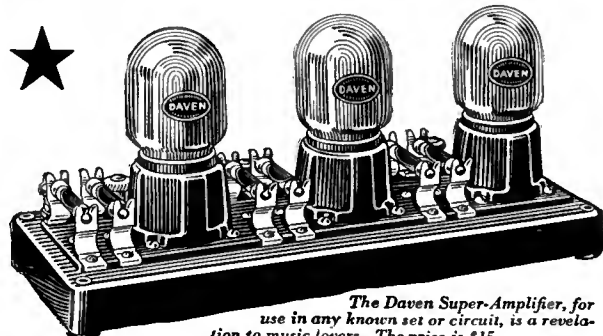
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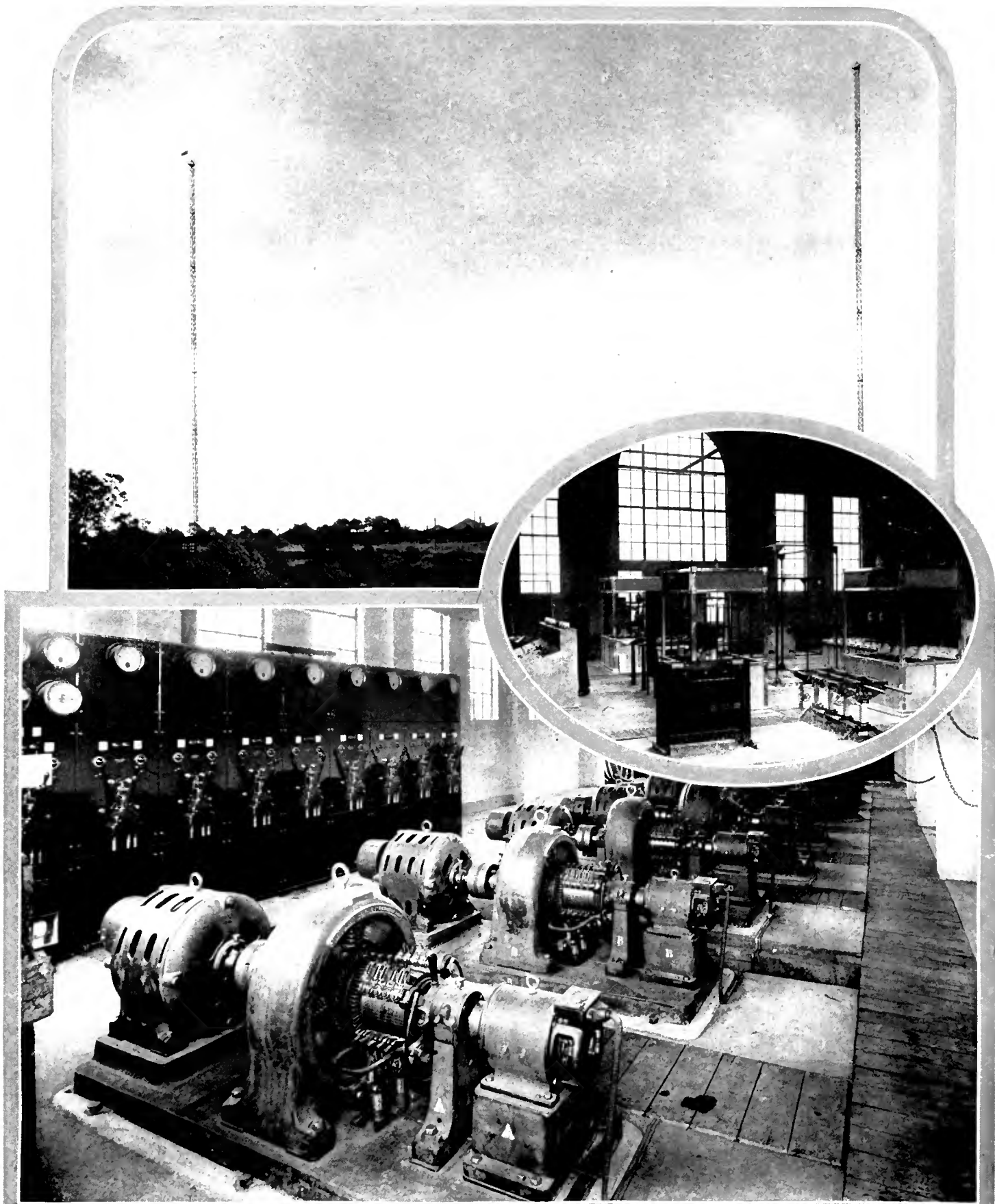
Check One Resistor Manual. 30c. is enclosed.
 Complete Catalogue (free).

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



ENGLAND'S GREATEST BROADCASTING STATION

Three unusual views of the new high-power station of the British Broadcasting Company at Daventry. The top view (© Barratt's) shows the twin 500-foot masts with the station building in the center, silhouetted against the cloudy English sky. The illustration in the oval insert, which at first sight might be mistaken for the interior of the great hall in a castle, shows a corner of the transmitter house. The illustration below shows the eight generators necessary to supply the 25,000 watts for the transmitter. Programs are sent out on 187 kc. (1600 meters) and can be heard throughout a large part of England with only a crystal receiver

RADIO BROADCAST

VOLUME VIII



NUMBER 1

NOVEMBER, 1925

They Shut the Door on Fortune

"Only a Toy," said the Wise Ones, of the Audion, and They Gave No Support to the "Aladdin's Lamp" of Radio—Some Important Incidents Hitherto Unpublished in the Life of Dr. Lee DeForest, Inventor of the Three-Element Vacuum Tube

By C. S. THOMPSON

ON THE sands behind the coral reefs of Washington Island, in the Pacific South Seas, a thousand miles southwest of Honolulu, an audion bulb was picked up some years ago. Bits of water-soaked wood, a rusty spike, a length or so of frayed rope were not uncommon on the beach, but the audion bulb was something new in flotsam. Here the audion turned up on the shore of an island 900 miles west of the nearest steamer lane.

There was a radio telegraph station at Washington Island. R. A. Travers was the operator. He saw the audion bulb and recognized the handiwork of the inventor, and that night put the bulb in the mail, with the following letter:

Washington Island,
Via Honolulu and Fanning Island.
December 1, 1919.

"Dr. Lee DeForest,
New York City,
U. S. A.

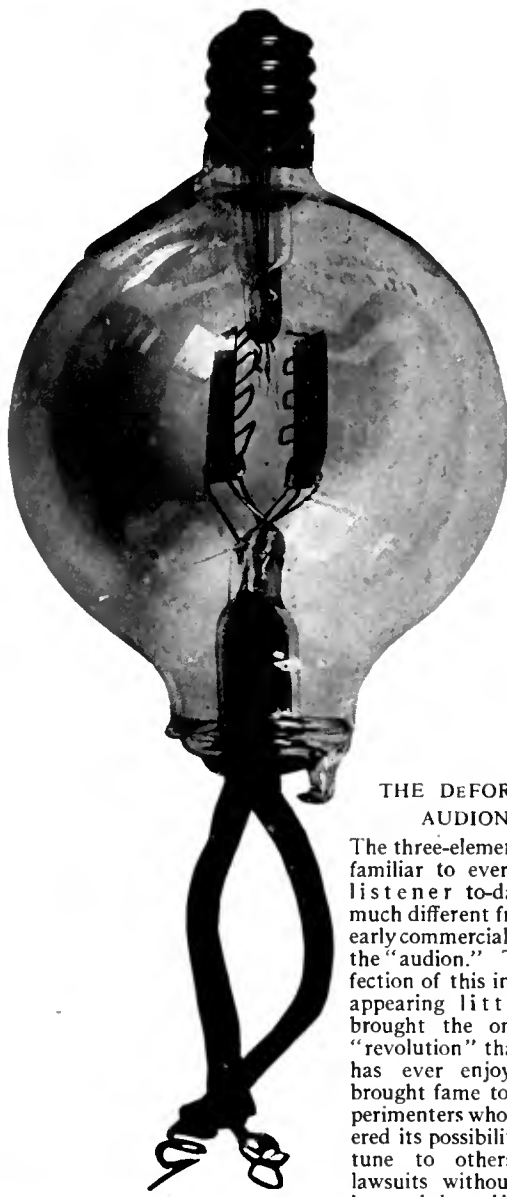
DEAR DR. DEFOREST:

I am sending you by parcels post an interesting valve I believe to be one of your pre-war types. . . . This valve traveled many miles through the Pacific ocean, bobbed over a coral reef, and came to rest on the sands of this island. . . . Washington Island is a wee spot in the wide Pacific, having less than a dozen miles of coast. . . . From wreckage picked up from time to time, it appears drifting objects come from the eastward. . . . I believe this valve will be of interest in your collection.

R. A. TRAVERS."

Doctor DeForest, at his laboratory, did find the bulb to be one of his own pre-war types. The story of this "lost audion" set his imagination working.

"If I could spend a couple of months," he said, "away from all cares on a paradise



© Paul Thompson

island in the South Seas, I could doubtless compose my soul sufficiently to write a poem worthy of the theme, but our New York subway is not conducive to poetic rhapsodies. There has been altogether too little poetry on radio from its beginning, but perhaps the poetry has been in the accomplishment itself."

The frail glass bulb, safe on the laboratory table at Highbridge, incidentally suggested to DeForest the story of his invention for so many dark years laughed at and scorned as a useless toy by investigating lawyers, telephone experts, men of science, engineers, captains of industry and their capitalists. Doctor DeForest's early experiences merely repeated the story of the flying machine, the locomotive, the moving picture, the talking machine, the power-driven car, the submarine, all, in their early stages, merely wild tales of the imagination fit only for the readers of a Jules Verne.

It was in the summer of 1912, already having lost two fortunes, that DeForest, at work on a meagre salary in California, went to the president of the company to borrow \$125. DeForest wanted the money to perpetuate the life of audion patents held by him in France. In payment, he offered half his interest in the French rights. The president heard the offer but thought it too much of a gamble and then, to the despair of the inventor, the rights reverted to the French Government. Then came the war, and the audion took its place as the very heart of radio communication. Countless bulbs were supplied to the allied armies in France.

"One million dollars is a conservative estimate of the royalties

THE DEFOREST AUDION

The three-element tubes familiar to every radio listener to-day look much different from this early commercial form of the "audion." The perfection of this innocent-looking little bulb brought the only real "revolution" that radio has ever enjoyed. It brought fame to the experimenters who discovered its possibilities, fortune to others—and lawsuits without number, and the end is not yet

which would have been paid us by the manufacturers during the period of the war alone," said DeForest recently. "But, unfortunately in 1912, my friend the president, thinking that I was only dreaming, withheld his one hundred and twenty-five."

Was it lack of faith in the dream of the young inventor, or failure to see the march of progress? The name of the president will not go down to future generations. Nor is it fair to put him in a class by himself. With him may be named a score of others who blindly shut the door on fortune appearing in the guise of our rather ambitious young inventor. We might include in this group of mentally near-sighted the following:

The eminent directors of an early wireless telegraph company.

Telephone experts of 1908, 1909, 1910, 1911.

An eminent professor of electrical engineering instructing the student, DeForest.

Some well-to-do college classmates.

The executives and attorneys of a leading American telephone company.

A learned district attorney who solemnly proclaimed the audion to be a worthless "piece of glass."

It was early in the history of the wireless telegraph that worldwide recognition was given DeForest as a pioneer. In this period of invention came the birth of the audion. The audion was a lamp about the size of an Edison bulb.

HOW THE AUDION WAS NAMED

THE tube contained a filament, a grid, and a plate. DeForest made up a name for it, he took the word "audio," to hear; and "ion" meaning one or more electrons, and combined them into the one word—"audion," the three-electrode vacuum tube. It is the "talking" or "listening" lamp.

The first patent on the audion was assigned by DeForest to an early American wireless company. But this company got into trouble. Rather than have anything more to do with them, the inventor turned in his stock holdings and took in exchange certain patents which the company considered of no particular value. Among these were the first audion patent applications. How much are the exclusive rights to these patents worth to-day? Ask these former directors of the early American wireless company, or the corporations to-day operating under the audion patents!

Just about this time, when "some care-

less hand was tossing aside the audion"

DeForest appeared before the New York Electrical Society to report on the development of his lamp. Telephone communication, in those days, was limited to a comparatively few miles. The Electrical Society meeting was widely advertised, and among those present were tele-

phone engineers. Their company at this time had paid \$400,000 for another device which they hoped would aid long distance operation. But this other device failed to do the job.

"My address," says DeForest, in

recalling this experience, "included a detailed description of my numerous patents, even including one taken out in January, 1907, for amplifying weak telephone currents. The audion amplifier patent indicated very clearly the service that the audion could perform as a telephone relay or repeater, the result of experiments which I had been conducting in the summer of 1906 on the top floor of the old Parker Building on Fourth Avenue, in New York. The telephone engineers heard my story but were skeptical—too skeptical for words. One, two, three, four years elapsed—years thrown away. It was not until 1912 that I at last succeeded, through a friend, in getting an opportunity to demonstrate the audion relay before the telephone company. With the audion, in less than two years, they opened telephone service across the continent."

So much for the telephone engineers of 1908, 1909, 1910, and 1911. But these men of science were not alone in shutting the door on the efforts of the young inventor.

"HE WILL NEVER AMOUNT TO ANYTHING"

MANY years earlier along came the professor of electrical engineering in the university where DeForest had set out to write his thesis on the "Reflection of Hertzian Waves Along Parallel Lines." One night, while the student was working in a basement laboratory, the lights in a classroom went out. DeForest was suspected of having removed the wrong fuse. Shortly afterward the professor discovered that DeForest had committed the grave crime of nailing his apparatus to a laboratory table. That was too much.

"Any student who will spoil a table like that," said the professor, "will never amount to anything."

DeForest pleaded the value of his work and what he hoped to accomplish, but the professor was firm, and out went the student. He wanted his Ph. D. and at length succeeded in being enrolled in another department of the university, where, incidentally, Morse did his early work on the telegraph. But at least the table was saved from the earmarks of the "worthless student."

Recently DeForest, attending a class reunion, was approached by a friend of earlier days.

"Is there still any money to be made in radio?" asked the classmate.

DeForest smiled. "Have you forgotten," he said, "not so many years ago I came to you for the loan of a few hundred dollars saying there was a fortune to be made in putting the audion on the market?"

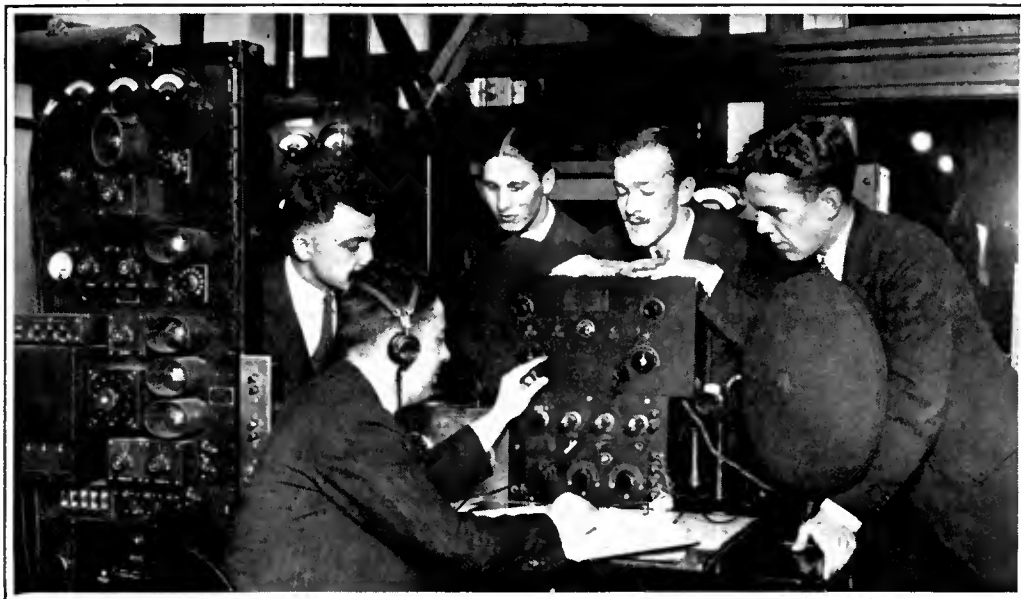
"No, Lee," replied the other, ruefully, "I certainly slammed the door on fortune."

In the year 1917, the telephone company which paid the first \$140,000 for rights to the audion entered into negotiations for further patents. The audion in the meantime had grown from a mere child of imagination to a good-sized boy. It was being used in many different ways. It picked up



MAKING MODERN VACUUM TUBES

The name of Doctor DeForest is always linked in the mind of the radio man with the three-element tube, although he was responsible for many other developments and perfections in radio, most of which had hard financial sledding, as Mr. Thompson suggests in this article. The early vacuum tube was made in small quantities and no two of them were electrically alike. This illustration shows how the more modern types of transmitting tubes are made. The tubes are slowly pumped out, so that almost no gas remains



IN A BROADCASTING STATION

Three-element tubes, whose use was originally discovered by Doctor DeForest, are used at every stage of both sending and receiving

radio. Last year the "amateur trade"—so-called—spent nearly four hundred million dollars on "the joke."

"A PIECE OF GLASS—WITHOUT MERIT"

PERHAPS the first prize in this competition for those who blindly shut the door on the young inventor should go to that eminent gentleman who many years ago occupied the position of district attorney in one of the Eastern courts. The device conceived by the young inventor chanced to be an exhibit in a trial of some corporation directors who proclaimed it to be a wonderful invention. They were selling stock in order to promote the use of the audion in the world of art, industry, and communication. They had been indicted by the grand jury, together

wireless dots and dashes across the seas. It carried the human voice on the telephone wires across continents. It had also entered the business arena as an oscillator. In other words, it had almost become a competitor of the huge alternating generator of our modern power houses. The sum of \$250,000 was finally agreed upon for the additional rights.

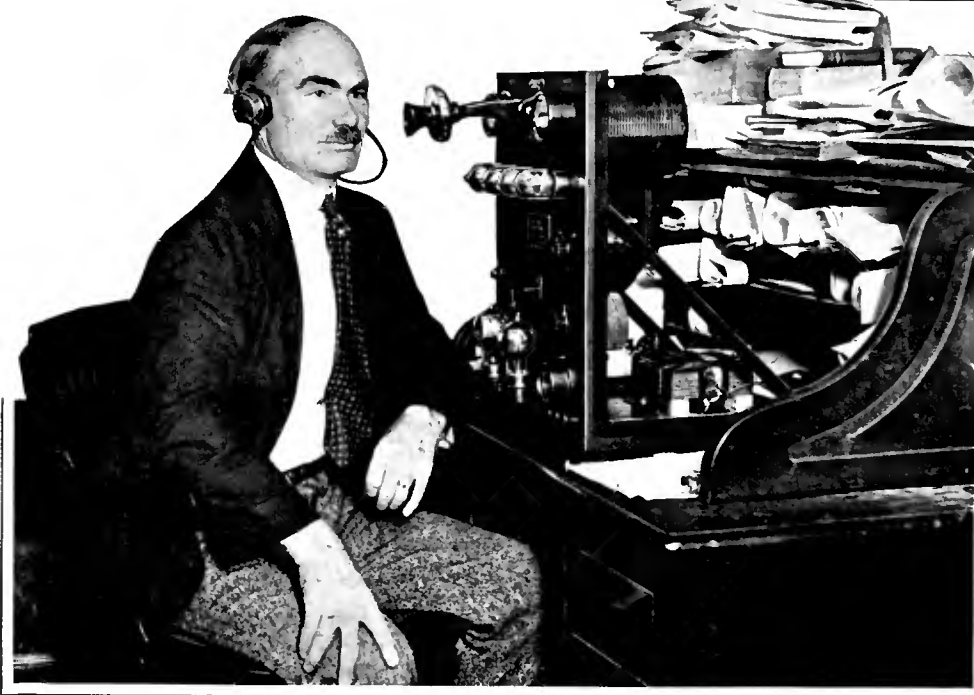
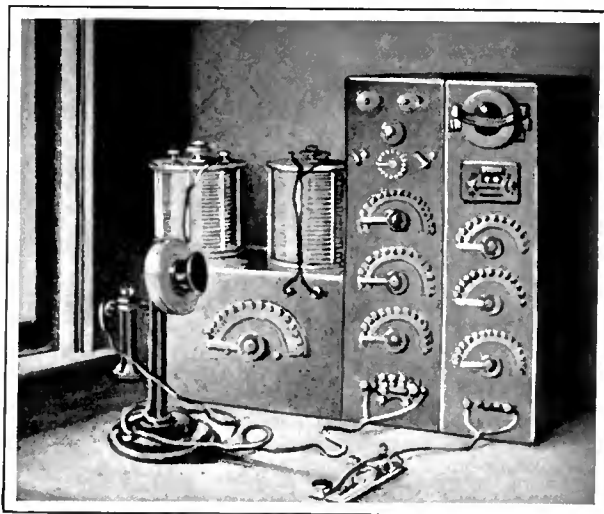
At last the attorneys and officials of the telephone company were satisfied. One of them said to the writer:

"We have all there is to have now under the audion patents."

"Yes," I interposed, "but not the exclusive right to sell radio sets to the public. DeForest retained that right."

"But what does that amount to?"

To be sure, in 1917, the right to sell to the "amateur" as it was designated, meant very little. In those days radio broadcasting was a joke. But, in less than three years, the country was inoculated with



DR. LEE DEFOREST AND HIS "WIRELESS TELEPHONE"

© Western Newspaper Union

As long ago in radio history as 1919 this outfit was announced to the public as the "last word in wireless telephony . . . destined to become quite popular in these uncertain days of telephonic ills." The vacuum tubes used in this model can be clearly seen. The sketch to the right, above, is a charcoal drawing of early wireless telephone and telegraph apparatus used by Doctor DeForest at a station in Washington. Its appearance is quite different from the large broadcast transmitter of to-day

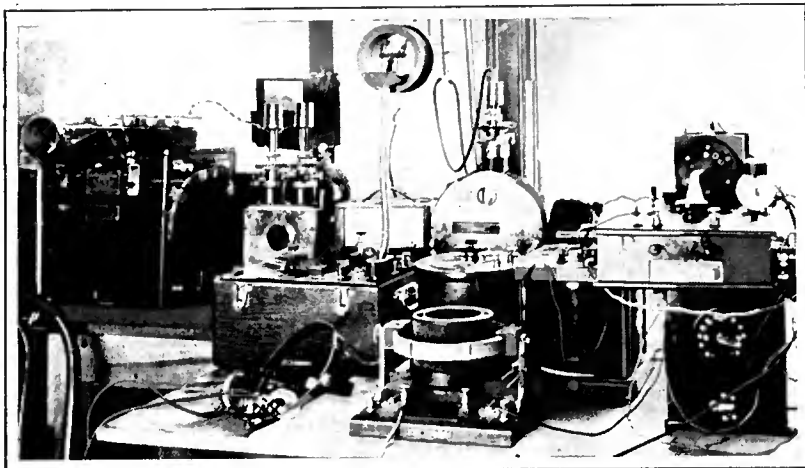
with the inventor, and stood facing a term in Atlanta.

But listen to the District Attorney:

"They would have us believe," said he in summing up, "that this little thing is a wonderful instrument of science. They are appealing to the public to subscribe to their stock. But let me tell you, gentlemen of the jury, they are preying on the minds of ignorant and simple people. This device is without merit. It is not a wonderful invention. It fails to perform the many marvels they claim for it. It is a piece of glass which has been built into the form of a lamp, not to perform scientific wonders, but to sell stock. I ask, therefore, that you bring in a verdict of guilty for all those who have been concerned with this palpable fraud."

One or more of the defendants were found guilty and actually went to the penitentiary, not altogether, perhaps, upon the question of the merit of the "piece of glass" but more likely because of their misuse of the mails in selling the stock of the corporation. The inventor was acquitted.

"In the audion," said Edison some years after the courtroom scene, "De-



HISTORIC WIRELESS APPARATUS

This view was taken in the DeForest laboratory and shows some early experimental apparatus. At the left is an early model of a wireless telephone, using an arc instead of vacuum tubes for power. In the center is a model of a "picture machine" and at the right a crude receiver. A vacuum tube (inverted) can be seen on the top of the cabinet

Forest has invented a device which amplifies sound so much that if a fly were to walk across the transmitter, the noise at the receiver would shatter your eardrums!"

Had these various gentlemen no prophetic inkling to stir their imaginations? Publicly the first radio broadcasting took place at Put-In-Bay on Lake Erie, July 15, 1907, at the regatta of the Inter-Lake Yacht Association, when the reports of the yacht race together with gramophone selections were reported by radio. Not many months later, audion bulbs were installed on the radio telephone receiving apparatus used by the fleet of Admiral "Fighting Bob" Evans in his noteworthy cruise around the world. Even as early as 1907, we had plenty of demonstrations of what might be accomplished in the transmission of news and music by radio. In May of that year the inventor announced: "Church music, sermons, lectures, etc., can be spread abroad by the radio telephone. In rural districts scores of individual radio telephone services can be main-

tained between widely separated farms, ranches, cross-road stores, etc. For the distribution of music, the radio telephone means an enormous increase of patronage among music lovers. It will very soon be possible to distribute grand opera music from transmitters placed on the stage of the Metropolitan Opera House by a radio telephone."

Such, in brief, is the tale of "The Lost Audion." The lamp which to-day, developed by engineering, makes it possible for your voice to span continents, for your ear to listen-in to nightly entertainments, or the spoken words of your president. The lamp which has made possible multiplex telephony or "wired wireless," the transmission of photographs by wire, the "talking picture," and a thousand and one other marvels of science and industry, eliminating the distance between nations and making us all one bigger human family. The first modest "audions" did their work quietly and well, and no one had the slightest inkling that the queer little bulb would some day expand radio, in all its branches, far beyond the sober plans of the



IN THE EXPERIMENTAL DAYS

A portable wireless telephone transmitter being tested in the fields near Newark, New Jersey. The operators were never certain in those days just how far their signals would travel; uncertainty was the one certain thing about wireless then. The outfit is one built by Doctor De Forest

early radio experimenters. Now at last we may well sing with the poet of the Pacific:

FLOTSAM

Wave-borne, a fragile thing of glass and wire
Past the grim reefs that guard a lonely land
The audion drifted. Balked of its desire.

The spent sea washed it on the level sand,
But we can fancy countless days you watched the ships go by—
The months, in idle drifting spent beneath a tropic sky!



IN AMATEUR STATIONS

Three-element vacuum tubes are widely used. Years ago, in 1912, an employer refused Doctor DeForest \$125 to renew his "audion" patents in France so the rights reverted to the French Government, and perhaps a fortune was lost. Elizabeth Zandonini, owner of station 3 CQ, Washington, is shown at her set. She is a radio aide at the Bureau of Standards



THE MARCH OF RADIO

By *J. J. Morecroft*
 Past President, Institute of Radio Engineers

Shall We Have A National Radio Council?

WE HEAR so much about various organizations nowadays, with their innumerable committees and sub-committees, that our natural reaction toward bringing into existence a new society is negative. Most of the hours that can be spared from our necessary daily tasks seem to be used up in committee meetings and discussions of one sort or another.

"Don't do it" was our first reaction to a suggestion for a national radio council made by the Radio Manufacturers Association. The society is active and influential; its members constitute many dependable radio manufacturers. Naturally any activities which bring about an increased interest in radio will be reflected in greater sales of apparatus, and it is undoubtedly the prime object of the Radio Manufacturers Association to bring about just this result.

We can look at the proposal of the Radio Manufacturers Association in just the same spirit as we consider the activities of the National Automobile Chamber of Commerce while primarily they are looking out for their own good, their vision may be broad enough to take in the idea that any movement which makes radio more pleasurable for the listeners increases their sales to just the same degree. The elimination of

interference, the improvement of programs, and all such activities might well be forwarded by the manufacturers association.

The report of the R. M. A. was evidently drawn up in the liberal spirit we have alluded to. A national radio council is recommended, whose function is not primarily to bring about increased sales for the manufacturers but rather to improve the radio situation as a whole. Among other things, Mr. Frank Reichmann, chairman of the R. M. A. committee, says, "We recommend the establishment of a National Radio Council to be composed of representatives of the Radio Manufacturers Association, dealers and jobbers, manufacturers' agents, the broadcasters, radio publications, and the listeners.

We are advised that the National Radio Trades Association, which has done much excellent work in the past, is anxious that the manufacturers get behind an organization of the dealers and jobbers. We understand that the National Association of Broadcasters is willing to help in organizing a central council, and we are assured that we will have the active support of the two leading listeners' organizations—the American Radio Association and the Broadcast Listeners Association of America.

We are also of the opinion that the American Radio Relay League should be invited to become a member of the council and we can promise that the Farm Radio Council will join.

This committee also recommends that the association take up the matter of further encouraging the teaching of radio in all manual training classes in all public and private schools.

This committee believes that by careful, conservative action during the coming year a great deal can be done to cement together all those interested in radio, to the end that the industry will be better prepared to repel legislative and other attacks, and that even greater public interest in radio will be assured.

What the "Straight Line Frequency" Condenser Means

WITH the increase in use of the term frequency, rather than wavelength in radio broadcasting ideas and practice, the straight line frequency condenser has appeared on the market and there seems to be considerable misunderstanding as to what and why it is.

It is not long since we made comment on the "low loss" condenser, a term which was invented by some astute radio business man to increase his sales. As we pointed out at that time "although some condensers do actually have lower electrical losses than others, due to better materials used for plates and insulation, the difference is so slight that any one of a dozen reputable condensers would show up equally well when connected in a receiving set." The



H. W. ARLIN

Chief Announcer at station KOKA, East Pittsburgh, holding a large water-cooled ten kw. transmitting tube in contrast to the piezo-electric crystal. This quartz crystal has the property of vibrating when properly excited at radio frequencies. It is inserted in the KDKA transmitter and holds the transmitted frequency very accurately on the proper adjustment

difference in loss of various standard condensers is so slight that accurate laboratory measurements are required to show it.

Not so, however, with the straight line frequency condenser; the use of such a condenser in radio sets is a real advance in the radio art. The assignment of various channels to different broadcasting stations is made because each station requires a definite number of cycles for its own use; the proper number depends upon the quality of the broadcast material, but in general it may be said that no station should be assigned a frequency within ten kilocycles of another located sufficiently close to interfere with the one in question. Thus if there were ten stations in one district they would naturally be assigned channels equally spaced in frequencies, say twenty kilocycles apart, and if the set being used is equipped with straight line frequency condensers these stations will be found at equally spaced points on the

tuning dials. With ordinary condensers of course this is by no means possible, for only one or two stations are found at the higher points of the scale, where at the lower end of the scale the different stations come in at points so close together that it is difficult to set accurately for them. These new condensers, however, show one station at 5, another at 10, another at 15, etc., all the way up the scale, and their use makes a set considerably easier to manipulate.

The Progress of Broadcast Relaying

AN ANNOUNCEMENT from KDKA confesses that what they call a new scheme of relaying has been tried out and found to be satisfactory. The Westinghouse station at Hastings, KFKX, which has been used as a relay outfit for quite some time, has ordinarily been operated on a different frequency from KDKA, so that any one midway between Pittsburgh and Nebraska might receive the same program from either station, providing he retuned as he wanted to listen to one station or the other. To operate both stations at the same frequencies brings in some technical difficulties, according to the engineering staff of

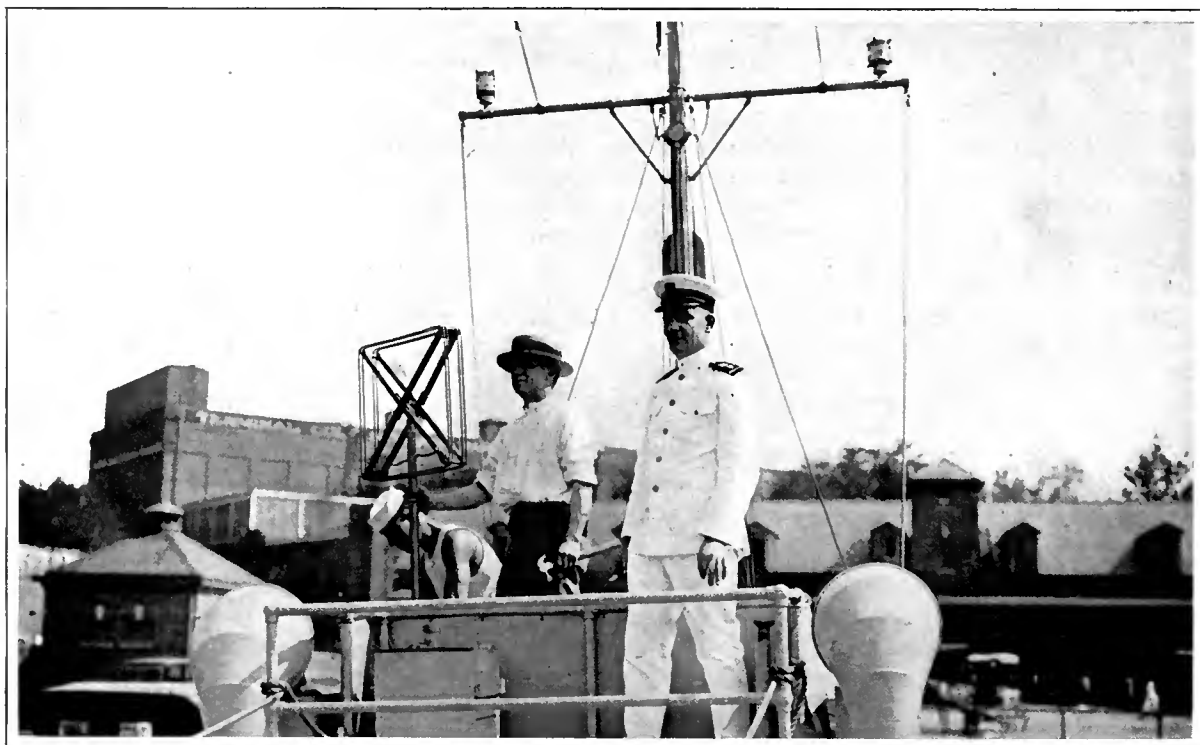
the Westinghouse Company, but recent improvements have overcome these troubles and now they say that both stations may be operated at the same frequency. The feat may have more promise than we now think it has.

It also said that the frequency of KDKA is now being held constant by the use of a piece of piezo-electric quartz. As we have related in these columns before, a small piece of good quartz crystal, properly cut and arranged in an electric circuit, will hold the frequency of oscillation so constant that no present methods can detect any change. The use of this frequency fixing scheme of KDKA seems much more important to us, as far as the March of Radio is concerned, than the rebroadcasting stunt mentioned above and about which such sweeping claims are made. We are interested to note that the other Westinghouse stations are soon to be equipped with quartz frequency stabilizers. This technical advance might well be followed by many other stations which evidently experience some difficulty in maintaining their frequency.

Radio for 1926: A Forecast

CARL BUTMAN has just completed an extensive survey of what the radio listener wants for 1926. His findings are in accord with what we have urged on our readers for quite some time.

The DX fan, the man who continually manipulates dials to see if he cannot catch the last letter perhaps of a station 500 miles farther away, is rapidly disappearing. He was ever a nuisance, this distance seek-



© Harris & Ewing

RADIO DETECTIVE EQUIPMENT ABOARD A RUM CHASER

The radio direction finder installed on the bridge of the CG198. It is said that many of the rum runners off the American coast are using radio to help them in their operations. The direction finder, as used by the "Dry Navy," is expected to be of great aid in locating the rum ships. The large carboy in the foreground supposedly contains distilled water

ing fanatic; no sooner had the radio set been tuned to one station and the call letter heard than he was off for another. A kind of sport it was, to be sure, but in the main, radio is to give entertainment to the family from stations close at home.

With the slow disappearance of the dx listener, the survey finds an ever-increasing demand for quality reception. Many people are just awakening to the realization of how very poor is the quality the loud speaker delivers and this has resulted in an insistent demand for faithful reproduction. As was said in these columns many months ago, it is very seldom that a radio loud speaker leads us to believe that the speaker is actually in the room and until this is so the goal, an attainable one, has certainly not been reached. Any skilled radio engineer can, if he has suitable laboratory facilities, develop a set which will amplify properly throughout the whole audible scale and from such a set, after the loud speaker manufacturers have much improved their product, reasonable quality may be expected. The present horn is eventually doomed to the radio scrap pile, we believe and the diaphragm type or possibly something better will take its place.

A growing tendency toward simple control is shown in the new sets and it seems that two-dial sets will soon predominate in the market. The simple regenerative receiver is on the down grade and the tuned radio frequency five-tube receiver seems to be the one most favored. It is well to point out that to get good quality with loud speaker reception, the ordinary small tube as used to-day must be done away with; it cannot possibly deliver enough power for the ordinary loud speaker to handle. In the new sets we are glad to see a new type of tube used in the last audio stage.

Quality is undoubtedly the keynote of progress for the sets of 1926.

The Radio Business as Others See It

THE Copper and Brass Research Organization, whose function is to compile all information useful to companies dealing in copper and brass products, has recently given out a summary of its investigations of the radio business. It is interesting to note that the estimate of the value of the coming year's radio business, and number of sets already in use, etc., compare quite closely with some other figures at hand compiled from the past reports of the Bureau of the Census. The Bureau reports are not brought up to date because compilations are made only every two years.

According to the Copper and Brass Association, "Manufacture and sale of radio receivers has established a record for rapid industrial expansion. In 1922 there were hardly 100,000 radio sets in use; in 1923 the number had grown to 2,000,000; in 1924 to 3,750,000, and by the end of 1925 it is estimated that the number of sets in

use will reach a total of 5,000,000. The retail value of sets and parts has grown from \$50,000,000 in 1922 to an estimated \$500,000,000 in 1925.

Public interest in radio has gained rapidly and apparently has continued unabated. Only a year and a half ago the consumer demand was far in excess of the manufacturers' ability to supply. At that time the number of home-made sets exceeded the factory-made, and there was a correspondingly large retail market for radio parts of every description. The last year has seen the beginning of something like stabilization in the industry. The trend of sales is now away from the home-made set and toward the set purchased as a complete unit.

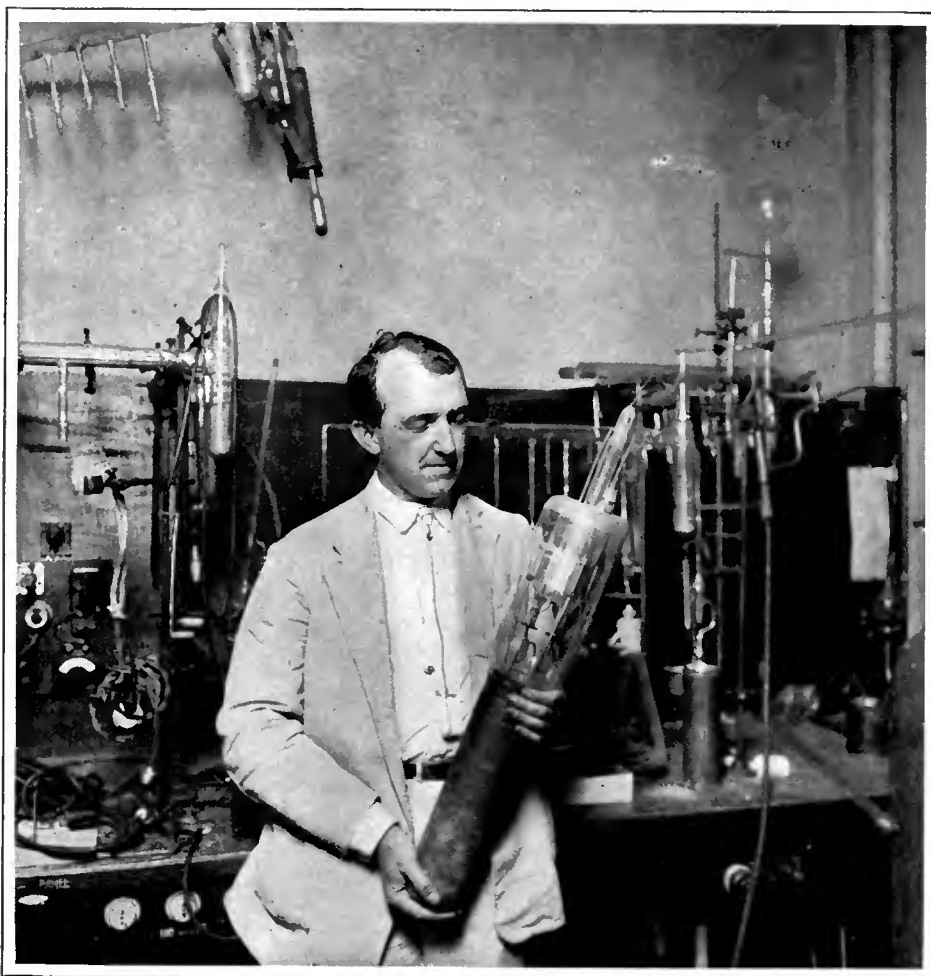
The present rate of manufacture, according to the Association's survey, indicates that 1925 production will be 2,000,000 sets in which the consumption of copper and brass will be about 7,750,000 pounds. These metals are used for antennas, ground connections, coils, condensers, tube sockets, panels, and miscellaneous small parts. The interesting report continues:

Radio now appears to be as universal in its appeal and as much a necessity as the automobile, so there is no reason to look for any falling

off in sales in the next few years. The radio purchaser is not only a good customer for tubes, batteries, plugs, jacks, and other miscellaneous parts, but almost generally he is ready, after using a set a year or two, to scrap it and replace it with another which has a more stylish cabinet or a newer "hook-up" or more tubes. Consequently both replacement and new set markets increase together with the market for parts and accessories.

A review by Mr. Carl Butman of Washington suggests the interesting note that in 1923 the average price of a radio outfit was \$16, in 1924 it was \$50, and to-day it is a hundred dollars or more. This higher priced equipment is not going to the high-salaried city dweller only, but the agricultural communities also show the same evidence of giving up the old five-dollar home-made set in favor of one which performs more reliably and has a more pleasing appearance.

Both of the reports place the probable number of receiving sets in the United States for 1926 as five million or over. When nation-wide broadcasts are carried out next year, therefore, it is evident that the potential audience is certainly measured in the millions, possibly ten or even more.



© Bell Telephone Laboratories

WILLIAM G. HOUSEKEEPER

An engineer of the Bell Telephone Laboratories who was recently awarded the John Scott Medal by the City of Philadelphia for his contribution to technical progress. The award carried with it a \$1000 prize. Mr. Housekeeper was responsible for the metal-glass seal in large vacuum tubes. Previous to his discovery, it had been almost impossible to make large vacuum tubes because of the difficulty of bringing out large leads through the glass. Mr. Housekeeper is here shown in his laboratory with one of the large tubes. Note how small the lead wire is made just where it passes through the glass

A Year of Conferences

THE International Radio Conference, many times delayed, is now to be held in Washington next spring. Not since the last international conference was held in London in 1912 have the various nations interested in radio met to discuss its problems. Invitations have now been sent out to forty-two different governments, asking them to send delegates to America in the spring of 1926. Congress has appropriated \$92,000 to defray the expenses of the conference, and outlines of the work to be covered have already been laid out. The subjects to be discussed include the revision of the International Radio Telegraph Convention and Regulations, the discussion of measures for the international supervision of communication by radio between large fixed stations, broadcasting, measures for elimination of interference, distress messages, radio aids to navigation, and other developments of the art which have come into being since the 1912 conference.

As this is written there is being held in Paris the International Telegraph Convention. The United States is not officially a party to this conference and our delegates will be seated as observers only. Three attended. In addition to these, certain of the government technical men

are being sent and the telephone, telegraph, and cable companies of America have many representatives in Paris to advise with the government representatives and their aids.

In addition to these two conferences, Secretary Hoover will probably call the regular annual national conference for some time in November. He rightly feels that the previous Washington conferences have been of value to the department in framing new policies and that this year especially, when there are many stations increasing their power, it will be well to test public feeling toward these more powerful stations. One station is already operating experimentally with fifty kilowatts, another is prepared to do so, and there are several operating at five kilowatts. The use of these greater powers has by no means resulted in the confusion and interference which many panic-stricken listeners predicted and it seems quite likely that this national conference will put its stamp of approval on the super-power channels.

The radiating receiver should get its share of adverse comment at the Washington conference. Listeners continually complain of these miniature broadcasting stations. We strongly urge the Department to put its official stamp of disapproval upon this prolific source of radio discomfort.

The Month in Radio

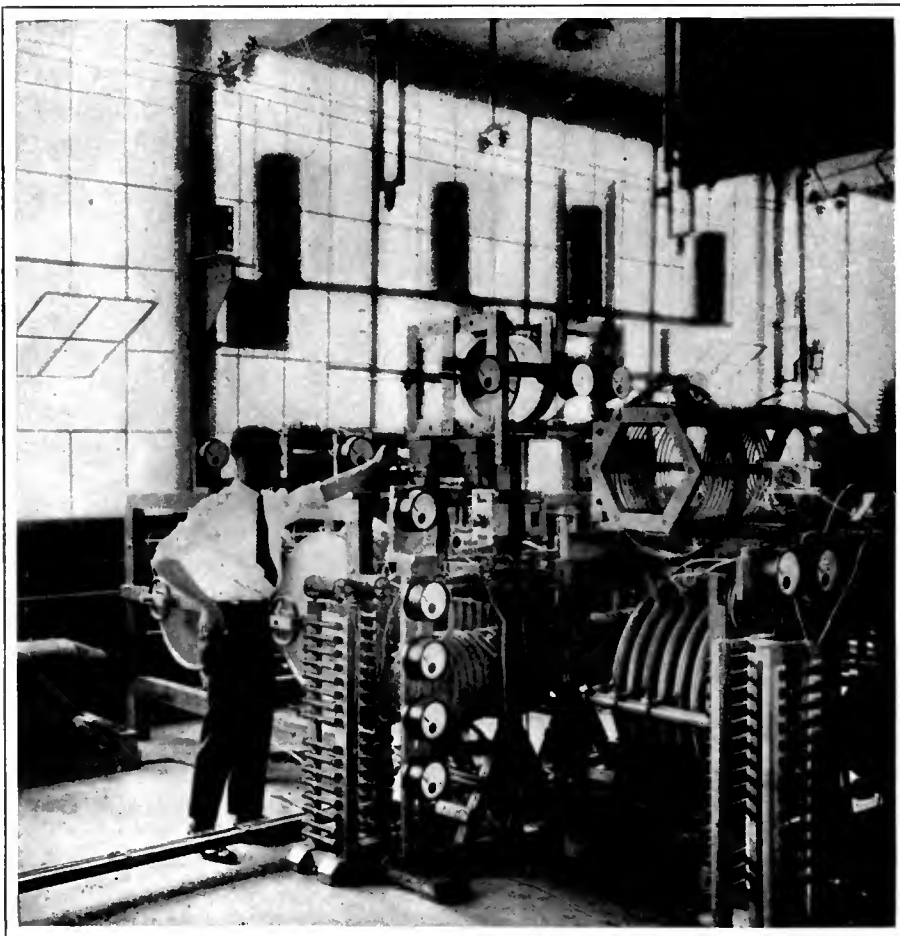
PRELIMINARY reports of the operation of the 50 kw. wgy transmitter gives some very interesting, though not startling, information. Comparative tests were recently carried out first with 2.5 kw. and then with 50 kw., that is, twenty times as much power as the first. Many listeners had expected that so much power would completely blanket other stations, but was not found to be the fact; the results so far obtained show that theory is able to predict what will happen at the higher powers and in this case the theory indicated that the blanketing effect would be pronounced only when close to the high-powered station. Listeners fifty miles away from one of these high-powered stations will probably be disappointed to find out how strong the signals really are; the signal will be about the same strength as from an ordinary station about ten miles away.

The useful area of transmission of the super power station is very much increased over the low powered station of course, and the quality of reception is improved because of the higher ratio of signal strength compared to static.

Much trouble is experienced by the average listener fifty miles or more away from a station due to the now well-known fading effects; the rapid waxing and waning of signal strength makes many radio evenings very disappointing. It had been supposed by some that fading would be lessened when the high power was used but such proved not to be the fact. The signal is of course much more audible with the higher power but its fading is just as pronounced as with the older lower powered sets.

THE cruise of our fleet through the southern Pacific has given rise to some remarkable distance events. The U. S. S. *Seattle* in the harbor at Wellington, New Zealand, has heard telephone conversations with a London amateur with remarkable regularity. The distance, slightly more than 12,000 miles, is as far as a radio telephone message can be transmitted on this earth. The operator on the *Seattle* has also maintained two-way communication with the naval experimental station at Bellevue as he crossed the Pacific from Honolulu to Australia. The Laboratory of RADIO BROADCAST station 2 GY communicated with the *Seattle* while she was leaving Tahiti. Our station used only a 5-watt tube, which is thought to establish a record for 5-watt transmission.

THE American consul in Paris, reporting to the Department of Commerce, sees but little market for American receiving sets in that country. So far, he says, broadcasting in this section has become popular only in a small degree compared to the situation in America. There are only four stations broadcasting, all of



THE FIRST AMERICAN "SUPER POWER" BROADCASTING STATION

The 50 kw. transmitter at station wgy, Schenectady. Recent tests were made to determine whether better program service could be given listeners if the power of the transmitting station were greatly increased

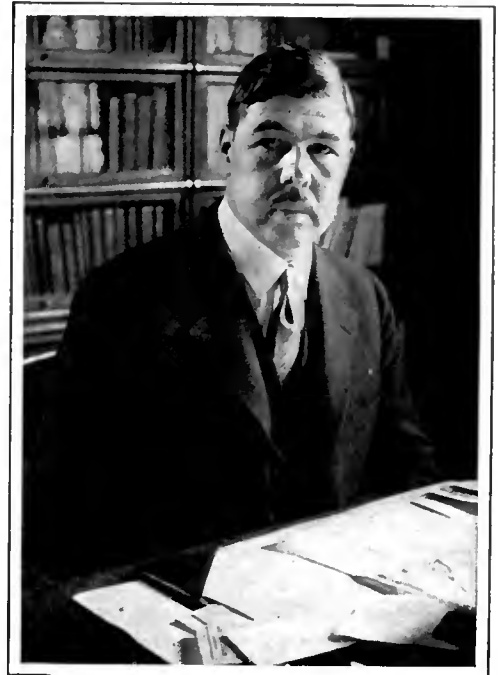


JOHN V. L. HOGAN
New York; Consulting Radio Engineer

"The report, recently made public by Secretary of the Navy Wilbur, relating to the work of the Naval Laboratories, which seemed to point to the possibility of the expensive high-powered, long wave stations now used for inter-continental radio communication being replaced by less expensive short wave, lower powered stations is especially interesting. The conclusions are quite in line with the recent reports on the same subject made by Dr. Alexanderson, of the General Electric Company at Schenectady. It is difficult to say definitely that the present high power, long wave stations will be replaced by the short wave transmitter because the short waves are not always reliable. However, there seems to be no doubt that they will be valuable adjuncts to the powerful long wave stations."

some time his death was regarded as a mystery, but careful examination of the radio installation on his plane indicated that defective insulation in the headphones and other parts of the transmitting set had permitted a shock of over one thousand volts to pass through his head. As a shock of only twenty or thirty volts around the head is extremely painful it is no wonder that the leakage of the thousand volt current into his ears was fatal.

IN BRITISH India, the government retains the right to supervise and inspect all broadcasting stations, censoring them and taking them over in emergencies. It is also required that each station, as in the United States, shall have a receiving set in continual service while broadcasting. Government matter, such as weather reports, educational lectures, and emergency dispatches must be handled free. No program can have more than ten per cent. of its time used for advertising purposes.



L. A. HAZELTINE
Hoboken; Professor of Electrical Engineering

*Interesting Things
Said Interestingly*

JOHN McCORMACK (London; Irish tenor): "I shall retire at 50 and from now on shall come to London each year to sing in the Albert Hall. However, I emphatically refuse to broadcast. I tried it once in New York and disliked it thoroughly."

A.L. RUBENSTEIN (New York; chief operator of the S. S. *Arcturus* with the recent William Beebe scientific expedition): "While we were in the Galapagos the broadcasting station that came in best was WMBF, at Miami Beach, Fla. Ordinarily we couldn't get New York. But on one occasion we asked the East Moriches station to request a certain concert from an orchestra in a Greenwich Village restaurant. The music we asked for was put on the air by WGBS, and came through with remarkable clarity, considering the distance and atmospheric conditions."

HERBERT H. FROST (Chicago; president Radio Manufacturers Association): "In the early part of 1917 I was assigned to the command of a radio company of one of the Regular Army Field Signal Battalions, and found that out of a total strength of seventy-six men in this company, 52 of them were licensed amateur operators who had enlisted at the first call, and I know of one town in Pennsylvania that gave 11 amateurs to the Signal Corps out of a total of 13 licensed members who were residents of that city. The American amateur and the American Radio Relay League have made their bid for fame, and stand before us today richly endowed with a past record in both peace and war. It is not too much to say that the experimental work they are now doing on short waves will revolutionize our present systems of transmission and reception over great distances."

JOSEPH D. R. FREED (Brooklyn; president Freed-Eisemann Radio Corporation): "I firmly believe that all kinds of freak circuits will be exploited within the next two months. The public should be warned against

"I would not advise any young man to attempt a short cut into radio engineering. The ordinary electrical engineering course should be sufficient, if followed by practical experience preferably with a large organization, or by post graduate work at college, the latter more especially for the man having a taste for research. My own collegiate work was simply the mechanical engineering course given by Stevens, and I found it quite sufficient to build on by studying in my spare time. While one cannot expect the present exceptional demand for radio engineers to continue indefinitely, it would be equally a mistake to consider radio as a fad or in any way transitory. There should continue to be good opportunities for experience and advancement in radio fields, perhaps more than in other branches of electrical engineering. I still have the same feeling that caused me to take up radio as a specialty, that it is especially attractive to men having a fondness for mathematics and its practical application."

high-sounding phrases and the mass of adjectives that will accompany reports of these circuits, such as used in hundreds of thousands of receiving sets, and the variations are only good for publicity, not as far as efficiency in reception is concerned. With so many receivers and with so many claims as to their merits, the public should study the situation very carefully. Surely, if freak circuits were really better, the leading manufacturers would be only too happy to use them in their regular lines, and to use the funds devoted to advertising these standard sets toward the boosting of the 'freaks'."

ROXY" (in *Broadcasting: Its New Day*, written in collaboration with R. F. Yates): "At the present time there are two changes that would rescue broadcasting from the shadow of disaster and place it on the solid footing it deserves. If half our better studios would cut down their broadcasting time and concentrate more upon quality than upon quantity, a very pleasing result would be the outcome. The second change would be that of converting some of the studios to a class basis."

them in Paris, and the number of listeners is probably less than we have in one good-sized city. The radio trade in France is of the opinion that from fifteen to twenty stations will be required to cover the country properly and that until such stations are erected and put into operation the number of broadcast listeners will remain comparatively small.

LAST year we exported close to \$6,000,000 worth of radio apparatus and this year shows a very decided increase. Judging by the value of the first half of the year's business it appears that our total radio exports for this year will exceed \$13,000,000.

A GERMAN court has recently held that not only has a tenant a right to erect an antenna on a housetop but that, owing to the importance of broadcasting, it is the duty of the proprietor to see that the tenant is enabled to put up an antenna on a house.

ONE of the flight sergeants of the R. A. F. was recently killed while conducting some radio experiments over the aerodrome at Andover, England. For

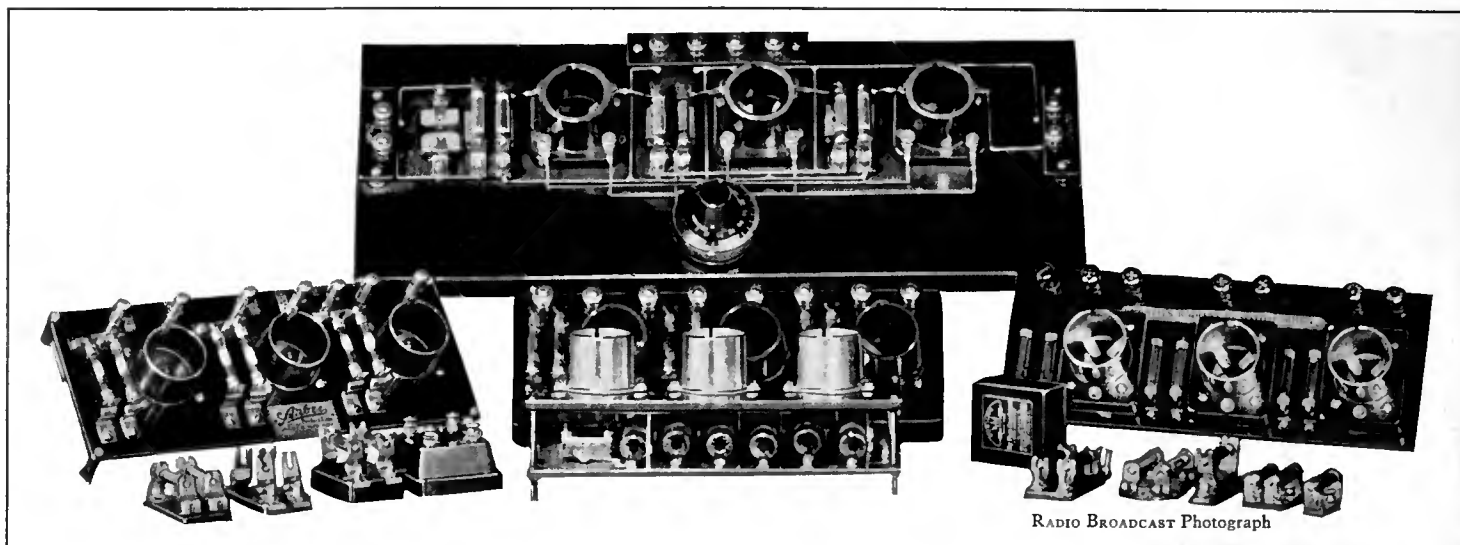


FIG. 1

Here are a few of the resistance units tried out in the RADIO BROADCAST Laboratory in conjunction with the development of the RADIO BROADCAST "Aristocrat." They include assemblies made by the Arbee, Electrad, Daven, Heath, and Crescent, as well as units from Cole, Brach, Muter, Dubilier, and Durham

The Radio Broadcast "Aristocrat"

How to Build a Five-Tube Receiver Which Has Extremely High Quality, Especially Fine Selectivity and Sensitivity

By ARTHUR H. LYNCH

FOR a very long time we have been looking for the kind of receiver that would be easy to build, easy to operate, and at the same time be comparatively economical. In the receiver described here, we have found what we consider a solution to the problem. There is but one main tuning control which makes the finding of stations so simple that the most inexperienced can secure surprising results. In an actual demonstration, we have been able to show that by means of this single control and no other adjustments whatever we were able to hear sixteen stations in less than three minutes, with a single turn of the tuning dial. When other adjustments were made—and where is the DX fan who will not want to be certain that he is getting the last drop of energy out of his set?—we have been able to procure distance with volume, which few receivers other than a super-heterodyne could have accomplished. And above all we have been able to secure tone quality which has been characterized by many of the radio designers and enthusiasts who have come to Garden City to witness the performance of our new outfit, as being far superior to most receivers they have seen or heard. We believe this receiver will do much to endear radio to those music lovers who

up to the present time have felt that radio reproduction was not sufficiently free from flaws to reproduce with true fidelity the music they love.

WHAT THE RECEIVER IS

IN COMBINING over the possible circuits of real worth to the home builder we have come to the conclusion that there are but three that possess the merits we sought, namely: the super-heterodyne, the neutrodyne in many of its advanced models, and the combination of a stage of tuned, neutralized radio-frequency amplification in combination with a regenerative detector and some more than ordinarily good system of audio-frequency amplification. After considerable thought to each of these we

decided in favor of the last, not because we thought the others less valuable but because the combination of price, distribution, ease of building, operating, and low upkeep cost seemed to be best carried out in the receiver we are now to describe.

SO, in the RADIO BROADCAST "Aristocrat," we have one stage of tuned, neutralized, radio-frequency amplification, a regenerative detector, and three stages of resistance-coupled amplification. Before going further let it be said that the resistance-coupled amplification we are using should not be confused with similar systems described in the past because it is now possible to maintain tone quality, for which this type of amplifier is famous, together with great volume, because of the foresightedness of some of the tube manufacturers who are now marketing what are known as high-Mu tubes. These tubes are designed for resistance-coupled amplification. The amplification per stage that is obtainable with them is far greater than has heretofore been generally possible.

Then, too, in the "Aristocrat" there are no rheostats whatever and the number of binding posts has been reduced to a minimum. In order to make the design, building, and operation of this type of receiver quite clear, and in order to demon-

THIS article is one of the features we have worked on to produce for RADIO BROADCAST in its new form. In changing the size and improving the general appearance of the magazine we are at the same time making great efforts to improve the quality of every single contribution in it. This receiver, frankly, is one of the first to be presented anywhere to the home constructor which unmistakably takes the lead in what is destined to be the whole progress of radio fashion. The receiver described here, although it is not difficult to build, has practically but one control, and is extremely economical in battery consumption, has the crowning merit of delivering a signal of unusually good quality. Radio constructors are no longer content to assemble a receiver which has merely the merit of great sensitivity or selectivity, or some other familiar point of superiority. The constructor is demanding, and rightly, that his receiver give the most faithful reproduction possible of the transmitted voice and music. That is the keynote of radio fashion for 1926, and that keynote the RADIO BROADCAST "Aristocrat" strikes.—THE EDITOR.

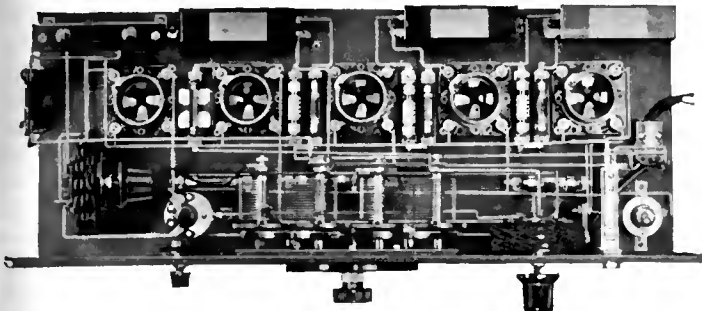


FIG. 2

In this assembly each unit is made with individual mounting. The antenna switch is behind the panel and .5 mfd. condensers are used in the resistance-coupled amplifier, and a short-circuiting switch is used on the ballast for the last tube to allow for use of either 5- or 6-volt tubes at will. The regeneration is controlled by a variable resistance across the tickler. A Cabelug is used for the battery wiring. For the experimenter who wishes to make frequent changes in his circuit this arrangement is just about ideal. The panel, by the way, is 7 x 21"

strate the variations that may be incorporated in it at the discretion of the home builder, we will describe at length but one of the group we have made, and will point out the differences between it and the others by means of the captions under the illustrations.

THE DESIGN AND ASSEMBLY

BY REFERRING to Fig. 5, it will be observed that there is but a single dial, in the center of the panel. This dial is used to control a Hanscom single control unit (first described in this magazine for October, 1925) and is the main tuning control. It is a unique arrangement of two Remler condensers geared together in a manner that makes tuning of the antenna and radio-frequency circuits simultaneous. The small knob below and to the left of the main dial is the vernier which is used to compensate for any slight variations between the windings of the circuits tuned by the two condensers. The knob below and to the right of the tuning dial is the filament switch. By referring to the circuit dia-

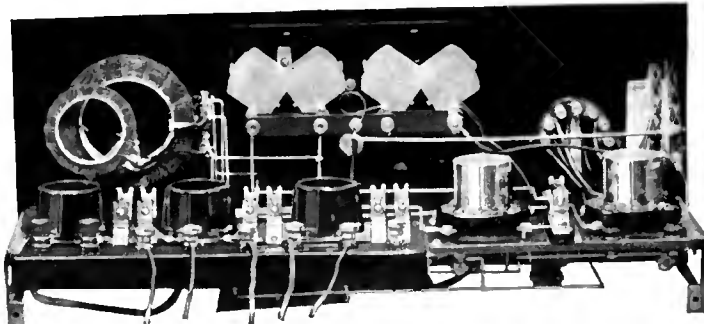
gram, it will be observed that the filament switch is placed in a position in the circuit that cuts out the by-pass condensers across the batteries, which would ordinarily form a high resistance leak and result in a drain on them even when the receiver was not actually in operation. The small knob at the left of the panel is used for the tap switch, connected to the primary of the antenna coupler, to compensate for antennas of different lengths. Once this switch has been set for a given antenna it need not be touched, except for ultra-fine tuning, when extreme selectivity or extremely long distance is desired. The knob on the right controls the regeneration, and may be considered a volume control.

Before passing on to the consideration of the remainder of the receiver it would be well to look over the accompanying illustrations and observe the variations that have been made in the panel design, the layout of the apparatus, and the different systems of tuning and regeneration control. There is very little difference in the actual performance of any of the models we have made and the selection you make may well be considered from a con-

venience standpoint rather than one of net results obtainable. Bear this in mind, however: you cannot expect to get the results we are getting if you buy your parts on nothing but a price basis. We have spared no expense in attempting to bring only the best to your attention and suggest that you make an attempt to get the best—not necessarily the most expensive. And when you are all through getting the best of parts and have done a thorough job in your building don't blame poor reception on the receiver if you hook some poor loud speaker to it.

But to continue, we may as well point out some of the other important points in the actual construction of this receiver. The panel of what we may consider our main model is 7 x 18 inches and there is plenty of room on it for all the equipment necessary, when a sub-base is employed. In this model we have used large-size inductances, in order to illustrate how the entire assembly may be housed in a standard cabinet. When other types of inductances are employed, as is the case in some of the other models, there will be a little more room in the cabinet.

It will be observed that the tuning in-



RADIO BROADCAST Photographs

FIG. 3

This receiver was made on a 7 x 18" panel and is intended to illustrate the method of using a complete resistance-coupled amplifier unit in connection with two additional tubes for the complete assembly. When 6-volt tubes such as Daven MU-20, and MU-6 are used, there is no need of making any alteration in the filament circuit of the amplifier, and the wiring is thus materially simplified. In this receiver we have used the regular Sickles Knockout coils. The ballast resistors for the first two tubes are shown beneath the sub-panel

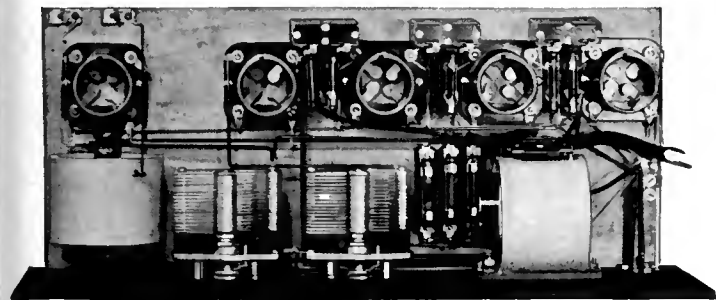
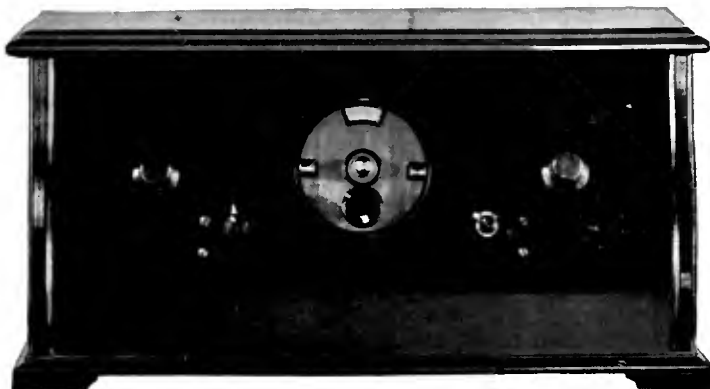


FIG. 4

On a recent visit to our laboratory Mr. McMurdo Silver built this receiver from the ground up in less than four hours. It is his version of the RADIO BROADCAST "Aristocrat." The single control feature is accomplished by belting two of his condensers together with fish line, letting one dial do all the moving. When it is desired to change the capacity in one circuit without altering the other, one condenser is held in place and the other turned. We are not as enthusiastic about this scheme as that devised by Hanscom, but it has enough merit to warrant attention. In this 7 x 18" receiver there is plenty of room, even with the large solenoid coils. The parts used include Hoosick sockets, A.B.C. panel, Accuratune vernier dials and knobs, Silver Knockout coils, .0005 S.L.F. variable condensers and .005 coupling condensers, Micamold coupling resistors, Muter mountings and grid leaks, Daven mountings and ballast resistors, Carter switch and jack and Belden battery cable



RADIO BROADCAST Photographs

FIG. 5

Front view of RADIO BROADCAST's "Aristocrat" made to fit in a cabinet providing for a 7 x 18" slanting panel. In this receiver, as the accompanying article will show, we have gone a long way afield and produced what we believe is a true departure from conventional design electrically, artistically, and mechanically. It will operate over comparatively long distances, produce music with great volume and fidelity with the advantage of one major tuning control and remarkable economy.

ductances and the variable condenser assembly antenna switch and battery switch are mounted on the main panel, while all the remaining equipment is either on the top or bottom of the 2½ x 17½-inch sub-panel, which is suspended from the main panel by means of Benjamin No. 8629 brackets.

On the upper side of the sub-panel will be found the five tube sockets, the threeresisto-couplers, the grid condenser and leak mounting, and the variable neutralizing condenser. It is also possible to find room for all the binding posts, including those for the three connections for the C battery, if they are thought to be desirable.

On the under side of the sub-panel there are five mountings which are used for the filament ballast resistors, when they are to be used. When they are to be taken out of the circuit, as explained a little later on, it is but necessary to make a direct connection between the two spring clips of the mounting.

LIST OF PARTS

THE list of parts used in the model we are considering is as follows. The variation in material that is possible is indicated in the accompanying illustrations.

1 7 x 18-inch panel, 1 2½ x 17½ inch sub-panel, Hanscom S. C. Condenser Unit, 1 set Eastern Knockout Coils, 1 Carter filament switch, 2 Apex knobs, 5 Benjamin sockets, 3 Daven resisto-couplers with 3-.1 megohm resistors and 1 each, 1 meg., .5 meg., and .25 meg. resistors, 1 Hammarlund neutralizing condenser. 2 .004 Sangamo fixed condensers. 1 Dubilier .5 microfarad by-pass condenser. 6 Daven No. 50 mountings, 1 Daven Leakandenser (a new unit, which combines the grid condenser and leak), 5 Daven Ballast Resistors. (The capacity of these resistors depends on the type of the tube used and the values for various tubes are given in that part of this article which deals with the circuit and its characteristics.) 1 Belden Standard Color, five wire, cable. 2 Benjamin No. 8629 brackets, 2 to 6 Eby binding posts. 2 dozen

6 or 8-32 round head, brass machine screws, ¾ inch long. About 6 two-foot lengths of bus bar.

THE CIRCUIT AND ITS CHARACTERISTICS

IN DESIGNING this receiver we have attempted to keep in mind the difficulties encountered by some of our readers, who sometimes find that their local dealer does not carry a stock of a particular item, for use in a receiver, whatever kind it may be, and for this reason have endeavored to indicate what we believe to be intelligent substitution and variation in design to accommodate units of different size without materially altering the performance of the circuit. By referring to the circuit diagram and the illustrations of the models we have made, you will be able to see how the various units may be made to fit in whatever space you have available and how they will conform to whatever type of construction you may prefer. If we go over the entire circuit and consider each unit individually, this may be a little more comprehensive. So we may as well start with the antenna coupler.

There are now many sets of coils on the market, designed for use in the now famous series of Knockout Receivers, which have been described in RADIO BROADCAST. Any of these coils may be used in the "Aristocrat".

The tuning condensers used do not by any means have to be those we have chosen to use. Any good pair of .0005 mfd. variables will do, but what we wanted was single control, and in the "Aristocrat" we have it in a very practical manner. The only remaining requisites are the ballast resistors and the units which comprise the resistance-coupled amplifier system.

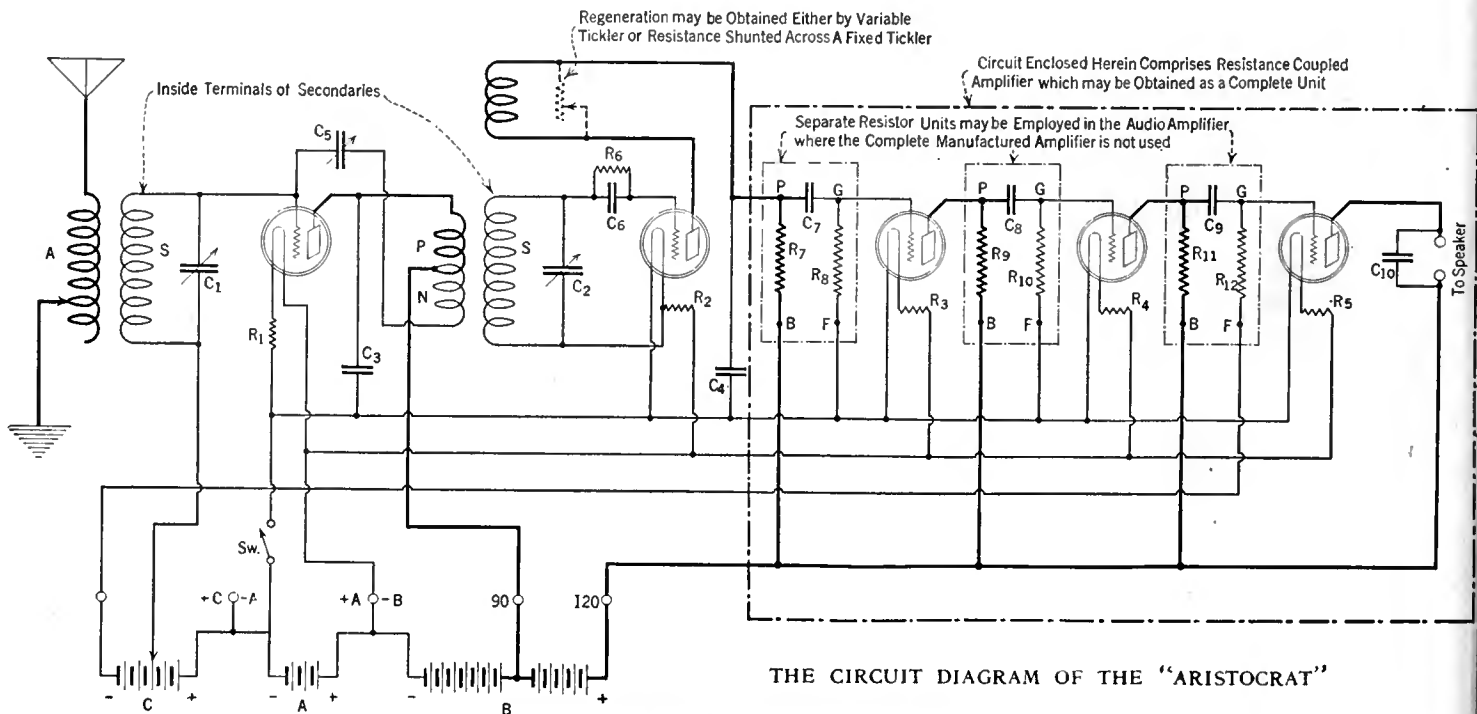
Let us consider the ballast resistors first. They are shown in the diagram as, R 1-2-3-4-5. Now the selection of these resistors will depend entirely upon the types

of tubes used and we have found what we consider an ideal combination in two of the standard storage battery tubes for the radio-frequency amplifier and the detector with two high-Mu tubes in the first two stages of the resistance-coupled amplifier and a semi-power tube in the last stage of the amplifier. Some tubes, such as the Daven MU-20, and MU-6; the Western Electric 216-A and the new Radiotron UX-210 will operate directly from a 6-volt storage battery without requiring any resistance in the filament circuit. Where tubes of this character are employed the ballast resistors and their mountings may be left out of the circuit entirely, or a direct connection may be made across the mounting, as shown in Fig. 2. In this receiver a ballast of ½ ampere capacity has been used with a Harvey Hubbell toggle switch connected directly across it. This makes it possible to use either 5- or 6-volt output tubes and either is thus assured the proper filament voltage. Most other high-Mu tubes are designed for use on 5 volts and where they are employed a ¼-ampere ballast should be used with each, or a single ballast of ½ or ¾-ampere rating may be used with two or three of them, in multiple.

That should clear up the resistance question, though it may be well to say in passing that filament rheostats may be used if they are on hand, and for extremely sensitive operation it will be found that a rheostat in the filament circuit of the radio-frequency amplifier tube provides greater flexibility than the ballast resistor method.

THE RESISTANCE-COUPLED AMPLIFIER

IN CHOOSING the system of construction for our principal model we have had in mind the idea that a certain balance may well be obtained between first cost and simplicity of assembly. For the inveterate experimenter we recommend the model



THE CIRCUIT DIAGRAM OF THE "ARISTOCRAT"

shown in Fig. 2. In a layout of this kind there is all the room necessary for experimenting with various units designed for the same purpose. This arrangement is a delight for the experimenter. For the average individual we believe our principal model will be more in keeping with his requirements and desires, for it permits him to make about all the changes he could desire without requiring an undue amount of wiring, as much of that has been done for him. For the third type of home builder, who desires to have as much of the building of a receiver as possible done in the factory, we suggest the model in Fig. 3 where a complete three-stage resistance-coupled amplifier unit has been shown.

One of the principal things to remember in connection with the building of a receiver in which a resistance-coupled amplifier is used is that it depends for its operation to a great extent on the actual resistance of the units employed. If, for instance, in one of the plate circuits where we have specified a resistance of .1 megohm (100,000 ohms) you use a mounting made of some material which in damp weather will absorb moisture, a measurement of the resistance in such a plate circuit will indicate that there is less resistance in the mounting itself than in the resistor used in it. There are many such devices being peddled about and you will do well to be certain that the units you procure do not suffer from such a defect. In other types of mountings which have been submitted to our laboratory for test we have found that the clips for holding the resistors are held to the insulating base by machine screws

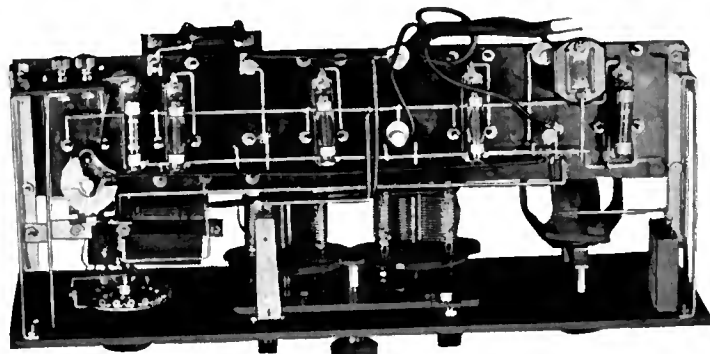
and locknuts. Obviously, if the heads of the screws are not thoroughly countersunk and the mounting is placed on top of a condenser with a metal case, a short circuit is almost inevitable. Where you do your mounting on a wood base it is well to keep the wiring off the wood itself, as this will prevent leaks occurring in unexpected and undesired places. Some cheap condensers have been found to have a very low resistance in damp weather.

Another thing about resistance-coupled amplification, which has not been given the attention it deserves, is the size of the coupling condensers. We have found that they should be much larger, for the best tone quality, than is ordinarily suggested. The mathematical and experimental background for this assertion is sound. Do not use condensers in your coupling units of less than .1 mfd. if you want to procure better than average quality.

When you have finished building this receiver and you want to make an actual test of its quality, in comparison with other receivers, connect first one and then the other to a Western Electric cone speaker. If the receiver is right, the cone can be worked with tremendous volume with-

out rattling. The rattle, as a rule, is not an inherent fault in the cone; it is the result of imperfect amplification. In using a Western Electric cone, it should be remembered that the impedance of the cone is much lower than most other speakers and the output tube used with it should be one with a plate impedance that matches the cone, such as the new semi-power tubes to which we have previously referred. If an ordinary tube is used with the cone, an output transformer should be used which will make up for the unbalanced condition that would otherwise result.

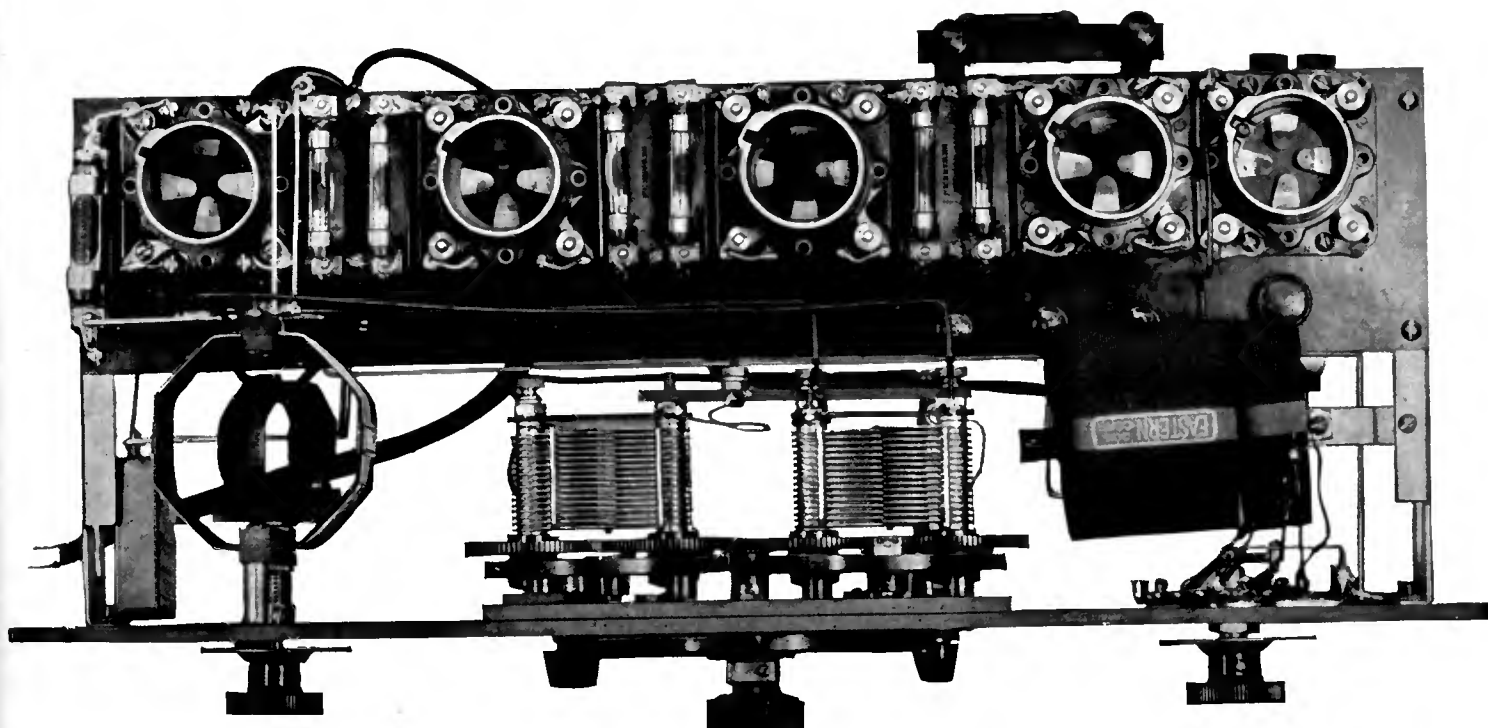
If you consider the little things in connection with the building of RADIO BROADCAST'S "Aristocrat" you will produce a receiver which you will be proud to exhibit to your friends. You will enjoy radio as it is but very seldom heard.



RADIO BROADCAST Photograph

FIG. 7

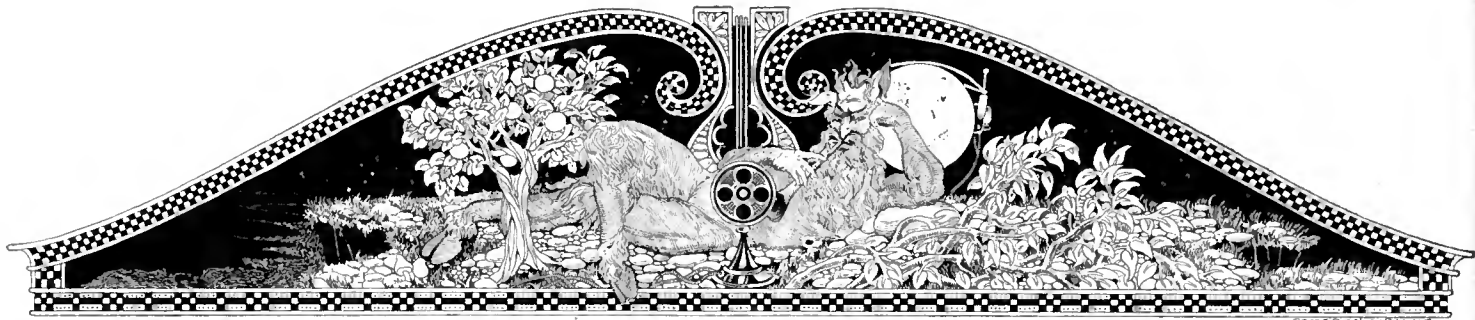
Bottom view of the "Aristocrat". Illustrating the wiring under the sub-panel. The only units not shown in Fig. 6 are the two Eby posts on the extreme left, for antenna and ground, the Amperite and Daven ballast for the filament circuit of each tube and the Belden battery cable



RADIO BROADCAST Photograph

FIG. 6

The "Aristocrat." Left to right on the sub-panel we have the Daven leakandenser, Benjamin socket, Sangamo .004 bypass condenser, Daven resisto-coupler with .1 and 1 meg. resistors, socket, resisto-coupler with .1 and 1/2 meg resistors, socket, resisto-coupler with .1 and .25 meg resistors, socket. The .1 microfarad condensers are within the resisto-couplers. The two Eby posts on the upper strip are for the loud speaker. The three posts on the lower side are for the C battery and the small knob is for the Hammarlund variable neutralizing condenser. Left to right on the main panel are the Benjamin bracket, Dubilier .5 by pass condenser, Eastern Knockout r. f. coupler with Apex knob, Hanscom single control unit with Marco dial, Yaxley filament switch, Eastern Knockout antenna coupler with Carter antenna switch and another bracket



The Listeners' Point of View

Conducted by Kingsley Welles

Who Are the Owners of Our Radio Sets?

WHEN the broadcast announcers tell you over the air that two million people are hearing the "program now being broadcast," it is breaking no confidences to say that they do not really know how many listeners they are actually reaching. Almost everyone who has had the opportunity has played fast and free with statistics dealing with radio, particularly the number of radio receivers and their owners. There is no positive way to tell just how many sets are in use. The question, "Have you a radio set?" might well be added to the already long list asked by the United States Census, although we should have to wait until 1930 before these now occult facts could be made public. It is an excellent maxim not to take any statistics too seriously, for like the Scriptures, the Devil can (and probably does) quote them for his own purposes.

But slices of the radio listening group have been visited by the equivalent of the Inquiring Reporter, and the results, while they prove nothing but facts about the given group, are interesting. The figures give one a pretty fair idea of what sort of an individual the composite radio listener is.

Two thirds of those interviewed owned receivers and nearly 72 per cent. were men. Ages varied from under 20 to the ripe age of 71. The group between 21 and 30 years old were most attached to radio. Men were more anxious to have a set installed than women, for more than 58 per cent. of those approached in the survey were men and responsible for the purchase of the equipment. Wives came second with a percentage of 22, while the clamor of the children in 20 per cent. of the total succeeded in securing the set.

Out of 1200 homes investigated in one survey, 66 per cent. were operating their first sets. The remaining third had owned radio equipment previously. Some families had owned as many as nine outfits; in fact, this group represented 5 per cent. of those interrogated. And 45

per cent. were using their second receiver, while 21 per cent. had purchased three. One home confessed to having six sets on hand; five others had five receivers apiece, and 110 households had two or more.

The investigators were much interested in learning why a particular make of receiver was bought. It was found that 46 per cent. of the owners purchased their set because they thought it the best make, while 17 per cent. acted on the advice of friends, and a lagging 12 per cent. bought because of low prices. Some were influenced by advertisements, but almost as many were convinced by a personal demonstration in their homes.

Radio receivers appear to be regarded by these groups as a necessity rather than a mere convenience, as some of the unconvinced seem to think. Out of 1166 set owners asked the price paid for their equipment, 24 per cent. did not know what it cost, although 12 per cent. bought be-

cause the cost was low. The initial cost of the sets varied from \$2 to \$650. The average cost of the receiver was \$100. The manufactured set cost more than the home-assembled receiver, which was found to cost about \$40. The survey indicated quite definitely that most of the present owners are willing and expect to pay more for their next set. Some 40 per cent. expect to pay between \$150 and \$200 for their new receiver.

Out of 1280 homes investigated in one census, nearly 36 per cent. had five-tube sets in operation, 9 per cent. used more than five tubes, and 19 per cent. used receivers with three tubes. Crystal and one-tube receivers accounted for 8 per cent. each. In England, by far the greatest number of listeners use crystal receivers, which are naturally not at all selective and their range is limited to about five or ten miles. One of these American surveys showed that 47 per cent. of the owners bought their sets in order to receive programs from distant stations. Selectivity was considered the most important factor by 42 per cent.

In Seattle, whose population by the last census is given as 237,000, a kind of radio census was taken, which showed that 18,000 radio receivers were in use in that area. Three years ago, the crystal set was very much in the majority in that city, as it was in almost every other. Now only 21 per cent. of the Seattle listeners use crystal receivers. Thirty-seven per cent. of the sets are single-tube ones—usually home made. Forty-eight per cent. of the tube receiving sets are either five- or six-tube affairs. Seattle is probably reasonably representative of the country, although it is highly doubtful that 21 per cent. of the outfits of the nation are crystal receivers.

Probably the most interesting part of the surveys is found in the answers to the question, "Who runs the set?" In 455 cases out of 644 it was the man of the house—71 per cent. Women did the tuning in 6 per cent. of the total and the children in 3 per cent.



THE FIRST OPERATIC BROADCASTER—1908
Mme. Mariette Mazarin, operatic soprano under the management of Oscar Hammerstein, who came to New York to create the rôle of "Elektra," shown in an old photograph singing in the microphone of an early DeForest arc radio telephone transmitter. A few earnest experimenters heard Mme. Mazarin then, but what an audience she would have to-day!

What Hope for Programs?

The response of the radio audiences to the concerts of the New York Philharmonic Orchestra is very significant. It is not improbable that several hundred thousand persons listened to these concerts over the air during the summer. That their appreciation is keen may be judged from the fact that wjz and wgy—fully alive to the public's wishes—have seen fit to give the concerts such prominence on their schedules. This in itself is encouraging. Even more so is the interest of the public in the best class of music. Broadcasting stations reported a year ago that there was a notable increase in the number of letters asking for more concert music. . . . The experience in this broadcasting shows that there is a much larger audience of music lovers in this country than was thought to exist. . . . What the Philharmonic has done, others can do. What we have lacked (in this country), save in the big cities, is the opportunity to hear good things. This the radio now gives us.—Editorial in the New York Times.

BY FAR the outstanding event of the summer radio season was the broadcasting of the Philharmonic Orchestra at the Lewisohn Stadium in New York. Aside from the fact that this broadcasting was technically the finest bit of broadcasting we have ever heard, the Philharmonic programs were noteworthy because of the high musical standard of the selections and their rendering. One hour of a Philharmonic concert is worth, by actual calculation, 2027 hours of any jazz band you can mention.

There are mutterings against jazz, and they are none too faint. We venture the prediction that the stations who want to stay in the van will have to rearrange their schedules so that jazz takes a secondary place on their programs—if for no better reason than variety. Who would attend a vaudeville performance where 50 per cent. of the program was devoted to dance music?

The wire links of WEAf to the outlands will furnish much excellent program material. The recent announcement by A. A. Kent that Metropolitan Opera stars have signed for a series of concerts, to be broadcast through WEAf and a chain of Middle Western stations beginning October 4, is the first good omen in the Fall Season. The WEAf Grand Opera Company will furnish tabloid grand opera to a large group of stations. We have heard many listeners say, and not a few have written us, that they think this feature one of the best to be found in the air lanes. There is now a pleasing tendency among program directors to arrange radio speeches which have some justification for their being. Program directors will never learn, however, that there is no possible justification for broadcasting an entire banquet. It is bad enough to be forced to attend a banquet, but when one has to listen to the rumble of moving dishes, the distorted sounds of an orchestra perhaps, and the hollow echoes of "speeches of the evening" which reverberate in the banquet hall despite the best efforts of the microphone to ensnare them—then the limit of something has been reached.

But in the main, the start of the fifth year of radio broadcasting is good. In a hundred little ways programs are being improved and more able individuals are coming to the studios, in the persons of both performer and director.

Church Broadcasting: A Failure

I THOUGHT, as a matter of course," writes Charles Magee Adams, of Milford, Ohio, "that a considerable majority of my neighbors picked up church

services regularly. They tune-in every other radio offering, and religion, regardless of creed, is something whose appeal is universal and fundamental. But I find that, on the contrary, the overwhelming majority of my neighbors' sets either stand idle during church hours or pick up a program of some other type if one is within range. They began listening zealously enough when the sets were new, these friends of mine (and I am sure they are representative of the radio audience), but gradually discontinued the practise, for reasons hinted at rather than explained. There were vague remarks, such as 'I don't care much about it.' From this and similar remarks and my own convictions, I came to the conclusion that something is wrong with church broadcasting."

In the September "Listeners' Point of View," issue was taken with the arrangement of Sunday programs in general and it was mentioned that broadcasting from churches is not very successful. Mr. Adams develops the point. "The Church thinks of broadcasting," he continues, "simply as a means of bringing its services to shut-ins and as a sample to interest prospects; in other words, broadcasting is an auxiliary to and substitute for attendance at services in person. This is not to say that these aims are not legitimate and laudable. Bringing help and comfort to dwellers in remote places or to invalids is a fine service; and attracting more people into church membership is altogether worth while.

Radio has placed at the disposal of the church an instrumentality for multiplying its usefulness to an extent that leaves possibilities difficult to grasp. Yet the church classifies radio as an auxiliary, a substitute; and continues to place the emphasis on assembling in congregations.



FLORENCE LONG ARNOLDI

Coloratura soprano, a regular artist at station WOAW, Omaha. Her voice has thrilled and delighted many an evening's radio audience. One might add that her costume is fully as charming as her voice



GOLDY AND DUSTY

Sometimes referred to as the Gold Dust Twins, who are heard every week from WEAf and a chain of stations, in an "indirect advertising" program. It is darkly hinted that they are two well-known concert singers, well known to buyers of phonograph records, who have turned their talents to broadcasting



MISS JEAN SARGENT

Who was for four years with WNAC, Boston, and now is in charge of women's programs at WHT, Chicago. Miss Sargent is said to be the first woman announcer. Her voice is frequently heard over WHT



"LOPEZ SPEAKING"

This concert, by Vincent Lopez and his orchestra, is being broadcast through the courtesy of station W-E-A-F direct from the Pennsylvania Hotel Grill. The next number . . . On the Radio"

This is much the same as if, during the last presidential inauguration, the nation-wide radio audience had been told that it might listen-in at home, but that attending the ceremonies in person was vastly to be preferred.

Mr. Adams goes on to enumerate the disadvantages of this widespread attempt to adapt the service designed for attendance in person to the special requirements of broadcasting. "The acoustics of church auditoriums result in cavernous boomings and reverberations . . . and it is impossible for the preacher to adapt his delivery both to the radio audience and to his congregation. Much the same is true of the incidental music. Announcements of interest only to the congregation must be made from time to time. These strike the listener as wholly irrelevant and are psychologically very important.

"The Church should arrange a special service, with universal appeal, conducted in a broadcasting studio according to the



KEITH MCLEOD

Accompanist and musical director of stations wjz and wjy, New York. He accompanies Mr. Godfrey Ludlow in the popular Sunday night recitals from wjz and is a pianist of great talent. Mr. McLeod is a Westerner, coming from Denver, Colorado

best radio practise. Sermons should be cut to somewhere near ten minutes—the length of maximum radio listener attention. (The closing speeches broadcast in the last presidential campaign by President Coolidge and Mr. Davis—the most effective radio addresses delivered by either—were 11 and 13 minutes long.) Radio has placed before the Church an opportunity for usefulness greater than any other single one in all its long history. The Church has failed so far to make the most of this opportunity, not because technical facilities are undeveloped, but because the Church has not chosen to adapt itself to this new potentiality." With all of which, needless to say, we heartily agree.

Do Women Know What They Want In Radio Programs?

IN ENGLAND recently, a woman graduate of Cambridge debated before the microphone with a woman who had been in charge of various canteens during the war on what subjects appeal most to women listeners. The Cambridge graduate favored amusing and intellectual talks of a non-domestic character, and the ex-canteen manager declared she wanted talks on practical subjects and "ultra-feminine topics"—whatever they are. Listeners were asked to express their views, and some 80 per cent. of the letters sided with the Cambridge woman. Cookery, child welfare, and household management talks were not wanted. The general cry was: "Take us out of the kitchen and take us out of ourselves!" The letter writers wanted talks on music, literature, travel, women's movements, etc., with an occasional fashion talk or humorous reading.

Almost without exception American broadcasting stations, when they have a program for women, have limited it to the obvious domestic things. No broadcaster has had the courage or the intelligence to arrange a program to appeal to the intelligence of women. One wonders whether this failure is due to a belief that it would be useless to make the attempt or because the program designers simply fail to appreciate the necessity.

However, a new feature for women has been started by the Washburn Crosby Company with the talks by Betty Crocker, on Monday, Wednesday, and Friday mornings through WEEL, Boston; WEAf, New York; WFI, Philadelphia; WCAE, Pittsburgh; WGR, Buffalo; WEAR, Cleveland; wvj, Detroit; WHT, Chicago; KSD, St. Louis; WDAF, Kansas City; KFI, Los Angeles; and wcco, St. Paul-Minneapolis. This is a genuine forward step in broadcasting, for it is the first time a national wire link has been employed for a program of "service." It is frankly commercial broadcasting, and that of the most defensible sort. Perhaps this national effort will awaken the program directors, and they will now busy themselves and arrange women's programs of broader appeal.



"ERNIE SPEAKING"

I want to thank all my radio friends for the wonderful letters they have sent me. I will be pleased to send a log book with a picture of my orchestra on it to everybody writing for one. The next number played by Ernie Golden and his Hotel McAlpin Orchestra will be 'The Farmer Took Another Load Away'"

The Shy Radio Minstrel

"A wandering minstrel I,
A thing of rags and patches. . . ."

MINSTRELS have quite gone out of fashion except as one reads of them in good old classical ballads, or hears the lines quoted above floated out at one during a "Mikado" performance. The fact is that the automobile—and we almost said radio—has made the minstrel business a bit superfluous, and probably unprofitable. To come out with a startling truth, radio broadcasting has brought the minstrel back again. Most of our modern minstrels travel on the best trains instead of a slow and probably underfed horse and are well paid for their time, as witness the favorite Wendell Hall—in the employ of the National Carbon Company, who only last



GODFREY LUDLOW

Staff violinist at station wjz getting his fine Stradivarius—the de Rougement, dated 1703—ready for a recital. Mr. Ludlow is an artist of high ability, and through his Sunday night concerts through wjz and wgy has won a very large following

year shadowed the microphone of most of the important broadcasters of the country. He sent this department, we recall, a postal card from Cuba while he was on his lyrical mission there.

There are a host of others who travel about, some who are paid for their services and others—a majority of the number, in all probability—who give their services to the broadcasters for the pure love of the thing, which, being translated, means for the "publicity value." The management of station KGO admits that within the past thirty days five radio minstrels reported to the studio manager, ready to do their bit "entertaining the silent audience of the day and night." One was armed with a harmonica, another played a Tyrolean zither, another carried a set of "sweet potatoes," while a fourth drove to the station in a Ford and unloaded his "kitchen piano" or dulcimer, which is stringed, and as a WEAFF announcer phrased it the other night, is "the grandfather of the piano."

"We are only observing the old Biblical injunction," admitted one of the minstrels. "We cast our music on the air, and, brother, it works! As I travel, I meet friends everywhere—and chicken dinners, too."

The electrical *wanderlust* has spread to broadcast announcers, too, for we have heard from a number of stations during the lately concluded summer, elaborate and flowery introduction of this well-known announcer, and that being presented over a rival but friendly microphone.

Broadcast Miscellany

WHEN broadcasters close their program, it is usual for them to announce the time. "Station xxx now signing off at 10:10 P. M., Central Standard Time. . . ." We took the trouble to check the announced time from a number of stations recently, and the variations from the actual minute were fearful to behold. It is a small matter, but if the broadcaster really means what he so often says about "service" we suggest he take care his clocks are right. We will wager that a good many trains are missed because of carelessness of this sort.

THE bubbling Ernie Golden, radio good fellow par excellence, announced from WMCA, New York, the other night that a certain performer would "now whistle 'To a Wild Rose.'" A curious occupation for a grown man, but perhaps less futile than the not uncommon announcement of this or that hopeful "broadcasting to listening relatives in Brest-Litovsk."

THE next number will be played by request." Similarly worded confidences are whispered into many a defenseless microphone, the good Marconi

only knows how many times each evening. This gracious compliance with wishes never fails to remind us of that ultra-complier, Josephus, whose fame is sung in a good old ballad:

Now these two boys are dead and gone.
Long may their ashes rest.
Bohunkus of the cholera died,
Josephus, by request.

IT IS the common practise among wire and radio telegraphers to use their initials or some other cabalistic set of letters to indicate their presence at the station, chiefly because it takes too much time to send with each message, "sent by operator Charles B. Smith," or the equivalent. When the radio operators became radio announcers, as many did in the early days of broadcasting, before the present age of specialization where every station with any claim to pretension has its staff of announcers, its program and publicity force, and its group of operators—they took with them the practise of giving their initials during the announcing. The original purpose of the abbreviation was to save time, but now there is no possible justification for the practise. The announcer is—if he is even moderately talented—an asset to his station, and in many ways he is as important as the event or the artist he introduces. Why, then, should he not give his name? The practise was begun by WEAFF. Millions, probably, heard the name of Graham McNamee, and were charmed by his easy grace and high talent for description. But some power above gave his orders and now no longer do the Bell System announcers reveal their identity. The Radio Corporation group do,

however, and if you don't believe that the name of the announcer adds a necessary touch to the broadcast proceedings, compare some night the offerings of a station representing each group. When the listener knows the name of the announcer serving him, an indefinable something is added which is highly desirable. It makes for better announcing, too; Milton Cross of WJZ probably felt a greater responsibility and approached the task of preparing those extraordinarily able program notes he gave for the New York Philharmonic Concerts (given through WGY, WJZ, and WRC) with considerably more enthusiasm since he knew that large numbers of listeners-in looked to him for his interpretations. And, *contra*, the WEAFF announcer who handles the Hotel Bossert orchestra several nights a week might make more certain that what he says by way of "fill in" is really funny, if his name were aërially signed to his remarks.

THE late Walter Camp and his system for the glorification of the American physique, known familiarly as the "Daily Dozen" is probably responsible for the radio popularity of the setting-up exercises. Aided by a bugle, and the less military piano, unseen physical training instructors dispense musically accompanied instructions for health exercises from a great many stations. Though there is no sure way of estimating, the number of exercises must be very large. We hope that this new addition to the radio program may become such a fixture that it entirely displaces the bedtime story—misguided juvenile sentimentalism which everyone, including the children, could well do without.



IN THE VILLAGE OF JUAN DIAZ, PANAMA

The natives hear a program from a Cuban broadcasting station. The radio receiver is part of the "on location" equipment of the company filming the picture "Spaces Beyond" in Panama. It is a question whether the natives living on the calm little Tapia River in the background were more impressed with the radio concerts or the strange behavior of the cameramen and directors

A Model 1926 Broadcast Receiver

Designed to Meet Present Requirements of Great Selectivity on All Frequency Bands, This Set Is Highly Satisfactory in Operation and Decidedly Easy to Build

By McMURDO SILVER

FOR some time past, the writer has felt that it should be possible to design a radio receiver possessing all of the valuable features of the best super-heterodynes, yet going a step beyond in dealing with the coming seasons' radio problems in a manner not possible with any previous systems, since none of the present aggravated reception conditions were even imagined during the past year.

Before examining this system in detail, it may be interesting to consider a few of the facts concerning present, and probably future, broadcasting conditions, which, incidentally, will explain in a measure the writer's apparent abandonment of the super-heterodyne school of thought. In a nutshell, a simpler system has been so improved that it is now nearly the equal of the super-heterodyne.

BROADCASTING CONDITIONS—TO-DAY AND YESTERDAY

LAST year at this time, the entire range of available broadcasting channels may have been occupied by transmitting stations, but any listener of a year's standing knows that in actual operation this was not so. Channels could often be found where stations were not transmitting, and it was seldom indeed that a fan could pick up the full quota of approximately 95 stations that would be required to fill properly the broadcast frequency range of 1500-550 kc. (200 to 546 meters), a range of some 950 kc. Obviously, there will be far more stations operating simultaneously than there were last year. Equally obviously, we require far more selective receivers this year than last.

To-day the range of the broadcast frequency is from 1500 to 550 kc. (200-546 meters). Re-broadcasting goes up to 5996 kc. (50 meters) in some cases, and it is quite possible that the regular broadcasting range may be extended above 1500 kc. (200 meters). Foreign super-power broadcasting takes place in many instances on long waves, running up to several thousand meters. Of what value, then, is last year's receiver, with its satisfactory operating range generally from 1330 to 520 kc. (225 to 575 meters)? This year, and future years, sets must be capable of covering a wide wavelength range—far wider than any existing designs will cover.

A RECEIVER TO MEET PRESENT CONDITIONS

IT IS felt that the receiver to be described adequately solves the problems encountered, with fewer tubes and less equipment than a super-heterodyne, yet is capable of equalling super-heterodyne selectivity and sensitivity—a goal indeed worth aiming at. The re-

ceiver itself is shown in the accompanying illustrations, which bring out the mechanical details of panel design, instrument arrangement, and wiring.

At first glance, the set does not seem at all original, since it consists merely of two stages of tuned radio frequency amplification, followed by a detector tube and two audio amplifiers. The circuit is a combination of the best points of all receivers, carefully executed with regard for the most recent discoveries, and the fund of information gained by the writer and his assistants through contact with many thousands of experimenters—men whose judgment of receiving equipment was based solely upon one thing, performance.

Since one of the first requirements was wavelength flexibility, it was necessary to devise a method of shifting inductances for different frequency bands. This made necessary the designing of interchangeable coil forms possessing a form factor suitable for all frequencies to be handled. For the higher frequency bands, the turns are spaced, while the coils for waves longer than the present broadcast band, the coils may be bank wound. Six contacts are provided on a reinforced ring at the bottom of each coil, upon which are mounted six studs in which the ends of the windings terminate, and which in turn make contact with springs in a special six-contact socket, so keyed that a coil cannot be inserted incorrectly. In order to change a frequency band, it is necessary only to remove the coils from their sockets and insert ones of different inductance values—an operation consuming about 10 seconds.

STRAIGHT LINE FREQUENCY CONDENSERS

THE condensers used with these inductances are of the type giving an approximately straight line frequency variation, or a uniform kilocycle variation for each dial division.

A very important factor for broadcast reception, particularly on short waves, is the ratio of inductance to capacity in a tuning circuit. The 500 mmf. (.0005 mfd.) condensers, which are commonly used, prove rather large for use above 1500 kc. (200 meters). Even above this, the inductance capacity ratio resulting from their use is not as good as with 350 mmf. (.00035 mfd.) condensers. In order that maximum signal strength may be obtained, the condenser capacity should be kept as low as possible. For another reason, this is of vital importance at short waves where tuning is practically impossible with large condensers. Above 6000 kc. (below 50 meters) tuning capacities should be on the order of 150 mmf. (.00015 mfd.) although below this, 350 mmf. seems quite satisfactory.

Neutralization, which is nothing more than fixed oscillation or regeneration control, could not be used. This is because the r. f. amplifier for a given frequency band, would have to be neutralized at the shortest wave to be received in that band so that the amplifier would not oscillate. Sensitivity would be obtained then only at the lower end of the wavelength band, while the receiver would be as inefficient and as little sensitive as the average neutrodyne at the longer waves. In this connection, the now popular circuits employing a stage of tuned neutralized r. f. amplification and a regenerative detector were considered. In them, due to reaction, regeneration in the detector circuit tends to assist the neutralized r. f. amplifier. This being at best an indirect solution of the problem, the r. f. amplifier in this design was made highly regenerative, with an increase in sensitivity, since a much stronger signal could then be delivered to the detector tube, the efficiency of which varies with the square of the applied voltage. This means that, with a given signal applied to the detector, doubling the strength of the signal will increase the detector response four times. In the new receiver, due to reaction, the detector circuit is rendered practically as sensitive as if direct regeneration were employed (see the writer's article in the March, 1925, issue of RADIO BROADCAST) through the reactive effect of regeneration in the r. f. amplifier.

NEW REGENERATION CONTROL

THE actual method of regeneration control employed is new, practically, and consists of a variable high resistance in shunt with the grid circuit of the

NOW and again, readers of RADIO BROADCAST have asked us why we did not publish more information on the familiar five-tube, tuned radio frequency receiver. Our position was that as soon as we found a receiver sufficiently good and sufficiently off the beaten path, a description would find its way into the pages of the magazine. RADIO BROADCAST has published many articles on the neutrodyne (December, 1923, January, and February, 1924, and August, 1924), and many more on applications of tuned radio frequency circuits. The receiver here described involves no "revolutionary circuit," but it contains other features which are certain to be of positive interest to the constructor. These departures in design are used which give ease of control, adjustment to various frequencies, and well-nigh perfect selectivity:

- 1 Plug-in coils for covering all broadcast frequencies.
- 2 Straight line frequency condensers, insuring even spacing of received frequencies along the dial. The exact dial location of a given station can be precalculated after referring to published programs.
- 3 Proper detector grid biasing instead of the conventional grid leak and condenser.
- 4 A new system of regeneration control achieved by shunting the r. f. secondary coil with a variable 500,000-ohm resistance.

This excellent article is another of the special features promised our readers in the new RADIO BROADCAST, and we think it well justifies its place.—THE EDITOR.

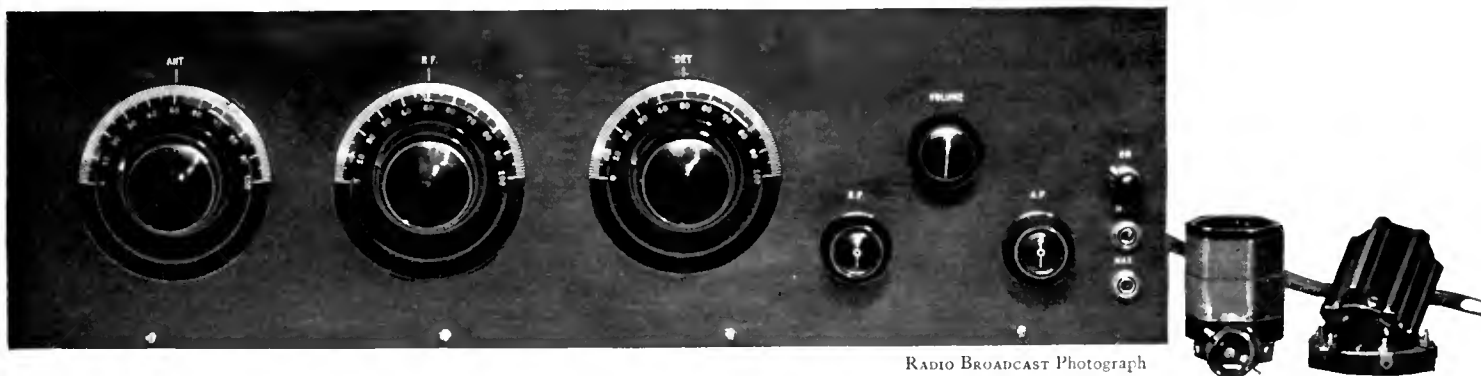


FIG. 1

Front panel view of the five-tube receiver described in this article. The three tuning dials may be linked together as one if desired. The plug-in coils are shown at the right

second r. f. tube. Customarily, a grid biasing potentiometer is employed which is extremely inefficient at short waves although satisfactory at long waves as in a super-heterodyne, or a series B battery resistance. The latter, the most popular method, is extremely unsatisfactory, as it merely controls oscillation by reducing the effective amplifier plate voltage. This process is bound to detune the set in a measure, as well as throw the amplifier tubes entirely off their proper operating characteristic if a C battery is employed, as should be done. In the system used, a variable resistance of 500,000 ohms is shunted across one tuned circuit feeding into the tube's grid circuit. The probable average operating resistance of the tube is about 150,000 ohms, so that the resistance is so far in excess of this that selectivity is not affected. Due to careful design of the circuit, it is only necessary to decrease the value of shunt resistance to not less than 300,000 ohms to get excellent oscillation control. Obviously, this method will not affect selectivity to the detrimental extent that any other method would.

Due to the extremely low losses of the three tuned circuits, the overall amplification curve resembles that of a band-pass filter, such as is used in carrier telephone work; in some cases for separation of carriers—not 10 kc. apart as in radio—but only 3 kc. apart. This is the ideal response curve and can only be obtained by other systems after they have gone beyond the limits of practicability; or practically by the super-

heterodyne. The next most satisfactory curve would probably result from the single r. f. amplifier and regenerative detector mentioned above.

The efficiency of the receiver decreases rapidly at frequencies greater than 2000 kc. (150 meters), so that at 6000 kc. (50 meters) it will probably only work slightly better than a regenerative detector and the same number of audio stages. This is true of all r. f. amplifiers, but it must be remembered that it is practically impossible to improve upon a regenerative detector at short waves. This is not because more sensitive systems cannot be built; rather, that they are not required—transmission efficiency renders the use of a terrifically sensitive receiver unnecessary.

AUDIO AMPLIFICATION

THE audio amplifier shown uses two standard $3\frac{1}{2}:1$ transformers, and will be found to give most excellent reproduction. However, resistance coupling may be used where practically perfect quality is desired. Unless high-Mu tubes are used in the first two stages, and a low-impedance tube (such as UX 112, UX 120, UX 210 or the Daven), in the last stage, resistance coupling is not worth while. The only high-Mu tubes generally available for standard sockets are made by Daven. However, using ordinary tubes, choke-coupled amplification will about equal resistance coupling, using the new 350-henry Thordarson autoformers. Three stages will be required, with but 90 volts of B battery rather than 135, as with the resistance audio amplifier.

SINGLE, DOUBLE, OR TRIPLE CONTROL

THE receiver may be tuned either as a single, double, or triple control outfit at will. Each condenser is provided with a pulley collar on its shaft, which may be connected with all the others by means of fish-line. While at first this idea may seem impracticable, it is well to remember that the builder of one of the country's finest commercial receivers has used the method for years. This season it will be found on the Bosch, Grebe, and Zenith receivers, not to mention others. It is, to the writer's mind, the most practical single-control scheme yet devised, because of its flexibility. Thus, the builder of a set may test it out carefully, determine just how it logs, then put the fish-line in place and realize a

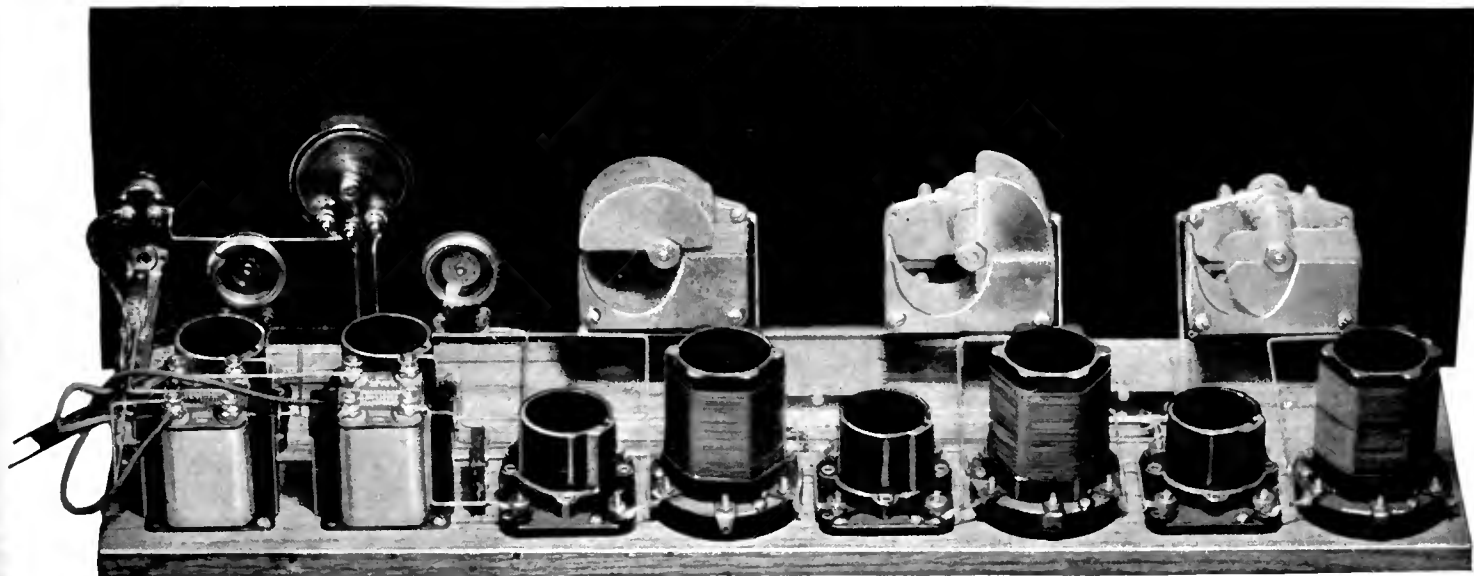


FIG. 2

The five-tube receiver from the rear. Note the three interchangeable coils and their sockets. The battery cord leading away from the left end carries all battery supply wiring

RADIO BROADCAST Photograph

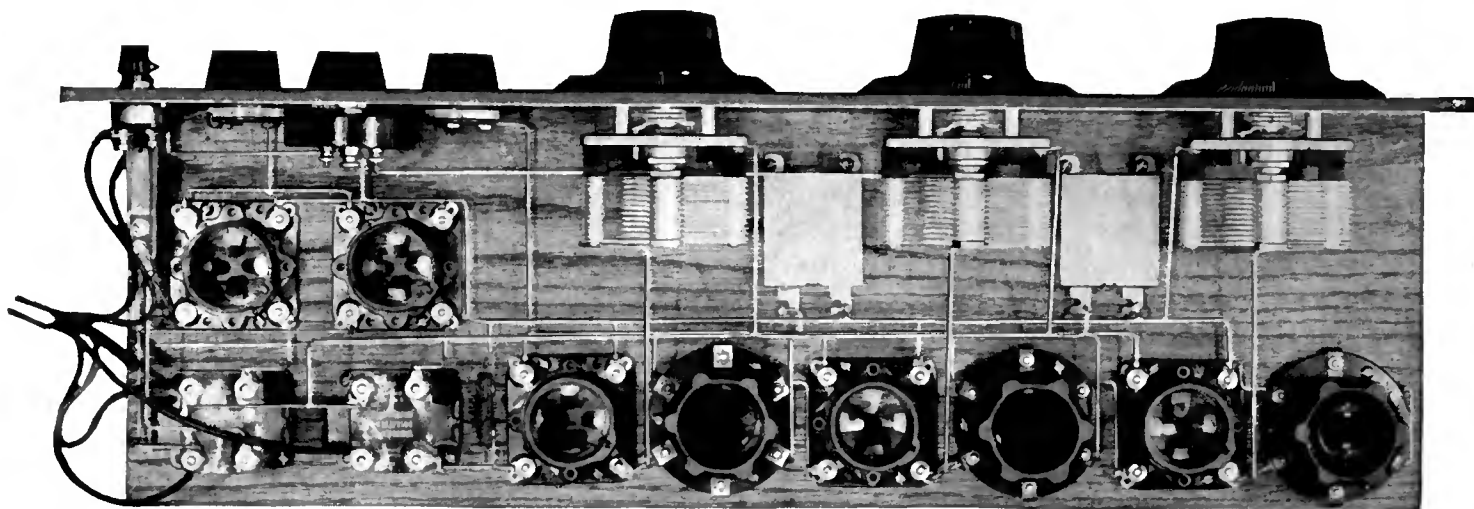


FIG. 3

RADIO BROADCAST Photograph

This photograph should be studied carefully before laying out the baseboard, since no dimensions are given. This is because different types of instruments may be substituted, so the layout can only be approximately followed with respect to spacing of the parts

true uni-control set without the fear that all the circuits may not be properly adjusted, as in the case of gang condensers. The use of external compensating capacities, often suggested with gang condensers, is not particularly to be recommended.

Further, a multiple range, uni-control receiver cannot be built practically. It might be possible to build it for one frequency range, but if coils must be interchanged, the circuits must be compensated for errors that cannot be overcome. This is where the beauty of the fish-line control comes in—it is merely necessary in logging at first to determine how many degrees apart the three dials may run for one set of coils, then when they are used, adjust the dials to this relation and go ahead tuning with but one or two controls as desired, since holding one or two dials with the fingers and turning the other merely causes the fish-line to slip, only to grip tightly again when but one dial is turned alone. Yet the arrangement is totally without play or backlash.

TUBES AND RHEOSTATS

THE receiver illustrated uses two rheostats, one for both r. f. tubes and detector, and one for the a. f. tubes. This permits the use of small tubes up to the detector, and larger or power tubes from there on. It is suggested that UV-201A and UX-201A (identically the same except for bases) be used throughout, up to the last stage, where a UX-112 or a UV-210 for extreme volume be used. Dry battery tubes may be employed if desired, but UV-201A's will be found to give about 15 per cent. greater volume. Rheostats are not vitally necessary, with tubes coming through with their present uniformity. There is no reason at all why Davens ballast resistors or Amperites may not be used for permanent filament control.

FLEXIBILITY

ONE feature of the set is its flexibility. It may be used on antenna or loop with either only a detector, one r. f. or two r. f. amplifiers. Suppose an antenna is to be used, the antenna coil with its adjustable rotor for maximum selectivity is inserted in the socket at the left end of the set. Then the r. f. coils are put in their sockets and the antenna and ground connected to posts 1 and 2 of the antenna socket. Thus, we have detector and two r. f. stages. If only one r. f. stage is desired, the first tube is removed, the antenna coil moved to the middle socket with antenna and ground connected to 1 and 2 of this socket, and the set tuned with the two right-hand dials. To use only the detector, the antenna coil and antenna and ground leads

are moved to the socket nearest the detector, and all tuning is done with the right-hand condenser. If a loop is to be used, the antenna coil is removed, and the loop leads connected to 3 and 4 of the socket from which the coil is removed, depending upon the number of r. f. stages desired. The a. f. amplifier is controlled by jacks, one for the first and one for the second stage. Thus the set may be changed from a two to a five tube set at will. The volume resistance serves as a smooth, even control of loud-speaker volume, by means of which any desired intensity of sound may be obtained at will.

RESULTS OBTAINED DURING AUGUST

DURING the latter part of August, the receiver was tested in the center of the Chicago loop district, among steel buildings, and in comparison with a completely shielded seven-tube super, capable of cutting side-bands, a neutrodyne and several other types of commercial tuned r. f. sets. The "super" gave, using a loop, slightly greater sensitivity. This could be made up by attaching a 20-foot wire to the grid side of the loop on the r. f. set. This was seven tubes against five of similar type. The other receivers were practically worthless on a loop. On a 40-foot antenna, the r. f. set and "super" were even—the point had been reached where the additional sensitivity of the "super" was useless. The other sets tested failed signally to equal the "super" or r. f. set—even to the point of the number of stations heard. Frequently DX stations would operate a speaker on the super or r. f. set, yet could not be heard on the other factory-built sets. The results in selectivity were similar. Either the "super" or r. f. set would eliminate some ten local broadcasters, a few less than 500 yards distant, which completely blanketed the other sets. Side-bands could be cut on any station at will with either "super" or r. f. set, but not with the others. On local broadcasters within one mile, the "super," shielded, was more selective than the r. f. set. Shielding the r. f. set evened things up. This would never be necessary, however, except where the set was but a few yards from a transmitter.

Then a sample receiver was tested in Garden City, Philadelphia was brought in in daylight with plenty of volume to be heard all over the house.

CONSTRUCTION OF THE SET

IN BUILDING the receiver, the following material was used. It is suggested that substitution be not indulged in, since many of the

items have been designed for the set. If one substitutes without proper knowledge of the electrical details he is almost courting disaster with the finished receiver.

- 3 Silver-Marshall 350 mmf. S. L. F. condensers
 - 3 Silver-Marshall six-contact coil sockets
 - Silver-Marshall coil forms or wound coils as required, three to one frequency range
 - 5 Naald, Silver-Marshall, or Benjamin cushioned UX or UV sockets
 - 2 Thordarson audio transformers, 3½:1
 - 2 Carter, U. S. L. or Pacent 6-ohm rheostats
 - 1 Centralab 500,000 ohm modulator
 - 1 Carter or Pacent 2-spring jack
 - 1 Carter or Pacent 1-spring jack
 - 1 Carter or Cutler-Hammer on-off switch
 - 1 Muter or Dubilier .002 mfd. condenser.
 - 2 Dubilier or Silver-Marshall .5 mfd. bypass condensers
 - 3 Kurz-Kasch moulded, Ezytoon or plain 4-inch dials, zero-left
 - 1 Belden 5-lead color cable
 - 1 7x24-½ inch bakelite panel
 - 1 7x23-½ inch oak baseboard
 - 15 Bus-bar lengths
 - 13 ¾-inch No. 6 R. H. N. P. brass wood screws
 - 10 ½-inch No. 6. R. H. N. P. brass wood screws
 - 6 ¼-inch No. 6 R. H. N. P. brass wood screws
 - 1 Rosin core solder
 - 1 Spaghetti
 - 27 Tinned lugs
- Tools required: Screw-driver, side-cutting pliers, soldering iron and non-corrosive soldering paste, hand drill with drills and countersinks

ASSEMBLY

THE panel is first laid out with the positions of the instrument centers as given in the pictorial diagram. These dimensions may be supplemented with the individual templates furnished with each instrument. The holes should be drilled and countersunk where required. The panel may be grained by rubbing lengthwise only with very fine sandpaper and lemon oil, it being finished off with steel wool so that no shiny spots appear. If engraving facilities are available, it may be engraved as shown in the photographs.

While the volume control resistance is shown above and between the two rheostats, it would be better to locate it below and between the middle dials. This would give shorter leads, and leave the space occupied by it in the set photographed free for a voltmeter, which is absolutely essential with 3-volt tubes unless fixed control resistances are used, such as Davens or Amperites.

Each separate part should be examined, and

every nut, screw, and spring adjusted and tightened before proceeding further. Lugs should be put on the sockets, rheostats, and wherever necessary. Then the hole locations may be laid out on the oak baseboard from the pictorial drawing, and each one started with a nail and hammer. All parts should be screwed down firmly in position, using the short screws for by-pass condensers and transformers, the medium ones for the sockets and the long ones for inductance sockets.

The wiring of the set is the simplest of assembly operations. The soldering iron should be heated, the point filed bright, rubbed in paste, and then in solder so that it will acquire a coat of tin, without which it would be impossible to solder. Each lug to be soldered should have the point of a pin carrying a little paste rubbed over it, the iron held to it and the end of the length of solder rubbed on the lug itself, not the iron. This will tin the iron. Another method is to pick up a drop of solder on the iron and deposit it on the lug by rubbing the lug with the iron tip until it is heated sufficiently to cause the solder to flow to it. This makes for neater work, but requires more skill. Rosin on a joint does not hurt it, providing there is solid solder underneath. Do not try to wire with anything but perfectly straight bus bar rolled flat between two boards. Then measure it carefully, cut and bend it to size, tin the ends, and finally solder it in place.

Many constructors prefer to use flexible wire in connecting up sets. In this particular receiver, this is permissible only for the filament, battery, and audio amplifier sections. All r. f. amplifier wiring should be of stiff bus bar, as illustrated, in order not to interfere with the satisfactory operation of the simplified control feature.

So far the panel has not been touched, only the baseboard having been wired. The proper parts should be mounted on the panel. After adjusting the condensers for the desired tension, the panel is screwed to the baseboard and the re-

maining wiring put in, after which the receiver is completed with the exception of the battery cable. This should have its short ends connected to the wiring where it terminates in instrument binding posts, say at the switch, rheostats, and transformers.

INDUCTANCES

IT IS probably simplest to buy machine wound coils, since any variation in wire tension, spacing, insulation, or impregnation will affect the operation of the single control feature slightly.

Using standard ribbed forms, the coils are wound as follows: Starting at the top of each tube with end 3, terminating this winding in 4, beginning again in 5, and ending in 6; 1 and 2 lead to the rotor, used only in the antenna coil. All coils are wound in the same direction with No. 26 d. s. c. wire, except the rotor, which is wound with No. 32 d. s. c.

ANTENNA COILS	1 to 2	3 to 4	5 to 6
1578-545 kc. (190-550 meters)	30 turns	42 turns	42 turns
3331-1428 kc. (90-210 meters)	16 turns	16 turns	16 turns
5996-2726 kc. (50-110 meters)	6 turns	7 turns	7 turns
R. F. TRANSFORMERS	1 to 2	3 to 4	5 to 6
1578-545 kc. (190-550 meters)		84 turns	18 turns
3331-1428 kc. (90-210 meters)		32 turns	7 turns
5996-2726 kc. (50-110 meters)		14 turns	4 turns

In the r. f. transformers, the winding 5-6, or primary, may be wound just over the lower end of winding 3-4, so that end 6 is just over 4. In the commercial forms, this smaller primary is located under instead of on top of the grid coil.

TESTING
AFTER the receiver has been completed, and the wiring checked against the circuit diagrams, it may be connected up, using one standard A battery as required, say a 6-volt, 90-ampere storage battery for UV-201 A's, one 4½-volt C battery and 90 volts of B battery, consisting of large 22½ or 45 volt blocks. The ends of the color cord are terminated at the batteries, with the exception of the B45 and B90 leads. With these unconnected, a tube inserted in a socket should light, if the switch is on, and the rheostats turned on. If this happens, remove the plus A lead from the A battery, and substitute for it the B45 and then the B90 leads. The tube should not light—if it does, the circuit is incorrect and should be checked for errors. Assuming the tube not to light, all batteries should be connected properly to the set.

With a water-pipe ground connected to either 1 or 2 of the left coil socket, and a 25 to 50-foot single wire indoor or outdoor antenna connected to whichever post (1 or 2) the ground has not been connected to, the set may be tuned, using the three dials. It should first be operated with headphones. The modulator or volume control should be turned all the way to the right, or at maximum. The antenna coil rotor should be so adjusted that its axis is parallel to those of the stator coils. All three dials will read

practically alike—that is, they will all be set at within one or two degrees of each other for a given station. Since each dial division may be assumed to represent approximately 10 kc. with s. l. f. condensers, a station might be easily located.

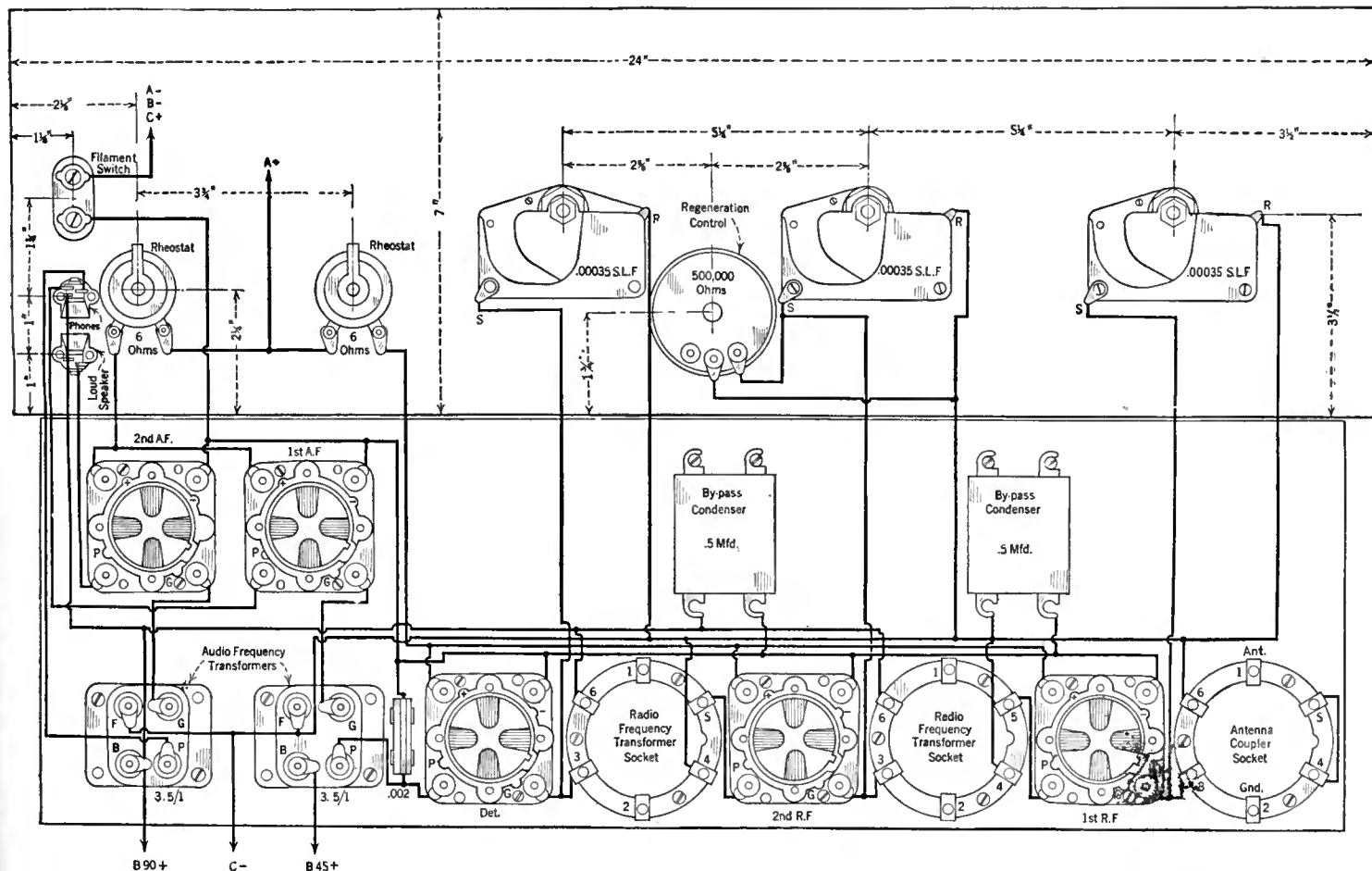


FIG. 4

In this diagram are combined a panel drilling layout, base-board layout to scale for the parts used, and a pictorial wiring diagram

FINDING UNKNOWN STATIONS

FOR simplicity, let us assume that zero on the dials equals 1500 kc. (200 meters) and 100 degrees equals 500 kc. Thus, we have 10 kc. per dial division. Suppose we want WHT, 750 kc. (400 meters) (we get this information from the call book or daily paper). Then 500 kc., our lower limit, subtracted from 750 kc.—WHT's frequency—gives us 250 kc., which, divided by 10 kc.—the frequency variation per dial degree—gives us 25. Thus, setting the dials at 25 degrees plus or minus one or two divisions will tune the set to 750 kc. (400 meters).

Suppose we were using straight line wavelength condensers. The process is different. Our wavelength range covered by 100 dial degrees may be assumed to be 200 to 550 meters, or a range of 350 meters. Thus, each dial division represents 3.5 meters. Suppose we want WHT again, at 400 meters. Then 200—our low wavelength limit—subtracted from 400—WHT's wave—gives 200, which, divided by 3.5—the number of meters per dial division—gives us approximately 57—the setting at which the set will be tuned to 400 meters.

It must be remembered that these figures are at best but approximate, due to unavoidable variation in individual receivers and tubes.

LEARNING TO TUNE

SUPPOSE we want to tune-in some particular station, the proper dial setting for which has been found in the manner previously suggested. It is merely necessary to set the center dial at the figures found, and rotate the remaining two slowly through a range slightly above and below the setting of the other. No doubt a click will be heard indicating oscillation, which will prevent satisfactory reception of stations as they will be heard only as a squeal. This is eliminated by retarding the volume control about one quarter of an arc. If the click is then no longer heard as the dials are rotated, tuning will be found to be quite simple, stations coming in with all three dials set approximately alike.

The system will oscillate only when all three tuned circuits are in approximate resonance—the condition indicated by the click. It should be possible to make the amplifier oscillate when the volume control is retarded not over one quarter. If this cannot be done, the rotor coil of the antenna inductance should be turned out in small steps until this is possible. The volume control regulates the volume of the receiver, as well as the selectivity, in that by means of it it is possible to vary the width of the frequency band passed from about 3 kc. on through the 10 kc. band required for good reception, and then to 25 kc. At this last adjustment, tuning will be found quite simple, as the set will be rather broad—with the volume control set from one half to full left position.

The size of the antenna will affect the position of the antenna rotor. A small antenna requires tight coupling—a long one almost right angle coupling. This adjustment must be found for each particular installation, but once ascertained need not be changed. Under all conditions of satisfactory operation, this antenna coupling will be so loose as effectively to prevent radiation, which could occur only with the amplifier oscillating—a condition not permitting of satisfactory reception. Further, the antenna coupling will also generally be sufficiently loose to eliminate the reactive effect of the antenna-ground system characteristics upon the first tuned grid circuit.

SINGLE OR DOUBLE CONTROL

THIS latter feature is what allows the three dials to read practically alike over their entire scale for different wavelengths. If the first dial is out of relation with the two right-hand ones, the remedy is to turn the rotor until it is nearly at right angles with the antenna stator coil. Suppose we find that throughout the range of the large coils our dials are separated by, say, two degrees each. The correction is simple. They must be turned on the condenser shafts so that they read alike.

It will probably be most satisfactory to use the

receiver as a dual control set, combining the two r. f. dials. To do this, a piece of heavy braided fish-line is necessary; this should be long enough to go around the pulleys on the two condenser shafts without the ends quite meeting. To the ends are spliced short pieces of magnet wire. Then, when the pulleys are joined with the fish-line, the two wire ends may be twisted together and gradually tightened up until all play is gone from the line, and turning one dial causes the other also to rotate. The wire provides a take-up in case the line stretches—since the ends can be twisted at any time with a pair of pincers. It will be found quite simple to release either dial at will, since the drive is purely due to friction. It is merely necessary to turn one dial while holding the other dial steady with a finger. Thus, a full advantage of individual circuit verniers are obtained, yet with a simple, efficient arrangement and no extra equipment.

To connect all three controls, the line is merely lengthened sufficiently to go around both end pulleys, and once completely around the middle pulley. It is fastened in the same manner as previously. Tuning is simpler, although either dial can be released at will by merely placing a finger on the other two to prevent their following the one rotated. If this is done, the simplicity of the panel may be enhanced by using small knobs on two of the condensers, and a large dial on one, since the small knobs serve merely as verniers, and need seldom be touched once the builder has become familiar with the operation through preliminary logging of the set without the simplified control feature.

It is hardly necessary to say that the builder will be well repaid for this effort in building the set—he will be, since it is about impossible to build a practical receiver, equally simple, capable of delivering better results. A hundred stations will not be heard the first night of operation—the set is far too selective for that. It will require several nights of patient tuning before the builder will realize that he really has a better set than his friends.

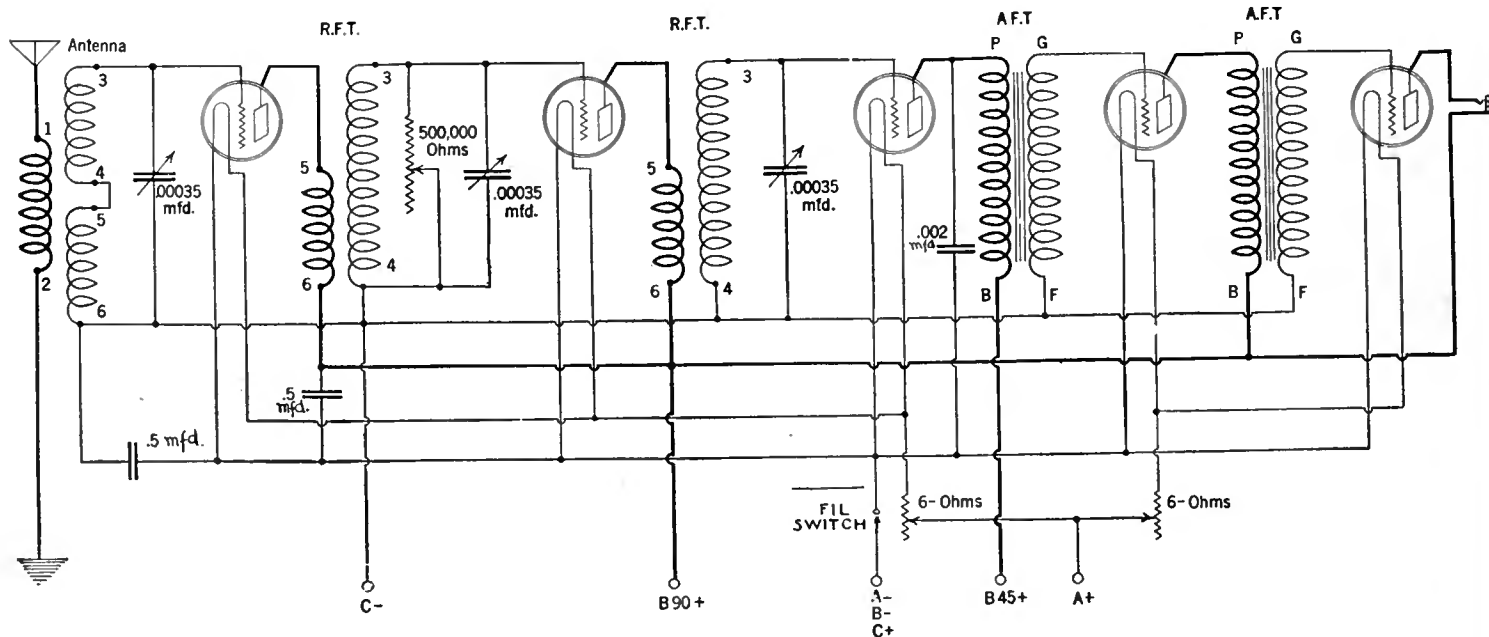
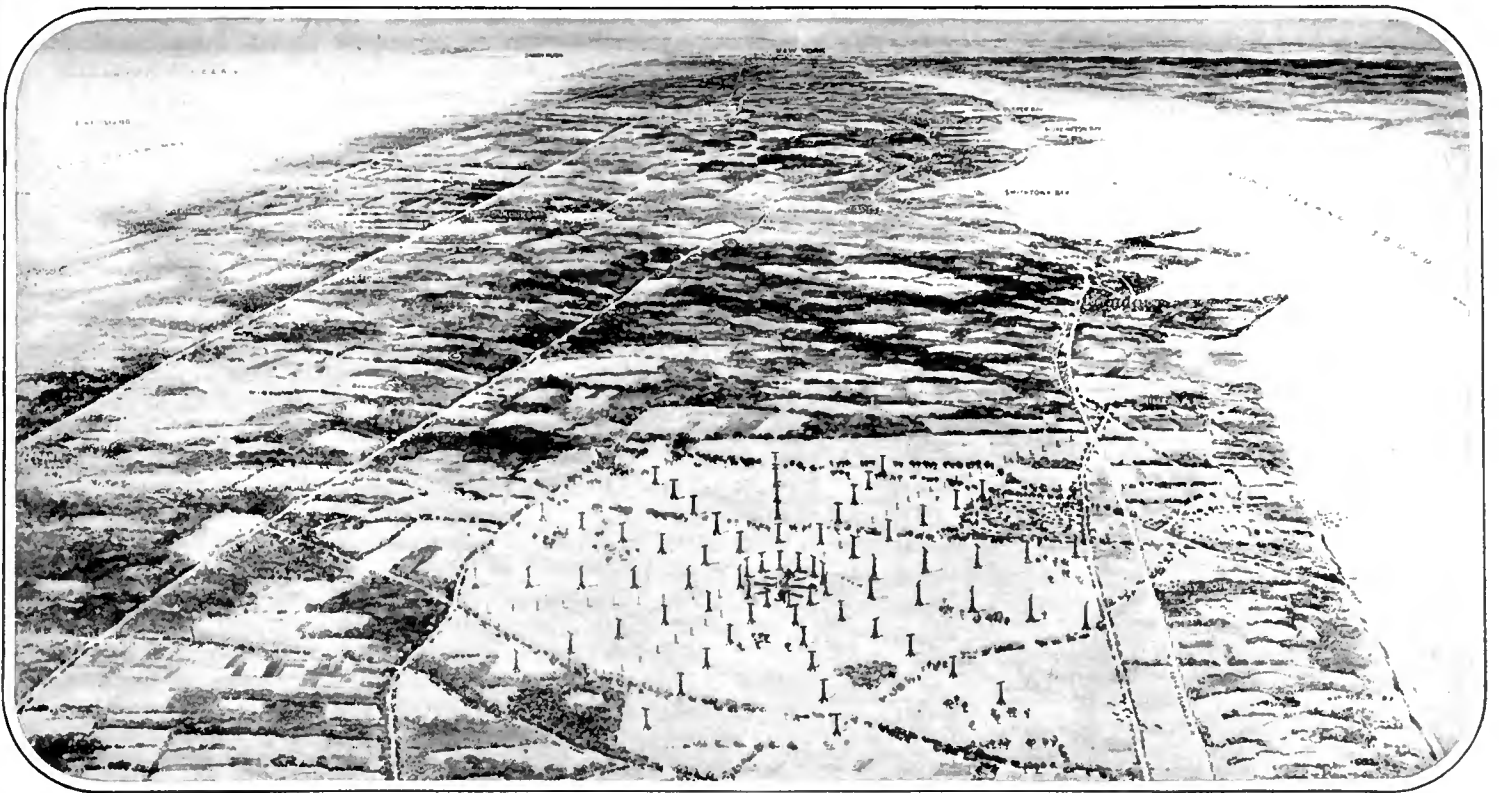


FIG. 5

This is the regular schematic diagram of Mr. Silver's new receiver. This should always be followed in wiring rather than the pictorial diagram, where the fan's knowledge of symbols is adequate.



THE LOCATION OF THE GREATEST RADIO TELEGRAPH STATION

On the American continent. The antennas and transmitting apparatus are located at Rocky Point, about sixty miles from New York. The operators who control the power of this huge station sit at tables in a building in Broad Street, New York. The messages are punched out on a mechanical tape sender and forwarded out over a wire line to the transmitters

“Radio Central”—Conqueror of Time and Distance

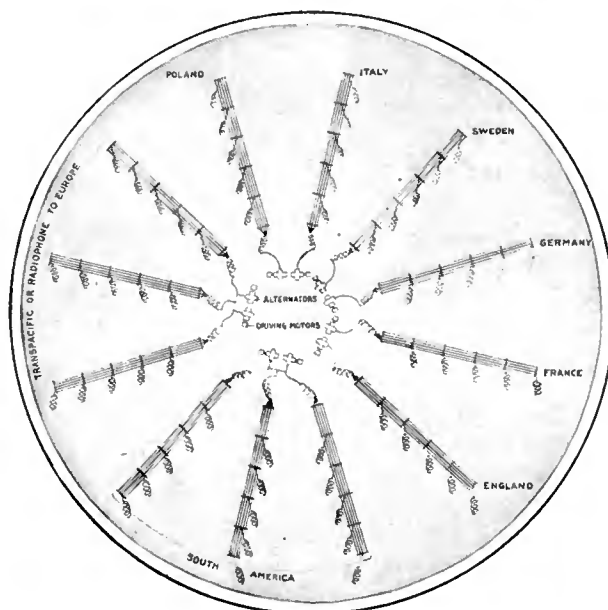
A Visit to the Great Radio Telegraph Station at Rocky Point, Long Island—the Radio Link With England, France, Norway, Sweden, Holland, Germany, Poland, Italy, and South America

By FRED J. TURNER

EVERY minute of the twenty-four hours of the day, every day of the full 365, the dit-dit-da-das of the radio code are shooting through space. And in England, France, Italy, Germany, Norway, Sweden, Poland, Holland, the Argentine, these code characters are being received and translated into messages.

For this, a great human and mechanical organization is needed. Powerful stations are required. Such an organization is the Radio Corporation of America and such a station is the one at Rocky Point, Long Island.

To the average man, an antenna is generally thought of as being a single wire 100 feet long supported from 40 to 60 feet above the ground. The voltage he thinks of in most radio work is seldom higher than 130

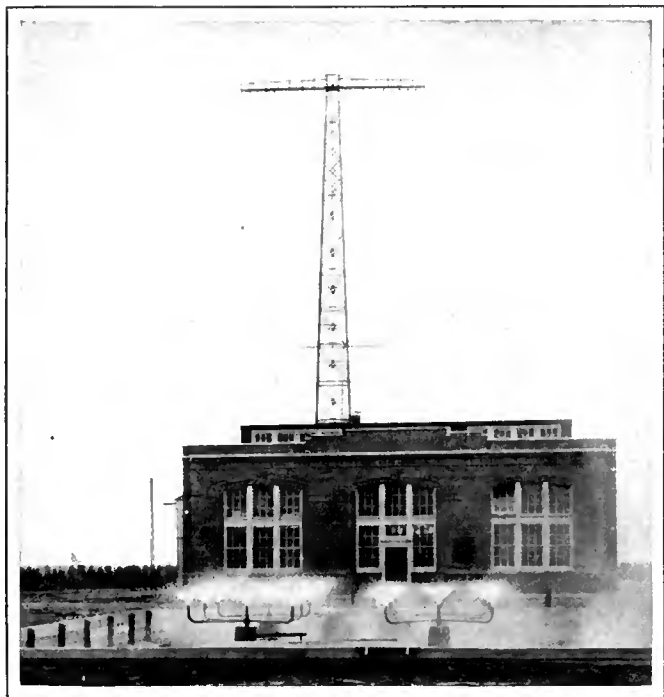


HOW THE GREAT ANTENNAS ARE CONNECTED

and he is, for the main, interested only in wavelengths of from 200 to 600.

Picture two antennas each one and one half miles in length, each consisting of twelve wires having a total length of 18 miles. And then picture the supports of these huge antennas, twelve in all, each 440 feet in height with cross arms 150 in length. Then try to understand the tremendous power that sends the messages, 800 amperes and 120,000 volts, and you begin to appreciate what a remarkable thing a great radio telegraph station is.

Arriving at the station, my first impression was that this was a lonesome spot. No houses were visible. Only one other passenger left the train. An automobile was in waiting and we climbed in. A drive of several miles over a fine, macadamized



OUTSIDE THE POWER HOUSE

The water cooling tanks are shown in action. Some of the water is used in the specially built water rheostats. The 440-foot towers look strangely dwarfed in the picture.

road, a turn into a graveled driveway and our machine came to a stop in front of a long one-storied building. Here I was met by W. H. Graff, the engineer in charge, to whom I presented my pass.

The house I was invited into is called the Community House. It is also known as "Bachelors' Hall," for it is here that the single men employed at the station are housed. The great, long room I saw was both the dining and recreation room. To the right was a billiard table and also a pool table. Dining tables, with their clean white linen and other table equipment, occupied the major part of the left side of the room. A radio set, one of the finest, was near the window. Roomy, restful chairs and settees. A big, open fireplace. The room had much the appearance of a country club.

MASSIVE TOWERS

MY FIRST close-up view of one of the great supporting towers was a surprising one. What had looked like tall, slender things, proved to be massive things of steel. Each tower, known as the self-supporting type, is fifty-four feet wide at the base. Each leg rests on huge blocks of concrete. The height of the towers is 440 feet, and the length of the cross pieces, ten feet wide, is 150 feet, or seventy-five feet in each direction from the center of the upright.

There are twelve of these towers. These are divided into two groups, of six each, set 1250 feet apart. They support an antenna containing twelve three-eighth inch copper-clad steel cables, running parallel. Rocky Point is in reality two stations. One is known as WQL and it transmits on 17.15 kilocycles (17,500 meters).

The other, WOK, sends its messages through the air on 18.22 kilocycles (16,465 meters).

Both antennas can be connected in an amazingly brief time, whenever it is found necessary, thus giving one or the other station a three-mile antenna containing fully thirty-six miles of over-head wire. With this great unit messages can be driven through space in an astounding way.

The ground around the station is flat as far as one can see. The absence of trees is also noticeable. This part of Long Island was a forest when it was taken over by the company and thousands of trees had to be removed to provide the cleared space required. The Radio Corporation now owns nine square miles in this section.

A tablet on the front of the building stated that this "Radio Central" station was built in 1920. Now, inside the building, and what a sight! Great motors and generators. Tall and wide panels with many switches, meters, lights, indicators and other things so familiar to those who have visited the control rooms of big electric companies. A caged section to the right could be seen with equipment of varying sizes and shapes set row on row, all connected with copper wires and bars of different thicknesses. Something to one

side spitting out big blue, electric flashes. The familiar sound of dots and dashes. Something about the entire room that bespoke power and mystery.

EIGHT THOUSAND DOLLARS FOR ELECTRICITY

EVERYTHING in the station, so I was told, had been designed with but one thought in mind, and that was to obtain the maximum of results with the minimum of waste. And it had to be so, for it costs a huge sum to operate a station like this. I understand that the cost of the current used here in one month is in excess of \$8000.

The current used to drive the great motors which in turn operate the powerful generators is taken from the Long Island Lighting Company's generating station located at Northport. It is transmitted over high-tension lines at a voltage of 22,000 at 60 cycles and stepped down after it reaches the radio station to 2200 volts, 60 cycles. As is well known to students of electricity, it is more economical to send electricity along at a high voltage and small amperage, because wires of a small diameter can be used to carry it.

The generators, which are one behind the other, are remarkable machines. Each is known as an Alexanderson 200 kilowatt high frequency generator. The one seen first as you enter the plant operates at 17,130 cycles per second and is used to send messages on 17.1 kilocycles (17,500 meters).

In these generators, which are known as inductor type alternators, there are 976 poles. Generators used for ordinary commercial work have only from 8 to 12 poles.

The motors are each of 500 horse-power and are known as induction motors. Each makes some 800 revolutions per minute. Through a set of step-up gears of a ratio of two and three quarters to one, the steel



INSIDE ONE OF THE OPERATOR'S COTTAGES

The company has built living quarters for the staff attached to the station. The married men live in homes like the one shown, while the bachelors have a kind of club, with a dining room, and every convenience.

rotor of the generator is driven by the motor at the required number of revolutions.

Just as the two antennas can be joined and used as one, so can both generators be operated in unison. And there are times when this is done, especially in sending messages over very great distances.

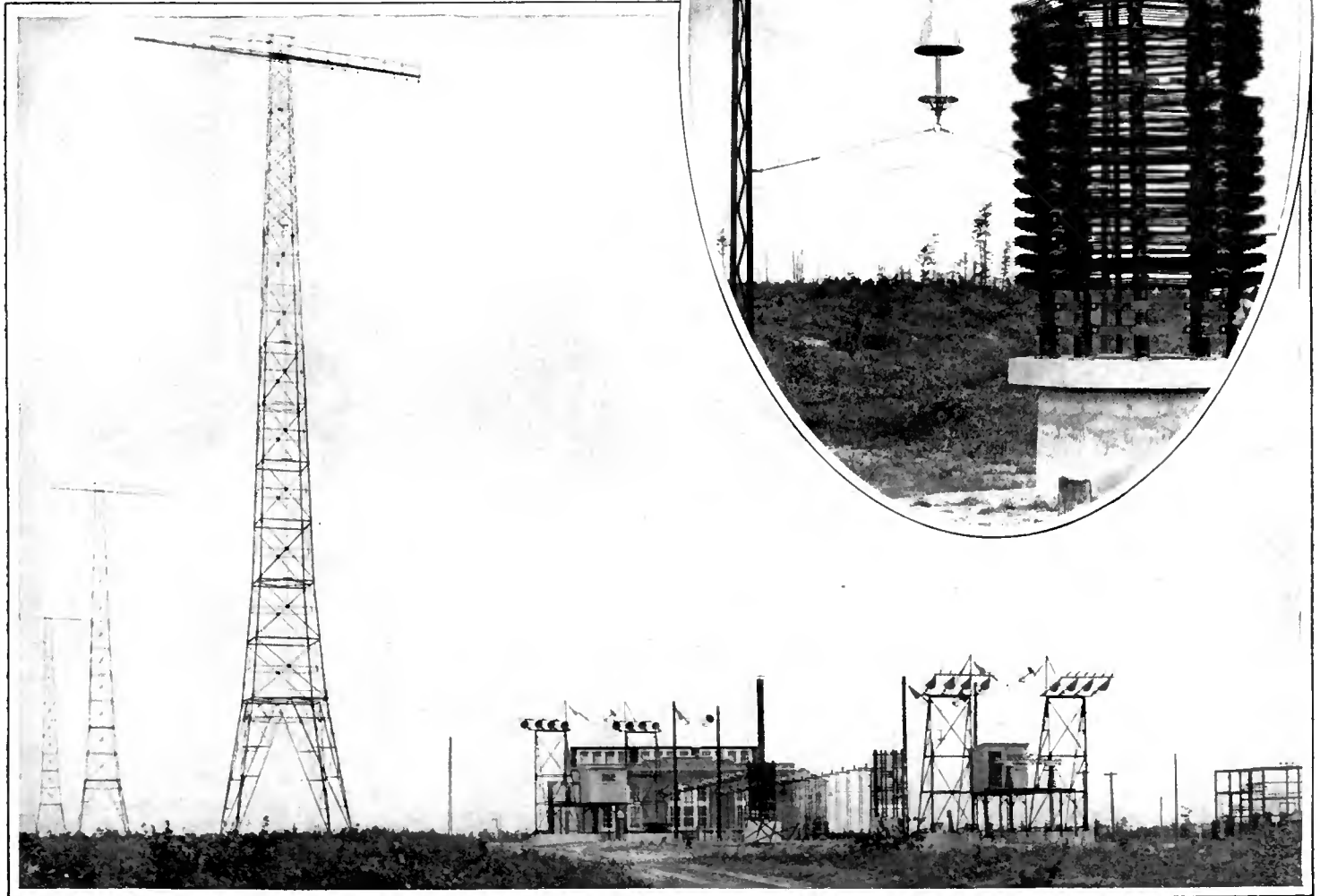
Seeing that my attention was being constantly attracted to a set of long, vertical metal arms which were constantly emitting big, blue, electrical flashes, like dots and dashes, I was told that they were the compensation relays. They were doing for the generator what the steam governor does for an engine. Without those relays there would be all kinds of trouble. When each dot or dash is sent the alternator is called upon to deliver a full load to send it up and through the antenna and out into space. Between each dot and dash the load is released and thus the motor would tend to run faster. In order that the generator can run at a constant speed at all times, these compensation relays close at each dot or dash, allowing the motor to draw from the line the amount of power required to drive the loaded alternator. In the interval between the dots and dashes, the compensation relays open and the motor receives only enough power

to drive the unloaded alternator at normal speed. For those who like precision it will be interesting to know that if there is a variation of one tenth of one per cent. in the frequency of the generator it is not considered to be working properly.

Down at 64 Broad Street, miles away, in New York, operators are seated in front of typewriters punching the dots and dashes on long ribbons of tape. This tape is run through a machine which causes the dots and dashes to be sent along great land cables to this station. They are started from Broad Street with a power of only 50 miliamperes at 120 volts and instantaneously sent through the air by this station with the tremendous force of nearly 800 amperes at 125,000 volts.

One of the very interesting things to see is a water rheostat. Yes, that is what each of the four big box-like affairs really are. As I looked into one of them, and I had to stretch quite a bit to

do so, I saw water rushing over a sort of a dam, set in front of a number of uprights. That dam, I was told, is raised and lowered at the will of the engineer. The higher the dam, the more deeply the uprights, or electrodes, are immersed in the water and the greater, therefore, the amount of current which flows between the electrodes through the water. This water constantly circulates through the electrode compartment and then past cooling coils to keep it from boiling.



A CLOSE-UP OF ONE OF THE MASTS

And back view of the transmitter house at the great Rocky Point Station of the Radio Corporation of America. The power is fed to the antennas from the wires supported on the quartet of insulators. The insert shows one of the multiple tuning inductances employed in adjusting the wavelength of the antenna. A man's head would come up a bit above the concrete base of the coil support, which gives some idea of its size

A FOREST OF METERS

CLOSE by, I saw a number of air blowers which were being used to send their cooling draughts along to the relays. It was by this means that the contacts were cooled and the arcs extinguished. (The arcs form when the relays are opened.)

The many meters, as one can see, are so arranged that they are visible from almost every part of the power house. Some of these were pointed out to me. One, a graphic meter, recorded all the variations in generator frequency. Another, close by, showed the frequencies and voltages of the incoming current supply.

Another look at the generators brought forth further information. They are the biggest of their type in the world. The armatures and fields are stationary and the high frequency is generated by large slotted steel rotors. The weight of each is two and one half tons. Each generator has two armature sections, one on each side of the rotor. There are 32 armature coils in each section and each armature coil is connected to the separate primary coil of one of the two air core generator output transformers belonging to each generator.

From the generator the current is passed along into the instruments which I had noticed in the caged section. Signs of brilliant red and big white letters warn of "Danger, High Voltage." A number of big, barrel-shaped things, with regular windings of three-eighth inch wire, I was told, were transformers. A giant variometer caught my eye. What a size! More

than three feet in diameter. It, together with others of a similar size, is regulated from the engineer's position, much like we who are broadcast fans regulate those in our sets. A number of big steel tanks close to the floor were pointed out and I learned that they were the variable impedances that actually controlled the flow of current from the generator output transformers to the antenna. Each of the variable impedances is oil insulated and water cooled.

The impression of bigness grows the longer one remains in the power house. In one section I saw hundreds and hundreds of fixed condensers joined together by ever and ever so many wires. The same kind of condensers used in our sets, but truly monsters when compared with ours.

Now, outside, the first thing I saw was a big coil on a platform. Its height was fully fifteen feet above the platform on which it stood. It is an antenna tuning coil. The current enters this at 7000 volts and leaves it at the top at 125,000. The men here are never careless. Each knows just what he is going to do before he does it. So great is the amount of electricity thrown out by those huge antennas that none of the workers attempts to crank their automobiles until they have grounded the handles by laying a long piece of steel against them. The metal of the automobile takes up the current which is prevented from reaching the ground by the rubber tires.

The insulators which look big from where I stood, I learned were really big. They are of the finest glazed porcelain, each being a hollow tube 72 inches long, three

and one half inches in diameter, with walls one inch thick. At the lower end, looking much like the steering wheels of automobiles, are the corona shields. Dropping over the insulators are the rain shields, called by the men, "petticoats."

At one side of the power house are small structures of metal on elevated platforms. Into each of these structures each of the twelve wires of the antenna terminate. At this point the twelve are converted into one by a series of switches, and as one wire is carried to the big antenna tuning coil. From there it goes to the power house. In the winter these metal structures are used for melting the ice and sleet which form on the antenna wires. If this were not done, the tremendous weight would cause them to fall to the ground. By sending a 60 cycle current through each wire, sufficient heat is created to melt the ice.

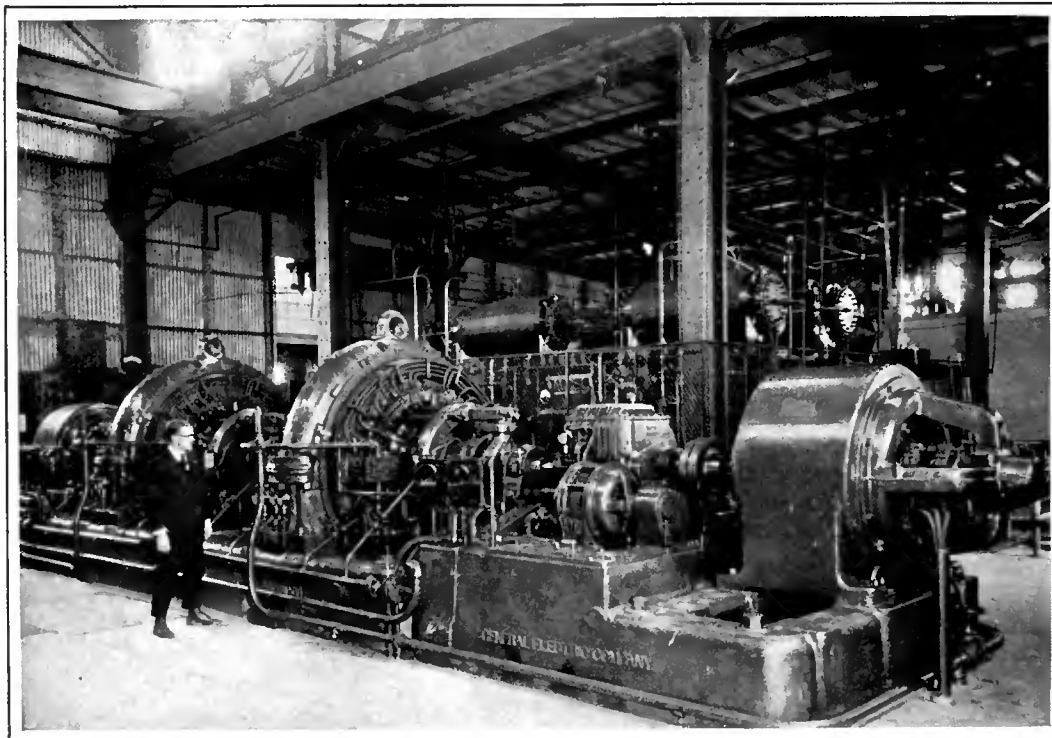
Looking up at those giant supports and meeting the long straight ladders that lead to the top, a platform at each 100 foot level breaking the climb, one cannot help but admire the nerve and skill of the riggers who work away up there.

There are five more huge tuning coils, one connected to each antenna at regular intervals throughout its length, in addition to the one just outside the power house. These insure the most efficient distribution of current over the entire antenna and ground system. This system is known as the multiple tuned antenna.

The ground system of this station is extremely interesting. Running parallel with the antennas, one on each side, are a number of telegraph poles, supporting a dozen or more wires. These, of course, are the same length as the antennas. Around each pole, about one third the distance from the ground, is a wire coil. Each coil is smaller the further away it is from the power house. Direct contact to the ground is made from them.

It can now be understood how this ground system is used. With a single ground connection, all the current would be concentrated in one spot and a great deal of energy would be wasted. A large number of ground connections, each receiving only a fraction of the total current, ensures low resistance and maximum efficiency. It will no doubt surprise many to know that two hundred and forty miles of bare copper wires are buried in the earth under the antennas for ground connections.

Before leaving I could not help stopping to look at the power house again and I got quite a thrill thinking that at that moment messages were being sent from New York over great land lines, through the many instruments inside the building and out into space to England, France, Italy, Holland, and the other countries almost as quickly as I could wink my eye.

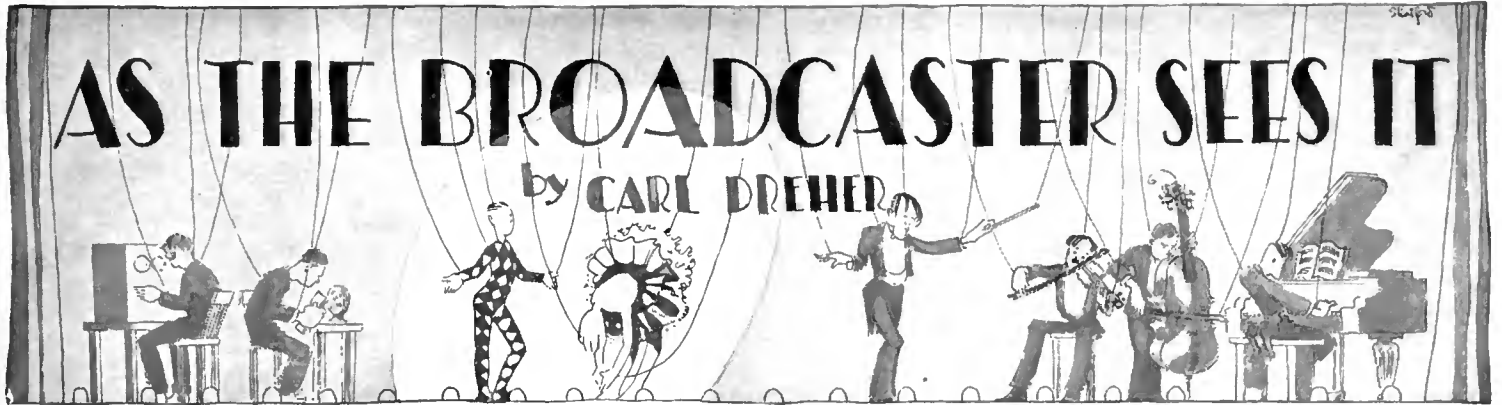


TWO ALEXANDERSON ALTERNATORS

Each of 200-kw. capacity, used to furnish power to the antennas. These machines, developed by Dr. E. F. W. Alexanderson of the General Electric Company, are much different from the usual commercial type of alternator in that they develop radio frequency current which is fed directly to the antenna. The armature and field coils are stationary and a carefully balanced rotor causes the magnetic fluctuations necessary to produce the current.

AS THE BROADCASTER SEES IT

by CARL DREHER



Drawings by Franklyn F. Stratford

The Complicated Business of Running a Broadcasting Station

INGENERAL the work of a broadcasting station falls naturally into two divisions, getting the programs, and broadcasting them. A third and indirectly connected function is that of securing publicity for the station's programs and achievements in newspapers and other publications. Three sorts of people, therefore, work at a broadcasting station: the program organizers, engineers, and publicity representatives. Musicians should be added as a fourth class, for, as we shall see, musicians as well as engineers are needed for the actual broadcasting, as well as in arranging the programs. The musicians function in the no man's land between the program and engineering departments. I refer, of course, to the musicians attached to the station staff, not to the artists or performers, with whom this article is not directly concerned.

Fig. 1 shows one possible organization chart of a good-sized broadcasting station. The great mogul on top is not the same in every station. On a newspaper which has gone in for broadcasting he may be one of the editors or the promotion manager. He may be the president or the vice-president of a radio company or any other organization that has entered the radio field. In the case of a university he may be a professor or dean. What happened in all these instances was the intrusion of a new activity into a more or less settled organization, engaged in selling chewing gum or operating a telephone system or in teaching or what not. Some executive, with or without qualifications for the task, was entrusted with the job of broadcasting.

Often the head of the enterprise took the new responsibility for himself. At any rate, this "manager or other executive" is the man who makes the ultimate decisions, who decides how much money shall be spent, what the policies of the station shall be, and other matters of that sort. He may not be found at the offices of the station, and he may have a lot of other things to do besides broadcasting, but his is the guiding hand, and, if he is not himself one of the chief executives or owners of the enterprise, he reports directly to them.

From this officer, the organization line splits into a number of divisions: program, publicity, and technical. There may be some variations. For example, if the station broadcasts for toll, and has an income, there may be a head accountant or bookkeeper. Again, the publicity man may not report directly to the executive; he may be a member of the program department. And often, of course, various diverse functions may be assigned to one man, complicating the chart in ways which need not be taken up here. If the station

is large, instead of one position shown on the chart, there may be a number with the same title. For example, there might be two music critics instead of one, as shown in Fig. 1. In presenting this chart, the object has been to make it inclusive enough for large stations and yet as simple as possible. Thus stenographers and general office workers are not included, and special workers, such as statisticians, who may be employed in some instances, are also omitted.

The work of the publicity representative is probably the least unfamiliar to the general reader, since press agents antedated broadcasting. However, it is not quite the same job in a broadcasting station as in a theatre or hotel. The publicity man goes around to the various radio editors in his town and tries to keep on amicable terms with them. They are necessary to him and he is also necessary to them, for he supplies them with material for their pages, material which may be written by a copy writer or by the press representative himself. The members of the publicity staff are also in contact with the artists, who give them photographs and data for articles, which, if they are interesting enough, get into the newspapers. Part of the publicity man's duty, also, is to attend to the printing of programs well in advance, sending them to newspapers, and calling up those in his own town, on all broadcasting days, to make corrections in these lists, for there is many a change in the programs between booking and modulation of the carrier. This information the press man secures from the booking de-



IT TAKES ALL KINDS OF PEOPLE TO RUN A BROADCASTING STATION

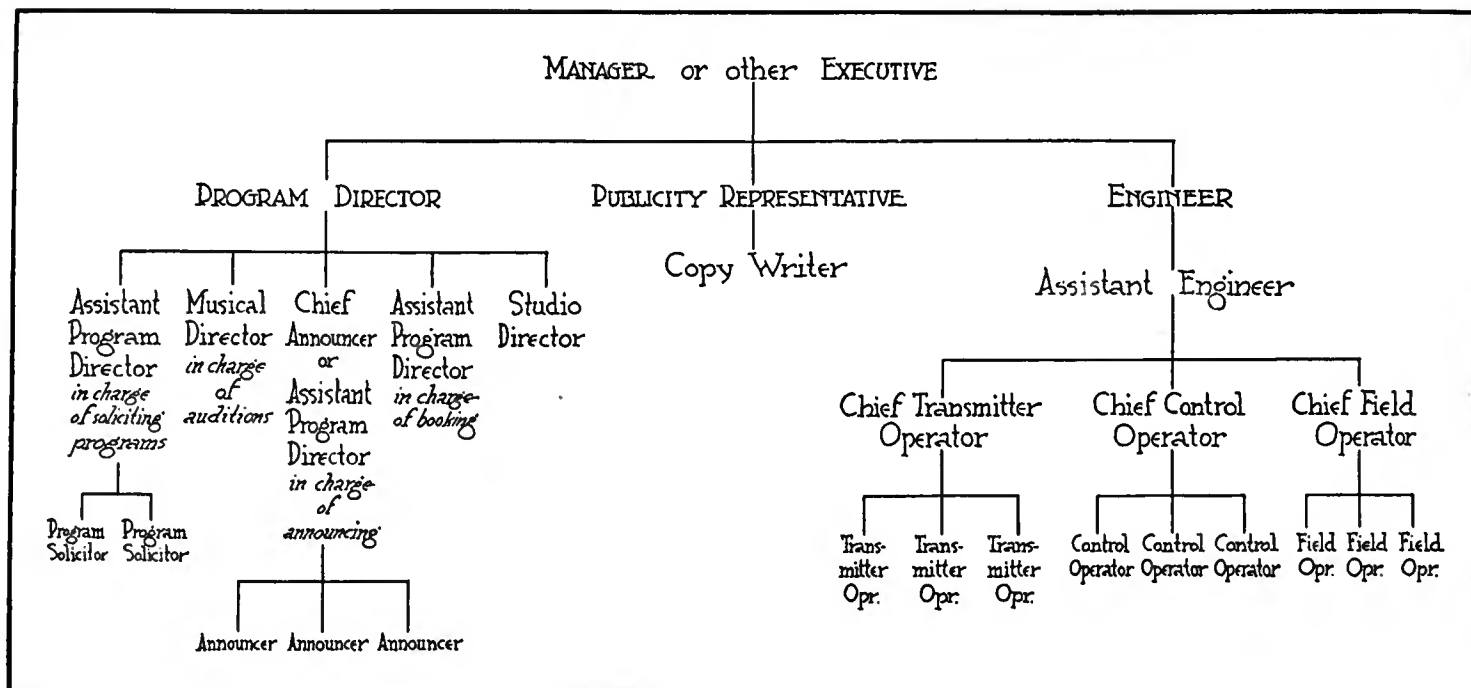


FIG. 1

"Organization chart" of a typical large broadcasting station. Mr. Dreher explains how the affairs of a typical station proceed—from the inside. A broadcasting station is a business organization, frequently one of some size, but the public knows very little about broadcasting except the impression gained from whatever they hear from the announcer

partment of the station. Publicity activities include photographing, of course, this being handled, ordinarily, by a professional photographer who does such work for the station as the publicity representative may direct. A scrap book is also kept, and the publicity representative may hand in occasional reports on the amount of space he has been able to secure, since the object of every station is to be well known, and a good press agent helps in that endeavor as much in broadcasting as in saving souls or governing the country.

The program director, like the chief executive to whom he reports, may have come into broadcasting from anywhere. Some of them are ex-concert managers, with a wide acquaintance among musicians. Others are ex-newspaper men. Still others are musicians, theatrical booking agents, actors, clergymen, to name a few of the vocations which might be mentioned. The oldest program manager in the New York district, in point of experience, is a mechanical engineer. What a program manager does not matter; his duties are to keep in touch with the public and its desires, to see that the station gets the best program material available, to mould the programs in accordance with station policy, to coördinate the work of his department, to report to the management and to exercise various other special and executive powers. In a large station, if he saw everyone who tries to see him, he would hold his job about a week before the hospital claimed him. His assistants protect him to some extent.

Among these assistants there may be a subordinate program director in charge of soliciting programs. He may have a squad of program solicitors under him, or he

may do all the work himself. If so, he is primarily an outside man, going around interviewing prospective broadcasters. He keeps a sharp watch on the newspapers for reports of what may turn out to be "features." If the station is one which sells time, he is a sort of advertising solicitor, seeking customers, aiding them to arrange suitable programs, etc.

Just as a magazine gets a certain number of unsolicited contributions from writers, so a good many artists, some very good, some very bad, visit a broadcasting studio to volunteer their services. Hence a musician must be attached to the staff to give these people auditions and weed out the poor ones. He may do this at a time when the station is not on the air, and serve as the accompanist of the station when it is broadcasting. He disposes of the aspirant he cannot use as tactfully as possible, and sends the remainder to the booking agent of the station, who is in a position to arrange for a definite time when they may broadcast. The musical critic should, if possible, be equipped with a suitable microphone pick-up, audio frequency amplifier, and loudspeaker, so that he may hear applicants about as they will sound on the air, for some people with satisfactory concert voices do not transmit well, owing to the limitations of present-day electrical reproduction.

The booking agent of the station may be an assistant program manager, or the program director's secretary. He or she must be in close touch with the director in order to carry out his wishes in making up the program, assigning desirable times in accordance with the importance of events, and so on. Generally, the booking official knows pretty well what the program

director will approve, and does not have to ask him in the majority of cases. The system of booking programs works with the program book as its basis, which is marked in quarter-hour intervals for all the time the station has on the air. When an event is booked, the appropriate spaces are filled in several weeks ahead of time, as a rule, and the program people can tell at a glance what time is still free. Thus a program solicitor may come to the booking clerk and ask, "What time have you free after 8 p. m. on November 3rd?" if he has something in mind for that date. The booking agent is also responsible, as a rule, for making sure, on the day of broadcasting, that none of the performers have forgotten their dates or will be unable to appear for one reason or another. He has another job—that of furnishing lists of events booked to the publicity man, engineer, and announcers, so that suitable action may be taken, schedules made out, etc. And, every day, the program for the day, correct in every detail, is issued to all the operating and announcing forces concerned.

So far we have been more concerned with making up the programs than with broadcasting them. The latter job is principally in the hands of the technical force, and it will be taken up in more detail in our next issue, when we expect to print an article on "Technical Routine in a Broadcasting Station." The operating personnel is headed by a technical man, styled variously as "Chief Operator," "Engineer-in-Charge," "Chief Engineer," or blessed with some other mellifluous title. Sometimes he is a graduate electrical engineer, sometimes he is not; but in any case his function is to see that the amperes flow

in the antenna, when needed, and that they are modulated as accurately as may be, on whatever speech and music the station is supposed to broadcast. The actual work of broadcasting, in the larger stations, is handled by a squad of operators or junior engineers, and the technical man in charge, like the program director, is something of an executive in addition to his specialized functions. But in most stations, probably, the engineer wears headphones and turns knobs. Assuming, however, that the station is a big one, the technical work is divided into outside or field pick-up, and internal station jobs. The field work is usually handled by a Chief Field Operator, who may have a considerable number of assistants, up to a dozen in some cases. He makes up the schedules for these men and usually handles some of the important jobs himself. The inside work may also be directed by a Chief Inside Operator, but frequently the control room of the station is separated from the power plant, so that a Chief Control Operator and a Chief Transmitter Operator are separately responsible for the work in these two departments. The control room is in close association with the studios, while the power plant is isolated; the former handles only relatively weak currents, while the latter deals with dangerous voltages and powers. Thus the qualifications for the various technical positions, inside and outside, vary widely. The operation of a good-sized station, with perhaps a score of engineers and operators on its staff, is quite a complicated enterprise, and the complications increase in proportion to the number of outside events where program material is carried to the station proper by wire lines. The routine and methods of technical broadcast operation will be taken up in detail in later issues, together with the tasks of the studio director and announcers, who work with the engineers in the actual broadcasting of the programs.

A Forgotten Romance: German Radio in Africa

POSSIBLY it should be called a tragedy. It is one of the stories of the war, of radio in war. As far as I know, it was never printed in the United States. A German radio and telegraph engineer, Doctor Roscher, wrote it for *Archiv für Post und Telegraphie*, August, 1920.

Before the war the Germans had a colony, Togoland, in West Africa. As early as 1909 they decided to place a wireless station there for communication with Berlin. The site chosen was Kamina, four miles from the terminus of the Hinterland Railroad.

"At last, on the night of the 7th of June, 1911," says Dr. Roscher, "after some two years' trying, signals were picked up for five minutes from the great station at Nauen. But before this was achieved mast

after mast had been destroyed by tornadoes, and when the first signals from Nauen reached them it was through a captive balloon some 450 feet up, as substitute. At the same time they heard Poldhu, Cornwall, talking." This "talking" was in telegraphic code, of course.

After prodigious labor in the tropical jungle, the station was completed on June 20, 1914. It had three steel masts 225 feet high, and six 360 feet high. The power was supplied by two 500 hp. turbines and two of 120 hp. By day it transmitted to Nauen on 6000 meters, by night on 4500. During the night it received, when it could, through the appalling equatorial static.

A few weeks after completion of the station the war broke out. It is said that 800,000 tons of German shipping were saved through the activities of this transmitter. It handled traffic from South America and Germany. Naturally, it was not left alone for long. The French advanced against it from Dahomey, the British from the Gold Coast Colony.

On August 27th the station was destroyed by its own personnel, in a few hours, by "explosions and smashing," in accordance with contingent instructions from Berlin. The enemy was then 30 miles away, in such numbers that successful resistance was out of the question.

"Finally," the account reads, "they proceeded to overthrow the nine towering masts by loosening the couplings at the

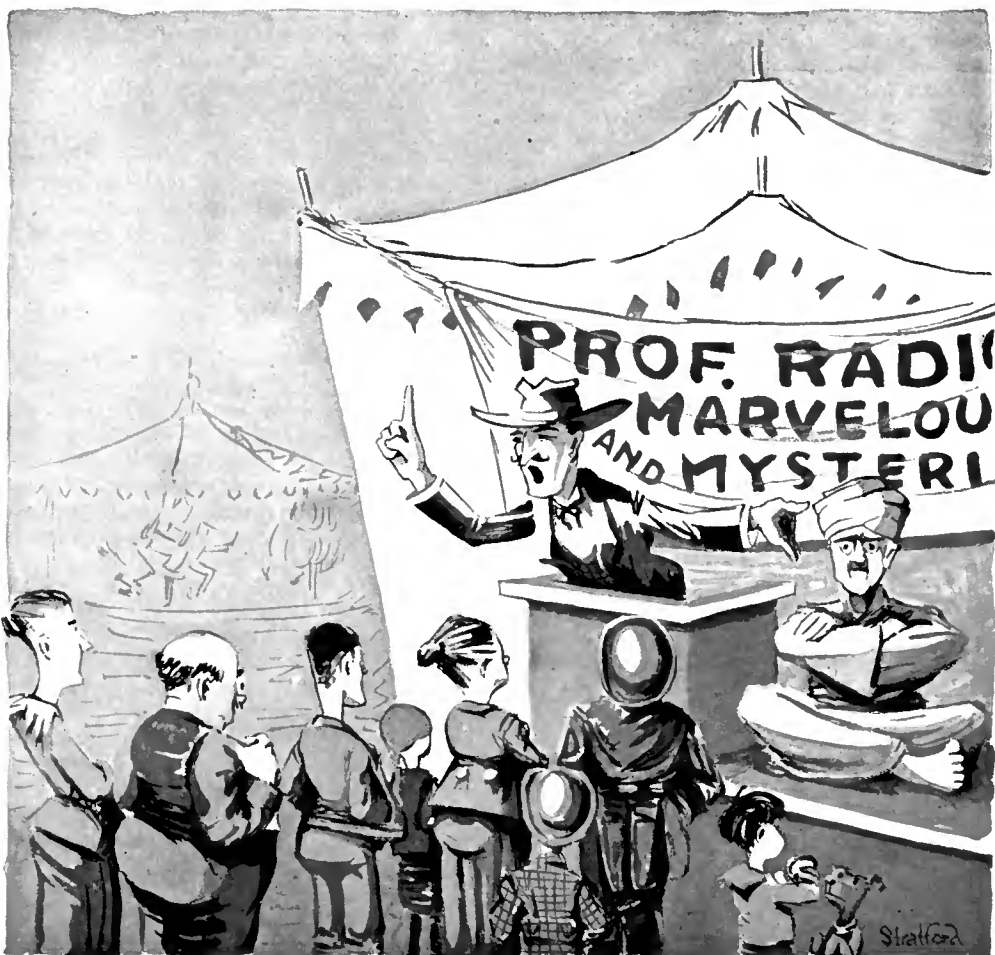
foundation blocks. Like a row of gigantic ninepins they went down, one after another, with a terrific metallic ringing noise, heard, it appeared later, far away in the silence of the night."

Five years of research, five weeks of service, and suicide. That was the career of the German station at Kamina in Togoland, which began and ended long before radio waves received their modern burden of jazz, grand opera, and inspirational talks.

Rebuttal in the Discussion of Super-Power

In the October magazine, Mr. Dreher and Professor Williams aired out the question of super-power broadcasters as opposed to the service which can be rendered by 500-watt stations. Professor Williams, of station WHAZ, Rensselaer Polytechnic Institute, Troy, New York, has accepted the opportunity to reply to Mr. Dreher's remarks in the October RADIO BROADCAST and they appear below. The views of Professor Williams and Mr. Dreher are not necessarily those of the editors. Professor Williams said, on page 764 of our October issue, that this magazine had "reversed its position on 500-watt stations." That is not the case. We are simply giving a hearing to both sides. Insofar as the present discussion is concerned, the debate is now closed.—THE EDITOR.

IN THE articles appearing in the September and October numbers of your magazine on the subject of super-power broadcasting stations, Mr. Dreher, unable to meet the facts brought out in the fields of electrical engineering, automobiling, and cash register use, all of which were selected by him, jumps into the field of



SOME ONE IS ALWAYS EXPLAINING THE MYSTERIES OF RADIO



RADIO INVESTIGATION IS AS FASCINATING AS THAT IN OTHER FIELDS

physical optics, drags Galileo and his telescope into the argument, and ends—I am sorry to say—by a rather harsh criticism of his opponent.

If radio broadcasting were carried on between two perfectly definite power levels, radio receiving sets could be designed to function satisfactorily in the hands of the radio public between those limits. This does not exclude the super-sensitive sets for scientific and industrial use any more than the fact that the human being has eyes excludes the use of the telescope or microscope in similar fields.

I do not know how much experience Mr. Dreher has had with the difficulties of properly adjusting telescopes and microscopes, but, from my own experience, I am thankful that my eyes function satisfactorily for most purposes without the aid of these complicated instruments which require so much skill for their satisfactory use, and at the same time are very expensive. Similarly, I am for a broadcasting system which will operate between fixed power levels so chosen that a relatively simple and inexpensive receiving set will function between these levels satisfactorily for general use, and will not require a great amount of technical skill on the part of the listener to operate it. While Mr. Dreher is unwilling to grant a high order of technical intelligence to the listener, he advocates putting in his hands the type of instrument which requires a maximum of technical intelligence to operate. This simply proves that he misunderstands the radio public, and does not know that the present trend in the manufacture of receiving sets and tubes is in the direction of making the complete receiver as near fool-proof as possible.

Nature has been very kind in not placing the sun in the direct line of vision at the time when the light rays from the sun are most intense and by placing the sun behind the earth at night in order that the earth's inhabitants may enjoy the moon or star-lit heavens without any interference from the sun's rays. If Mr. Dreher can devise some scheme whereby he can shut down his super-power stations altogether, or remove them so far in space, time, or wavelength from the other broadcasting stations so that they will interfere as little—with the programs now being broadcast—as the sun interferes with our enjoyment of the heavens at night, I do not believe that any one will object, and he can enjoy his super-power stations to his heart's content.

My opponent accuses me of not being courageous enough to enter the radio field against him. It was not lack of courage, but lack of a mean

disposition, and, even now, after a second challenge, I would rather not do it. However, let us look into this little computation of his. He is a very clever and interesting writer and uses a lot of words to prove simply this: If you have 500 watts and increase it to 50,000 watts, everything else remaining constant (presumably, including the science of mathematics) you have one hundred times as much power on the antenna, and therefore one hundred times as much power at all other locations. Now, if he had had as much experience as I have had during the last fifteen years trying to transmit energy at different power levels to the points where you want it to go, instead of into copper roofs, water-pipes, steel buildings, etc., he would never have penned that article and misled his readers into believing that they were going to receive one hundred times the volume from WGY's 50,000-watt transmitter, on its first test, that they receive from our 500-watt transmitter. This is no argument against super-power, but against the deplorably misleading statements one reads in the radio press. Station WHAZ stood by on August 24, 1925, to allow WGY to complete their transmission tests, and our staff was as disappointed as the WGY staff with the results. It was my good fortune to be listening in at one of our test stations and the increase in power level at that location was almost nothing.

The set I was operating is one we are at present using for field strength measurements. It makes one of the best receiving sets (I did not make it) I have ever had. On several occasions I have loaned this set to B. C. L.'s and they have been invariably dissatisfied with it, the reason being that it requires as fine and delicate adjustment as a high-grade microscope and when not properly handled will absolutely ruin the best program beyond recognition.

Mr. Dreher's other contention regarding the advantages of one or two steps of amplification at the transmitter rather than at the receivers reads as easily as the one just discussed and is as misleading. Here again he assumes ideal conditions which do not exist. The simple fundamental error made in his assumption is that a receiving set receives energy only at the frequency for which it is tuned. He intimates that I have never listened to DX. Well, I have, and I have not only amplified DX signals to loud speaker value but have sent them out through our experimental station 2 XAP with sufficient power and clearness to be heard in California without appreciable distortion. These re-broadcasting experiments were carried out in

connection with other experiments, the primary purpose of which was to determine the facts regarding the sensitivity and selectivity of the most widely used receiving sets already owned by the B. C. L.'s. Station 2 XAP was used as an interfering station with different amounts of power in the antenna and at different frequencies (wavelengths). The receiving sets were located at various points at different distances from 2 XAP. These experiments proved conclusively that increasing the power level of the interfering station, which is usually a local station, by as much as one or two steps of amplification prevented us from receiving stations which could be received at the lower power levels of 2 XAP with good enough quality for re-broadcasting purposes. It could not be expected that conclusions drawn from radio engineering experiments carried out through two cold winters would agree with opinions formed in a steam-heated New York City office. You must decide for yourselves which are of greater value.

Space will not permit me to tell you the little I know about transatlantic radio telephony and telegraphy and how international broadcasting will be accomplished. I will content myself with the statement that our station has already been rebroadcast on the other side of the Atlantic, and I am not really as ignorant on the subject as Mr. Dreher would have you believe.

I cannot agree with my opponent in his final conclusion to the effect that talk on this subject is of no value. If he really has a set that can be interfered with by a cat rubbing his back against the fence and cannot pick up a 500-watt station only one hundred and fifty miles away, we have learned something from his side of the argument, granting my points sum up to zero.

The Memoirs of a Radio Engineer

VI

IN 1910 I graduated from the elementary school, and a little later my family moved to another house, where I started what may not have been an innovation, but it was certainly an early use of an expedient now very common—the resort to an indoor antenna where it is not feasible to erect one outdoors. The landlord objected to my trespassing on the roof of his three-story treasure, on the ground that I would wear through the sheet iron and cause the roof to leak, that I might fall off, that an antenna would be unsightly, that it would attract the unchained lightnings, etc., etc. So I strung two wires about fifty feet through our apartment and, as the neighborhood was one of frame structures, obtained satisfactory results, as the times went. I had a crystal detector, consisting of a piece of silicon, ground flat and smooth on one surface—God knows why, but the current superstition was that silicon should be used in that way—and imbedded in solder, with a blunt brass point pressing down on it. This was attached to the antenna and a gas pipe ground, and a 75-ohm receiver, swiped from some telephone desk set, connected in parallel with it. Once in a while this combination picked up signals very faintly. They were probably those of near-by amateurs. After a while I got together a tuner—a cardboard mailing tube about

two inches in diameter, wound with No. 24 enameled wire, and provided with two sliders making contact with a bare swath the length of the winding. This constituted a conductively coupled system, with a tuned antenna and approximately tuned secondary or detector circuit. It was quite effective, remarkably so in comparison with the untuned set, and it was further improved by the substitution of a galena—cat whisker detector for silicon. Picking up a signal was no longer an achievement; it could be accomplished almost any time. The United Wireless station at 42 Broadway, New York City, came in fairly loud, although about eight miles away. There was also the Wanamaker station, MHI, in New York, communicating with MHE in Philadelphia—perhaps this was a little later; it is rather hard to remember down to a year after fifteen of them have rolled by. The rest were largely amateurs. I also had a transmitting station. My parents had bought me a quarter-inch spark coil, in a quartered oak case. In my own room, which measured about eight by ten feet, I strung up an antenna of aluminum wire, which was popular at that time, consisting of about a dozen wires forming a grid which covered the whole ceiling. The spark coil, operated from dry cells and keyed by some crude spring and knob arrangement, when connected to this antenna and a ground, was heard by an amateur about five blocks away; we engaged in conversation, and he paid me a visit, declaring that I came in louder than some of the boys with outdoor antennas. The spark gap, I recollect, consisted of zinc electrodes turned out for me by a boy who attended Stuyvesant High School and had access to the machine shop there. Among other amateurs in the neighborhood, some were using long single wire antennas at a time when multi-wire ones were all the fashion, until, on the advent of broadcasting, the single wire antenna for reception came into its own. Many quaint superstitions regarding antennas and other radio subjects raged among these innocents. For example, it was declared, on the strength of an article in a periodical, that "the wavelength of an aerial was four times its mean height above the instruments." There was one comrade, it happened, who had a sloping antenna running from his roof to a clothes-pole, with a horizontal lead to the set, the lower end of the antenna being about as far below the apparatus as the upper end was higher. In a discussion on wavelengths, in which everyone boasted of the great length of his own wave, one of his rivals taunted this fellow, saying, "You ain't got no wavelength," and backing his argument with the article in question. Confronted with the fact that the antenna radiated audible signals, he merely shrugged his shoulders and admitted that there might be signals, but, properly speaking, no wavelength existed. I do not remember the name of this dialectician, but he deserves high honors, for he

is the forbear, in the radio field, of a great multitude who substitute words for sense, and they should keep his memory green.

It was in the early part of 1912 that I wrote my first radio article, for which I received the sum of 65 cents. It was a description of a Tesla coil, fed from the quarter-inch spark coil which also furnished the oscillations for my transmitting set, and it was certainly one of the smallest Tesla coils ever made. The secondary or high frequency winding covered an ordinary small test tube, the turns being No. 30 silk-covered wire carefully spaced by hand and dipped in wax. Over this were wound a few turns of heavy weather-proof wire, in parallel with a leyden jar across the spark gap of the induction coil. The secondary of the Tesla converter gave a one half inch high frequency spark, which, being confined to the surface of the body, could be taken without sensation—a great opportunity for fooling other boys who believed that an electric spark always meant a severe shock to any one monkeying with it. The same credulity was being exploited by some vaudeville acts built around large Tesla transformers, throwing sparks several feet long, which enabled the actors or "professors" to announce that they could withstand potentials of millions of volts where a mere 1800 would kill an ordinary man in the electric chair. The distinction between high frequency currents and d. c., and the matter of the number of amperes actually flowing through vital tissues, were of course unmentioned in these acts.

For the July, 1913, issue of *Modern Electrics* I also wrote an article on "indoor aerials," which won the third prize of \$1.00. Recently, in looking up this publication, I was amused to note that the second prize in that issue (\$2.50) was captured by Harold Beverage, who was probably at that time a student at the University of Maine, or, more likely, preparing for his college course, as I was. He was not writing about antennas, in fact, his contribution was electrical in nature and really had nothing to do with radio. About six years later this boy was to invent a new type of antenna, the "wave antenna," whose highly directional properties, eliminating the bulk of the static on trans-oceanic reception, marked a great step forward in high power commercial radio.

In 1912, however, antennas were not

yet familiar objects, and the indoor variety, particularly, seemed very strange to most people. They could not conceive of waves penetrating wood and glass and other solid objects. One friend of my father's came to the house and listened attentively to the wireless signals, but when he asked whether I had an antenna on the roof, and I pointed to my indoor wire, he declared vehemently that I was hoaxing him, and that the signals were being cooked up somewhere in that room. I argued with him for a long time, and grew very angry, for I was young and it irritated me to be accused of fraud when I knew that the signals were genuine and there was nothing extraordinary in such reception. I had not yet learned the truth of Schiller's saying, "Against stupidity the gods themselves fight in vain," an aphorism which the progress of the engineering arts has not affected in any way.

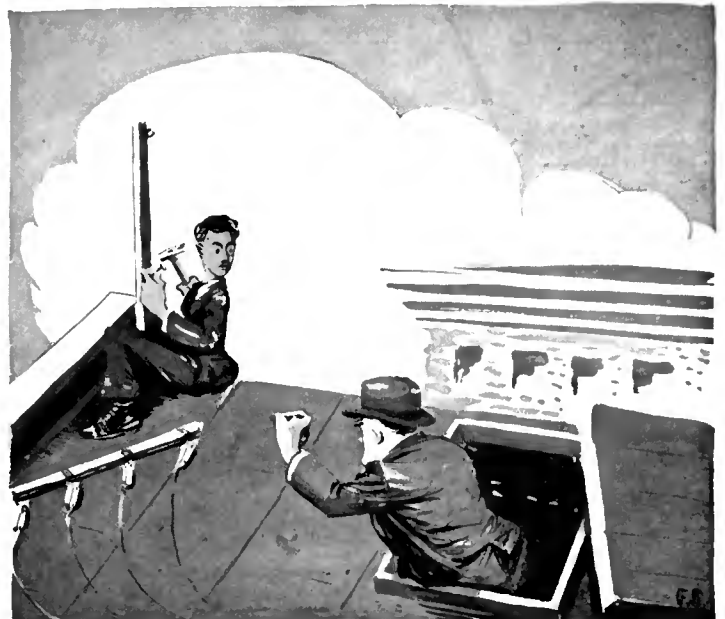
The Country Is Saved! Advertisement of a manufacturer of automobile accessories entering the radio field:

Hiccough & Co. Radio—the *ensemble* radio—is now ready!

The good news has been hard to keep! Extreme secrecy has guarded every move and discovery of Hiccough engineers, who have for more than two years been engaged in the solution of a tremendous problem—the *perfection of radio!* Yet for months the radio world has been atremble with the rumor that "something revolutionary in radio is about to be announced."

So the announcement of Hiccough & Co. is not a surprise because everybody has been expecting it. You know you yourself have been waiting for a concern like Hiccough & Co. to take the uncertainties, disappointments, and troubles out of radio and give you only real results.

Italics and exclamation marks not ours. At last! Radio is to be made perfect—by a manufacturer of automobile accessories.



THE LANDLORD OBJECTED TO TRESPASSING ON HIS TIN TREASURE

Improving the Cone Loud Speaker

CONE-TYPE loud speakers, particularly the Western Electric Loud Speaking Telephone No. 540AW, when used with a receiver not designed especially for use with them, may be greatly improved by a few simple adjustments. If these suggestions are followed with care, a greatly improved signal will result, and the speaker itself will not be harmed. It is no es-

pecial secret that many Western Electric engineers make these adjustments on speakers used on their own radio sets. This is the first time that information for doing the trick has been made public. The operation, in the parlance of the engineers, is called loading.

The first operation necessary is to loosen the small thumb screw at the apex of the cone. It is well to wind a rubber band around it after loosening, to prevent its becoming lost.

The second operation (see Fig. 1), is the removal of the five screws nearest the center, at the rear of the speaker. Removing these



FIG. 1

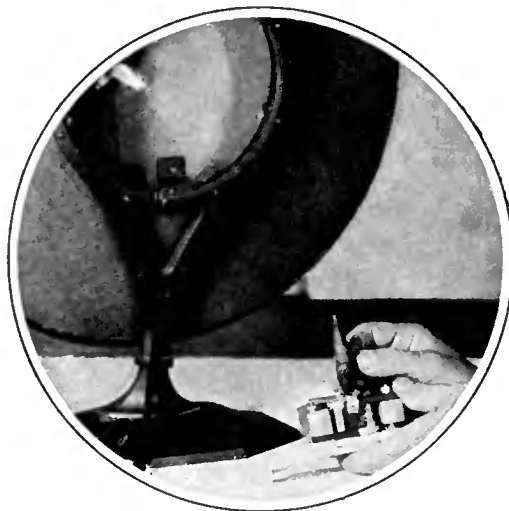


FIG. 3

screws permits the metal ring, the composition ring, and the metal shield which they hold in place, to be removed and leaves the mechanism open to view. The third operation is the removal of the three screws which hold the mechanism in place on the main frame.

The fourth step in the procedure is to remove the small screw to which the screw driver is pointing in Fig. 2, and to place a small piece of friction tape between the two metal parts the screw holds

together. Of course, a small hole must be cut in the tape to permit the screw to pass through. Then the piston of the driving mechanism (see Fig. 4) is wound with rubber tape which is tightly stretched. In applying the tape to the piston, great care must be used to avoid bending the pin.

After the driving pin has been wound with rubber tape as shown in Fig. 3, the tape should be vulcanized by burning a match under it. After the tape is vulcanized (see Fig. 4) it will not loosen while the speaker is in operation. With this step, the alterations to the cone are complete and re-assembly is begun. First, place the driving mechanism back in place and hold it there temporarily by bringing up the three supporting screws with their lock washers. This mechanism must be centered, and that may be accomplished by shifting it oneway and another before the supporting screws are brought up tightly. Following this, it is but necessary to replace the parts removed and tighten the thumb screw and the job is done. The sound produced by the remodeled cone is greatly improved.

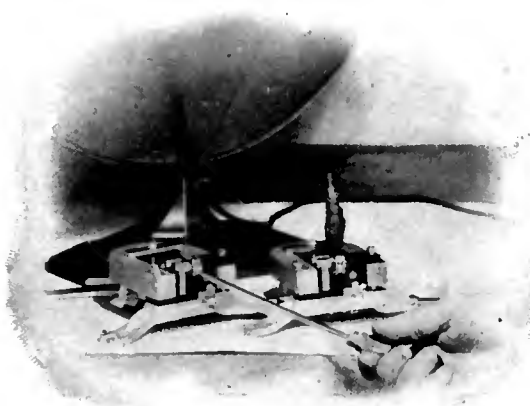


FIG. 2

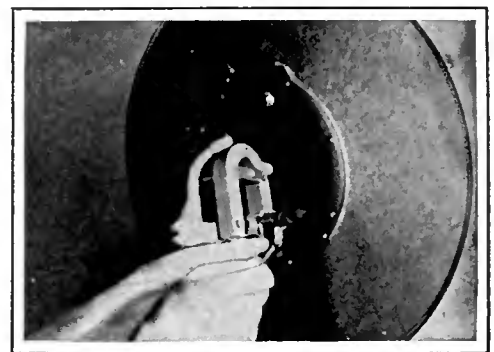


FIG. 4

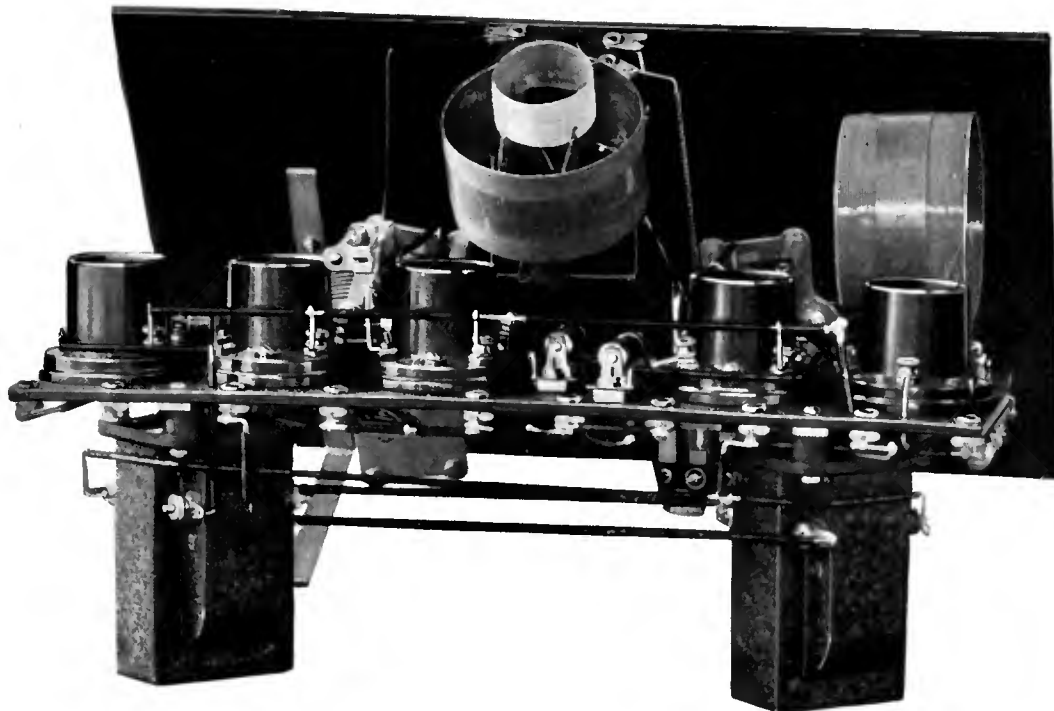


FIG. 1

A rear illustration. By means of small bushings, the audio-frequency transformers are underslung from the bottom of the shelf. In order from right to left the tube sockets are, first audio-frequency amplifier, radio-frequency amplifier, detector, and the last two are the two parallel tube sockets of the second stage audio amplifier

An Improved Five-Tube Receiver for the Inexperienced Constructor

The Crystallization of Modern Improvements in Receiver Design—Especially Arranged for Ease of Assembly and Operation

By ARTHUR H. FULTON, Jr.

ALONG with the developments in receivers to be made public for the fall radio season comes one which, in the estimation of its designers, is very high up in the scale. A great deal of time and study and many hours have been spent in the laboratory to produce a five-tube receiver—improved electrically especially in the unseen parts that are so important—that would give to the inexperienced constructor a receiver which would contain the best results of design and at the same time have a finished commercial appearance. A receiver has been designed which is very easy to assemble. All the constructor needs is a soldering iron, a few other tools, the parts, and the ambition to complete the job.

The term assembly is used advisedly because it can hardly be said that the receiver to be described entails either elaborate

construction or detailed layout, dimensioning, or the necessity of machine shop equipment.

Electrically, the circuit embodies and incorporates every important and worthwhile refinement of control and accuracy of coil design that can be approached in factory-made jobs. Here is a receiver employing a tuned, neutralized radio-frequency amplifier which has unusually

high "gain", a regenerative detector followed by a straight stage of audio-frequency amplification, and that in turn followed by a special power amplifier consisting of two tubes arranged with their elements connected in parallel.

No reflex feature is employed in the circuit, which sets this design off from the conventional Roberts Knockout circuit, which is, in many ways, similar. The high degree of selectivity and sensitivity of the five-tube set may be attributed to these modern improvements and changes.

Going one better than the orthodox kit idea, the designers of this receiver so arranged its construction that with the aid of a basic unit consisting of the panel, shelf, and miscellaneous hardware, it is possible for the builder to patronize his local radio dealer in the choice of the various other elements necessary for the construction of

*T*HERE is a story behind the development of the receiver described in this article. It was felt that there were a large number of radio enthusiasts, not especially gifted mechanically, who would welcome the design of an outfit which would take the guesswork out of home receiver construction. It would be possible, thought the designers, to produce a highly efficient five-tube non-radiating receiver embodying all the best points of the Roberts Knockout receiver—which, month in and month out, continues to be the most popular receiver for home construction in use in the United States to-day—and to select a group of the best parts obtainable on the market, even to the panel. So the result is a design which we can heartily commend to any constructor who wants to build an efficient receiver with as few mechanical difficulties as possible, and who, when the thing is completed, will have a set whose appearance is as finished as a factory-made product.

—THE EDITOR.

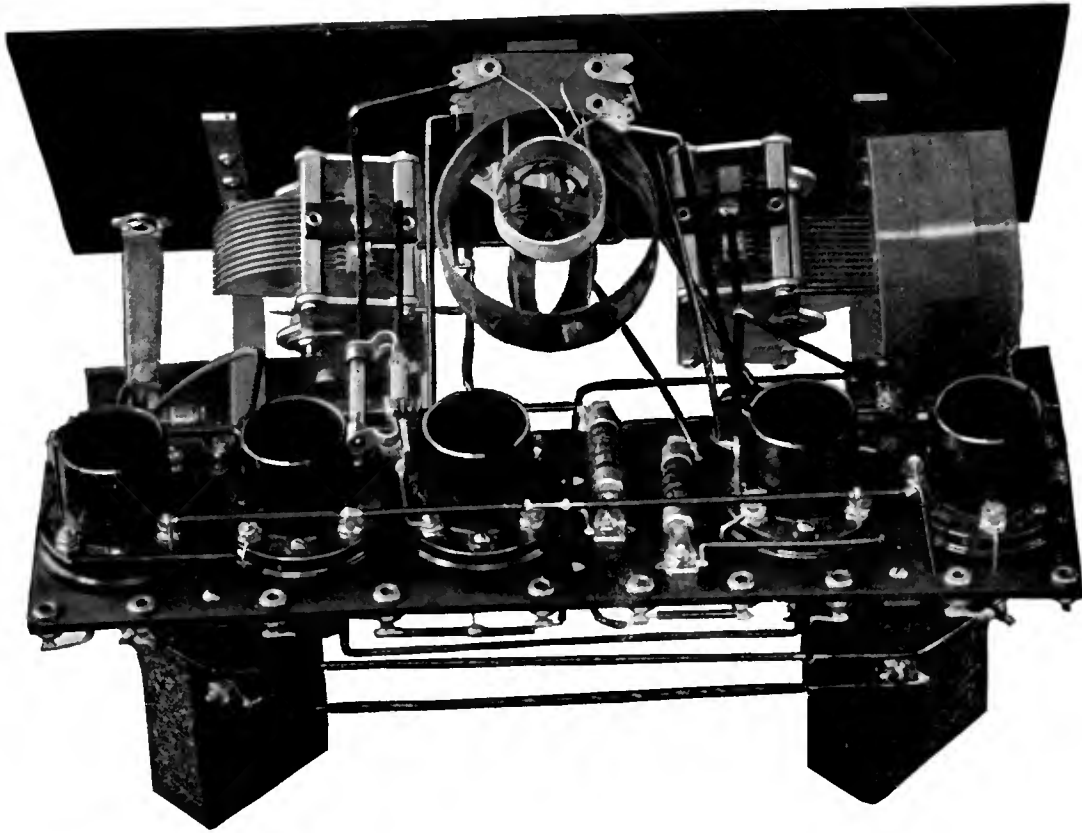


FIG. 2

The apparatus behind the panel. This view clearly shows the location and placement of the sockets, ballast resistances, and pin jacks on the shelf. Note that the coil units are at right angles to each other

the set. Instead of working from a set of blue prints on to a panel, the constructor has the opportunity of buying the panel ready-drilled, together with the other essentials, and merely assembles the rest of the material which goes to form the completed receiver. Brackets, cut and bent to shape, support a shelf upon which a majority of the apparatus, such as tube sockets, audio-frequency transformers, ballast resistances, and the neutralizing condenser are mounted in the completed job.

THE APPARATUS USED

IN ITS mechanical and electrical design, consideration has been given seriously to the employment of none but the best apparatus obtainable (all of which has been tested and approved by the Laboratory of RADIO BROADCAST). In its present form, the construction and operation of the receiver has been modified to simplicity with the inclusion of ballast resistances for all but one tube, one output jack for the loud speaker, and pin jacks for battery terminals mounted on the rear of the tube shelf. Following the trend of modern design, the receiver has been constructed on a slanting panel and is entirely self-contained thereon, the apparatus being mounted either directly on the panel or on the shelf supported by the brass brackets which are fastened to the panel.

High grade audio-frequency transformers employed in the audio amplifier, together with the peculiar parallel arrangement of the last two tubes, insure distortionless quality output.

In this receiver the tubes are not situated in the conventional manner, but in order from left to right looking over the top of the receiver are: first audio, radio frequency, detector, second audio (this last named consists of two tubes connected in parallel).

Volume is controlled by means of the filament rheostat connected in series with the filament of the radio-frequency tube.

The tuning coils used permit of the reception of signals from those stations which operate on the higher frequencies (low wavelengths) and will amply cover those stations situated at the other end of the scale.

The tuning is reasonably sharp on the antenna coil control due to the absence of reflexing. Tuning in the detector circuit is the same as before and is comparable to tuning a regenerative receiver by the squeal method. Briefly, to tune with this method, the tickler is well advanced to produce regeneration and by rotating the detector tuning condenser, squeals will be heard every time the circuit beats with the carrier wave of a station transmitting at that time. Once a desired station is located in this manner, the squeal can be eliminated by loosening the coupling between the secondary and tickler. While, in the standard three-circuit regenerative receivers this system would play havoc with other receivers in the neighborhood, in this receiver, due to the use of the Roberts system of neutralization which is a positive preventive, no squeal is passed along to the antenna to cause disturbance.

Three views of the receiver shown here indicate its commercial appearance and mechanical design, and by means of the prepared parts, duplication in design by all those attempting its construction is assured. The models shown differ in some points of mechanical refinement from the receivers it will be possible to construct from the commercially available units.

Considering the individual variations in the construction of receivers described in radio periodicals, and realizing the troubles encountered by constructors in modifying original designs to suit their own fancies, it is not difficult to appreciate the special attractions and favor of a plan which will minimize the detailed dimensioning, layout, and assembly of receivers.

Analyzing the circuit in Fig. 4 the salient features herewith described are apparent.

ELECTRICAL DETAILS OF THE CIRCUIT

IN THE receiver illustrated, the variable condensers C_1 and C_2 are shunted across their respective secondary coils, the first secondary functioning as a combined primary-secondary, in auto-transformer fashion, but in the finished model, a separate antenna coil has been provided. These condensers are of the standard .0005 mfd. value. The condenser C_3 is that with which neutralization is obtained and is of the value of .000032 mfd. Two by-pass condensers, C_5 and C_6 , are employed, one across the primary of the first audio transformer, and B battery in its circuit, its value being .001 mfd. and the other a .006 mfd. one, connected from the minus A to the

lower end of the plate coil in the radio-frequency tube circuit.

A tickler having variable coupling with the detector secondary provides regeneration. The grid leak condenser C_4 is .00025 mfd., shunted by a grid leak of 2 megohms. The value of the grid leak will vary with the particular detector tube used.

Low ratio audio-frequency transformers of the latest design, having large iron cores upon which are wound large coils, should be used. This sort of transformer gives equal response on all the audio frequencies, insuring good quality of signal.

The unusual system of parallel tube amplification is practically new to the radio broadcast field, and is intended for the prevention of overloading in the last audio amplifier.

Two major controls afford tuning over the entire broadcast range. These are the tuning condensers; the detector circuit is so designed that its tuning is slightly sharper than the antenna circuit. As previously explained, regeneration adds to the simplicity of tuning, and the control for the tickler coil is located in the top center of the panel.

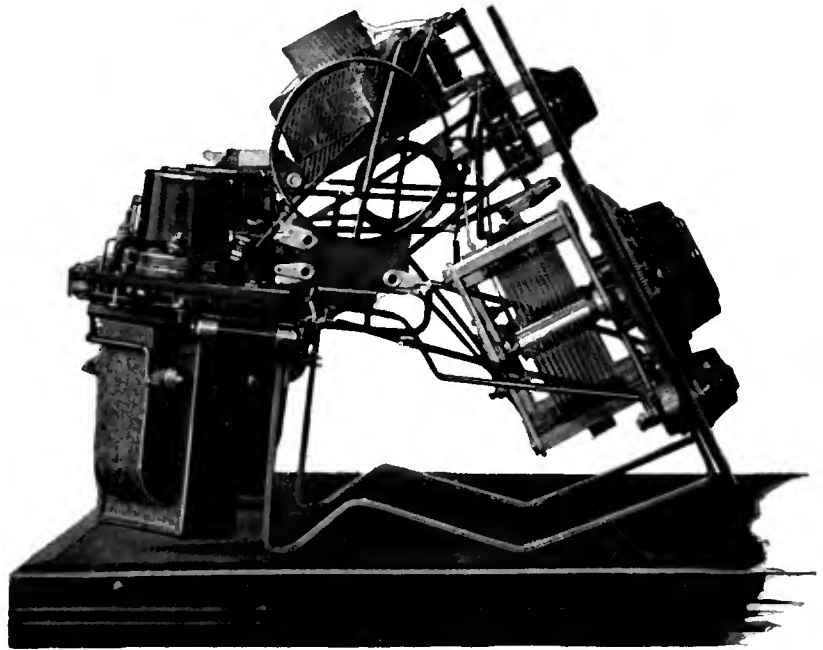


FIG. 3

A clear representation of the method of supporting the coils, shelf, and brackets. The audio-frequency transformers are mounted at right angles to each other to minimize magnetic coupling effects

This improved five-tube receiver employs the following parts, others, similar, can be selected from apparatus approved by RADIO BROADCAST:

1 Neutralizing Condenser, .00032mfd. (Hammarlund)	\$ 1.80
2 Audio-frequency Transformers, Rauland Lyric, @ \$5.00 ea.	18.00
2 Condensers, .0005mfd. (Hammarlund), @ \$5.00 ea.	10.00
2 Dials, 4 inch, Na-ald, @ \$.75 ea.	1.50
1 Dial, 1 1/2 inch, Na-ald.	.25
4 Ballast Resistances, Amperite, @ \$1.10 ea.	4.40
1 set Roberts Coils, Hammarlund	6.00
5 Sockets, Na-ald, @ \$.75 ea.	3.75
1 Rheostat, 25 ohms, Carter	1.00
1 Filament Switch, Carter.	.65
10 TipJacks, Union, @ \$.25 a pair	1.25
1 Single Circuit Jack, Carter	.70
1 Grid Condenser, .00025mfd., Dubilier	.50
1 Grid Leak, Durham	.40
1 By-pass Condenser, .002mfd., Dubilier	.45
1 By-pass Condenser, .006mfd., Dubilier	.65
Panel, Hardware, sub-base etc., Hammarlund	9.40
	\$60.70

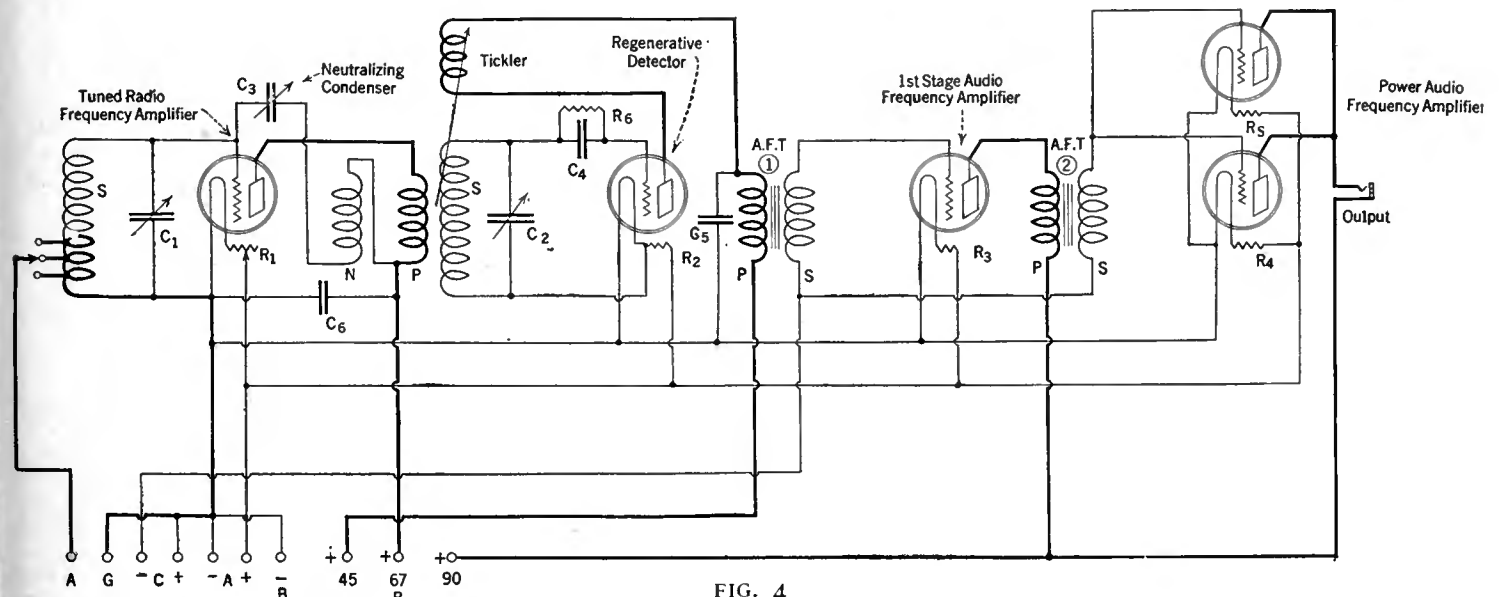


FIG. 4

The circuit diagram of the final receiver differs slightly with the diagram here in that a separate antenna coil is provided in place of the auto-transformer arrangement shown. This antenna coil has three leads, the two ends and a center tap which allows of correct adjustment of the antenna coupler with the particular length of antenna used. The values of the various apparatus employed are: C_1 and $C_2 = .0005$ mfd.; $C_3 = .000032$ mfd.; $C_4 = .00025$ mfd.; $C_5 = .002$ mfd.; $C_6 = .006$ mfd.; $R_1 = 25$ ohms, $R_2, R_3, R_4, R_5 = 1/2$ -ampere filament ballast resistances; $R_6 = 2$ meg; AFT1 and AFT2 = 2 to 1 audio-frequency transformers. Note the parallel arrangement of the last two tubes. The neutralizing and primary windings of the r.f. coupler are indicated as a double-wound coil, but in reality it is a single-wound coil with a tap taken off the middle turn

What Do We Know

The Fascinating New Problems of Radio High Frequencies—A Distinct Branch of Are Yet to Be Discovered—How Radio

By KEITH

Director, Radio

Aside from the frequency and the power used, the other factors limiting our transmission are the time of day, the type of antenna, and nature of the country between the transmitting station and the receiver. At night, conditions are vastly different than during daylight—as all radio enthusiasts know. The effect of intervening objects has not been completely investigated.

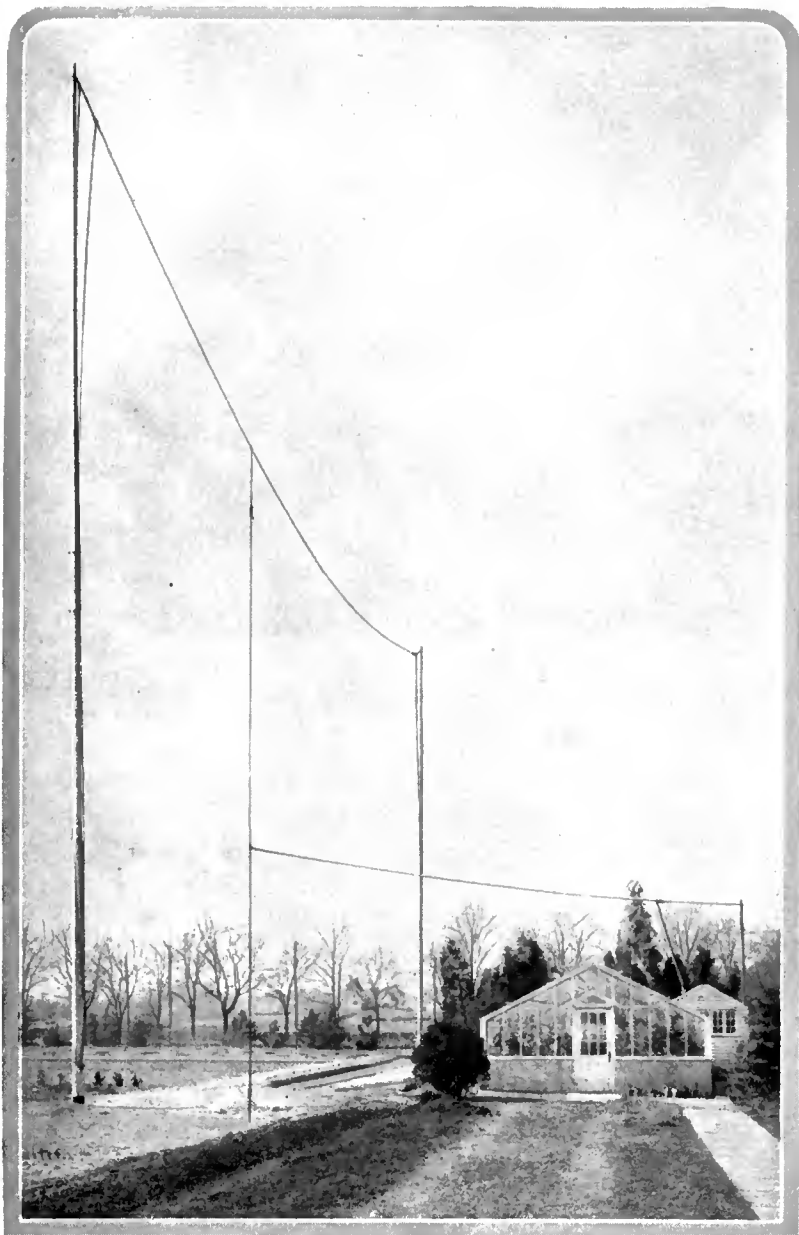
Other conditions theoretically remaining the same, increasing the transmission frequency (decreasing wavelength) widens the radius over which signals from our station may be heard. If the frequency is increased we find that our range increases accordingly until at 7000 to 12,000 kilocycles (40 to 20 meters) we can communicate during the daytime over distances that are considered very good at night on the lower frequencies (longer wavelengths). At the same time, we seem to find that our signals are not heard near by, but that they take a peculiar jump and come down again at some greater distance. This view is maintained by several experimenters, notably John Reinartz, and yet remains to be proved or disproved.

THE CLOCK IS IMPORTANT IN SHORT WAVE WORK

ALTHOUGH greater distances may be covered with a medium power, the reliability of communication suffers, for fading and other disturbing effects become quite noticeable. At still higher frequencies, the time of day is of great importance, but so little is known of transmission on the highest amateur band, 60,000 kilocycles (5 meters), that it is unsafe to make any definite assumptions of what actually happens.

The MacMillan Arctic expedition of last year was out of touch with civilization for many weeks because the operators were not equipped to route their traffic over the very high frequency (short wavelength) bands. The expedition this year has been in continual touch with amateurs in this country as well as those in England, Australia, and other far distant lands. The communication last year was accomplished on 1500 kc., while this year it was chiefly accomplished at 7000 kc. While the expedition was in continual daylight this year, it was necessary to use still higher frequencies, and successful communication was carried out with amateur station 9 cxx in Cedar Rapids, Iowa, on the extremely high frequency of approximately 20,000 kilocycles (16 meters).

THERE are a surprisingly large number of broadcast listeners who are able to understand what goes on in the always interesting amateur radio channels. The fact that the amateurs use code almost exclusively has not prevented these ambitious ones from buckling down and learning the code, setting up equipment—which costs less than many a home-assembled super-heterodyne—and reaching out themselves over astonishingly great distances. This article announces experiments which are bound to be of interest to “transmitting amateurs” and the many broadcast listeners whose interest in radio is broadening out. The RADIO BROADCAST-Eveready



RADIO BROADCAST Photograph

THE TRANSMITTER HOUSE AND ANTENNA AT 2 GY

Where the RADIO BROADCAST-Eveready short wave experiments are in progress. The “driver” antenna can be clearly seen above the small operating house in the right foreground. The main 40-meter antenna is suspended vertically from the supports between the two 85-foot masts

WHEN radio amateurs first explored the region of the very high frequencies, say beyond 2000 kilocycles (100 meters and lower) the phenomenal distances covered with low power were attributed to the total lack of interference encountered there. Then as these high frequency ether lanes became the common property of thousands of amateurs, it was realized that the results obtained there were due to other causes than freedom from interference.

What these other causes are has been the subject for considerable speculation among the radio learned, and the experimental work carried out to discover the laws governing very transmission at high frequencies has been very valuable. To aid in this experimental work, the Laboratory of RADIO BROADCAST has in operation a station work-

ing on high frequencies under the amateur call of 2 GY. This work will be prosecuted during the coming winter with the cooperation of the National Carbon Company in an endeavor to learn all that is possible of what goes on on the higher frequency bands.

To see what happens at these higher frequencies, let us perform a hypothetical experiment at our transmitting station. Starting with 1500 kilocycles (200 meters)—the wave used by all amateurs in the “good old days”—let us see how far, on the average, we may transmit with a given power.

About Short Waves?

Transmission and Reception on Very Radio Investigation in Which Many Facts Enthusiasts Can Join the Experiments

HENNEY

Broadcast Laboratory

Communication between the S. S. Peary at Etah, Greenland, and 2GY has been successful at night on 7000 kilocycles, but not a sound could be heard from the expedition in daytime until our receivers were tuned to the higher frequencies.

What takes place along the high frequency bands? How far may one expect to carry out reliable communication in daylight, and at night, with a given amount of power and at a given frequency? Do signals actually jump over near-by stations to reappear at some much greater distance? What is the relation between time of day and distance of transmission? What of seasonal differences? Of increase in power? Are some frequencies good at certain hours and not at others?

These and other questions are assailing every true radio investigator. Station 2 GY was established to work on the high frequency bands, and considerable time and energy will be devoted to the solution of certain particular aspects of these broad problems.

AID OF EXPERIMENTERS IS WANTED

TO AID in this work, the staff of the RADIO BROADCAST-Everyday short wave experimental station are compelled to call upon other amateurs. To this end the Staff is desirous of hearing from all amateurs who may be able to aid, either by listening to transmissions from 2 GY at definite periods or in other ways to be arranged.

At the present time, the station is experimenting in two directions. One has to do with antenna systems and the other is the relation between power and reliability of communication.

A brief description of the antenna now in use at 2GY will explain the manner in which other amateurs may aid in this work. A single vertical wire, one half wavelength long (about 65 feet) is "fed" by a transmission line from the transmitter which is working on the so-called 7000-kilocycle (40-meter) band.

The questions to be answered are, what is the proper length, one half wavelength, or more or less? At which point along the antenna should the driver wire be attached? What are the best methods of indicating resonance? What is the effect of using two or more parallel vertical wires, each tuned to the transmitting frequency? Should the wire be vertical or horizontal?

Those who have studied the classical wave theories in

experiments will give all interested experimenters an opportunity to take a personal share in as interesting an experiment as we know of and this article tells something of the problems which have to be solved. High frequency (short wave) transmission in the last two years has set the radio world by the ears and the more that can be found out about the strange phenomena the faster will radio advance. Succeeding articles in this series will tell more about the progress of the experiments, which will, we think, be of great service to all the experimenters in this field, and which will, we hope, further the interest of the veriest of fans in this engrossing subject. — THE EDITOR.

CHAPTER IX

EXPERIMENTS ON THE IDENTITY OF ELECTRIC WAVES AND LIGHT

Hertz's Apparatus for Shorter Electric Waves. — After Hertz had succeeded in proving that the action of an electric oscillation spreads out as a wave into space, he planned experiments with the object of concentrating this action and making it perceptible to greater distances, by putting the oscillator in the focal line of a large concave cylindrical mirror. In order to avoid the disproportion between the length of the waves and the dimensions he was able to give to the

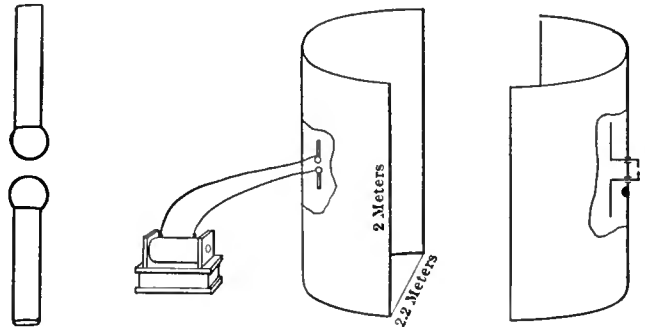


FIG. 28. Hertz's rectilinear oscillator.

FIG. 29. Hertz's cylindrical mirrors. Oscillator is at left; resonator, at right.

mirror, Hertz made the oscillator smaller, so that the length of the waves was less than one-tenth of those first discovered.

The form of oscillator used in these experiments is shown in Fig. 28. The two halves of the oscillator were cylindrical bodies 3 cm. in diameter, terminating in spheres 4 cm. in diameter. The total length of the oscillator was 26 cm., and the spark gap was usually about 3 mm.

For a receiving circuit, the circle of wire used in the previous experiments was replaced by a linear resonator, consisting of two straight pieces of wire, each 50 cm. long and 5 mm. in diameter, adjusted in a straight line so that their near ends were 5 cm. apart.

51

THE HERTZ OSCILLATOR SYSTEM

A page from the text book (copyright by McGraw Hill Book Company), *Principles of Wireless Telegraphy*, by Prof. George W. Pierce of Harvard University. As early as 1888, Professor Hertz, at Bonn, Germany, performed experiments in directive radio transmission, using waves of about 66 centimeters. Some of the methods used by Professor Hertz are being revived at the present time, a curious instance of a technical "swing around the circle"

the older texts will see the similarity between this single wire to the original oscillators of Hertz. One half of the wire is the antenna, and the remainder is the counterpoise of the usual antenna installation.

The advantages of such an antenna are several. In the first place, it may be situated some distance from the transmitter proper with the result that all absorbing material may be removed from the field of the antenna. The single wire operated very near its fundamental frequency (wavelength), or at a harmonic of it will have a very high radiation resistance with the result that a given

amount of power put into it will be efficiently radiated into space. The only disadvantage discovered to date is that it is somewhat "tricky" to get into actual operation.

Amateurs who have experimented with such an antenna system are invited to write of their work to the Laboratory. Actual measurements of course are greatly to be desired.

WHAT RELATION EXISTS BETWEEN POWER AND DISTANCE?

WITH regard to the relation between power and distance, the experiments already under way will reveal the questions the RADIO BROADCAST-Everyday experimenters would like to answer.

For several months the power used at 2 GY consisted of a battery powered 50-watt tube. About 120 watts input to the plate was used. Occasionally 1500 volts "raw" a. c. was placed on the plate and

at times the 1500 volts were rectified by means of an "S" tube rectifier.

The daylight range that could be expected from such an installation seemed to be from 800 to 1000 miles since stations in Florida, Ohio, and Illinois were worked without difficulty in broad daylight with considerable reliability.

When the 50 "watter" suddenly burned out, a 5-watt power tube was installed in its place and with about 40 watts input to the plate, the same range was obtained as with the larger tube. At night several communications were carried out with very low power. Notable among this work was that done with 4 JR in Gastonia, North Carolina, and 4 kw in Jacksonville, Florida. With the latter station communication was established when about 25 watts were used. Then the plate voltage was steadily reduced until finally only 100 volts were used with a plate current of 12 milliamperes. This represents a power input of 1.2 watts—and still 4 kw answered all of the questions that were sent to him from 2 GY. In other words, successful and reliable communication had been carried out with a power-mileage ratio of more than 800 miles per watt. This was not freak transmission nor was it due to excessive fading,

Some Important Radio Questions to Be Answered

- What takes place along the high frequency bands?
- How far may one expect to carry on reliable communication in daylight, and at night, with a given amount of power and at a given frequency?
- Do signals actually "jump over" near-by stations, to reappear at some much greater distance?
- What is the relation between time of day and distance of transmission?
- What difference do the seasons make in short wave transmission and reception?
- Are some frequencies good at certain hours and not at others?

since the transmission lasted for nearly an hour, and followed similar work with 4 JR. While it is realized that it is one thing actually to exchange signals with a station and another to send and receive messages from it, it is believed that this "800 miles per watt" can be repeated or bettered. Recently 2 GY established communication and received several messages from the U. S. S. *Seattle* when she was leaving Tahiti in the South Seas. This is a distance of about 7000 miles and the communication was carried out on 97.5 watts. A still better record is the work with 7 uz, Seattle, Washington, two days in succession with a power of 5.4 watts. Station 2 GY has communicated with a number of amateurs who were using receiving tubes for transmitters.

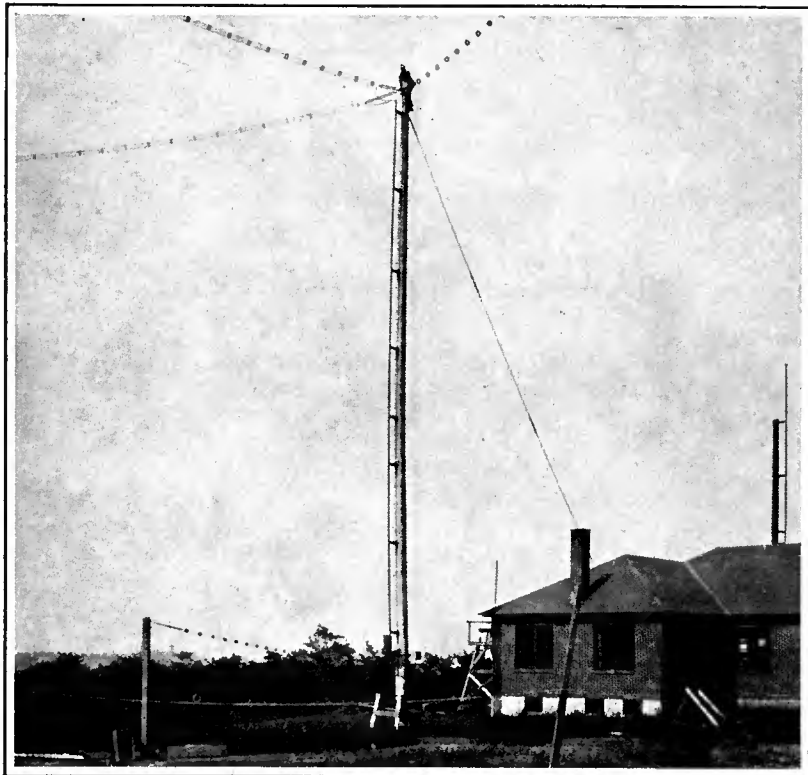
suggested that a long message, copied perhaps from a magazine, be transmitted and checked back to see whether the communication was sufficiently dependable for the carrying out of traffic.

Amateurs who care to aid the Staff in the RADIO BROADCAST-Eveready experiments in their short wave, low-powered work are invited to write to the Laboratory of RADIO BROADCAST indicating in what manner they may best be able to help. Interesting experiments and experiences of amateur operators are always appreciated.

Amateurs who care to take part in the winter's tests from 2 GY are requested to communicate with this station, and interesting experiences of any operators will be appreciated at all times.

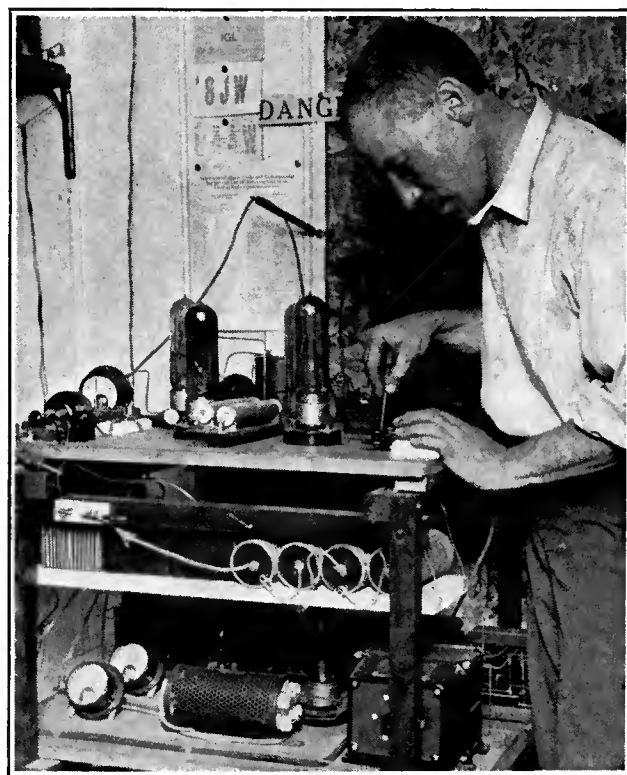
There is the recent performance of Canadian 9 CK on Vancouver Island, British Columbia, who worked for an hour with an Australian amateur when using a 5-volt receiving tube with 400 B battery volts on the plate.

The Staff would like to hear from amateurs who have records of successful low-powered transmissions especially when the time of day, distances covered, and power used are known. If communication is attained on very low power, it is



THE KDKA SHORT WAVE ANTENNA

Where the "driver" principle is employed to energize the antenna. One of the high frequency antennas can just be seen behind the station house at the right of the photograph. The driver system is in use on the longer antenna. Note the coupling coil at the base of the wooden mast. The wires suspended from the short pole are the counterpoise and take the place of a "ground." Signals radiated from this antenna have been received in Europe and Africa and are much more consistent than these sent out on the lower frequency



A TYPICAL AMATEUR SHORT WAVE OUTFIT

This one is owned by Mr. Leo Johnson, of New York City. His station call is 2 CTQ. Although many amateur stations are not famous for their scrupulously neat appearance, these experimenters have been able to reach out with their short wave signals to surprising distances. Amateur signals have been heard over a distance of 12,000 miles, which is as far in one direction as it is possible to transmit a radio signal

An A. C. Receiver and Power Amplifier

Design and Assembly of a New High Quality Amplifier Operating from Alternating Current Together with a High-Efficiency Four-Tube Receiver with an A. C. Plate Supply

By JAMES MILLEN

IT HAS been suggested by a number of radio authorities that one of the essentials for good audio quality is high plate voltage. The most practical way in which to obtain this high plate voltage is from a current-tap operated from the a. c. electric light socket. Such a system also permits lighting the filament of the last tube with a. c., so that the use of a 5-watt power tube for this purpose is made possible.

Until now, the construction of a quality audio amplifier which would operate from the a. c. line has been almost impossible as many of the essential parts were unobtainable in the open market.

Realizing the advantages of an amplifier which would require neither A, B, or C batteries, and which at the same time would give amplification with an unusually high quality, RADIO BROADCAST has done much experimental work in order to determine the best design for the parts required.

Regardless of how fine an amplifier one has, if the loud speaker is poor, the received signal will probably sound no better, if as good, as from a poor amplifier connected to the same poor speaker. A number of good speakers are now obtainable on the radio market. Of particular merit are the cones.

In order to obtain quality output with a quality speaker, it is necessary that all the apparatus along the line be of high quality. The broadcasting station must produce high quality signals, the receiver must supply the power amplifier with high quality input and so on to the speaker.

In this paper will be described the con-

struction of a complete receiver operated mainly from the lamp socket. The receiver employs one stage of radio frequency amplification with a regenerative detector, and an audio-frequency amplifier embodying all the requirements for high quality.

The requirements are: 1. Use proper



*R*ADIO constructors are watching with eagle eye to see what the fall season brings out in new design. The receiver and power amplifier described here so completely by Mr. Millen combines ideas far in the forefront of radio progress. The audio amplifier is a particularly interesting bit of design. Mr. Crom's article in RADIO BROADCAST for October, 1925, laid down some theories of the audio amplifier and Mr. Millen's design puts his suggestion into definite form. And—perhaps most important of all—the plate supply of the entire receiver is drawn from alternating current; and in addition, the filament of the power amplifier is heated by A.C. The quality of the received signal, using this set-up with a cone type loud speaker, is almost beyond reproach.—THE EDITOR.



value of C battery for the signal voltage at the grid of each tube. 2. Use plate voltage which corresponds to this C voltage. 3. Use transformers with proper primary inductances. 4. Use a. f. by-pass condensers. 5. Cable filament and plate leads. 6. Burn tubes so as to secure proper electron emission. 7. Employ an output device to keep the d. c. component

of the space current on the last tube from flowing through the loud speaker.

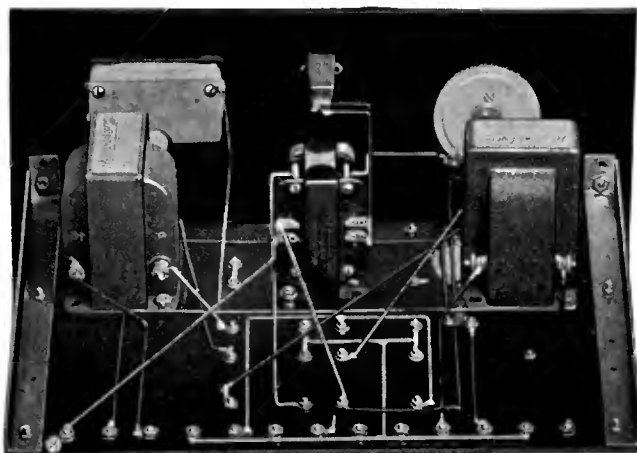
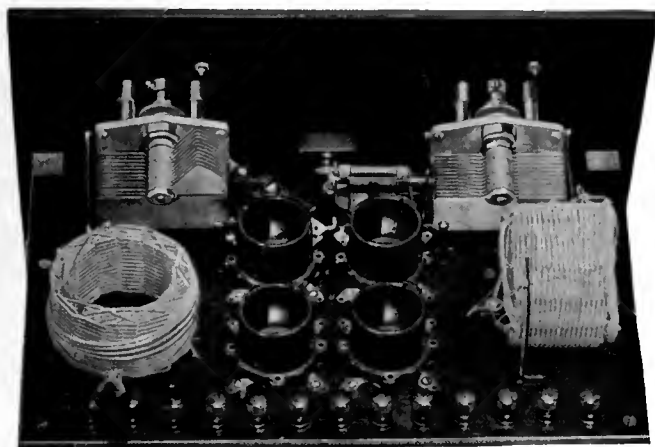
Since many of the readers of RADIO BROADCAST already have receivers of various kinds which they do not care to change, the construction of a power amplifier and power supply unit which will enable them to improve their present outfit will also be described.

The quality of output that will be obtained from the power amplifier does not materially differ from that obtained from a good resistance-coupled amplifier with a low impedance tube (so as better to match impedance of the cone type speakers) in the last stage. The main difference is that one power stage will do what three resistance stages will, and at the same time eliminate the batteries.

As the two tubes in a push pull amplifier are operated 180° out of phase, distortion due to insufficient C and B voltage cancels out, and good quality is thus obtained with low voltage.

THE CONSTRUCTION OF A KNOCKOUT SET WITH QUALITY POWER AUDIO AMPLIFICATION

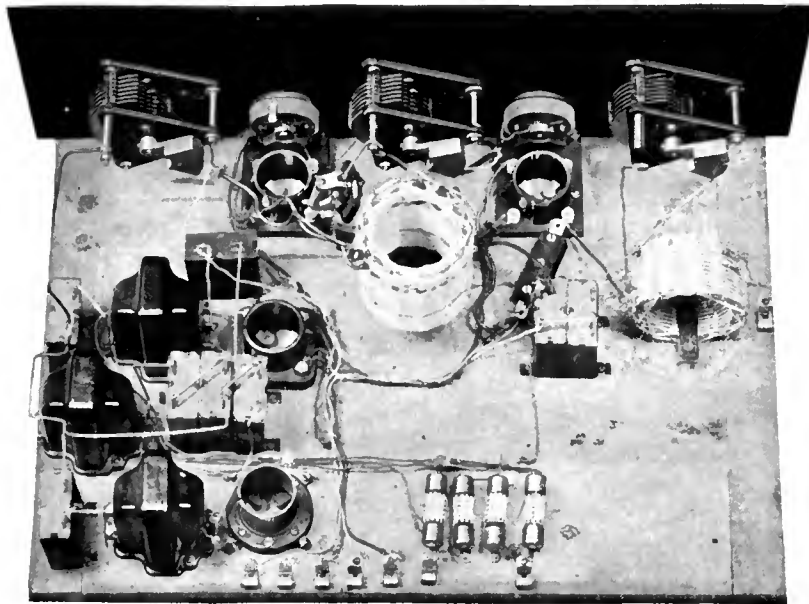
THE set proper employs the standard Roberts Knockout circuit. The writer made a number of experimental models and in some, reflexed the first audio through the radio tube. The sets shown in Figs. 1, 2, and 3 are not reflexed, and, though the elimination of the reflex requires an additional tube, such a set will give more volume without danger of overloading the first audio tube, which may happen with the reflex model on loud signals.



RADIO BROADCAST Photographs

FIGS. 1 AND 2

Fig. 1 (Top of sub-base views). The receiving set with power amplifier. The a. c. power supply unit is contained in a separate cabinet. Fig. 2 (Under sub-base) Note the output transformer, which serves the double purpose of keeping the d. c. component of the plate current out of the loud speaker and making possible the use of a low impedance speaker



RADIO BROADCAST Photograph

FIG. 3

An experimental receiver with a high quality audio amplifier. Audio frequency by-pass condensers, an output transformer, and high C and B voltages are employed. The power supply unit is contained in a separate cabinet, but in order to reduce the number of leads between the power unit and the set, the voltage dividing resistors are mounted in the set as shown

The only batteries required with this set are one small $4\frac{1}{2}$ -volt C battery and three dry cells.

The first three tubes may be three, one and a half-, or five-volt. Although the amplification obtained with the smaller tubes is somewhat less than that obtainable with storage battery tubes, there are several advantages to be gained by the use of the

small tubes. First, the maximum output obtained from the small tubes will not be great enough to overload the power tube and thus cause it to distort. In other words, in order not to overload the power tube, the maximum signal voltage applied to the grid of this tube must not be greater than the C battery voltage. In this amplifier, therefore, a signal voltage in excess

of about 22 to 24 volts (with a UV-202 or 27-28 volts with UX-210) will very likely cause distortion. As most of the input transformers, which are recommended for use with the last stage in this amplifier, have a ratio of 2:1, the output signal voltage from the first audio stage should not exceed 12 volts. Measurements made in the RADIO BROADCAST Laboratory showed that output peak signal voltages (measured with a vacuum tube voltmeter) obtained from the first audio tube using a UV-109 were never likely to exceed the 12-volt limit.

Should overloading take place in your amplifier, it will readily be detected by the plate circuit milliammeter needle movement as described by Mr. Crom in his article in the October RADIO BROADCAST. In order to remedy the trouble, connect a variable resistance, such as Bradleyohm No. 10, a Clarostat, Royalty No. B, or similar resistance across the secondary of the first audio transformer and adjust it until the distortion is eliminated. The effect of this resistance is to reduce the signal voltage which will be applied to the grid of the last tube and incidentally that which will be applied to the grid of the first tube. If this resistance were connected across the secondary of the second transformer, it would accomplish the same results, as far as the power tube is concerned, but it would not have eased the load on the first audio frequency tube, and, as this amplifier has been designed so that overloading (when three volt tubes are used) will start in the first stage slightly before (if at all) it will in the

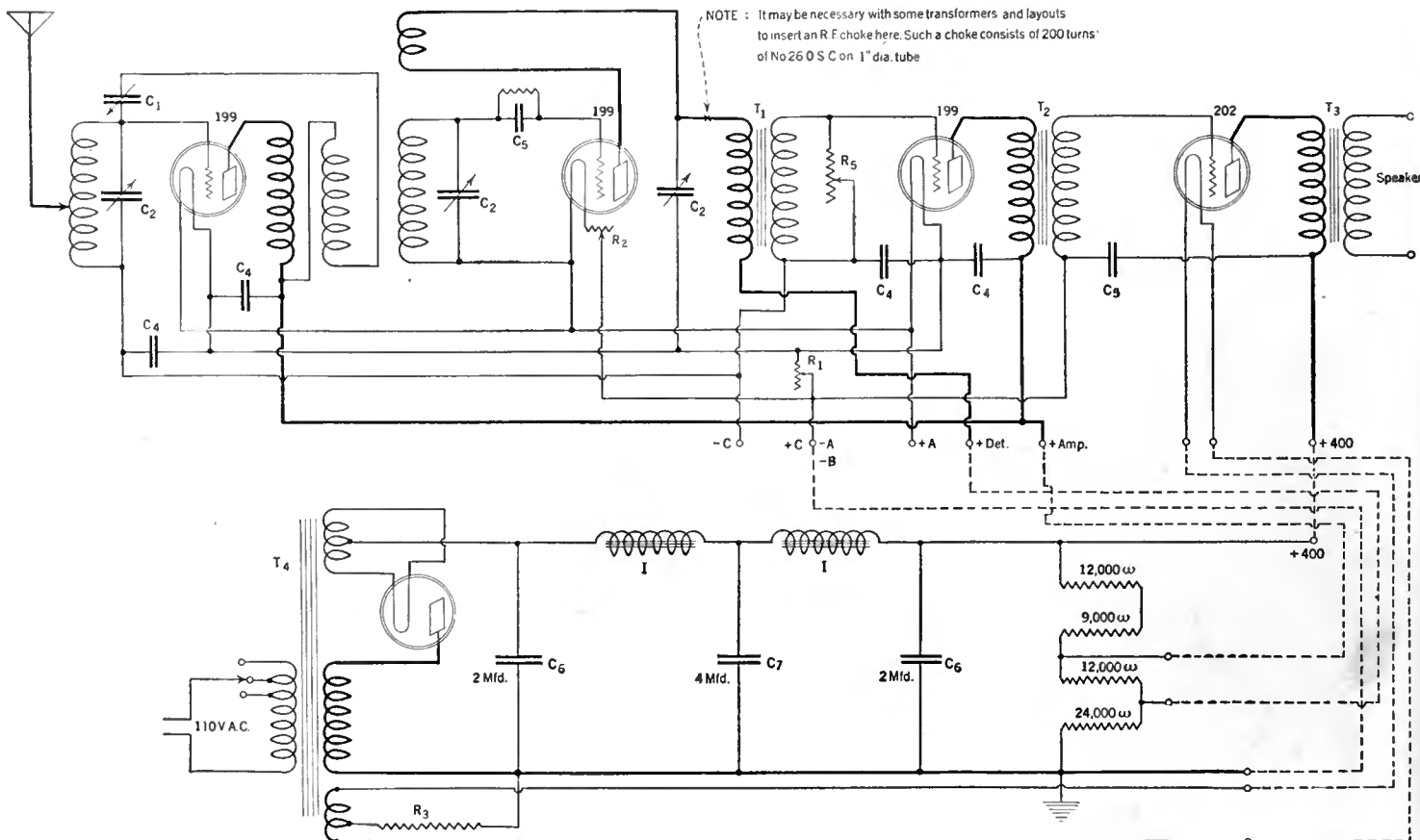


FIG. 4

The circuit diagram of the complete receiver

power stage, the proper way is to reduce the load on all tubes by means of a resistance across the first transformer secondary. Such a variable resistance also serves as an excellent volume control.

Instead of the variable tickler to control the regenerative detector, frequently in a receiver employing a circuit of this sort a fixed tickler and variable by-pass condenser are employed. With this arrangement, the tuning of the detector condenser is not affected by the regeneration control.

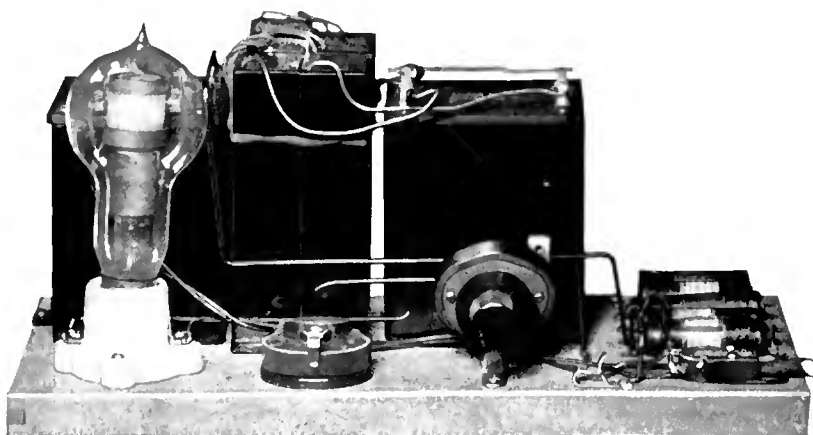
Another satisfactory method of controlling regeneration when a fixed tickler is employed, is by means of a variable resistance connected across the tickler coil.

The coils may be the standard coils made for the Roberts circuit, such as the Supercoils, Sickles diamond weave, etc., or they may be home made. The two tuning condensers have a maximum capacity of .0005 mfd., and with the coils described above cover a frequency range of from 1363 to 545 kilocycles (220-550 meters). A rheostat is provided for the detector and another for the two amplifier (r. f. and a. f.) tubes.

If three-volt tubes are to be used (and their use is highly recommended) it will be better to use them in sockets designed for them rather than using adapters in large sockets, as shown in the photographs.

All filament and plate leads are "cabled." Furthermore, large by-pass condensers are provided in all the amplifier circuits. As the construction, neutralization, and

operation of sets with neutralized r. f. amplifiers and regenerative detectors has been dealt with so many times in previous issues of RADIO BROADCAST, the subject will not be further discussed here. Those who are not already familiar with circuits of this type are referred to the article by Mr. Keith Henney in the April, 1925, RADIO BROADCAST or to any of the articles by Mr. J. B. Brennan.



RADIO BROADCAST Photograph

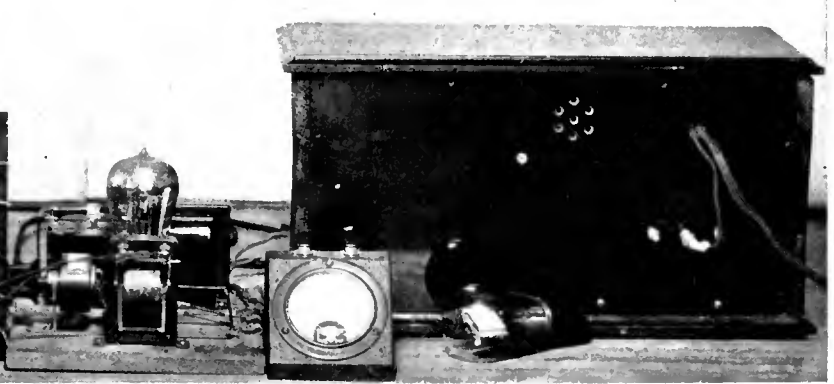
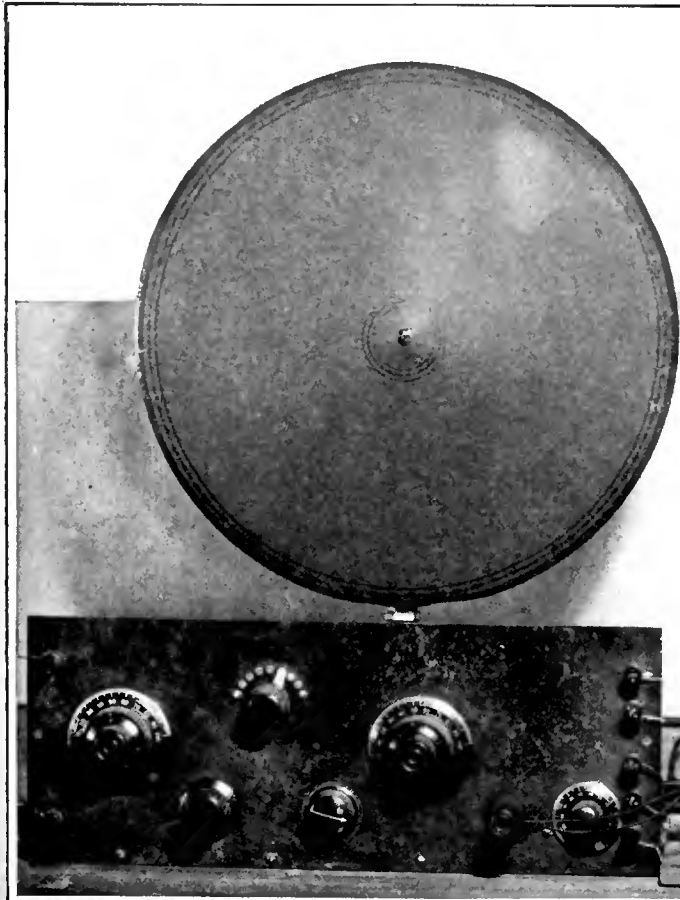
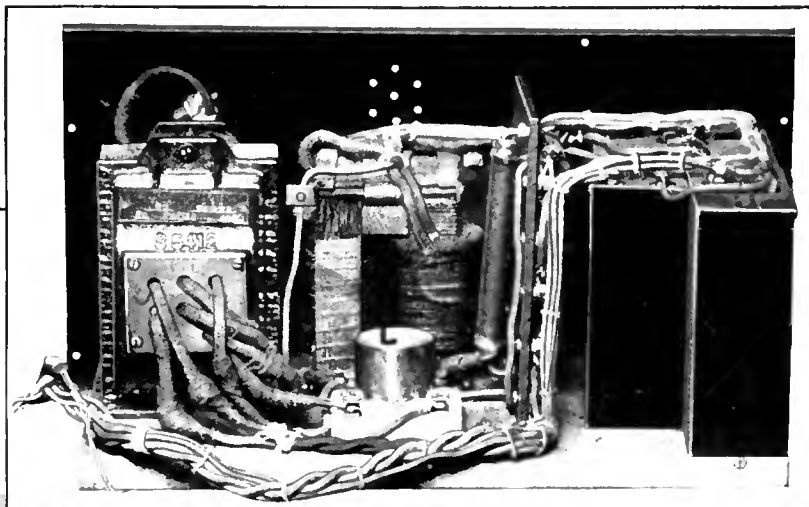
FIG. 5

A power supply unit employing an S tube as a rectifier. The transformer and the chokes are contained in separate iron boxes with bakelite panels

THE POWER AMPLIFIER

THE necessary components of the power amplifier are input transformer, power tube, by-pass condensers, and output transformer.

The input transformers may be any high-



FIGS. 6 AND 7

RADIO BROADCAST Photograph

Interior of the power supply unit shown in Fig. 7 is in the insert at the upper right. The large photograph shows an experimental layout with the high-quality amplifier and power supply unit connected to a two-tube Knockout receiver. An impedance-capacity output device is employed in the amplifier

grade low ratio audio transformer. Those successfully tried out by the writer in his amplifier were Rauland Lyric, Amertran ($3\frac{1}{2}:1$), and General Radio No. 285A. They should have a turn ratio of from 2 to $3\frac{1}{2}$ to 1, not higher.

The power tube may be a UV-202 or a UX-210.

The UX-210 and the UV-202 operate from the transformers without rheostats. The UV-202 is most easily obtained by writing direct to Amateur Sales Division Radio Corporation of America, 233 Broadway, New York. It sells for \$3.50. The UX-210 lists at \$9.00 and is obtained from any Radio Corporation or Cunningham dealer.

Several of the independent tube manufacturers are now making power tubes with 5-volt filaments. Double rheostats, as shown in Fig. 13, will have to be used with them.

The grid return condenser may be any of the paper condensers. About one mfd. is a satisfactory size. The plate by-pass condenser, however, must be capable of continuously withstanding the full plate voltage (about 400 volts). Most of the small paper condensers, such as the No. 765 Dubilier, will not stand up when put to this use. The Dubilier No. 769, W. E., Tobe, Acme No. 750 volt, or four of the lower voltage condensers connected in a series-parallel arrangement will be necessary.

The output device serves two purposes. The first is that it keeps the direct current from going through the speaker, and, second, it "matches" impedances. Thus, if a transformer is used the primary must have the proper impedance to work with the power tube and the secondary must be designed to fit the speaker. The plate impedance of the power tubes available for use in the set is the same. The impedances of some of the high-grade loud speakers, however, are quite different, and they may be grouped into two classes, high and low impedance. The Western Electric cone is a low impedance speaker, whereas the Farrand-Godley has a high

impedance. Therefore, in purchasing an output transformer, the type of speaker that it is to be used with must be kept in mind.

Some constructors may have a pair of push-pull transformers on hand. An output push-pull transformer can be used as an output transformer for the amplifier. The mid tap on the primary should be disregarded and the plate of the power tube connected to one of the terminals marked P (or plate) and the plus B to the other terminal marked P (or plate). The loud speaker (which, for most push-pull transformers, excepting the Western Electric, should be of fairly high impedance) is connected to the "output" or "speaker" posts.

There is another method of connecting the loud speaker which does not require a transformer. It is illustrated in Fig. 12, and employed in the amplifier shown in Fig. 6. The "Amerchoke" and the Thor-darson Autoformer make ideal impedances for this use.

When these parts have been wired up as shown in Figs. 11 and 12 the receiver itself is complete. There then remains the construction of the power unit for operating it from the house current.

CONSTRUCTION OF POWER UNIT

THE power unit is merely an "overgrown" B-substitute with an additional transformer winding. The rectifying device should be either a thermionic or an S tube. Both have been very successfully employed. The parts required for the construction of the power unit are transformer, tube and socket, chokes, condensers, and resistance units.

Transformers suitable for this purpose are the General Radio, Amertran, Acme, Dongan, and Jefferson. A suitable transformer must have at least one 7.5-volt secondary (with mid tap), and at least one 450- to 500-volt winding.

The transformer must also have a 110-volt primary, or better yet, have taps to take care of variations in line voltage from 105 to 120. If a thermionic tube (Kenotron, UV-202, UX-210, UX-216B) is to be employed

as a rectifier, then two 7.5-volt windings will be required. An S tube has no filament and, consequently, requires no filament heating winding.

Either double- or single-wave rectification may be employed. Both give excellent results, but the double-wave rectifier has the advantage of not requiring quite as elaborate a filter system as the single wave. However, for double wave rectification two rectifying tubes are required and two high-voltage transformer secondaries.

The power supply units described in this paper are of the single-wave rectification type, requiring but one rectifier tube and one high-voltage transformer secondary. The transformer should be rated at about 50 watts.

If a power tube (UV-202, UX-210, etc.) is employed as the rectifier, it is highly important that the grid and plate be connected together. The Kenotron, UV-216, which is the same as a UV-202 but designed only for rectifying and, therefore, having no grid, may be obtained from the Amateur Sales Division, Radio Corporation of America, 233 Broadway, New York. The UX-216 B, which is the rectifier patterned after the UX-210, is carried by all R. C. A. and Cunningham dealers.

Two chokes of about 50 henries each are required for the filter system. They must be designed for a total current of about 30 milliamperes and have as low a d. c. resistance as is economically practical. Such chokes may be obtained from Amertran, Jefferson, Dongan, Molliformer, Apco, or General Radio Companies, or they may be made at home as described by the writer in the June and October issues of RADIO BROADCAST.

The filter condensers must be capable of continuously withstanding the high voltage. There is generally quite a difference between "flash" voltage and "Maximum working" d. c. voltage. It is this last rating that is important and it must be at least 500 and preferably 750 volts in order to be satisfactory for use in the filter. Condensers which meet this requirement are manufactured by Dubilier (No. 769)

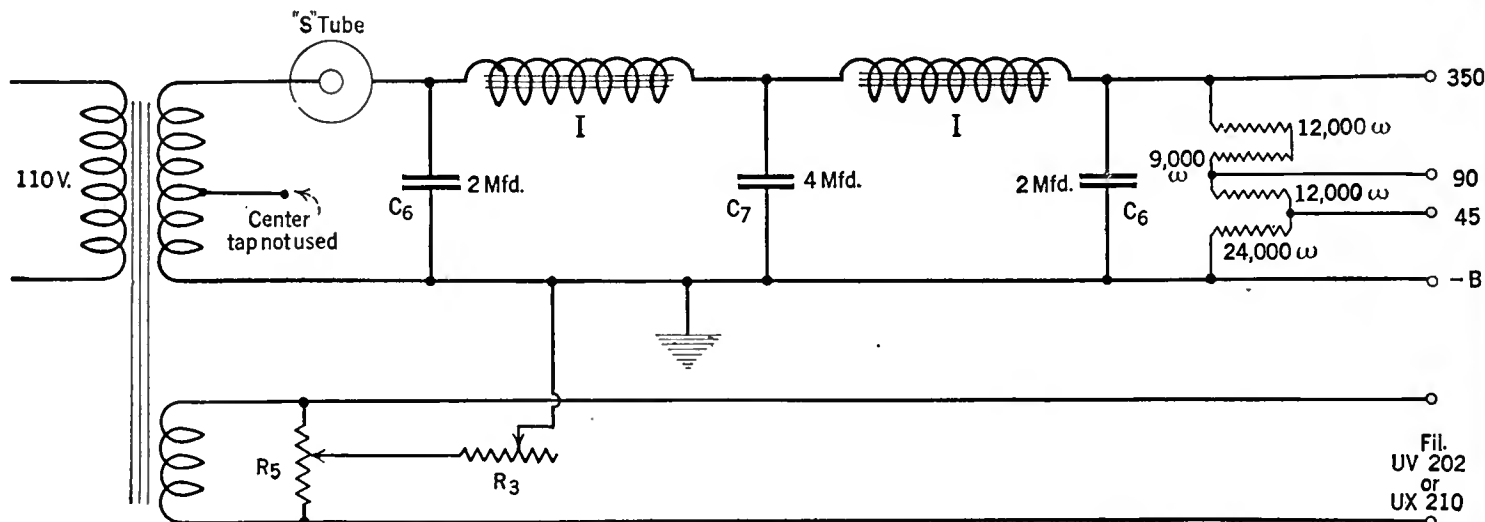


FIG. 8

The circuit diagram of the power supply unit shown in Fig. 5

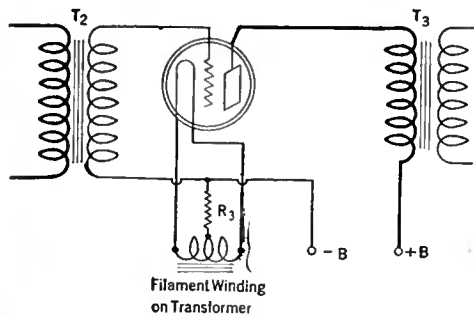


FIG. 9

The C bias is obtained by means of the voltage drop across the resistance R_3

but not No. 765), Acme, Tobe Dutschmann and Western Electric. W. E. condensers may be obtained from C. E. Jacobs, 2802 N. Kedzie Ave., Chicago.

Several resistance units are required in order to secure the proper B voltages for

the detector, r. f. tube, and first a. f. tube as well as the negative C voltage for the grid of the power tube. The values and connections for these units are indicated in Figs. 4 and 8. They may be of Ward-Leonard, Crescent, or Allen-Bradley make.

In place of the fixed 1250-ohm unit employed for obtaining the proper negative bias on the power tube, a C battery of about 22½ volts (for uv-202 or 28 volts for ux-210) may be employed. The voltage should in that case be adjusted for best results as indicated by the millimeter tests outlined by Mr. Crom in RADIO BROADCAST for October.

Another way of varying the negative bias to the power tube which does not require a separate C battery, is the use of a variable resistance such as the Clarostat or Electrad Royal. We believe this to be the best method, as the proper C bias may be obtained by varying the resistance while observing the plate milliammeter.

The power supply unit is generally most conveniently located under the table on which the set is placed. The several leads from the power unit to the set should be "bundled" together into a cable; one of the standard battery cables such as the Jones or Belden may be used for the purpose. The 110-volt a. c. cord is thus kept a fair distance away from the set proper. This is of slightly more importance in reflexed sets.

If the power unit is placed in a cabinet, such as the one in Fig. 7, it is important to provide proper ventilation so that the heat generated by the rectifier tube will be dissipated. The plate milliammeter (0-50 m. a.) may also be conveniently located if de-

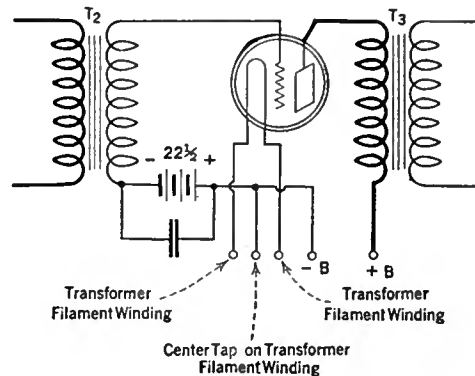


FIG. 10

A C battery may be employed with the power amplifier, if desired, instead of obtaining the grid bias from the power supply unit

sired, on the panel of the power supply unit. This is also a good place for the 110-volt switch.

OPERATION OF THE SET

AS THE operation and neutralization of receivers employing this circuit have been covered in a number of previous articles in RADIO BROADCAST, they will not be taken up again.

The adjustment of the power amplifier, however, will no doubt present some new problems to many of the readers. The filaments of both the power amplifier and the rectifier tubes must be operated at exactly the right voltage. This is particularly true of the uv-202 when used as an amplifier. If the filament voltage is too low, it will cause a great deal of distortion. On the other hand, if it is too high, the life of the tube will be materially shortened. The filament voltage of the 210 is not as critical as the 202. Ordinarily the only way to adjust the filament voltage properly is with an a. c. voltmeter, but the use of such an instrument will not be necessary with the transformers recommended in this article, as the voltage supplied is just right, providing sufficiently heavy wire, such as No. 16 or No. 18 flexible lamp cord or the equivalent solid wire is employed in connecting the tube socket to the filament winding on the transformer. Furthermore, the length of the filament line should preferably not exceed three feet. It is also highly important, especially with the uv-202, that the tube makes very good contact in the socket.

When a 6-volt tube is to be used, or if the Acme 75-watt c. w. transformer (which has a 10 instead of 7.5 volt filament winding) is used with either a 6- or 7½-volt tube, it is necessary to employ two rheostats, one in each filament lead; they must both be adjusted simultaneously in order that the resistance in each filament lead will be about the same. See Fig. 130.

When rheostats are employed to adjust the

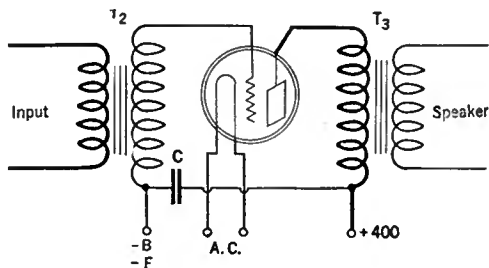


FIG. 11

The circuit diagram of the power amplifier using an output transformer

COST OF MATERIAL

Used in the Complete Receiver

	MAXIMUM PRICE
<i>The Receiver</i>	
Panel	
Base Board	
3 General Radio, Silver, Hammarlund, or other good condensers, max. cap. 500 mmfd.	\$15.00
3 Dials	8.00
1 Set Robert Coils	
1 A. F. Transformer T_1 (1 General Radio, No. 285, \$6; 1 Amertran No. AF 6, \$7).	
1 Neutralizing Condenser C_1	
3 Sockets	
2 Rheostats R_1 and R_2	
1 Volume Control R_3 (Clarostat, \$2.25; Bradleyohm No. 10, \$2.00; Royally (Electrad) No. B, \$1.50)	
1 Grid Condenser and Leak C_2	
4 1 mfd. By-pass Condensers C_3	5.00
<i>The Power Amplifier</i>	
Input Transformer T_2 (General Radio, No. 285-A, \$6; Amertran, No. A F 7, \$7).	
Output Device	
General Radio Transformer No. 367, T_3 (for W. E. Cone)	7.00
Output push-pull transformer (for high Impedance Speakers) or	
Impedance-Output (for either high or low Impedance Speakers), Thordarson Auto-former, I, \$5; Amer-choke No. 154, I, \$6; 1-4 mfd. condenser (or total of 4 mfd., \$5).	
Socket	
1 Mfd. By-pass Condenser C_4 (Tobe Deutschmann, \$1.25; Dubilier No. 678, \$1.75).	
<i>Power Supply Unit</i>	
Power Transformer T_4 (Amertran No. PF 45, \$12; General Radio No. 365 (for "S" tube), \$12; General Radio No. 273M (Additional filament winding for rectifier tube,) \$12).	
Chokes 1, (2 Amer-chokes No. 854 at \$6, \$12; 2 Molliformers at \$6, \$12; 2 apco chokes at \$6, \$12; 1 General Radio double choke No. 366, \$12).	
Filter Condensers (500 volt) C_5 , C_6 , (4 Dubilier No. 764, \$3.50, \$14; 4 Tobe Deutschmann No. 709 2 mfd., \$1.75, \$7; 4 W. E. 2 mfd., \$1.65, \$6.60).	
Socket	
Milliammeter (0.25 m.a.), (Jewel, Weston, \$8.)	
Jones Cable (or Belden)	1.00
Resistance Units (Bradley Units, 2 12,000 ohms; 1 10,000 ohms; 1 25,000 ohms, \$.75 each; Ward Leonard H S Units; Crescent, 2 12,000 ohms; 1 9,000 ohms; 1 24,000 ohms, \$2.50 each (All special) \$10).	
Grid Bias Resistance R_3 (Ward Leonard (fixed) (L S 1250), \$.85; Clarostat, \$2.25; Royally, \$1.50).	
<i>Tubes</i>	
UX 210	9.00
UV 202	3.50
KENOTRON	3.00
RECTRON 216B	7.50
<i>Speaker</i>	
Switches, Screws, Lamp Cord and Plug, Box or Base Board for Power Supply Unit.	
The completed receiver, including tubes but not speaker, will cost approximately \$100.	

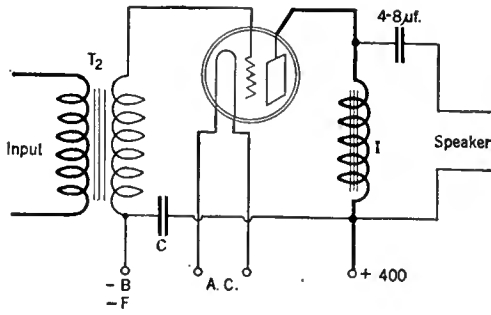


FIG. 12

The circuit diagram of the power amplifier using an impedance-capacity output device

filament voltage, it is strongly recommended that a good a. c. voltmeter be used as an aid to securing the proper adjustment. To dispense with the use of such an instrument is not economy. The life of a tube is very materially reduced when operated at higher than rated voltages.

Rheostats for this use must be capable of carrying about 2½ amperes. The resistance may be one or two ohms. Such rheostats are manufactured by Amsco, Acme, Fada, Pacent, and General Radio. If a variable resistance is employed for obtaining the grid bias, it should be adjusted so that the millimeter in the plate circuit of the power tube remains reasonably still when receiving signals of varying intensity.

The plate current drawn by the power tube should not exceed about 20 mils. Seventeen or eighteen is about correct for most 202's and about 20 for the 210's.

If an Acme c. w. transformer is employed, it

will be necessary to use an S tube as the rectifier; there being no rectifier filament winding provided on this transformer (the S tube has no filament). The No. 5000 S tube is best suited for this purpose, although the No. 4000 may be employed if desired. The No. 5000 only costs \$6.50, whereas the other costs \$10.00. S tubes are best obtained direct from the factory.

The voltage of one half of the split high voltage secondary on the Acme transformer is too low and the entire voltage is too high. Therefore, it is necessary to use the entire

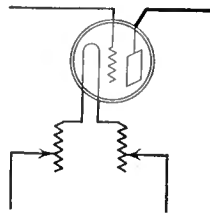


FIG. 13

The way in which rheostats must be connected when a 6-volt tube is to be operated from a higher voltage transformer winding

secondary and connect a resistance of from 5000 to 6000 ohms in series with the plus lead as shown in Fig. 14. The drop in voltage across this resistance results in the proper output voltage.

A POWER AMPLIFIER FOR YOUR RECEIVER

FIGURES 7, 11, 12, show the power amplifier, similar to the one used in the complete set, mounted on a small board by itself. The same power unit as is employed to operate the complete set (Figs. 1, 2, 3) is used to operate this amplifier as

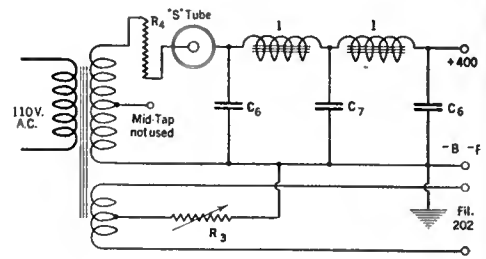


FIG. 14

Circuit diagram showing proper connections for employing a standard Acme c. w. transformer

well as supply the B voltages to the small outfit to which it is connected. Such a combination possesses most of the advantages of the complete set (for it is practically the same thing) and at the same time makes it unnecessary to discard the small set.

In most cases it will be necessary to connect a variable resistance such as a Bradleyohm No. 10, Royalty B, or Clorostat across the secondary of the reflex transformer. It is also necessary to keep the a. c. lines as far as possible from the reflex amplifier in order that a. c. "hum" will not be picked by induction, and, most important of all, ground the negative B.

Such a combination as shown in Fig. 6 results in a considerable "gain" in volume without the loss of any of the high quality for which the Roberts Knockout receiver is so well known.

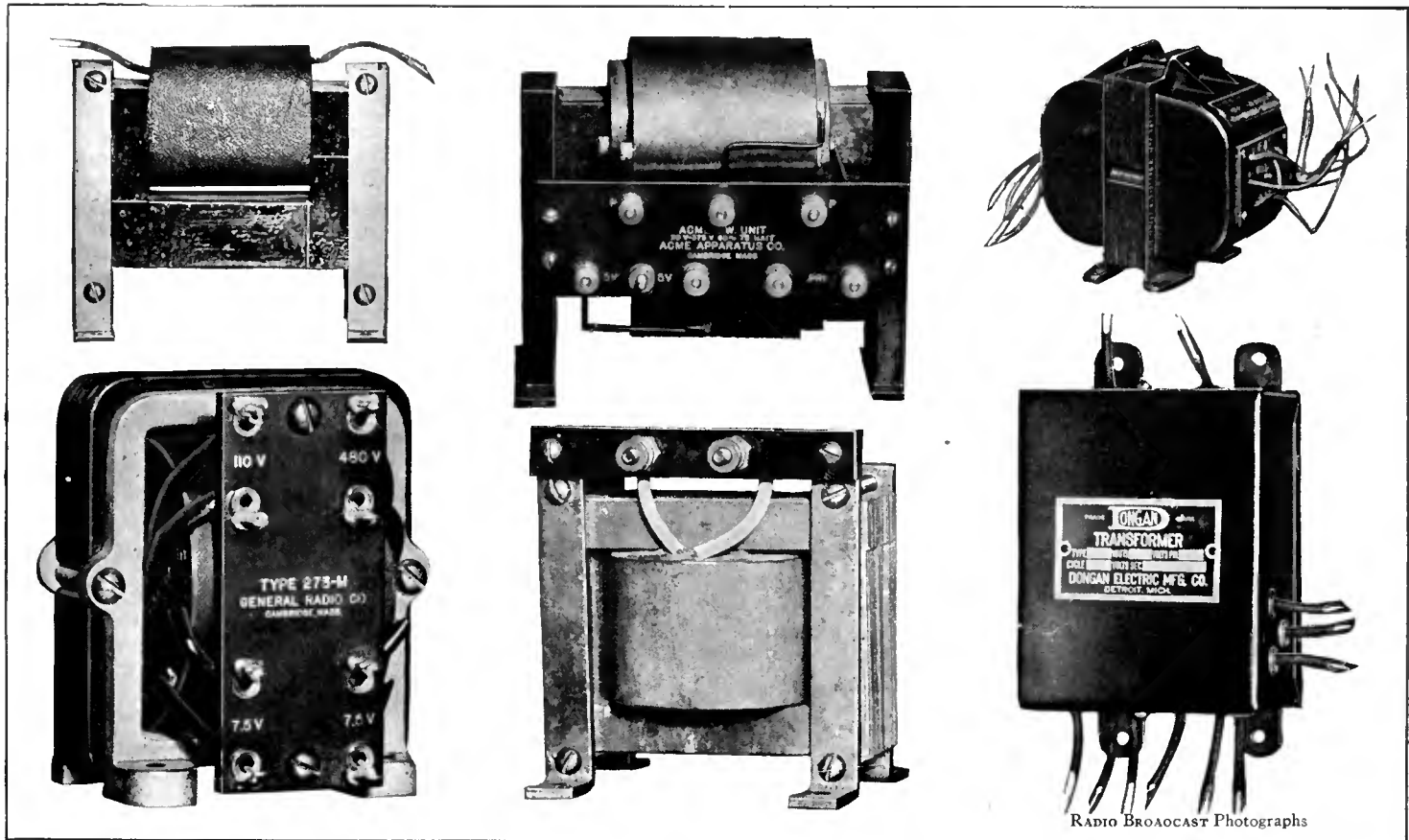


FIG. 15

There are a number of excellent transformers and chokes now obtainable in the radio market. Some which have been successfully used, but which are not shown in the other photographs, are grouped here

When the Doctor Came to the Farallones —By Radio

How Broadcasting Has Brought the Advantages of City Life to a Barren Pacific Island

By LEWIS N. WAITE

THE following episode, a little drama of modern science, has an interest which reaches far beyond the small group of persons it concerns, and it is for this reason that it is told.

The incident occurred some few months ago on the lonely Farallone Islands, which are situated off the mid-northern coast of California. A young child belonging to one of the half-a-dozen families then living on the island was taken seriously ill. There was no physician available on the Farallones, none nearer than San Francisco, twenty-five miles distant over the ocean. The condition of the child indicated that its illness was no ordinary one, and the services of a skilled physician were urgently required.

To carry the child to San Francisco or to summon a specialist to the Island seemed the only possible things to do, but both these plans involved hours of delay. Those at the bedside realized that such delay might prove costly or even fatal. It was at this point that science stepped in with an alternative plan.

On the Island, the Government maintains, together with other devices for the assistance of navigation, a radio signal station, and so once again it fell to the lot of wireless to serve humanity in an hour of distress. Within a few moments after it had been decided to make wireless serve as a physician, the operator on duty was in touch with San Francisco and the San Francisco radio office was telephoning to locate a specialist in children's diseases. Less than half an hour passed before the specialist and the father of the child were in direct communication, aided by the long arm of the radio telegraph. Then followed a long series of questions and answers, while the doctor, thirty miles away, familiarized himself with the case, made his diagnosis, and, finally, prescribed a course of treatment. It was an illness that required immediate attention along a particular line; a delay of a dozen hours might have proved fatal.

THE RADIO DOCTOR SAVES LIVES

THE instructions given over the radio were scrupulously followed in the sick room, and the next day reports from the Island were so encouraging that the doctor pronounced his radio patient out of danger. In a week, the child's recovery was complete.

This incident serves to illustrate in a

striking way how modern inventiveness is changing very materially the lives of those who live in remote and inaccessible places. New methods of communication are drawing scattered communities closer together, and, perhaps, gradually fusing the thought and interests of the country into a homogeneous whole.

More than in most communities, radio has influenced the lives of those on the Farallone Islands. Only here, and in other similarly isolated colonies, can the change be truly called revolutionary.



FARALLONE LIGHT

Whose beam at night is the first suggestion to sea travelers bound for San Francisco that they are approaching the western coast of the United States. Recently, radio brought aid to a child on the coast who was seriously ill. A physician in San Francisco was reached through the Naval radio station and gave a diagnosis and suggestion for treatment which cured the child. Broadcasting has brought the Islanders close to the entire western half of the country and has altered the monotony of their lonely existence

Where formerly the two or three dozen isolated citizens who live on the Islands derived their sole contact with the outer world from the infrequent visits of government supply boats, and their own still less frequent visits to the mainland, the broadcasting stations now have placed at their disposal a variety of entertainment that must make their lives, in comparison with their former existence, almost unbelievably pleasurable. All of the Pacific Coast and many of the inland broadcasting stations are within range of the Farallone receiving sets. Frequently now, of an evening, these people dance to the music of the jazziest of metropolitan orchestras, or listen to a lecture or a play. They hear news items that otherwise would not have reached them until after the arrival of the government tug, perhaps days later. The radio has at last beaten down the barrier of the Pacific and made these lowly inhabitants of the Farallones sharers in the bustle and activity of life on the mainland.

THE ISLAND STAGE WHERE RADIO PLAYS

THE Farallones are as bleak and rugged a group of islands as may be found anywhere in the world. There is nothing about their steep cliffs and rocky crags, and their inhospitable, reef-fringed shores, to attract settlers. The fact that they are inhabited at all is due to an accident of location. For the Islands lie due west of San Francisco Bay, twenty-five miles from the Golden Gate.

Standing thus directly in the path of steamers plying to and from the Orient, the Farallones were so serious a menace to navigation that the Government was forced many years ago to establish a lighthouse there. The lighthouse, one of the most powerful and important on the Pacific Coast, is perched on top of one of the rocky summits, 350 feet above the sea. To many hundreds of travelers from the Orient, this flashing light, visible for 26 miles, is the first welcoming signal from America, the first intimation of land after weeks at sea.

Other means of safe-guarding shipping, supplementing the lighthouse, were presently established on the Farallones. For use during foggy weather—frequent in this district during certain seasons—a powerful siren was installed, its intermittent blast, audible for miles, announcing that danger of running on the rocks was imminent for any ship that might be groping about in



THE FARALLONES

Are lonely barren islands, about twenty-five miles due west of San Francisco Bay. It is the fashion to speak of radio revolutionizing domestic life because of the new and varied entertainment it introduced into the home. That is rarely true, but in isolated spots such as these islands, broadcasting does bring many of the municipal advantages to the door step of isolated people

the vicinity. More recently, as the science of marine signalling has developed, other safety devices have been added, among them submarine bells. The radio compass signal station, installed for the purpose of assisting ships at sea in checking their positions, was one of the earliest additions to the Islands' safety equipment.

With the installation of these various devices, the population of the Islands, which at first consisted only of the lighthouse keepers, has steadily increased. To-day the government employees and their families alone make up a considerable community. They are adequately housed and cared for with materials brought from the mainland. Naturally, reserve stores of supplies are maintained on the Islands, and these supplies are carefully checked and frequently replenished.

The normal, matter-of-fact community life which the inhabitants lead is not notably different from that of little settlements elsewhere. But an example of the ingenuity employed in overcoming difficulties that ordinarily would be considered insurmountable is shown by the way in which the inhabitants of the Islands obtain their water supply. The Islands have no natural supply of fresh water. The task of shipping water from the mainland was impracticable, both because of the large quantity required and the difficulty of transporting it from the vessel to the Islands, which difficulty is due to the currents and reefs that make the landing of supplies a difficult feat.

The solution to the problem was

that the Islands, while they contain no sub-surface water, have a very heavy rainfall, which, it was decided, should be gathered and conserved. The top of the largest building of the Islands was made to serve as a shield in which the water was collected and then drained off into storage tanks. By an admirable combination of pleasure and utility, the inhabitants use the concrete roof of this building during dry weather for a tennis court.

NOW THE FINGER OF ATTENTION POINTS

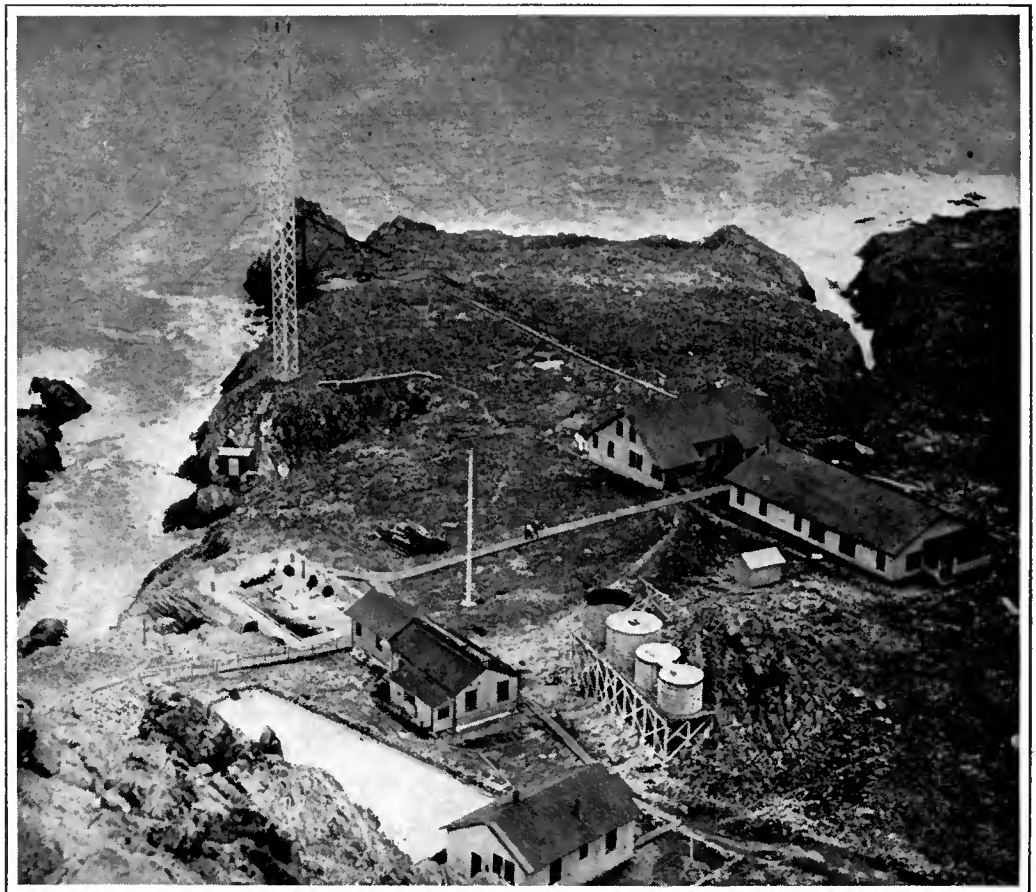
NORMALLY, the Farallones receive but little attention from the outside world. The inhabitants go about year after year performing their monotonous task of issuing warnings to shipping and keeping their signals in order, and they neither expect nor want attention from those who live on the mainland. But occasionally something happens that brings the Islands before the public.

Recently the Farallones figured prominently in the newspapers of the Pacific Coast, and in a very curious way. A Coast Guard cutter, cruising about in search of rum-runners, sighted such a vessel off the Farallones and, after a chase, succeeded in capturing it and bringing it into San Francisco Bay. The steamer and its cargo, valued at several hundred thousand

dollars, was held by the prohibition authorities and confiscation proceedings were begun.

At this point attorneys representing the owners of the vessel put forward a novel defense. They advanced the argument that the seizure was illegal because the vessel, at the time of its capture, was more than twelve miles from United States territory—the maximum distance at which arrest for violation of this law can take place. This statement the prosecution emphatically denied and proceeded to prove that the capture was made only a mile or two off the Farallones. The attorneys for the defendants then made the statement that the Farallones, never having been formally annexed to the United States, were not in reality a part of this country, and that the arrest was therefore an illegal one.

So surprising a charge naturally created widespread interest and led to a careful search in musty, long-forgotten records. Whether or not these lonely rocky islands will be proved to be ownerless has not yet been determined. But in the meantime the little group of lighthouse keepers and signal station operators go unconcerned about their tasks, conducting quietly the affairs of the community in which they live, and gathering about their radio sets in the evening to listen to the grand opera or the jazz orchestras of the outside world.

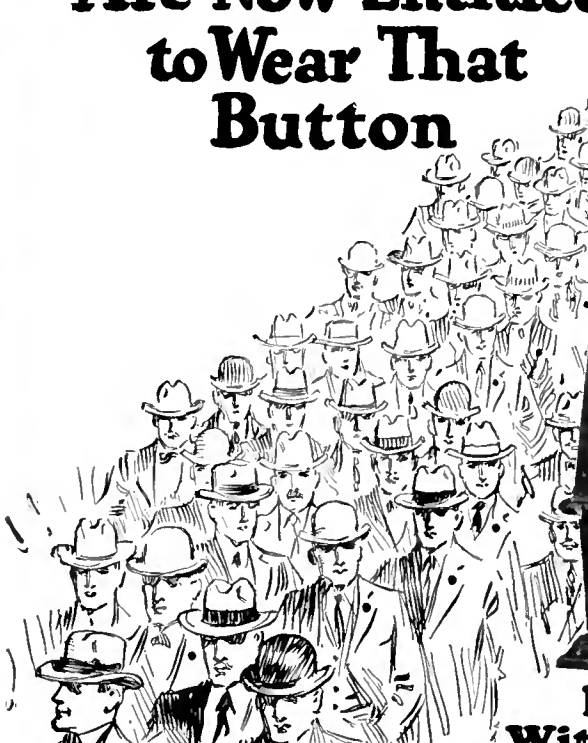


SOUTH ISLAND

In the Farallone group, off the California coast, showing the combination watershed and tennis court in the lower left. The radio tower is part of the Navy radio installation which forms the sole link to the mainland. The Farallones are about twenty-five miles off the coast, almost opposite San Francisco, and are barren and storm-swept. The population is very small

3176 Trained Factory Representatives

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OZARKA radio instruments are demonstrated, sold, installed and serviced by direct factory representatives only. These men have been thoroughly trained by our own engineers who designed and perfected the Ozarka.

It is not exaggerating to state that hundreds of thousands of homes are waiting for "Radio with Service."

The success of any radio instrument, like the automobile, depends on the quality of service rendered.

In other words they are waiting for the Ozarka trained man. Already we have 3176 such representatives, and the field is barely scratched. Ozarka training is very thorough, intensely interesting, and quickly absorbed through study in spare time, by any man who is mechanically inclined.

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In territory not now covered, the right man is wanted. The investment in money is small, but investment in time and study is considerable. If you are willing to put forth the necessary effort to obtain a splendid, profitable business of your own, write and say "Send me your Ozarka Plan Book No. 100." It may be the turning point in your life. Don't fail to mention the name of your county. Use the coupon!



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“NOW, I HAVE FOUND . . .”

A Department Where Readers Can Exchange Ideas and Suggestions of Value to the Radio Constructor and Operator

IN THE August RADIO BROADCAST it was announced that a prize of twenty-five dollars would be given to the reader who submitted the best idea for the “Now, I Have Found . . .” department, during each three months' period. The best suggestion published during the last quarter is that of Mr. Welsford A. West, whose two ideas were published in the September number, on page 660. This award will be continued and announcement made every three months. All used manuscripts will be paid for at the usual rates, that is, from two to ten dollars each. Those submitted should be no longer than about three hundred words, and should be typewritten. Address your letters to this department, RADIO BROADCAST, Garden City, New York

MEASURING HIGH RESISTANCE

WHEN the experimenter constructs a resistance-coupled audio amplifier and doesn't get proper results, he often wonders if the resistances used are in good condition and of correct values. Such resistances may be measured with a good-grade voltmeter of known resistance having about a zero to eight scale or less. If you don't know your meter's resistance, write to the maker. The use of good B batteries of about 90 volts is essential as using partly run down batteries will affect the results obtained.

Make connections as shown in the sketch, Fig. 1, the resistance under test being shown at X. Note voltmeter reading.

In a test made with some .1 megohm resistances, the B voltage was 90, meter resistance 496 ohms, reading .42 volts.

Substituting, $X = 90 \times 496 \div .42 = 106285$ ohms = .106 megohms.

Precaution: Test only high resistances such as used for the above purpose.

Testing low resistances will damage the meter.

The above formula is not absolutely correct according to theory, but error may be disregarded for practical purposes such as this test is suggested for.

CLAUDE SCHUDER, Sumner, Illinois.

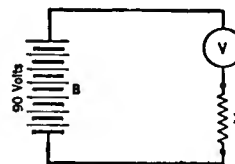


FIG. 1

DESCRIPTION OF A NEW NP COIL FOR THE ROBERTS RECEIVER

THERE have been written reams and reams of information on the wonders and drawbacks of the now justly famous Roberts circuit. However, one very important point has been overlooked.

The big question usually asked was, “Why is my set dead on certain frequencies (wavelengths)?” This question being a serious one, every possible reason for this undesired condition was considered and an organized search for the cause of the trouble instituted. Transformers spaced too close to coils, coupling effects, high resistance condensers, open-circuited or defective coils, and a thousand and one other things suggested themselves at the time. After spending considerable time on this problem, a Roberts set which extended for over three feet on an old super-heterodyne panel, resulted from the experiments. The reason for this lengthy arrangement was to keep all instruments as far away as possible from

each other, and to avoid any detrimental feedback or absorption which might take place in a more congested layout. But the outfit still showed the same symptoms, and the only place left to look for trouble was in the design of the coils. Here was found the secret of the difficulty.

All descriptions of the NP coil have advised that this winding should be done in a rather peculiar fashion. That is, two parallel wires are wound at the same time over the same form, and are connected top to bottom in such a way that they form a continuous wire with a tap in the center. The reason for this peculiar type of winding is that it makes neutralization much easier. Be that as it may, it certainly does make everything else much more difficult.

Probably the reader of this article knows something about distributed capacity and perhaps he is a little uncertain as to what it is all about and why it is one of the things to be avoided in a radio receiver.

The electrical energy which flows through the coils of your radio set is much the same as water in a pipe, and the insulation of the wire in your coils forms the piping which holds in the current. The tendency of the electrical energy is to leak through the insulation. This tendency is altogether governed by the distributed capacity or leakage area and the amount of pressure. The leakage action generally takes place from one turn to the next and, as only a small amount of voltage builds up in one turn, the effective loss is very small. However, the regular Roberts NP coil is wound so that the potential difference between adjacent turns varies from zero to forty volts, which may be seen in B, Fig. 2. We can very easily calculate the mean voltage between windings or across the condensers. It is 20 volts. Therefore we have approximately twenty times the loss which we have in a coil of proper design.

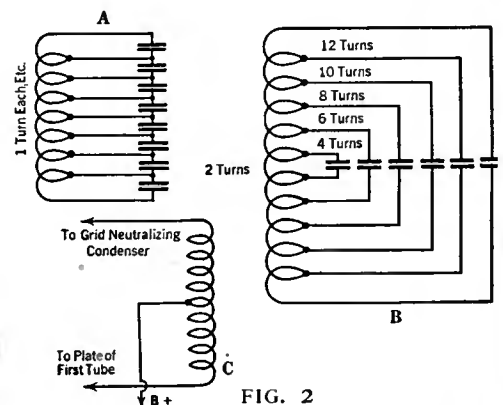
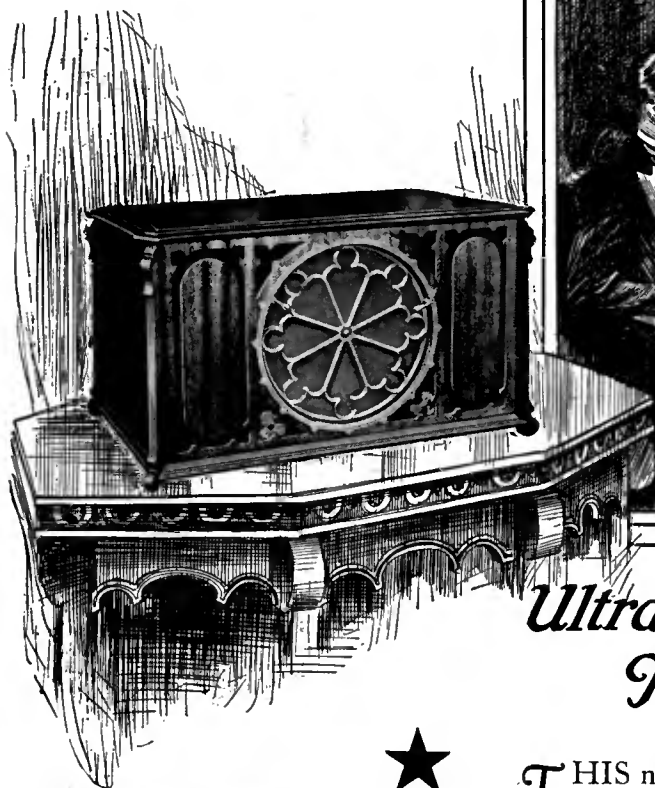


FIG. 2

A New Conception of Radio

*A
New Kind of Receiver
No Dials - No Panel
Built-in Loudspeaker*



*Ultra Simplicity ~
Tastefully Unobtrusive*

★
\$135

THIS new kind of radio-musical instrument marks the mastery of technicalities to the point where the whole range of radio's resources are literally at your instant command.

The Ultradyne, Model L-3, supplants the usual "laboratory machine." It is a new artistic table-piece that makes the entrance of radio into the well-appointed home *unobtrusive, inconspicuous*. It represents the triumph of art over mere mechanics.

The Ultradyne Model L-3 fulfills everything that the critically-minded have demanded of radio. Why wait any longer, why deny yourself the infinite treasures of radio? The ideal has at last been attained!

The Ultradyne Receiver is worthy of the place of honor in luxurious homes.

Skepticism will vanish if you will let your local dealer demonstrate this new modern radio receiver.

Illustrated folder on request.

PHENIX RADIO CORPORATION, 116-C EAST 25TH ST., NEW YORK

The Ultradyne, Model L-3 is a six-tube receiver employing the fundamental principles of the best circuits, greatly refined and marvelously simplified. No dials—no panel: Just two inconspicuous levers which constitute a station-selector. Duco finished, two-toned mahogany cabinet.

Designed by R. E. Lacault, E. E., Chief Engineer of this Company, and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on the assembly lock bolts of all genuine ULTRADYNE Model L-3 Receivers. All Receivers are guaranteed so long as these seals remain unbroken.



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The APEX Super Five without accessories..	\$95
The APEX De Luxe without accessories...	135
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There are also other factors which tend to make this type of winding unsuitable for use in a radio receiver, such as the high natural period of the coil and its inability to respond to different frequencies (wavelengths). However, we will not go into a discussion of these matters as they are largely dependent upon the master offender—distributed capacity.

Several different experiments were tried with this coil, and by removing turns enough to reduce the natural period to about two thousand kilocycles (150 meters), very satisfactory reception was had over the entire frequency band. However, the efficiency dropped very slightly at the lower frequencies (longer wavelengths), but this was expected as there were now too few turns for efficient transformation on the lower frequencies.

After trying several different styles of NP coils, the design which seemed most efficient for all around use consisted of an ordinary diamond weave coil containing forty turns of wire tapped at the 20th turn and connected in the following manner: inside lead to plate, center tap to B battery positive and outside lead to the neutralizing condenser. See C, Fig. 2.

A great many of these coils have been installed in Roberts receivers which had not been giving the best of results. This new style of NP coil has in every case shown far superior results to the old-style coils.

RALPH D. TYGERT,
Springfield, Massachusetts.

A GOOD NEUTRALIZING CONDENSER FOR THE ROBERTS CIRCUIT

AFTER experimenting with several types of neutralizing condensers on the market, from plate condensers to sliding condensers, it was found that the average type was either too large or too small, either in size and capacity, or that they were not efficient in operation. In making adjustments they were not protected against body capacity.

The condenser used in my laboratory for this purpose can be constructed in a few minutes from material to be found in any home laboratory. As Fig. 3 shows, the condenser is made by taking a piece of one quarter-inch copper tubing, one and one-half inches long, a piece of cambric

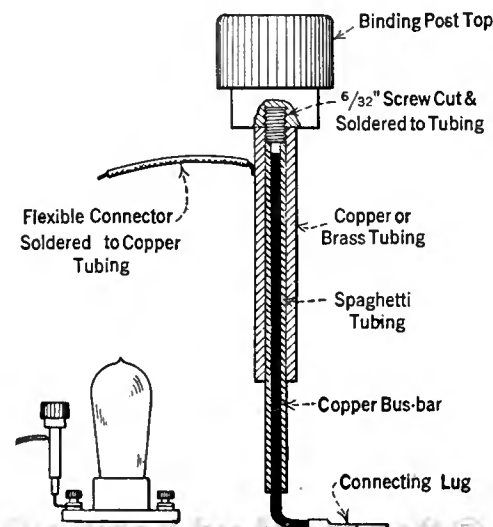


FIG. 3

spaghetti, two and one-half inches long, which is passed up into the copper tube at one end, and a three sixteenths-inch threaded binding post screw with the head cut off, to be soldered at the upper end of the copper tube. A bakelite binding post thumb grip is to be placed on this screw, which acts as a handle for making adjustment. A piece of insulated copper wire (flexible preferred) is soldered to the upper surface of the copper tube, which is to be connected to the N lead of the NP coil. The condenser is now nearly completed and the last step is to cut a piece of No. 14 copper bus bar wire long enough to pass into the cambric tubing two and one fourth inches, leaving enough to attach to a lug which is placed on the binding post of the tube socket marked G. The neutralizing condenser is now completed and when mounted on the tube socket as indicated in the drawing, should stand parallel to it. Neutralize in the usual way by simply sliding the tube back and forth on the bus bar.

H. A. FRANCHERE,
Lake Crystal, Minnesota.

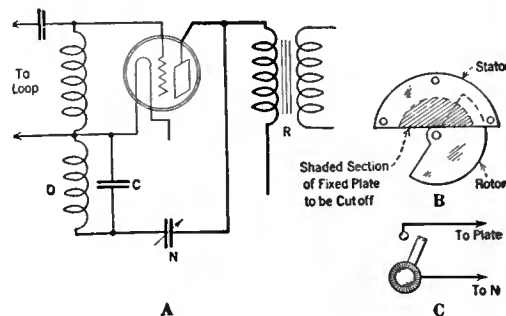


FIG. 4

SHORT WAVES ON THE HANSCOM SUPER-HETERODYNE

SOME builders of this set have noticed that the volume on the high-frequency (short-wave) stations is not as great as from stations operating on lower frequencies (longer waves.) Theoretically, the super-heterodyne should give uniform amplification throughout the entire range of frequencies, but the Hanscom circuit makes use of regeneration in the first tube, thus making possible the great volume which the set possesses for loop reception. The diagram A, Fig. 4, shows the circuits of the first tube. The condenser N is usually of the midget variable type. It will be noticed that as its capacity is decreased the signal strength increases rapidly until the first tube breaks into oscillation. The radio frequency output of the first tube goes through the iron core radio-frequency transformer R. The action of the condenser N, is to prevent a tuned plate feed back by by-passing radio frequency through itself and the fixed condenser C. At the same time as N is increased, there occurs a feedback through the coil D which acts as a tickler at intermediate frequency.

On the short waves it will be noticed that there is no tendency for the first tube to oscillate and this is caused by the residual capacity of the condenser N even though set at zero. To prove this, it is only necessary to disconnect the wire from the plate of the tube to N and a great increase in signal strength will be noted.

With N set at zero, the first tube will oscillate as we go up the scale, usually at about 750 kilocycles (400 meters) but with

The New WAVE MASTER - a Radio Set Worthy to Bear the KELLOGG Name



The Wave Master Console Model

A handsome genuine mahogany design with battery compartments and inbuilt horn. Price, **\$275.00**

Without battery table, price - - **\$225.00**

Also made in the beautiful Console model, genuine mahogany, price, **\$235.00**



"I never dreamed it was such fun"

"I used to be content to enjoy radio merely as a listener, never realizing how much greater pleasure I was missing. I had no idea of the fascinations of radio tuning—the fun of going after any station and getting it."

WHEN you make a telephone call, the operator connects you first with the "exchange" and then with the desired number of that group or division.

To "connect" the WAVE MASTER instantly with any desired broadcasting station, you first set the pointer for the "Exchange" or wave zone group to which the station belongs and then merely turn the Station Selector dial. "Expert" tuning becomes child's play. To separate stations very close together in their wavelengths, is astonishingly easy.

When buying any radio set, protect yourself by learning something about the firm that produced it—their reliability and experience. For 28 years Kellogg has produced the finest of telephone apparatus. Since radio began Kellogg has built the highest quality parts.

If you do not know where you can see, try and hear the WAVE MASTER in your neighborhood, write us. We'll give you the name of your nearest dealer, and, if you wish it, a full technical explanation of the Wave Master Circuit. Ask for Folder No. 5-K.

Radio Dealers and Jobbers

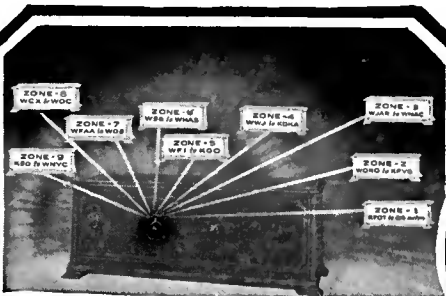
The WAVE MASTER franchise backed by Kellogg resources and our powerful advertising campaign, is most valuable. Open territories are being rapidly taken up. If interested, wire or call on us promptly for our money-making proposition.



A Year Ahead! The WAVE MASTER, 5-Tube Standard Model

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A Separate Circuit for Each 40 Meter Wavelength Band
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The illustration pictures the take-off of the winning flight and in 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 somewhere 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.

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the above mentioned wire disconnected, the first tube will oscillate at about 1000 kilocycles (300 meters). Unfortunately there is no small variable condenser available with a minimum capacity sufficiently low to function on the shorter waves with maximum efficiency. To those who are experimentally inclined, we suggest the cutting of the fixed plates of a three-plate vernier as indicated in B, the point being

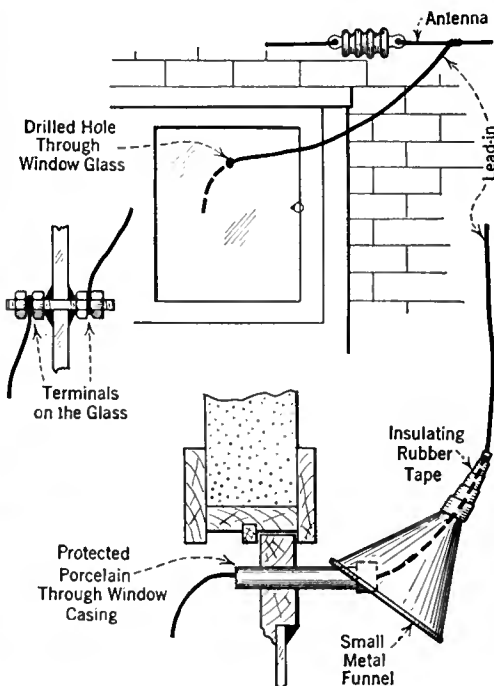


FIG. 5

to make a condenser with a wide separation between the edges of the fixed and rotating-plates at zero setting. It is also possible to connect a single point switch so that the condenser N may be cut out of the circuit as indicated in C. Needless to say, the leads to the condenser N from the set should be as short and direct as possible, particularly the lead from the plate of the tube.

A. T. HANSCOM,
Woonsocket, Rhode Island.

A LEAD-IN PROBLEM

A RADIO friend of the writer, erected an antenna some hundred and twenty-five feet in length, about forty feet above ground, brought the lead wire down past the drain spout, and under the lower sash of the window directly in contact with the stone sill.

Results; a strangled band and gagged call letters, with other muffled sounds, were received with the aid of five tubes in a high-priced receiver.

It took one radio expert about ten minutes to fix up the antenna and about three hours explaining to this friend why his antenna failed, even though at this time the latter is hardly convinced of having made any grave error in running the wire as he did.

The manner of leading in an antenna wire, which was used to correct this aforementioned mistake, is illustrated in the attached sketch, Fig. 5, and is about the cleverest and most practical of any which the writer has observed. A single small hole is drilled through the center of the window glass. The antenna lead passes through this hole obtaining insulation of the

most desirable type, and at the same time providing a support for the wire. The same idea can be further improved by the use of a small threaded rod having screw terminal nuts at each end to attach or detach the lead wire. In drilling through the glass, it is advisable to use a small hard drill with turpentine as a drill lubricant, turning the drill quite fast and giving only enough pressure to cause the drill to cut.

In another illustration shown in the same sketch, a method of leading the antenna through the window casing is shown. The antenna wire leads through a porcelain tube, placed through a bored hole in the wood. Surrounding the lead through the porcelain, is a small metal funnel, secured with tape as shown in the sketch. The funnel not only prevents the water following through the tube, but it also keeps the lead dry below this point, preventing a leak which would be found detrimental to reception.

G. A. LUERS,
Washington, District of Columbia.

AN EFFICIENT COIL COVERING THE BROADCASTING FREQUENCIES

I HAVE found that with the 35-turn coil which is illustrated in Fig. 6 and shunted by a good .0005 mfd. variable condenser, frequencies from 1500 kilocycles (200 meters) to 545 kilocycles (550 meters) may be covered, and I know of no other winding in which 35 turns will cover this range.

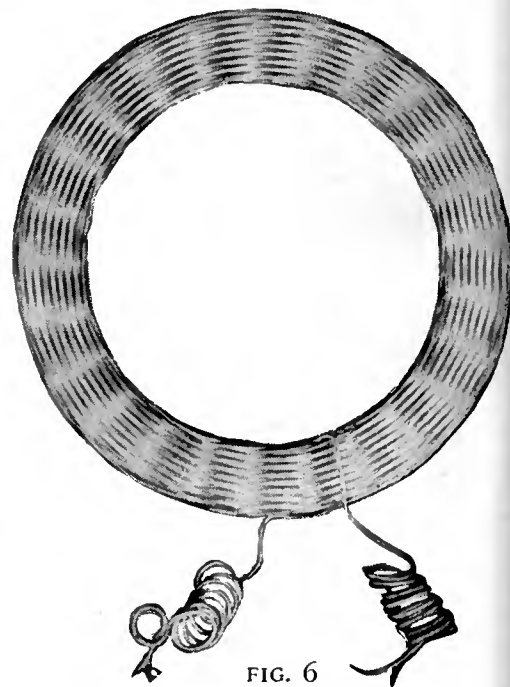


FIG. 6

This coil is wound on a form 3 inches in diameter, with 25 pegs equally spaced, and is wound over two and under two, and sewed as shown in the photograph, Fig. 6.

W. H. MAYFIELD, Miami, Arizona.

About Contributions

THIS department particularly welcomes short manuscripts relating to all matters pertaining to workshop practice, such as the handling of tools, and general hints of a constructional nature. These, as in the one of other contributions for the "Now I Have Found . . ." section, should not be longer than about 300 words and should be typewritten.

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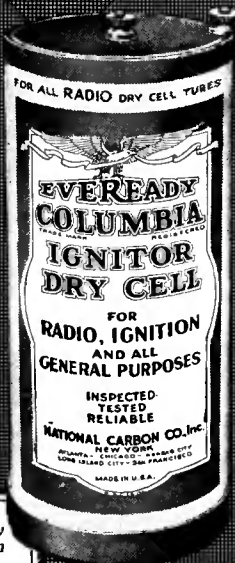
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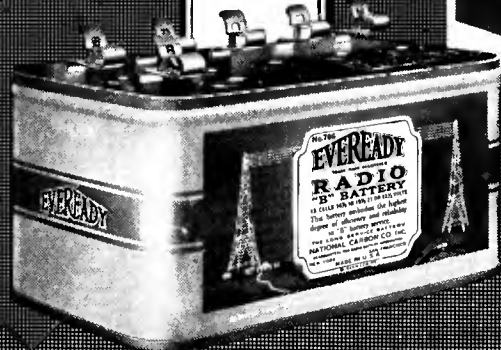
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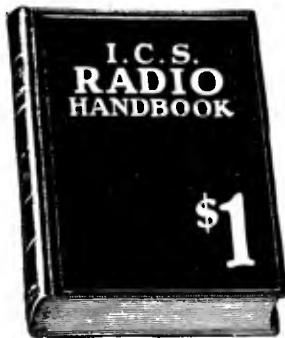
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1. WILL YOU GIVE ME A CLEAR, NON-TECHNICAL EXPLANATION OF STATIC AND FADING?—A. R. S.—Yonkers, New York.
2. ON THE LONGER BROADCAST WAVELENGTHS MY RECEIVER PRODUCES POOR VOLUME. WHAT IS THE CAUSE?—A. C. P.—Grove City, Pennsylvania.

3. WILL YOU DESCRIBE THE CONSTRUCTION OF BOX AND SPIRAL LOOP ANTENNAS?—R. M. C.—Oak Park, Illinois.
4. HOW MAY THE NEW TOROID COILS BE SUBSTITUTED FOR THOSE NOW CONTAINED IN NEUTRODYNES AND OTHER TUNED RADIO-FREQUENCY RECEIVERS?—T. J. Mc G.—Hartford, Connecticut.

EXPLAINING STATIC AND FADING

MANY times have the questions been asked, what is static; what causes it; what is fading?

At the present time much attention is being given to the subject of static and in answer to the specific question of our correspondent, nothing could be more timely in answer than the paper prepared by Dr. A. F. Van Dyck, on this very interesting topic. Dr. Van Dyck is a former General Electric engineer and at present is connected with the Radio Corporation of America. His recent researches on the static problem admirably qualify him to speak on the subject:

"First, let us consider what radio transmission is. We know that a radio sending station sends out from its antenna, in all directions, a disturbance of electric forces. We cannot see or hear or otherwise observe with our senses just how this disturbance behaves, as we can with light waves and sound waves. We consider it quite natural that a stone wall stops the light beam from a searchlight, or that a bugle call can be heard much farther over water than through a forest, or that under certain air conditions on a desert the mirage phenomenon is observed. So to know what to expect in radio, we need only to remember that some things in space will stop, or reflect, or perhaps absorb the traveling radio waves, just as some other things in space stop or absorb or reflect light waves or sound waves.

"Substances which are obstructions to light or sound waves are not necessarily such to radio waves. For example, we know that radio waves pass through the walls of a house with only slight loss. But there is some substance in the space around the earth which does have effect upon radio waves. This substance is not uniformly distributed through space but is present here and there, is continually changing location and magnitude, and consequently has very erratic effects on the passage of radio waves. The condition is quite similar to the use of a searchlight in a fog which might be varying rapidly in density or location, or both. This radio fog is commonly supposed to be made of ionized air, that is, air which by some influence has become a partial conductor of electricity. Of course it never stands still and is changing from moment to moment under the influence of the complicated conditions of our atmosphere, and so the radio wave passing through space has an adventurous journey because it meets electrically charged clouds, patches of ionized air, and perhaps other obstacles of which we know nothing.

"It is a fact, often observed, that it is possible to work radio communication over much greater distances at night than in the daytime. This

may be explained by the effect of the sun upon the air, which causes ionization of it, and is most active in the daytime, and practically absent at night. The sun seems to be responsible, without question, in view of the fact that very erratic results in long distance reception are always noticed at sunrise and sunset.

"With the preceding statements in mind it should be clear that when one is receiving over long distances—several hundreds of miles—it is natural for the waves to come through strong at one moment, and to fade away considerably the next moment, as some obstacle to radio waves comes between the transmitter and receiver. This explains, too, why one transmitting station, of two or more which are being heard, may get weaker, while the others do not. These effects are much more frequent in the summer than in the winter season, presumably because of the greater influence of the sun on earth and its atmosphere during that season.

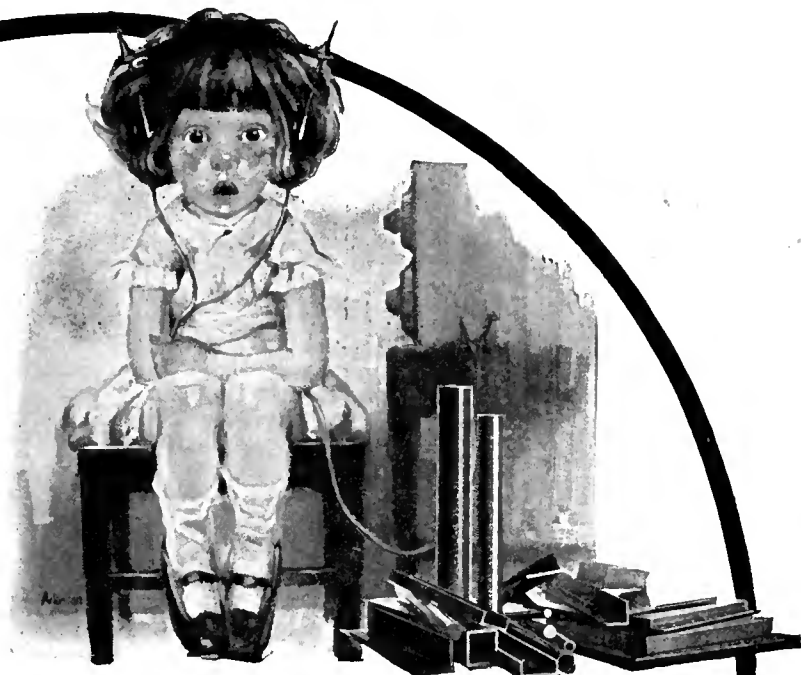
"These ionized clouds sometimes reflect the waves, much as a mirror does a light wave, and very peculiar reception effects are sometimes noticed. Sometimes the signals are made stronger instead of weaker, sometimes they may be lost altogether, as the several effects of reflection and absorption combine.

"And now, let us consider that arch enemy of radio—static. When Marconi first began to receive messages over distances of a few miles he noted, besides the signals he was listening for, noises which had nothing to do with the signals.

"These noises have been called strays, or atmospherics, or static, and their elimination is the most important problem in radio communication to-day. The intensity of this disturbance is different at different parts of the earth's surface, being progressively worse from the temperate to the tropical zones. The intensity of static varies greatly with the seasons of the year. For example, in the northern part of the United States, it is practically absent during the winter months, increases during the spring, and is most severe during the summer. There are at least two or three kinds of static, but the most troublesome kind is the one which is due to traveling electric waves, in nature just like radio waves, and caused by electrical disturbances somewhere in space. A lightning flash produces a traveling electric-wave, much like a radio wave, and if we can assume that lightning flashes, large and small, are occurring continuously somewhere we have a reasonable explanation of static. Of course, these discharges do not always manifest themselves by a display of lightning, the majority in fact being small discharges inside of or between clouds. Also it is probable that the continuous

(Continued on page 84)

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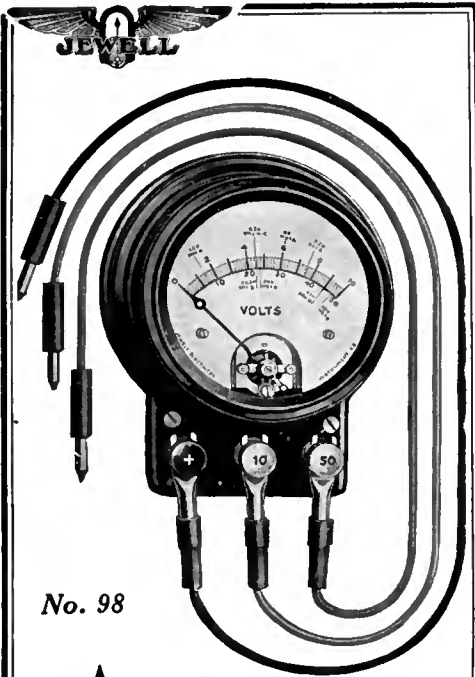
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atmospheric changes above the surface of the earth, such as the formation of water vapor clouds, are accompanied by electrical disturbances which travel to the earth.

"We know that static is worse in the summer when variations in the atmosphere are greater and more frequent. Also it is often observed in the winter time that the formation of snow causes static. Without knowing definitely the origin of this disturbance, it seems safe to assume that the actions which take place in our atmosphere, due to the air, the sun, sun spots, water vapor, etc., are responsible for the creation of these irregular, irresponsible, and very troublesome waves which we call static. Since they are so much like the radio waves in nature, no way has yet been found of eliminating them completely. Progress has been made in the last few years, however, and the transoceanic stations are much more free of this interference than formerly. The problem of complete elimination of static is the most difficult one in radio, and if solved, we shall have a new epoch in radio because it will then be possible greatly to reduce the power of transmitting stations and the reliability of communication increased."

RECEIVER COIL RESISTANCE

MANY owners of radio receivers observe that their sets will respond quite satisfactorily on the lower end of the scale of the condenser dial, but above a certain setting the volume produced will decrease considerably and the selectivity is not as sharp as is desirable.

Granting that a thorough inspection of a receiver has disclosed no error in circuit wiring or defect in coils, tubes, etc., it is fair to assume that this condition is due to the use of coil units which, while otherwise O. K., have an exceedingly high resistance at the higher end of the condenser scale.

Resistance in a coil may be attributed to 1. insulation within the field of the coil, such as tubing, panels, and other nearby objects; 2. the use of "dope" which is used as a binder to hold the coil together; 3. the use of fine wire (ordinarily circuits should employ coils wound with wire not smaller than No. 28 wire or larger than No. 18 d. c. c.)

Resistance here should not be confused with the ordinary use of the term where it is employed to indicate the direct resistance of a piece of wire. Rather, it is a value which changes with each change in frequency to which the circuit may be tuned. This is brought out quite clearly in the table of measurements which follows. These measurements were obtained by a regular laboratory procedure.

FREQUENCY	RESISTANCE	
	COIL NO. 1	COIL NO. 2
1500 KC. (200M)	75.5 ohms	95.5
1200 KC. (250M)	38.5 "	108.5
1000 KC. (300M)	24.5 "	300.0
750 KC. (400M)	16.5 "	72.0
600 KC. (500M)	35.5 "	18.5
500 KC. (600M)	10.5 "	12.5

From the above it will be observed that in coil No. 2 the resistance gradually rose from 95.5 ohms at 1500 kc. (200 meters) to 300 ohms at 1000 kc. (300 meters) and then gradually decreased to 12.5 ohms at 500 kc. (600 meters). In all receiving circuits it is essential that the resistance of the tuner circuits be kept as low as possible. Where this is not the case, poor selectivity, with a loss in volume, is sure to result.

Obviously the solution to this problem lies in the use of coils having a minimum of resistance which depends upon the several points as here-

tofore discussed. Broadcast listeners do not usually have the means to make these measurements, however, and it is necessary for them to judge entirely by ear and eye in the matter of volume and selectivity. But for those who do have means for making these measurements, the following table of measurements of a coil which has proven satisfactory is given for comparison.

FREQUENCY	RESISTANCE
1500 KC. (200M)	20.5 ohms
1200 KC. (250M)	12.5 "
1000 KC. (300M)	12.5 "
750 KC. (400M)	10.5 "
600 KC. (500M)	8.5 "
500 KC. (600M)	7.5 "

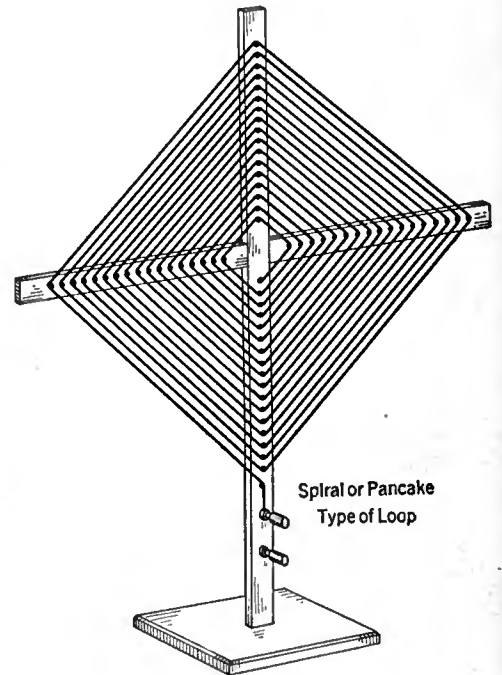


FIG. 1

LOOP CONSTRUCTION

IN THE main, two types of loops are used for reception. The spiral type, more commonly known as the pancake type, is the easier of the two to build. It has marked directional effects and may be used successfully in a direction-finding station. See Fig. 1.

To construct this type of loop two pieces of one inch square wood are required, one thirty inches long, the other twenty-four inches long. The shorter of the two is the horizontal piece while the other is the vertical piece, to which may be fastened an appropriate base. By means of a half lap joint, the two sticks are fastened together to form a cross.

The two pieces are so crossed that three of the arms will measure 12 inches from the point of intersection, while the fourth, which is fixed to the base, measures 18 inches.

Five inches out from the centre, on each of the four arms, is placed a No. 4 round head brass wood screw 1/2 inch long. Fifteen more screws of the same size are located on each of the four arms, each screw being placed 3/8 of an inch apart.

The winding of the wire is begun on the inside screws and outward, the two ends of the wire being made fast to binding posts located at the lower end of the vertical arm. Stranded wire having double silk or cotton covered insulation will be found best.

In Fig. 2 is shown the box type of loop which consists of a specially constructed frame upon which is wound the wire in a horizontal plane. Its constructional details are apparent from a reference to the illustration. The depth of the

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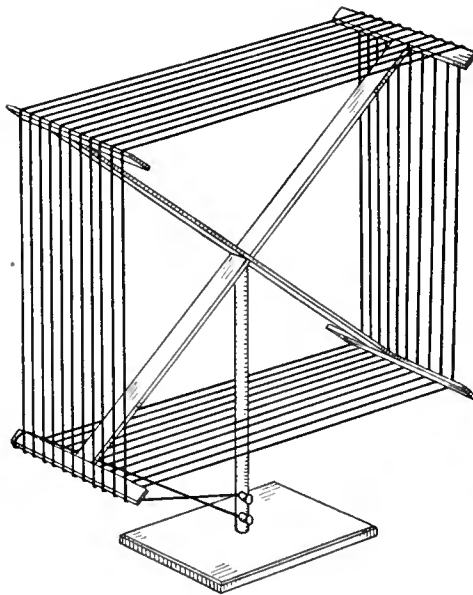


FIG. 2

box is 9½ inches and the diagonal pieces are 36 inches long. Sixteen turns of loop wire are wound on the frame, the turns being separated ½ inch.

SUBSTITUTING TOROID COILS IN NEUTRODYNES

LATELY the toroid type of coil, under many different trade names, has come to the front as a promising substitute for the coil unit in receivers where inherent neutralization was not possible. This new type of coil possesses the property of confining its electro-magnetic field within itself. With other coils the field usually shapes itself outward and around the coil, thus interlinking with the

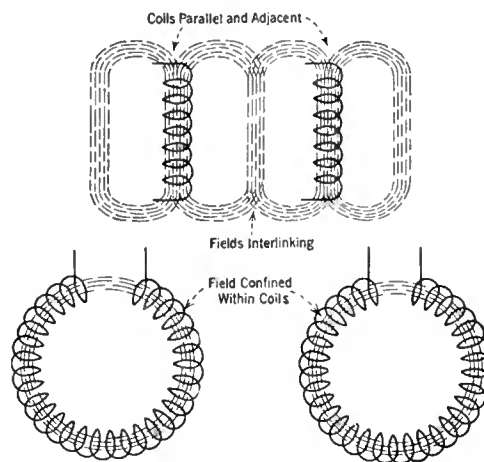


FIG. 3

fields of nearby coil units and causing uncontrolled oscillation due to energy feedback. See Fig. 3.

To replace the older type of cylindrical coil with a toroid in a neutrodyne, for instance, is not a difficult matter. The toroids have four binding posts as terminals for their windings. These are P, B, G, and F, not unlike those markings for audio-frequency transformers.

When the toroid coil is used as an antenna coupler, the terminals P, B constitute the antenna-primary coil to which are connected the

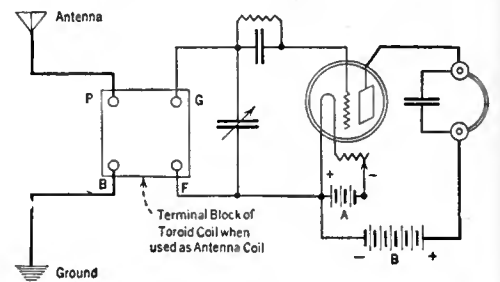
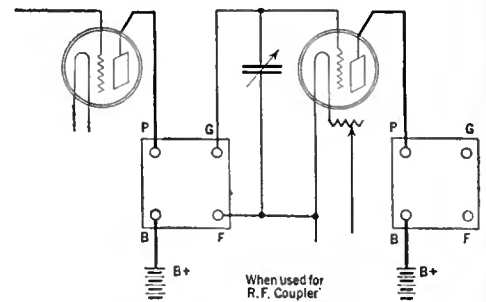
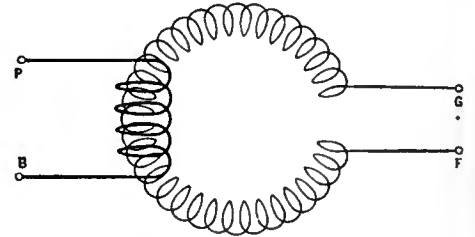


FIG. 4

antenna and ground leads. When used as an inter-stage coupler, in a radio-frequency circuit, the terminals P, B constitute the plate (primary) winding, terminal P connecting to the plate of the preceding tube and terminal B connecting to the positive B battery lead.

In both instances the secondary terminals G and F connect to the grid and filament leads of the next tube. The several points brought out in this discussion are evident in Fig. 4. The above is true only of coils having two distinct windings, primary to secondary, and does not hold when a tap is taken off the coil for antenna use.

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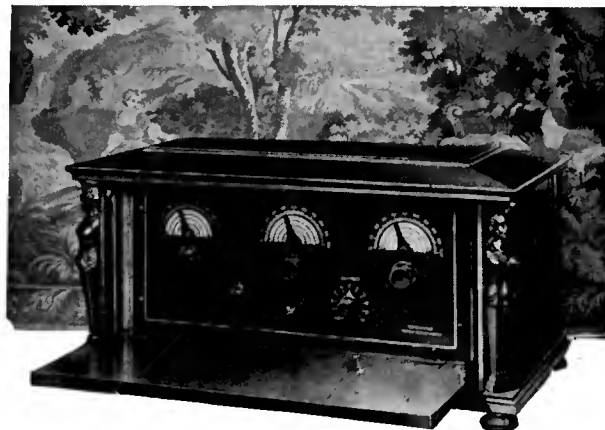
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THE BEST IN CURRENT RADIO PERIODICALS

The First Installment of a Useful Classified Survey of Material Appearing in the Radio Press

By E. D. SHALKHAUSER

How This Survey Can Help You

HOW often have you looked for information contained in some article which you recall having read months ago—the description of the Browning-Drake receiver, or the measurement of losses in inductance coils, for example? After looking through probably several issues of a dozen different publications you either give up or become interested in something altogether different.

When data is wanted on some particular subject, a systematic file of subjects and titles becomes a real radio encyclopedia. Instead of having merely the title of an article given, which often is misleading, a summary of the contents gives all the information. These surveys cover the radio field as gleaned from material in to-day's periodicals. They will always serve as a future reference-guide to all who are interested in the science of radio, whether engineer, manufacturer, dealer, experimenter, or listener.

To be of practical value and easily accessible, these surveys should either be filed in a scrap book, or pasted on individual cards and filed according to numbers, or alphabetically. In the matter of classification of articles, the Bureau of Standards circular No. 138 has been followed. This may be obtained from the Government Printing Office, Washington, District of Columbia, for ten cents. In addition, each abstract has certain key-words placed at the upper right, which may be used for the purpose of filing articles alphabetically.

With this series of surveys we hope to aid our readers and help them through many difficulties which they no doubt have often experienced. In future we will give information and references to articles previously surveyed upon receipt of a stamped and self-addressed envelope.

Following is a brief outline of the Dewey Decimal System used in the Bureau of Standards circular No. 138:

R000 RADIO COMMUNICATION IN GENERAL.

Under this heading will appear all subject matter pertaining to laws, regulations, history, publications, etc., which deal with radio in a general way.

R100 PRINCIPLES UNDERLYING RADIO COMMUNICATION.

Here will be given the phenomena of radio waves, their underlying theory of propagation, the principle of antenna and counterpoise, design and characteristics of vacuum tubes and their behavior in circuits, types of circuits, transmitting and receiving apparatus and their principles of operation.

R200 RADIO MEASUREMENTS AND STANDARDIZATION METHODS.

The various known methods which have been used in measuring frequency, wavelength, resonance, capacity, inductance, resistance current, voltage, dielectric constants, and properties of materials, will be mentioned here.

R300 RADIO APPARATUS AND EQUIPMENT.

A description of various types of antennas and their properties, the use of the electron tube in various types of receiving and transmitting sets, other methods of transmission of signals, various detecting devices used in reception, instruments and parts of circuits, come under this heading.

R400 RADIO COMMUNICATION SYSTEMS.

The spark, modulated wave and continuous wave systems in transmission, beat and other methods of reception, wired wireless, automatic printing, the buzzerphone and Fullerphone, will be given here.

R500 APPLICATIONS OF RADIO.

To aviation, navigation, commerce, military, private and broadcasting, and the specific information under their headings, are referred to here.

R600 RADIO STATIONS.

The operation, equipment, and management of radio installations, both transmitting and receiving, the testing, the rules and regulations concerning stations, the reports and bulletins issued, will follow under this heading.

R700 RADIO MANUFACTURING.

Data relative to costs and contracts of radio equipment from raw material to finished product, including factories, tools, equipment, management, sales and advertising, follows here.

R800 NON-RADIO SUBJECTS.

The matter of patents in general; the mathematics and physics, including chemistry, geology and geography; meters of various kinds; all information not strictly pertaining to radio, but correlated to this subject, will be found under this heading.

R900 MISCELLANEOUS MATERIAL.

A Key to Recent Radio Articles

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, Radio-frequency.
RADIO BROADCAST, Sept. 1925, pp. 581-585.
"An All-Wave Tuned Radio Frequency Receiver."
Zeh Bouck.

To make broadcast reception possible from foreign as well as domestic stations, a receiver should be able to cover a band of from 200 to 2600 meters. Ordinary tapped inductances entail too great losses when used for wide wavelength ranges. By using the well-known honeycomb coils, the desired range can be obtained. The list of parts required, the circuit diagram and construction data is very completely given. A list of foreign broadcasting stations is appended.

R430. INTERFERENCE ELIMINATION. INTERFERENCE.
RADIO BROADCAST, Sept. 1925, pp. 586-590.
"When Broadcast Stations Interfere." C. B. Jolliffe.

The cause of so-called heterodyning of broadcast stations is explained by diagram and found to exist when broadcast stations deviate somewhat from their assigned frequencies. Some interference with programs broadcast from other stations is due to beat note produced when frequencies come too close together. The author describes how stations must constantly be checked by station operators and radio supervisors in the various government districts in order to maintain their assigned frequency.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, Super-phiodyne.
RADIO BROADCAST, Sept. 1925, pp. 620-622.
"A Single-Control Receiver," C. L. Farrand.

A receiver, known as the super-phiodyne, is described, giving more detailed information on the operation and adjusting of the circuit, also described in July RADIO BROADCAST, pp. 387-392. Although a single control receiver, it gives just as great selectivity as a good super-heterodyne because the individual circuits are matched. The exact operation of this set, using a two-stage radio-frequency amplifier, is described technically, the circuit diagrams giving the necessary detail.

R375. DETECTORS AND RECTIFIERS. RECTIFIERS, Tungar tube.
RADIO BROADCAST, Sept. 1925, pp. 640-650.
"How to Make a Universal Battery Charger," Roland F. Beers.

The author reviews briefly the theory of a. c. rectification by various methods, and proceeds to describe the construction and operation of a tungar charger which can be used for a frequency range of from 25 to 70 cycles. Considerable detail in the assembly of this charger, parts required, and final instructions for operation, leave no opportunity for guesswork. Only 150 watts are consumed by this 2-ampere charger.

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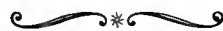
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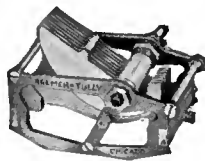
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R344. ELECTRON TUBE GENERATORS. OSCILLATOR, Modulated

RADIO BROADCAST. Sept. 1925, pp. 604-609.
"What is to Become of the Home Constructor?" Keith Henney.

The radio field for the "home constructor" goes beyond mere set building if he is at all interested in the science of radio. In this article, RADIO BROADCAST makes the first attempt to bridge the gap between the larger scientific laboratories and the home workshop by guiding the constructor in the building and testing of apparatus for experimental purposes. The first instrument described is a modulated oscillator comprising a high frequency and a low frequency oscillator in one. Its construction is simple and can be used as an audio oscillator, radio oscillator, and modulated oscillator, for a variety of purposes.

R385.5 MICROPHONES. MICROPHONE.

RADIO BROADCAST. Sept. 1925, pp. 612-615.
"Microphone Placing in Studios," Carl Dreher.

The microphone in a broadcasting studio is very sensitive to air vibrations and its proper operation and placing is quite important. How it is connected and set for receiving sound waves properly for transmission is explained and illustrated. Depending upon the type of musical instrument used, the microphone must be placed so as to receive a proportionate amount of sound energy. Blasting or reflection from walls causes distortion in the received wave.

R582. TRANSMISSION OF PHOTOGRAPHS. PHOTOGRAPH TRANSMISSION.

Popular Radio. Aug. 1925, pp. 107-113.
"Motion Pictures by Ether Waves," Charles Allen Herndon.

The transmission of shadow pictures has been accomplished by C. Francis Jenkins. With his teloramophone, using four photo-electric cells and a rotating disc of lenses, he has been able to build up pictures at the rate of 15 per second and throw them on an illuminated screen, thus giving the effect of true moving pictures. The bulb used in bringing the pictures out clearly on the screen has a well of gas instead of the common filament. This light will go on and off instantaneously with the current. Photographs of the inventor and his machine in detail illustrate the system used.

R360. ELECTRON TUBE RECEIVING SETS. RECEIVER, Grebe Synchronphase.

Popular Radio. Aug. 1925, pp. 116-127.
"No. 7. The Grebe Synchronphase," S. Gordon Taylor.

In this 7th of a series of articles, explaining the theory, operation, equipment and care of manufactured receivers, the Grebe synchronphase is discussed. This is a tuned radio frequency receiver of five tubes. The wiring diagram is shown complete, while the exterior and interior views of the set illustrate the placing of the various parts, including the "binocular" coils. The battery connections for the complete equipment, and the proper method of tuning, are described in detail. The receiver can be easily charted because the straight-line frequency condensers give equal spacing on the dials between stations.

R376.3. LOUD SPEAKING REPRODUCERS. LOUD-SPEAKERS

Popular Radio. Aug. 1925, pp. 128-129.
"A New Type of Hornless Loudspeaker," W. T. Meenam.

A brief description of the operating principles of a new loud speaker, having several new features. A small paper cone is used as a horn, the field winding of the coil moving the voice-current coil is obtained from a d. c. source. A diagram of the working principles is given.

R532. APPLICATION OF RADIO TO THE PRESS. PRESS.

RADIO BROADCAST. Sept. 1925, pp. 575-580.
"Is the Radio Newspaper Next?" James C. Young.

The effects of radio on newspaper work is felt not only in the matter of disseminating news, but also is becoming really a part of the press. In broadcasting happenings as soon as they occur, following a regular schedule, newspapers will likely change somewhat from their present practice of flashing news in glaring headlines and settle down to a practice similar to that of magazines. Some of the larger papers have installed their own stations both for transmission and reception of news, and the radio newspaper will before long become another of the many innovations of our present-day life.

R480. RELAY SYSTEMS. PORTABLE STATIONS.

Popular Radio. Aug. 1925, pp. 130-135.
"A Mobile Radio Relay Station," David Lay.

The 63-meter mobile radio relay station of the A. H. Grebe Company, WGMU, is shown and described in detail. Fig. 5 represents the circuit diagram of the transmitter, Fig. 7 the microphone control. Photographs of the receiver and transmitter give an idea how relay stations pick up programs at remote points and relay them to the main station for rebroadcasting. This outfit is mounted in an automobile. It uses four 50-watt tubes as oscillators with a motor generator of 1500 volts furnishing the plate energy.

R381. CONDENSERS. CONDENSERS.

Proceedings I. R. F. Aug. 1925, pp. 507-509.
"The Straight-line Frequency Variable Condenser,"

H. C. Forbes.
The equation for the shape of the rotary plates in a rotary variable condenser is developed so that the frequency-angular setting characteristic is a straight line. The equation for the capacity of this condenser at any angular setting is also given.

R383.1. GRID LEAKS. GRID LEAKS.

Popular Radio. Aug. 1925, pp. 154-158.
"Important Trifles in Radio: The Grid Leak," R. F.

Yates.
Though very insignificant physically, the grid leak is a very vital part in a receiver. Although of specific resistance when new its value changes considerably with age. The best kind of a grid leak would be a two-element vacuum tube with battery and rheostat connected as in Fig. 3. Several standard types of variable leaks are good when properly used.

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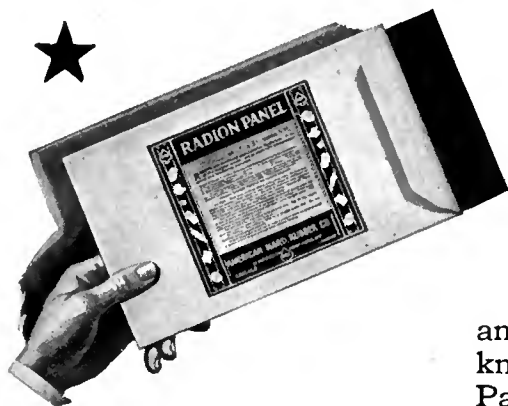
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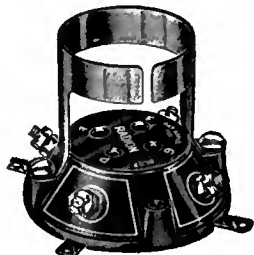
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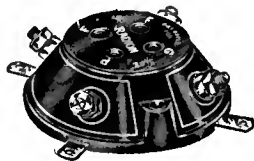
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R343. ELECTRON TUBE RECEIVING SETS. RECEIVER. *Radio*. Aug. 1925, pp. 35ff. 5-100 meters.
"A 5 to 100 Meter Radio Receiver," D. B. McGown.
For high frequency telegraph reception the simple regenerative feedback circuit gives very good results. The construction and operation of such a receiver is delicate and must be done properly. A series of coils are necessary to cover the band of frequencies. The construction data include number of turns, diameter and approximate wave length covered by coils, and method of mounting.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER. *QST*. Aug. 1925, pp. 11-14. 15-200 meters.
"Plug-in-Coil Receivers," John M. Clayton.
A short wave receiver covering the present amateur bands within 15-200 meters must have rapidly interchangeable coils to be of any value in good operation. Space wound plug-in coils of various sizes serve the purpose well. The views of circuit diagrams and receiver show the arrangement of parts, and data for constructing the coils is given. General Radio coils of the plug-in type can be used also. The two receivers described make use of either the manufactured coils or the home made ones. Both receivers are one-tube sets; amplifiers can be added.

R369. ELECTRON TUBE RECEIVING SETS. RECEIVER. *QST*. Aug. 1925, pp. 16-19. *DeForest D-17*.
"The DeForest D-17 Receiver," E. A. Livingstone.
This receiver is a five-tube reflex set covering a band from 220 to 550 meters. The circuit diagram is shown complete, also internal views of the finished receiver. The data covering the set is very complete, even giving size of condensers, transformer ratios and gauge of wire used in them, and their characteristics, including those of the remaining parts of the instrument. Real information for the owner of one of these receivers.

R342.15. AMPLIFIER TRANSFORMER. TRANSFORMERS. *QST*. Aug. 1925, pp. 24-25. *Voltage ratio*.
"Measurement of Voltage Ratio of Audio and R. F. Transformers," R. R. Ramsey.
The article presents a mathematical discussion of audio and radio frequency transformer-ratios and how to measure them. The application of the method outlined is applied to the neutrodyne circuit in the case of radio-frequency transformers.

R355. HIGH-VOLTAGE GENERATORS. GENERATORS. *QST*. Aug. 1925, pp. 26-27.
"The Bowdoin's Generators," E. W. Berry.
A new type of generator built by the Electrical Specialty Company has been designed for use on the ship *Bowdoin*. This machine gives almost a perfect sine wave, excellent commutation and has a greater capacity to size than former types, due to material changes made in field construction and winding. It is also remarkably free from ripple effects.

R386. FILTERS. FILTER CIRCUIT. *QST*. Aug. 1925, pp. 33-34.
"Smoothing Circuits for Half-Wave Rectification," F. S. Dellenbaugh, jr.
In smoothing out rectified a. c. voltage for plate supply, both capacity and inductance must be used in order to obtain steady output. What effect mere inductance or capacity will have, and how the combination is used to best advantage, is simply explained in this discussion and illustrated with diagrams.

R240. RESISTANCE; DECREMENT; PHASE DIFFERENCE; POWER LOSS. LOSSES IN APPARATUS. *QST*. Aug. 1925, pp. 37-38.
"Loss Comparisons," W. L. Seibert.
In the discussion, the author describes a convenient method of comparing losses in variable air condensers and other parts of radio frequency receiving circuits. By this scheme, using a standard one-tube receiving circuit, other instruments may be compared, so that the best apparatus can be selected for radio purposes. It is a very simple method and can be applied in any experimenter's work-shop.

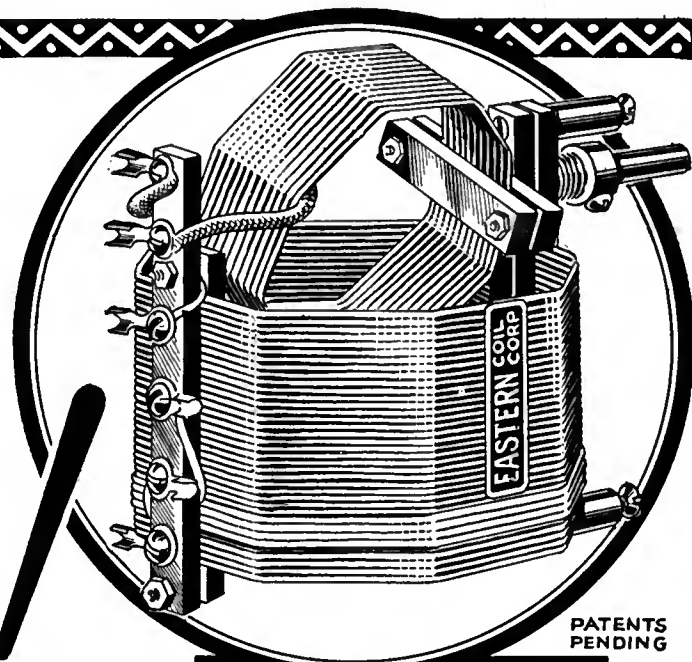
R800 (535.3). PHOTO-ELECTRIC PHENOMENA. SELENIUM CELLS. *Radio Engineering*. July, 1925, pp. 346-349.
"Selenium and Photo-Electric Cells," Samuel Wein.
Selenium was discovered about 100 years ago. It is found in various minerals as listed in this discussion. How it is extracted, the amount annually produced, the methods used in purification, and its chemical and physical characteristics are given in detail. Just as it was discovered by accident, so also the fact that its light sensitivity is very great was determined accidentally. A non-conductor of electricity when not subjected to light, its conductivity is materially great when light waves strike it, the difference being from 15 to 20 per cent. A list of references to other authors on the subject is appended.

R800 (535.3). PHOTO-ELECTRIC PHENOMENA. SELENIUM CELLS. *Radio Engineering*. July, 1925, pp. 390-392.
"Selenium and Photo-Electric Cells," Samuel Wein.
In this second chapter on Selenium Cells, Mr. Wein discusses the essentials of their construction, and the various forms of cells used to-day. The methods employed in fixing the selenium to the conducting wires is simple yet delicate. The seven diagrams show the various types of cells which have been made and used in experimental laboratories. A list of references to other articles on the subject is appended.

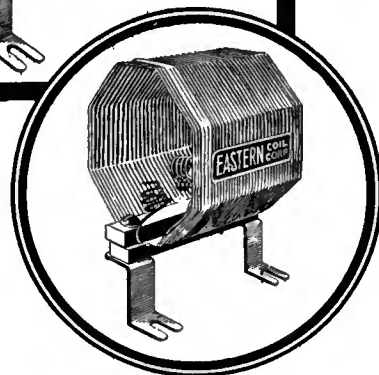
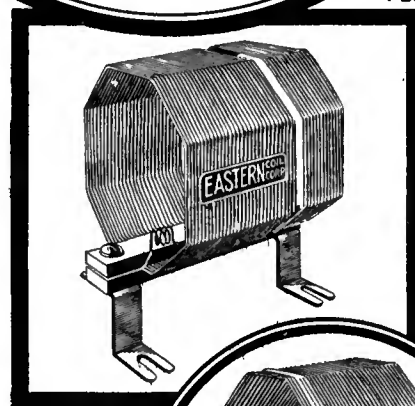
R333. ELECTRON TUBES; THREE ELECTRODE. TUBES, *Radio*. Aug. 1925, pp. 17ff. *AC. receiving*.
"Principles of Alternating Current Tubes," E. E. Turner.
A tube for receiving sets operating on alternating current for both filament and plate supply, has been designed and is destined to relieve the listener of the troublesome wet cell batteries. The tube has been developed by the General Electric Company and its operating features are illustrated in the article. The A. C. hum has been practically eliminated by the use of filter-systems in the plate circuit. The electron emission is obtained through indirect heating of an oxide coated cylinder. This tube is by no means perfected, but represents a step in the right direction.

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R800 (537.65) PIEZO-ELECTRIC PHENOMENA. CRYSTALS, Piezo-electric.

Radio News, Aug. 1925, pp. 142ff.

"The Piezo-Electric Oscillograph," C. B. Bazzoni.

When current passes through a circuit certain effects are observed, known primarily as thermo-electric, Seebeck, Peltier, Thompson, Nerst, Hall, Leduc, and others which are of interest. These effects are explained briefly. Electric currents may also be produced with the aid of crystals. Two effects, the pyro-electric and piezo-electric, are of special interest in the study of crystals, and are described. Because of the piezo-electric effect, oscillographs may be constructed with very little cost, which, when suitably mounted, record frequencies up to 5000 cycles. The Rochelle salt crystals can easily be made with the aid of the information given. Other uses for the oscillograph suggest themselves after the apparatus has been constructed and used.

R381. CONDENSERS.

CONDENSERS.

Radio News, Aug. 1925, pp. 188ff.

"Straight-Line Frequency Condensers," Sylvan Harris.

A detailed discussion covering straight-line wavelength, capacity, and frequency condensers and how they are mathematically designed and constructed. The curves show the comparison of the three types of condensers, dial-setting vs. kilocycles. Since broadcasting stations are separated according to kilocycles, this frequency should form the basis for condenser construction. All stations would then be equally separated on the dial. The article is very complete, in illustrations as well as information.

R420. CONTINUOUS WAVE SYSTEMS.

TRANSMITTERS

100-200 m.

Proceedings I. R. E. Aug. 1925, pp. 413-436

"Recent Commercial Development in Short Wave-Transmitters and Receivers," by S. E. Anderson, L. M. Clement, and G. C. DeCoutouly.

This paper describes the transmitter and receiver recently developed for use by the United States Coast Guard. This apparatus is for operation on wavelengths between 100 and 200 meters. A short summary of the various circuit considerations is included. The actual transmitter finally developed is also described together with its operating characteristics. In considering the radio receiver, the various problems to be met in the design of a radio receiver of this character are dealt with at some length. The frequency characteristics of the radio receiver, as developed, are shown, and the method of determining them is described in detail. The transmitter and receiver performed very satisfactorily under conditions considerably more severe than will be met in actual service.

R376.3. LOUD-SPEAKING REPRODUCERS.

LOUD-SPEAKERS.

Proceedings I. R. E. Aug. 1925, pp. 437-460.

"Design of Telephone Receivers for Loud-Speaking Purposes," C. R. Hanna.

A discussion of the advantages and disadvantages of various present day electro-magnetic receivers is given in a mathematical outline. A new type, called the balanced diaphragm receiver, is described and the details of design worked out. The experimental work includes resistance and reactance curves and a verification of the theory covering the design.

R387.1. SHIELDS.

SHIELDING.

Proceedings I. R. E. Aug. 1925, pp. 477-505.

"The Shielding of Electric and Magnetic Fields,"

J. H. Murecroft, A. Turner.

An experimental investigation of the shielding of electric and magnetic fields is reported, for both constant and changing fields.

The effect of using iron shells, or sheets, for shielding against the fields of permanent magnets, as well as those set up by electric currents, is considered; the best form for the iron sheets is deduced and an expression for a measure of the shielding action suggested.

The reason for the leakage of magnetic and electric fields is shown to be due to differences of magnetic or electric potentials in the circuit in which the fluxes are being set up; several cases are cited in which no external fields are set up, as the circuits exhibit no differences in potential.

An expression for the shielding effect of a short-circuited coil is deduced and experimental verification is offered for frequencies between 10^2 and 10^6 cycles per second.

Finally the shielding effect of metal sheets against changing magnetic fields is analyzed, and experimental results are given to show how the action depends upon the characteristics of the material of which the shielding plate is made, its thickness, and upon the frequency used. The effect of slits in the metal sheet, and the value of wire mesh, is indicated.

R235. MUTUAL INDUCTANCE.

MUTUAL

INDUCTANCE.

Proceedings I. R. E. Aug. 1925, pp. 511-512.

"Calculation of the Mutual Inductance of Co-axial Cylindrical Coils of Small Radial Depth," F. B. Vogdes.

This article shows how the mutual inductance of co-axial cylindrical coils of small radial depth may readily be obtained by the use of curves of a type recently described by the United States Bureau of Standards. These curves cover the mutual inductance between coaxial circles, and by a very simple process of summation their usefulness can be extended to coils of small radial depth.

R343. ELECTRON TUBE RECEIVERS. SUPER-HETERODYNE, Radio. Aug. 1925, pp. 11ff.

"The Modified Best Super-heterodyne," G. M. Best.

The Best Super-heterodyne has been redesigned by the author to cover wavelengths from 40 to 580 meters. In this first article a shielded model using dry cell tubes is described. Three controls are needed. The oscillator coil can be removed and exchanged for one covering a different band of frequencies. A complete description of construction and operation is given, including diagrams and panel layouts.

R142. COUPLED CIRCUITS.

COUPLING.

Radio, Aug. 1925, pp. 30 ff.

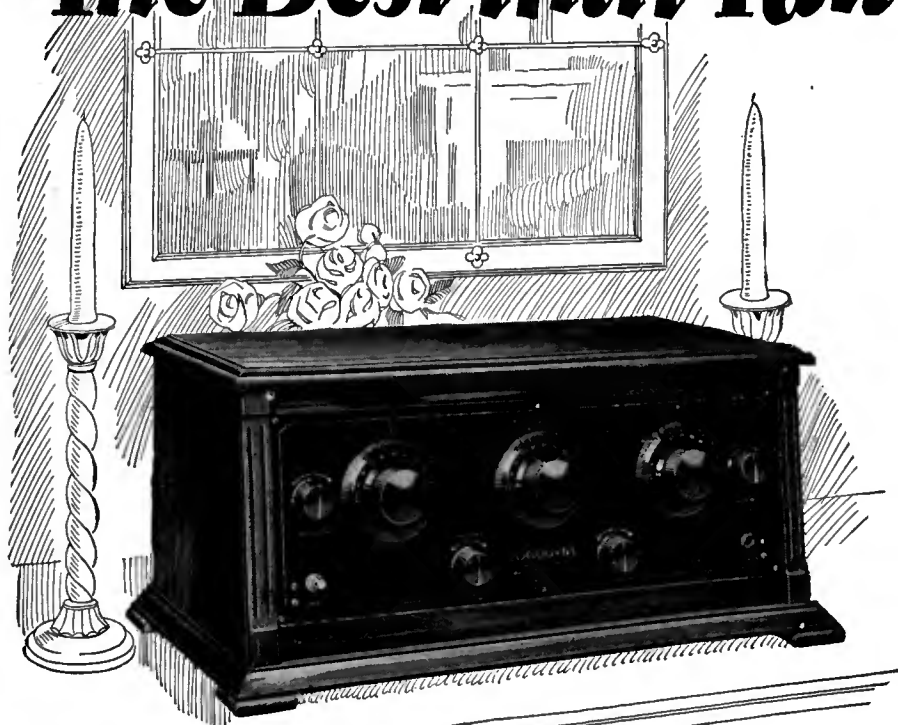
"Coupling," L. R. Felder.

How energy is transferred from one circuit to another is discussed by the author in an elementary way. Resistance, inductance and capacity coupling are taken up in turn and explained with the aid of diagrams.

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The Emblem of  Worth in Radio

The Best that Radio Offers



LOG·O·DYNE \$90⁰⁰
"BIG FIVE"

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.

If the LOGODYNE Big Five excelled only in performance it would not be a KODEL RADIO.

But combining as it does the ultimate in good performance, a tone as mellow and true as a rare old music instrument, a cabinet artistry worthy of the old masters the LOGODYNE Big Five expresses the perfection required of the entire KODEL RADIO line—the best that radio offers.

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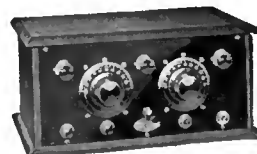
LOGODYNE "Big Five" Console Model—the Aristocrat of Radio; built-in loud speaker; compartment for batteries and charger a masterpiece in furniture design. \$275



LOGODYNE "Standard Five" Console Model—beautiful brown mahogany; built-in loud speaker; compartment for A and B batteries and charger..... \$165



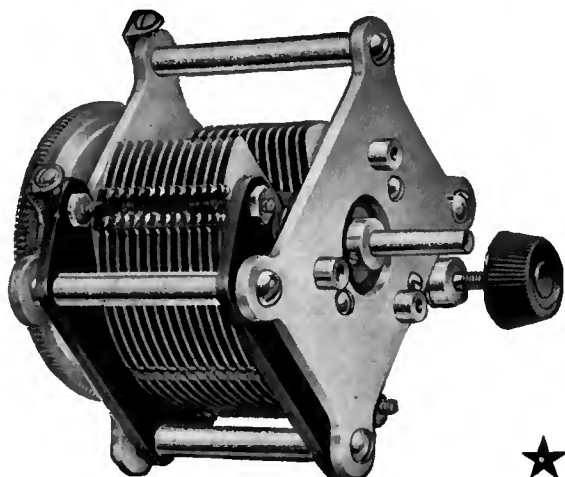
LOGODYNE "Standard Five" —five tubes self-balanced tuned radio frequency; gold engraved panel and sub-panel; battery compartment; handsome brown mahogany cabinet..... \$70



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
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Announcing



the New Type 334

GENERAL RADIO

Straightline Wavelength Condenser

In certain instances of radio construction the shielding effect of a metal end plate condenser is particularly desirable.

To meet the popular demand for this type of condenser the new type 334 has been developed and is now available at popular prices in all standard capacities both with and without vernier.

In designing these condensers points that have been stressed particularly are ruggedness, permanence of calibration, and uniformity between individual condensers of the same capacity.

These are the factors so essential to the successful operation of modern radio sets.

Rotor and Stator units are similar to those used in the well known type 247 condensers and good interplate conductivity is assured through solder-sealed contacts.

All General Radio condensers are rigidly inspected before leaving the factory and are thoroughly guaranteed electrically and mechanically.

With Vernier			With Counterweight		
Type	Capacity	Price	Type	Capacity	Price
334-H	.0005 MF.	\$5.25	334-F	.0005 MF.	\$4.25
334-P	.00035 MF.	5.00	334-N	.00035 MF.	4.00
334-M	.00025 MF.	4.75	334-K	.00025 MF.	3.75

Ask to see them at your local dealer's
or write for our new Catalog 922-B.

GENERAL RADIO Co.

Cambridge, Mass.

R402. SHORT WAVE SYSTEMS. SHORT WAVE STATIONS.
Radio. Aug. 1925, pp. 10ff.
"Short Wave Work at Naval Research Laboratory,"
S. R. Winters.

Tests on 20 meters have shown that great distances can be spanned with comparatively low power transmitters. This fact has been established at the Naval Research Laboratory under the supervision of Dr. A. H. Taylor. With the transmitter, receiver and antenna as illustrated, communication was carried on with stations in England and Australia.

R210. FREQUENCY; WAVELENGTH. KILOCYCLES.
Radio. Aug. 1925, pp. 24ff.
"Ideal Tuning in Kilocycles," E. E. Griffin.

The advantages of using kilocycles in preference to wavelengths are many. With a more general use of the term, kilocycle, eventually all apparatus will be constructed on this new basis. Using frequency designation simplifies tuning and leads to clear understanding of the principles involved. The author illustrates this point very clearly. Since most receivers use a variable condenser in tuning, it is of course desirable to employ a condenser of the straight line frequency type, not straight line wavelength or straight line capacity as shown.

R162. SELECTIVITY IN RECEIVERS. SELECTIVITY.
Radio. Aug. 1925, pp. 27ff.
"Selectivity Versus Distortion in a Super-heterodyne,"
J. E. Anderson.

A minute analysis of the part that the intermediate filter plays in a super-heterodyne is given. What frequency ratios are best in obtaining all-around good results when tuning in on certain stations can best be determined by using some definite intermediate frequency to which the filter is tuned, and determining by illustration what beat notes are set up. This the author brings out very clearly. Since selectivity and distortion increase with a lowering in frequency for the filter circuits, some value must be chosen which gives the minimum for both. Curves showing the distortion ratios illustrate the points discussed. By proper selection of audio frequency transformers much of the distortion introduced through the filter circuit can be eliminated.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVERS.
Radio. Aug. 1925, pp. 20ff.
"More Miles to the Dollar," V. G. Mathison.

Directions are given for the construction of a cheap and selective three-tube Browning-Drake receiver, employing several novel modifications in coil construction and arrangement. Diagrams of winding and setting complete the information.

The Winner of Our \$500 Prize Cover Contest

OUR new cover, which, as the reader will readily see, is an entirely distinct departure from anything else we have heretofore done in this respect, and is the design of Mr. Fred J. Edgars of Tenafly, New Jersey. Out of nearly a hundred cover designs submitted, his was chosen by the judges as being the most original and generally attractive.

Mr. Edgars was born in Dover, a seaport on the southeast coast of England, and is descended

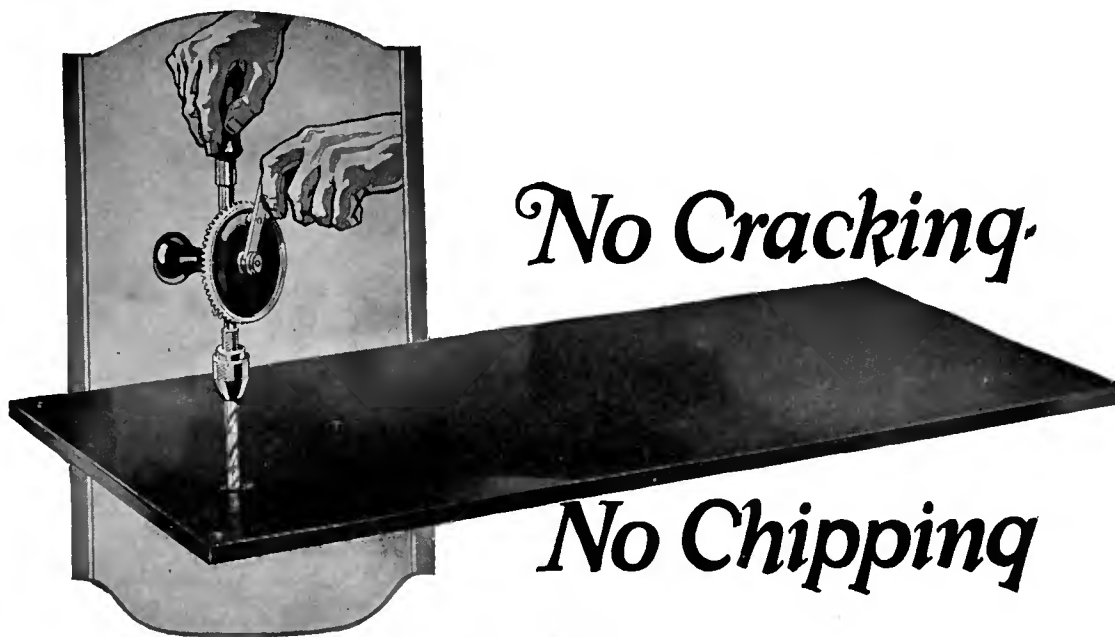
from a long line of artisans and shipbuilders. Very early in life he felt the urge to paint, and in fact, sold his first landscape when only nine years old. After this he spent some time studying at Kensington, in London, and was able there to develop fully his desire to paint subjects from nature and other natural subjects. Mr. Edgars is probably more American than English now, for he has been in this country



MR. FRED J.
EDGARS

for more than forty years, since 1881. He spent a number of years doing theatrical scenery painting and was very successful at this, but later branched out into doing illustration work for national advertisers. He has been employed in this branch of creative work for some twenty years now.

Throughout all his painting he strives to use the colorful effects of natural subjects and is largely inspired by the many flowers which bloom in his garden, a view of which is obtained through his studio window. His hobbies are carpentry and farming.



No Cracking ★

No Chipping

DRILL and machine the Goodrich Silvertown Radio Panel with full confidence—no special tools are required—it won't break at the edge, crack or chip.

It is made with a full degree of Goodrich skill and rubber knowledge, after long study of radio requirements—the product of a company that has always held quality and service as first considerations.

Science says that rubber is the best material for panels. Then by all means buy the best rubber panel—and that brings you straight to Goodrich Silvertown.

Fifty-five years of rubber manufacturing experience are a guarantee of greatest efficiency in the following products Goodrich has built for radio—

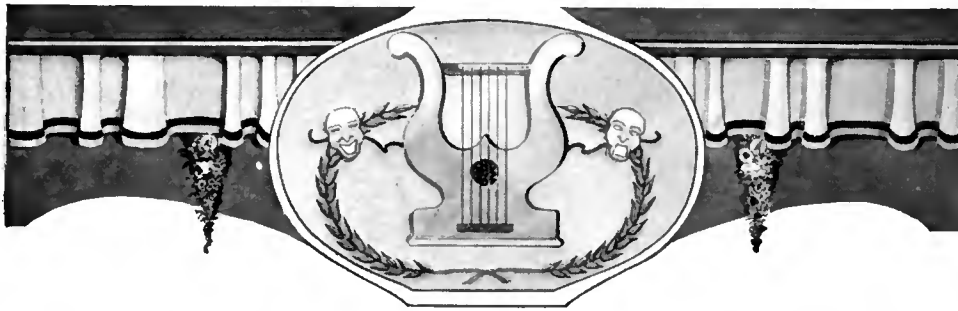
Goodrich V. T. Sockets Spaghetti Tubing
Goodrich Variometers Unwound Battery Mats
Goodrich Radiophone Ear Cushions

The B. F. Goodrich Rubber Company
Established 1870 Akron, Ohio

- 1 Easier to drill and machine.
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- 3 Lower free sulphur—no discoloration.
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Goodrich
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The Radio Panel Supreme!

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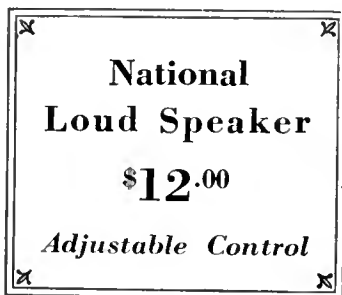
Fifty Years for Stability

Discriminating people must have assurance of unquestioned stability back of every piece of merchandise they purchase.

This year, the fiftieth anniversary of the Holtzer-Cabot Electric Company, is an opportune time to bring before the radio public a medium priced loud speaker that is unsurpassed by any other at, or near its price.

This loud speaker is on sale at dealers who are most jealous of their reputation.

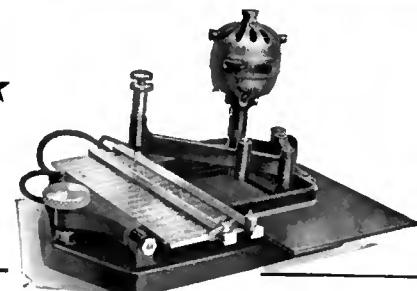
Insist upon hearing it.



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**HOLTZER-CABOT
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Rapid Engraving Machine For Engraving Radio Panels

Easy to operate. Will increase Radio Dealers income
A low price engraving equipment for engraving the words used on radio panels, trade-marks, and border and corner designs. Will engrave on Hard Rubber, Bakelite, Aluminum, and other soft metals. Price of complete equipment, \$135.00.

Will earn several dollars an hour engraving panels for amateurs building their own sets.
Branch Tool Co., Dept. G, Forestdale, R. I.

FROST-RADIO



TUBE ★
CONTROL
UNIT

\$1⁷⁵

(6, 25 or 35 ohms)

COMBINES Vernier Rheostat and Potentiometer. Single hole mounting. 6, 25 or 35 ohm rheostat, 400 Potentiometer. Genuine Moulded Bakelite.
List: \$1.75. Pacific Coast price slightly higher.



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How to Eliminate Local Interference

Part I

How the Interference Originating in Electrical Apparatus Reaches Your Radio Receiver

FOR the past year, the Research Council of Canada, on behalf of the Department of Marine and Fisheries, has been conducting an investigation into the cause of and means of locating and suppressing radio inductive interference. This series of articles, of which this is the first, is reprinted from an excellent little pamphlet, published by the Radio Branch of the Department of Marine and Fisheries of the Dominion of Canada Government. The book is entitled "Radio Inductive Interference, Bulletin Number 1." Many of the suggestions contained in this series have not been offered in other quarters, and we are sure that radio listeners who have been cursed with artificial interference of one sort or another will welcome the help this series offers.

—THE EDITOR.

HOW THE INTERFERENCE ORIGINATING IN ELECTRICAL APPARATUS REACHES YOUR RADIO RECEIVER

ALL electrical conductors carrying current are surrounded by an electromagnetic field. When the current in a conductor changes, the electromagnetic field also changes in a similar way and will induce a voltage in any radio receiving antenna close to it.

There is also another field, called the electrostatic field, surrounding all electric conductors at high voltage. A change in this electrostatic field also induces a voltage in the antenna of any radio receiver which is close to the power wires.

Under normal operating conditions on electric power lines, this electromagnetic and electrostatic field which surrounds the conductors does not extend more than a few yards from the power line. In some cases, however, where the change of current or the change of voltage is of a very sudden nature, called an electrical surge, a radio receiving antenna situated at a considerable distance from the power line may be affected. An electrical surge may travel many miles along a power line, and produce a radiation which may be picked up on radio receivers.

In cases where it is not practicable to get far enough away from the power lines, the antenna should be run as nearly as possible in a direction at right angles to the power line, as the induction from power lines is very much greater on antennas which run parallel to them.

In no case should an antenna be erected above a power wire in such a way that it would be possible for it to come in contact with the power wire in case it should accidentally fall. Many accidents have been caused in the past by antennas accidentally coming in contact with power wires.

CHARACTERISTICS OF RADIO INDUCTIVE INTERFERENCE

THE following characteristics of the radio inductive interference from some sources may provide useful clues in the investigation.

1. *Battery chargers of the vibrator type* cause an electrical surge which may travel along the supply wires of the secondary distribution system and cause radio interference to all receivers near these wires. This interference is very staccato in character and consists of a regular series of clicks corresponding to the frequency



The real solution to the tuning problem!



MAKE your radio a 1926 model. Replace your present Dials with Rathbun Straight Line Frequency Converters which spread all stations within the range of your receiver uniformly around the whole circle of 360°. All stations are a uniform distance apart on these new Converters which is the ideal tuning condition.

Why be satisfied with Dials or Condensers which are limited to 180° or only half the dial? Why stop at 180° when there are 360° in the circle? No gears with their back lash, no friction with its slippage in Rathbun Straight Line Frequency Converters—only two moving parts, a variable cam and a lever. Easily and quickly installed on any set—it is not necessary to cut Condenser shaft or drill panels.

The Rathbun Straight Line Frequency Converter is one of the few really new things in radio during the past three years.

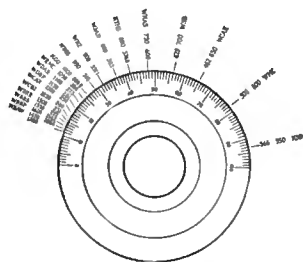
Don't forget that we build the Rathbun Single Hole Mounting Condenser with genuine Bakelite ends. This year's models are all enclosed with transparent pyralin dust bands which preserve their high efficiency for life. Small, light, rugged, handsome and none lower loss or higher in efficiency. Always reasonably priced.

Ask your dealer for Rathbun Straight Line Frequency Converters. If he has not yet stocked them, he will quickly obtain them

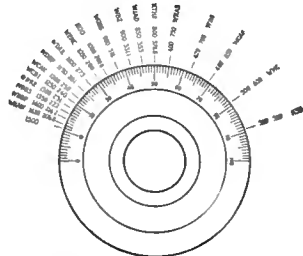
PRICE \$3.50

**Rathbun
Manufacturing Co., Inc.
Jamestown, New York**

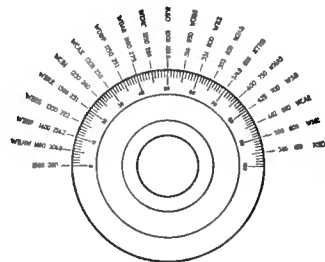
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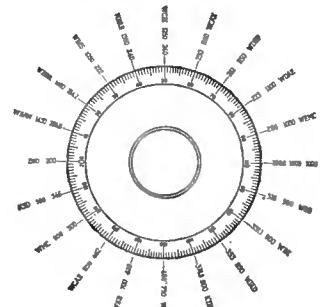
Stations indicated in kilocycles and wave lengths showing crowding with an ordinary capacity condenser



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



JOT down the call letters in the handy slot—right on the dial itself—and there is your permanent record of the dial settings.

The One Dial That's All a Dial Should Be

You'll never know how much difference a dial can make until you actually get your hands on the new Mar-Co. It splits a single degree into hair's breadth divisions. It responds to your slightest touch with no suggestion of backlash.

Smooth—precise—and strikingly handsome—built for your present set and for your next year's set as well—it is what you'd expect of Mar-Co—see it at your dealer's.

This is the dial specified in the new resistance-coupled circuit, described in this issue.

NICKEL PLATED \$2.50

GOLD PLATED \$3.00

Clockwise or Counter-Clockwise Action

MARTIN-COPELAND CO., Providence, R. I.

MAR-CO Vernier Dial



22½ Volt
un-acid
everlasting
rechargeable
"B"
Storage Battery
\$2.95



including chemical
Does not lose charge standing idle.
SPECIAL—2 2 ¼ (4 5 volts) \$5.25; 90 volts \$10.00. Any special detector or amplifying voltage easily had. Very easily charged. Nearly 3 years sold on a non-red tape 30 day trial offer with complete refund if not thoroughly satisfied. Further guaranteed 2 years. Knock-down kits at still greater savings. Complete ready to run "B" battery charger \$2.75. Sample cell 35c. Order direct—send no money—simply pay expressman when delivered, or write for my free literature, testimonials, and guarantee. My large 36-page radio goods catalogue 10c. Same day shipments.
B. F. SMITH, 31 Washington Ave., Danbury, Conn.

M & M Low Loss INSULATORS

Perfect your entire installation by insulating your antenna-ground system. Your set is not responsible for energy lost through a poorly insulated aerial. Use M & M Low-Loss Lead-in and Wall Insulators.

4" Lead-in Insulators \$.50
10" Lead-in Insulators80
20" Lead-in Insulators 1.50
5" Wall Insulators60

DEALERS: If your jobber can not supply you write us direct, giving us your jobber's name. Send for our Catalog.

The M & M Co.
CLEVELAND, OHIO.

of the alternating current supplying the charger.

2. *Commutator motors* in some cases cause radio interference due to sparking of the brushes, and may often be recognized by the sound in the radio receiver. The interference noise will rise in pitch as the motor speeds up. In cases of motors running at less than 300 revolutions per minute it is sometimes possible to count the speed of the motor by listening to the radio receiver and observing the second hand of a watch.

With practice an observer may learn to count much higher speeds by listening to the run of the sounds by fours and counting only the beginning of each group of four. To acquire this ability it is suggested that at first the hand be moved down at the beginning of each group, and when this can be done easily the motions of the hand may be counted.

FAULTS OF HIGH VOLTAGE LINES

A *FAULTY insulator* on a transmission line of 30,000 volts or more may sometimes cause an electrical surge which travels along the transmission line for many miles and causes radio interference to receivers situated within a few hundred yards of this line. This radio interference may be induced into other lines which run parallel to it and thus be distributed over a wide area, possibly throughout the entire city. This interference is usually continuous, but may under some conditions be intermittent and very erratic. The number of cases of such interference, however, is very small, as faulty insulators usually cause the shut down of the transmission line for repair.

4. *A transmission line* which sparks to some insulated conductor, such as an insulated guy wire or an ungrounded conduit, may cause radio interference of a similar nature to that described as originating on a faulty insulator. In this case, however, the interference may continue for weeks or months without causing any power shut down, as the amount of current flowing is only sufficient to charge the ungrounded metal and not sufficient to indicate at the power house. In case such a fault is caused by a line swinging into contact with a guy wire, it is usually noticed to be intermittent during windy weather.

FAULTS IN TRANSFORMERS

INTERFERENCE which is caused by defective insulation in conduit or in electrical apparatus, is sometimes intermittent and comes on when the apparatus is vibrated or subjected to strain by expansion due to a change of temperature. For example: A faulty bushing on the primary of the transformer may cause radio interference by sparking to the ungrounded frame of the transformer when the transformer is subjected to vibration by the passing of a truck along the road.

Transformers which produce an audible hum do not necessarily cause radio interference, as this hum is usually produced by the vibration of the laminations of the core.

6. *Charging of lightning arresters* is heard in the radio receiver as a very loud roar, but only lasts for a few seconds. Sometimes this is repeated a number of times as a series of lightning arresters are charged at one station. Most power companies charge their arresters at times outside the broadcasting period, such as noon or 2:00 or 3:00 o'clock in the morning. The interference from lightning arresters may be heard for many miles from the source.

7. *Cottrell Precipitators* sometimes cause radio interference which may be heard at a distance of 15 miles, but when proper means are taken to reduce this interference at its source they cannot be heard at a distance of more than one mile.



Radio Receiver

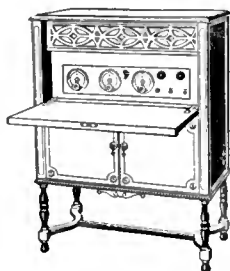


Radio evenings are complete If you have a Valleytone

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.

Valleytone Console Model



Valley table with built-in loud speaker

You can always count on a full evening's entertainment if you have a Valleytone Radio Receiving Set.

Music with your dinner . . . bedtime stories for the children . . . a play, an opera, or a concert . . . jazz, mammy songs, spirituals . . . the whole range of radio broadcasting can be yours.

With the Valleytone, you can choose your programs by the clock and hear them all the evening through.

For the Valleytone is selective. It will separate and bring in stations only four or five meters apart and will easily separate local and distant stations.

Valleytone selectivity gives a new meaning and puts a new pleasure in radio.

And with the balanced tone of the Valleytone when you hear a station you marvel that any reproducing mechanism can really achieve such faithfulness and such natural results.

The superiority of the Valleytone can be demonstrated. The Valleytone thrives on comparison. Wherever it is judged by results and performance, it wins a new owner.

Any authorized dealer will be glad to demonstrate the Valleytone for you.

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

ANOTHER RADIO TRIUMPH

BRACH

PUR-A-TONE AUDIO COUPLER

An Improved Resistance Coupler



Here is the result of months of experimentation in the Brach Laboratories. Unusual features such as standardization and interchangeability for all stages have been accomplished by the use of a 1-micro-farad condenser and specially designed resistors that are non microphonic and capable of withstanding high voltages. To insure permanent uniformity all connections are either soldered or held by screw pressure instead of the usual spring contact.

These features have been at once recognized by Radio Engineers of national repute who have replaced resistance couplers with Brach Pur-A-Tone Audio Couplers in order to obtain maximum results.

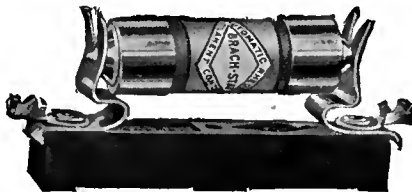
BRACH-STAT AUTOMATIC Filament Control

The Ultimate Standard for Fine Receivers

Brach-Stats completely eliminate the need for hand rheostats, on all amplified circuits—fewer controls—better operation.

The uniformity of control of the filament current obtained by the use of Brach-Stats has far exceeded the greatest expectations of noted Radio Engineers.

All set constructors should provide for their use.



Brach Pur-A-Tone Audio Couplers and Brach-Stats are notable contributions to the successful Roberts Circuit featured in this issue of Radio Broadcast.

L. S. BRACH MFG. CO., NEWARK, N. J.

Electrical Specialists for Over 20 Years

PRELIMINARY TEST TO INVESTIGATE RADIO INDUCTIVE INTERFERENCE

FIRST TEST:

To determine if the noise in the radio receiver is due to a fault in your receiver or is actually interference coming in on the air.

Disconnect your antenna and ground wires and if there is no reduction in the intensity of the noise while the broadcast music is stopped by the disconnection, the probability is that the source of the noise is in your own receiving set, in the form of a loose connection, faulty batteries, or defective tube.

Also shake your ground wire near the ground connection to make sure that the noise you hear is not caused by a bad connection at this point.

SECOND TEST:

To determine whether the interference originates in your own house lighting circuit.

From cases of interference investigated it has been found that a great number of these are of a purely local nature, originating in such sources as a lamp loose in its socket, or a loose plug of a heater, or from faulty household apparatus. While the interference is apparent, have somebody open your main house-lighting switch for a few seconds while you listen in on the radio receiver. If the interference stops when the switch is open, the source of the interference is probably in your own circuit. This test should be repeated several times, however, as there may have been a misleading coincidence with something occurring outside at the instant this switch was opened. Many sources of interference do not start again immediately the switch is closed, so that observations taken at the instant of opening the switch are more reliable than those taken at the instant of closing it.

THIRD TEST:

To determine the extent of the area affected by this interference.

When you are assured that the interference comes in on the air and does not originate in your own set or in your own house lighting circuit, you should cooperate with others in your district who have radio receivers. Great care should be taken in making this test to avoid the danger of confusing the interference which originates from different sources, which may appear similar in the radio receiver. The most satisfactory way of making this test is for one observer to listen to the interference received on two radio receivers at different points at the same time by means of the telephone system. To carry out this test, an assistant at the distant radio receiver should place his head-phones (or preferably his loud speaker) near the transmitter of the telephone in order that the observer at the other radio receiver may listen at the same time to the interference heard on his own receiver at his right ear, while listening to the interference heard at the distant radio receiver by means of the telephone to his left ear. This test should be continued for a sufficient length of time to observe a number of variations in the nature of the interference.

In cases where it is not convenient to use the telephone system for this test, the two observers at distant radio receivers may keep an accurate log of the interference, but in this case they should first synchronize their watches and record any characteristic change in the interference heard, noting the time accurately to within a few seconds.

FOURTH TEST:

To determine if any suspected source actually causes radio interference.

In carrying out this test either of the two

RADIO BROADCAST

For December

will be a better magazine than this. Make sure of it by telling your newsdealer to hold one for you—or better still, subscribe through him or direct.

RADIO BROADCAST

Garden City New York



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A Binding Post that really does excel, looks, action, service and convenience. 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

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FORMICA ★ RADIO PANELS TUBES AND RODS

WRITE TO-DAY for your copy of our new catalog listing and pricing 3384 different sizes and kinds of Formica Radio Panels, 126 different sizes of Formica Tubes, and 21 different sizes of Formica Rods.

DRILLING—ENGRAVING

Lowest prices consistent with good work.

STARRETT MFG. CO.

521 S. Green St. - Chicago, Ill.



CLAROTUNER

A KNOCK-OUT for the Knock-out!"—that's what a prominent engineer said when he saw the CLAROTUNER in action. And the moment you lay eyes on this latest creation, the moment you discover how miraculously sharp is its tuning, you will be just as enthusiastic. You will realize why Radio Broadcast experts recommend it, and use it in the Radio Broadcast Knockout, Roberts, Phonograph Model and similiar hook-ups.

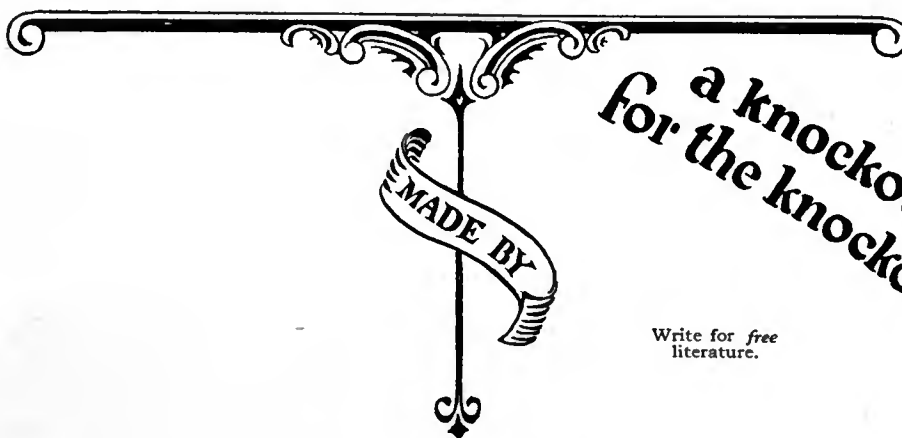
Low-loss coils, sturdy compactness, and absolute one hole mounting are only a few of the features. The biggest thing is the precision control—as smooth as velvet. The antenna coupler, by the way, is one hole mounting too, and eliminates all extra switch points and levers. Ask your dealer!

CLAROTUNER, model 2RK (two units as shown). . . . \$7.50

(In case distribution has not reached your dealer, send your remittance direct to the address given below.)



The famous CLAROSTAT, heart of the CLAROTUNER. \$2.25



a knockout for the knockout!

Write for free literature.

American Mechanical Laboratories, Inc., 285-287 North 6th St., Brooklyn, N. Y.



The Season's Sensation

\$15⁰⁰

THE KODEL MICROPHONE LOUD SPEAKER is an exact replica of the transmitting microphone used in broadcasting.

The efficient Kodel reproducing unit, with an ingenious new snail-shell horn, mounted inside the microphone case, produces a remarkably clear, full-toned volume. Non-vibrating tone chamber eliminates distortion.

The \$15 model incorporates the new Kodel, Jr. unit; with the large Kodel unit, \$20.

Radio dealers everywhere have them
THE KODEL RADIO CORP.
505 E. Pearl St., Cincinnati, O.

KODEL
MICROPHONE
SPEAKER

Design
Patented

**The KODEL
MICROPHONE
LOUD SPEAKER**

systems referred to in Test No. 3 is suitable. Great accuracy is required in these tests, for it has been found that many misleading reports have been received from observers who were not sufficiently accurate in their observations. For instance, interference has been reported to be associated with the switching on of the street lights in cases where the interference actually was produced by another circuit which was switched on every evening about dusk. If the observers in this case had noted the time very accurately, the source of the interference could have been located much more readily.

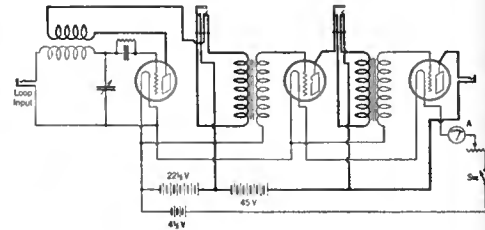


FIG. 1

This circuit, in conjunction with a loop may be satisfactorily employed to locate some sources of interference

FIFTH TEST:

To determine where the interference radiates from, by means of a portable radio receiver.

In cases where a portable radio receiver is available the source of interference may be very often traced by this means. In cases where the radio interference is of such a weak nature that it only interferes with the reception of distant broadcast signals, a very sensitive loop receiver is required to pick this up. A portable super-heterodyne receiver complete with batteries thoroughly shielded is best for this purpose. A much less sensitive receiver may, however, be used in connection with the loop which will be suitable for determining the conductors from which the interference radiates. In cases where the interference is coming in along the conductors of the electric light or power system, a single circuit regenerative receiver having two stages of audio frequency amplification is sufficiently sensitive to give indication when the loop of the receiver is placed within a few yards of the conductor radiating the interference.

A detailed description of more elaborate apparatus used by Canadian Government Radio Inspectors and suitable for investigation in power houses will be published in another pamphlet now in course of preparation.

GENERAL NOTES

IN MAKING all these tests it is important to approach the subject with an unprejudiced mind as to the source of the interference, and before concluding that the interference is caused by any given source, it is well to consider all possible conditions in which the interference may have originated from some other unknown cause. Investigating interference is a very fascinating detective game and one would sometimes suppose that the source of the interference had a sense of humor and was trying to evade detection in a manner similar to that of the most clever criminal.

The obvious and only satisfactory method of suppressing radio inductive interference that is caused by electrical apparatus which is defective, is to put this apparatus in good condition. The owners of such electrical apparatus are usually very pleased to have their attention drawn to the fact that their apparatus is in need of repair.

Could You Use More Money?

No matter what your present income is, wouldn't you like some extra cash?

Well, here's your chance to get it!

DOUBLEDAY, PAGE & CO. wish to enlist earnest and reliable men and women throughout the country who will appreciate an opportunity to make money.

Our plan insures immediate cash returns, in amounts limited only by your own ability.

This is no ordinary subscription proposition. You can't afford to overlook it.

Write Agents' Service Division

DOUBLEDAY, PAGE & CO.

Garden City, N. Y.



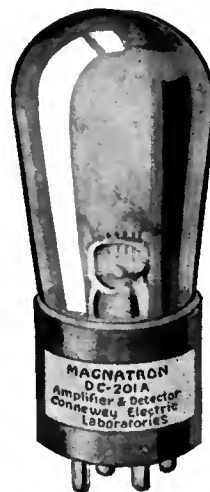
Vigilance

Constant vigilance is the price of uniformity and constant vigilance is maintained over Magnatrons. That is why Magnatrons are uniform, and uniformly good.

The Magnatron DC-201A, DC-199, and DC-199 (large base) now list for only \$2.50 each.

Connevey Electric Laboratories
Magnatron Bldg. Hoboken, N. J.

**MAGNATRON
REX**
the new
tube for
'B' battery
eliminators



MAGNATRONS

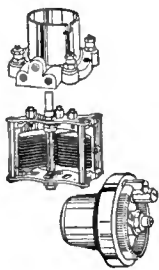
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The AMSCO ALLOCATING CONDENSER (STRAIGHT LINE FREQUENCY)



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.



Made in three capacities—Single or Siamese. Ask your dealer, or write for details of the entire AMSCO Line of engineered radio parts.

AMSCO PRODUCTS, INC. Dept. E
Broome and Lafayette Streets, N.Y.C.



New!—a handsome instrument at a low price. The AMSCO Vernier Dial gives fineness to your fingers. Steps-down 13 to 1, backwards or forwards, fast or slow without momentum or back-lash.

WHAT OUR READERS WRITE US

*J. H. Dellinger Praises Our
Frequency-Wavelength Policy*

AS WE stated in our August number, RADIO BROADCAST will no longer use the term wavelength except in parentheses after its equivalent in kilocycles. It is probable that everybody ultimately will fall in with this idea, and already condenser manufacturers are realizing this is so, and are designing new instruments giving a straight-line frequency reading. These latter have specially shaped plates designed so that any movement of the dial will give a reading in degrees directionally proportional to the frequency, all the way around the dial. We recently had a letter from Dr. J. H. Dellinger, the president of the Institute of Radio Engineers, in which he commends us upon our step.

Editor, RADIO BROADCAST,
Doubleday, Page & Company
Garden City, New York.

SIR:

Ever since the Second National Radio Conference, held in 1923, there has been an increasing use of the concept of frequency and its expression in kilocycles in place of the use of wavelengths in meters. The realization has rapidly spread that the use of wavelengths in radio is unnecessary and that its original introduction was a mistake. I have noted with pleasure the statement of policy on page 499 of the August RADIO BROADCAST, namely, that in future issues of the magazine frequencies will be used as standard, with wavelengths given thereafter in parentheses. Not only was this policy stated but succeeding issues of the magazine have proved that the editorial staff intend to abide by this announcement. With convenient conversion tables freely available and with excellent articles like that of Professor Morecroft's in your August issue explaining the superiority of frequencies in kilocycles, there is no longer any reason why this change of practice should confuse anyone. I congratulate you on assuming a position of leadership in this change to a modern and rational basis of radio expression.

Very truly yours,
J. H. DELLINGER
President, Institute of Radio Engineers.

What a Foreign Reader Thinks of "Radio Broadcast"

THE following congratulatory letter was received recently from the Count de Warn, who was a High Commissioner of the International Amateur Congress of 1925 held in Paris.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

I have just come across a copy of RADIO BROADCAST. Allow me to congratulate you for your very excellent magazine which I did not know of before. Although I am a bit late, please put me down for a five years subscription for which I enclose my cheque. I intend to try a super-heterodyne of American make and hope that you will advise me on this question.

Yours faithfully,
COUNT DE WARN,
Alpes Maritimes, France.

The Causes of Fading

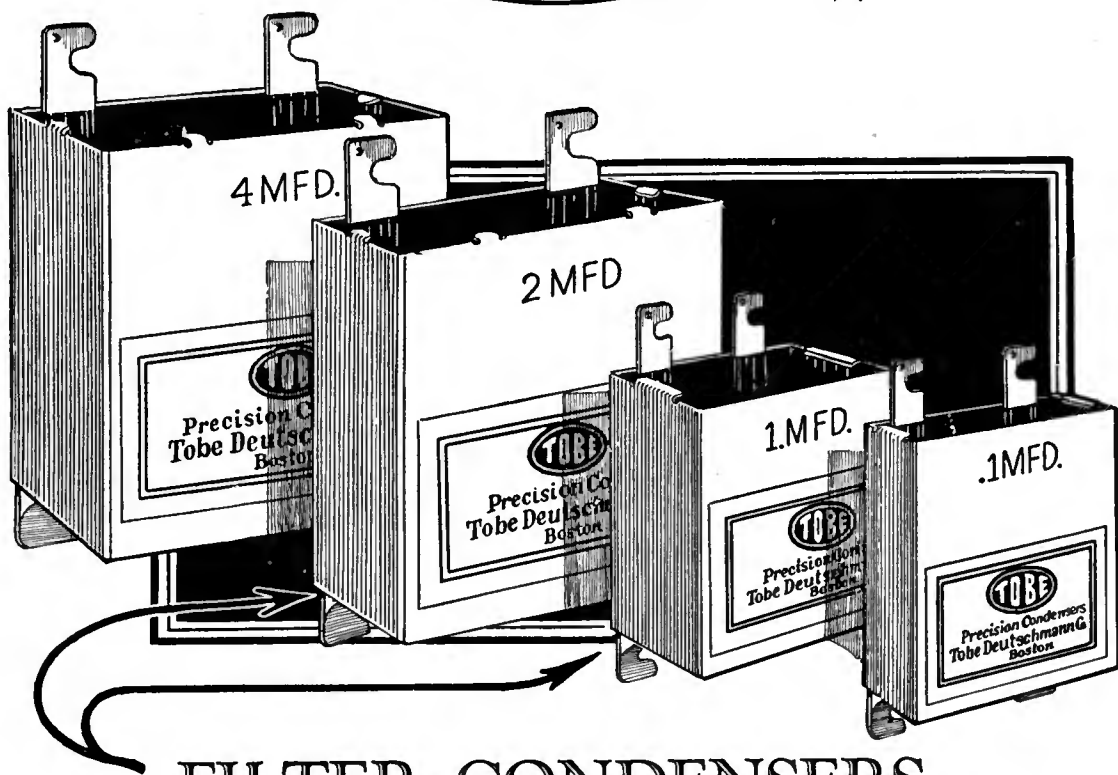
THE late discussions of the fading of radio signals at the time of the total eclipse of the sun have revived interest in the popular

WOULD YOU HELP YOURSELF TO OUR CASH BOX—if we said "GO AHEAD"?

ALL RIGHT, THEN—GO AHEAD! . . .
THE CASH IS THERE. . . . And it's easy to get
The Holiday Season is approaching with its heavy drain on your income. What are you doing about it?
Will it be just as it was last year? Or do you really want some spare-time cash.
If you are in earnest, let us tell you how you can get it.
There's much to gain and nothing to lose.

Write: Agents' Service Division

DOUBLEDAY, PAGE & CO. Garden City, N. Y.



FILTER CONDENSERS

recommended for 'B' battery eliminator circuits

RADIO BROADCAST'S article in this issue on 'B' battery eliminators shows that the following TOBE condensers can be used in building the set: 5 type 708 and 7 type 709.

Any 'B' battery eliminator circuit depends very largely for its operating efficiency upon the filter condensers used. TOBE condensers alone possess all of the following favorable characteristics:

Will operate at voltages up to 700 D. C. without breakdown or overheating.

High megohm resistance—indicating perfect insulation. Capacities guaranteed to be within 5% of accuracy.

Extreme heat or cold has no effect on TOBE condensers. Compact and handsome in appearance.

Tobe condensers are better condensers—distinguishable by their silvered finished case. Ask your dealer for them by name "TOBE."

.1 M.F.D.	Type 705	Price \$.70
1. M.F.D.	Type 708	Price 1.25
2. M.F.D.	Type 709	Price 1.75
4. M.F.D.	Type 711	Price 3.75

Tobe Deutschmann Company
 CORNHILL BOSTON, MASS.



"Astoundingly Selective"
"Delightfully clear tone with Amazing Volume"
"Tremendously Powerful"
"Gets 200 to 600 meter Stations coast to coast"
"A great big beautiful set"
"Simple to tune - easy to log"

BUILT LIKE—LOOKS LIKE—PERFORMS LIKE A \$200 SET

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, refinements and improvements such as you might expect to find only on the newest sets selling at higher prices.

MIRACO RADIO GETS 'EM COAST & COAST

Reports from Ultra-5 users everywhere leave us to add. These are typical of the many to our files and which we receive daily.

PENNSYLVANIA HEARS CALIFORNIA VERY LOUD

I received the Ultra-5 Set, set it up as directions called for, and received Dallas, TEXAS first station. Will list a few of the stations received in two hours: KDKA, WHAS, WDR, WJAW, WOS, WTAM, WCAE, WLW, WOO, WJY, WJS, KFI, KSI, WWJ, WHN, WJX. It is very easy for me to receive Los Angeles, California, loud enough to be heard in any room in the house. W. E., Uolontown, Penna.

CALIFORNIA GETS NEW YORK ON LOUSPEAKER

I have got stations from coast to coast without any trouble at all on the Ultra-5. WTAM, Cleveland, Ohio, comes in on loudspeaker nearly as loud as the nearby stations do. I have brought in on loudspeaker with ample volume, hear all over the room stations WEAF, N. Y., KDKA, Pittsburg, Pa., WGY, N. Y., CHCK, Ottawa, Wis., Cincinnati, WCOO, St. Paul, Minn., WLS, Chicago, S. S., Dorris, California.

NEW JERSEY HEARS CALIFORNIA ON LOUSPEAKER

MIRACO Ultra-5 working fine. Have received Western coast. Had two stations in California on same night. Have had many other stations. Receive all other stations with loudspeaker. Nivison Vao., Freehold, N. J.

MONTANA HEARS BOTH COASTS

Ultra-5 Set is O. K. Have got New York to Los Angeles, Winnipeg to Dallas, Texas. Have had some 60 odd stations in two weeks. W. H., Polson, Montana.

RADIO EXPERT SPEAKS FROM EXPERIENCE

As I sell almost all kinds of sets, I have operated all of them and will state that the Miraco Ultra-5 is as good if not better than any other set in the market today. Felix J., Pawtucket, Rhode Island.

PREFERS IT TO \$150 SETS

I received your Miraco Ultra-5 Radio Set and it surely is a peach. I have tried and heard radios up to the value of \$150.00, but I like yours the best. William L., Syracuse, N. Y.

ILLINOIS HEARS ALASKA

The night I received the Ultra-5 I tuned in New York City. The second day I tuned in KFI, Los Angeles, Calif., and KFI, Juneau, Alaska. Can hear anything in the United States. I will put it against any set I have ever heard. H. H., Ashkum, Illinois.

GOT CALIFORNIA BETTER THAN \$269 SET

Received the Miraco Ultra-5 the other day and it is a big surprise. Compared it with my friends' \$269.00 and could bring them in just as loud and clear on my Ultra-5. Really I brought in Los Angeles, California, on speaker louder than he did. Am more than pleased. Kyle, New Albany, Miss.

now only \$59⁵⁰ retail

SEND FOR SPECIAL OFFER!

The Powerful New
MIRACO
Ultra-5

[FIVE TUBE OUTFIT IN BEAUTIFUL MAHOGANY CASE]

Let the testimony of its many users everywhere—as voluntarily reported to us in writing—convince you that a Miraco Ultra 5 actually is unsurpassed for selectivity, long distance range, clear tone, loud speaker volume and beauty—combined with economy and simplicity of operation—at several times the price. Send coupon for plenty of this proof and reports of users which leave no doubt that the Miraco Ultra 5 gets programs coast to coast.

Completely built, carefully tested and factory guaranteed by one of America's oldest and most successful makers of quality sets, the Miraco Ultra-5 illustrated above (latest improved model for 1936) in the opinion of radio experts is an astonishing bargain. Selectivity, long

distance reception, clarity and volume have been amazingly increased—"B" battery consumption is minimized—oscillations are easily controlled on all wave-lengths, through use of latest radio inventions. Among these are: "Duo-formers" (ultra low-loss inductance coils); the "Counter-Balancer" (patented); flexible wiring which prevents broken or noisy connections; an adjustment for different length aerials; use of only two rheostats; a cut-out switch; concealed wiring under genuine Formica sub-panel; beautifully gold-etched genuine Formica front panel; large Bakelite knobs with "arrow point" indicators (for fine tuning)—and other features of costliest sets. Literature describes them fully. Send for it—and Special Offer!

Other Miraco Long Distance Sets \$13⁵⁰ 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 \$27.95 (retail) operates loud speaker on distant stations. New one-tube Model R is also

a record-breaker for distance at \$13.75. All Miraco sets work on storage or dry batteries, are easily connected and operated. Unmatched value! 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 host of users in every state prove Miraco sets—at their rock-bottom factory prices—outperform sets costing up to three times as much. 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**

AGENTS, DEALERS
 Write for the new Miraco proposition!

MIDWEST RADIO CORPORATION
 Floorer Builders of Sets, 406-F, E, Eighth St. Cincinnati, O.
 Send free literature, SPECIAL OFFER and all particulars regarding Miraco Sets. () Agent () User () Dealer.

NAME

ADDRESS

mind about this peculiar and little-known peculiarity of radio transmission. It is probable that scientific and popular interest in the fading of signals is more acute now than it ever has been before. The suggestions below were written by an electrical engineer whose theories are certainly interesting. Elsewhere in this issue the probable causes of fading are ably discussed but so interesting is the letter below that we make no apology for covering the subject in two separate departments.

Editor, RADIO BROADCAST,
 Doubleday, Page & Company
 Garden City, New York.

SIR:

It is generally recognized that air molecules are ionized by the sun's rays and that the resulting charged air dissipates the energy of radio waves, since it is a partial conductor of electricity. Likewise an ionized layer of air, being a conductor, will act in the same manner as a metal reflector, though in less degree, to reflect the radio waves. As night approaches, the air becomes less and less conductive with consequent increase of signal strength, but it is highly probable that the air is always slightly ionized, even in the absence of the sun's rays. This may be a result of light from the stars and moon, or the air may retain some of its charge for long periods after the ionizing rays of the sun have been removed. Even if the lower layers of air between two stations are completely neutral, electrically, there is the possibility that the upper layers are acted upon by sunlight, especially if the stations are in an east-west line. It has been stated by observers that the worst fading occurs in such a direction.

Now as to the real causes of fading, there are possibly three, which may be: (1) at the sending station, (2) at the receiving station, and (3) between the two stations. It is possible that there may be a cyclic variation in the electrical state or condition of either the sending or receiving apparatus (tubes), but this is rather doubtful. Of course an antenna system swayed by the wind will become detuned, and there is an additional probable cause, in that layers of air of varying density may pass under the antenna and thus alter its capacity. If either of these two factors just mentioned were the contributing cause, it would be possible to tune the station in again by adjusting the controls. However, in all too many cases no amount of tuning will bring in the station. We must wait a few minutes until the signal increases in strength of its own accord. Generally this is a gradual increase.

The facts seem to indicate that fading is due to variable conditions existing between the sending and the receiving station. We know that there are always layers of air of different densities, temperatures, and humidities, and if we grant that these layers are always slightly ionized, which is likely, we have at once a plausible explanation for fading. For suppose that a station is receiving with good audibility at any one moment, and suppose, then, that an extended layer of ionized air drifts between the sending and receiving station. The signal waves will then be both reflected and absorbed by the conducting "sheet" of air, and therefore the signal strength at the receiving station will be materially reduced until the ionized body of air has drifted past the path between the two stations. There are, of course, many moving layers of air between two stations widely separated, and consequently it would be expected that fading would be worse for such stations.

The varying ionization of the layers of air would result from the varying factors such as temperature, density and humidity, when the air is exposed to the same ionizing source such as sunlight. A further cause of ionization is the friction of the various air streams.

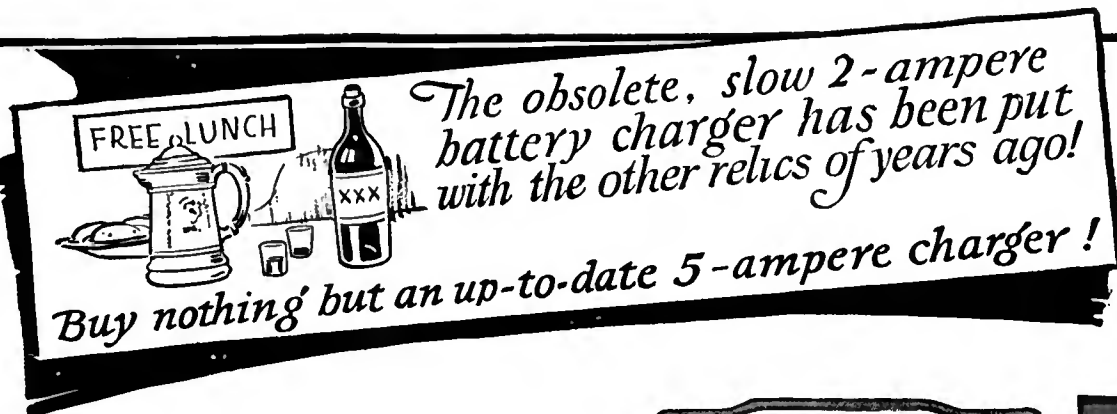
There is still another possible cause of fading in that the numerous ether waves may interfere to cause partial neutralization, but the air layer explanation seems more plausible.

Yours very truly,
 A. G. THOMAS,
 Lynchburg, Virginia.

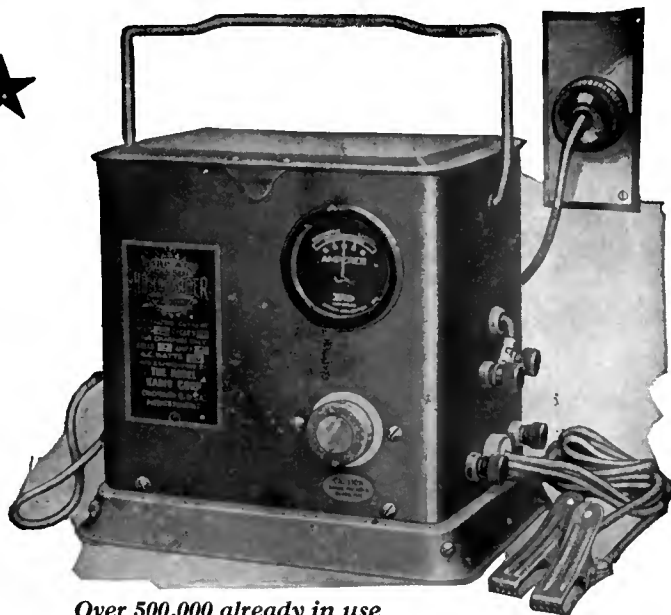
How To Use Radio Tubes

is the title of an article by Keith Henney, Director of the Radio Broadcast Laboratories, to be printed in the December issue. Special attention is given to the new tubes by the Radio Corporation of America. Much help will be given on how to use the best tube for the best purpose.

Reserve a copy of December Radio Broadcast at your news dealer or radio supply store.



The New Improved
 5 AMP. A & B
 GOLD SEAL
HOMCHARGER
 \$19⁵⁰



Over 500,000 already in use

Charges in One-Third the Time!

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 fireproof.

Beautiful cabinet in maroon and gold.

Free Write for new edition of our instructive booklet on radio operation "The Secret of Distance and Volume in Radio."

It takes only one-third as long to fully charge your battery with the New Improved 5-ampere **GOLD SEAL HOMCHARGER**.

No more of the long, bothersome waits that were necessary when the slow inefficient 2-ampere charger was the best that radio offered. The New Improved **GOLD SEAL HOMCHARGER** charges 150% faster—fully charges the average battery overnight—and it charges both **A and B** batteries without additional equipment.

Before you buy any charger be sure it charges at 5-amperes. To be absolutely sure insist on the **GOLD SEAL HOMCHARGER**.

The Kodel Radio Corporation
 505 East Pearl Street Cincinnati, Ohio



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