RADIO BROADCAST

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Making Permanent Records of Radio Programs

How a Thin Iron Wire and the Force of Magnetism is Being Used to Record the Famous Bits of Radio Programs with the Very Shading of the Speaker's Voice

BY I. R. LOUNSBERRY

THE crowd is yelling—the excitement is intense, and our favorite, J. Andrew White, says clearly: "Third round—now the men have left the corner—they are in the center of the ring—Berlenbach looks for an opening—Abbot is backing up from Berlenbach—this powerful man crouches low—Berlenbach has just received three, four, five to the body and he hooks to Abbot's jaw—three, four, five, six, seven—Abbot is taking the count—eight, nine—he's up—Abbot is up—" And the fight goes on with the frenzied fans at the ringside yelling away and the radio audience listening with a thrill to every word of the announcer.

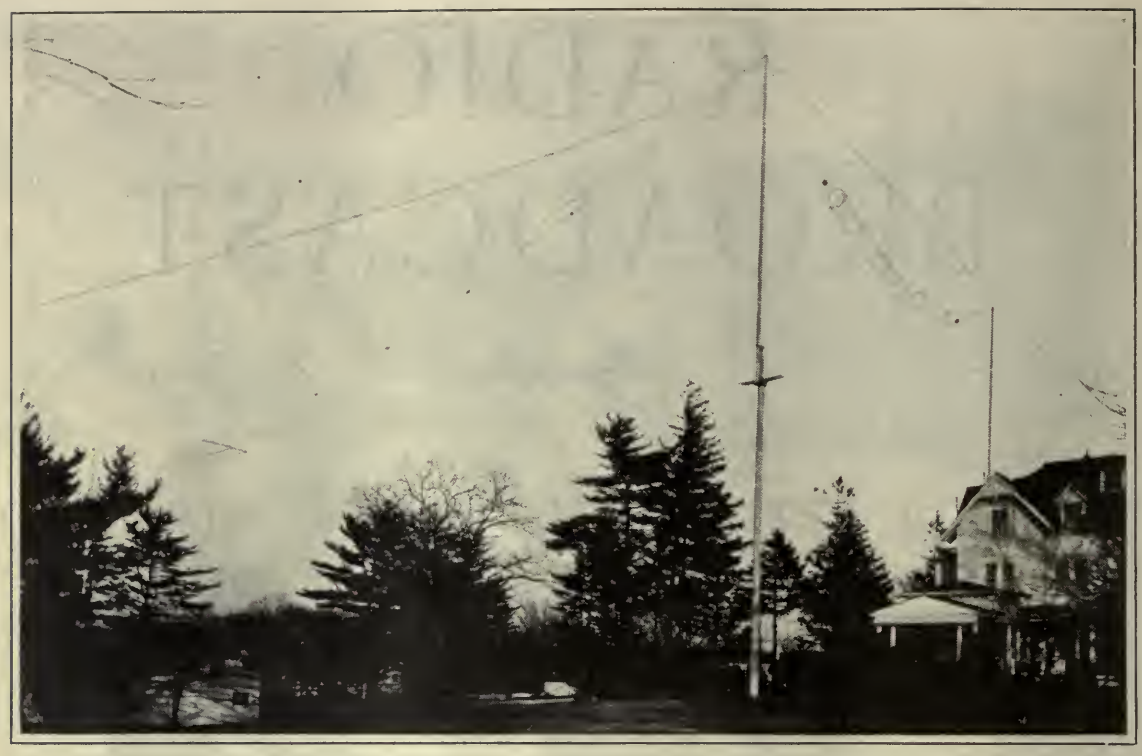
But—the time of this is eight A. M., August second, and that fight occurred at night, April twenty-ninth. How is this? And in a similar way to-day, or a hundred years hence we may hear the radio announcer say, "The next voice you will hear will be that of the President of the United States, Calvin Coolidge, speaking from the White House, Washington, D. C." The answer is the "phonowire," the latest addition to the art of radio broadcasting.

The "phonowire" as we call it, is an application through considerable circuit development work of an old system of stenographic-dictation machine made by the American Telegraphone Company. This new system has been developed by the W. R. Seigle Laboratories at Mamaroneck, New York, and is the work of Mr. W. R. Seigle, director of the laboratories, and of the writer. This process of magnetic recording

The Voices of Great Men May Live After Them

A radio program is here this minute and gone the next, "followed by the next number in to-night's entertainment." Many thoughtful persons have deplored the ephemeral quality of some of the notable speeches which have been broadcast and wished that there were some practical way to preserve them. A written speech preserved in type is a cold thing at best, but with the Phonowire, an adaptation of the invention of Valdemar Poulsen, it is possible to record any notable radio event and retransmit it at a later time.

There are other methods of recording, such as Mr. C. A. Hoxie's Pallophotophone, but the method Mr. Lounsberry describes is very simple and quite effective.—THE EDITOR.



THE LABORATORY AT MAMARONECK, NEW YORK

Where development work is being done on the Phonowire, which magnetically preserves voice or music of a radio program and by a reversal of the recording process can retransmit the "record"

was originally the work of Valdemar Poulsen, that famous Danish inventor, who first accomplished a record on a steel disc. This later took the form of a fine steel wire. It is the application of this original method to the radio and other modern devices which has held our attention for a long time.

HOW THE PHONOWIRE WORKS

THE recording unit consists essentially of a long steel wire one-hundredth of an inch in diameter which is wound on spools and driven from one spool to another by an electric motor. As the wire is wound from spool to spool it is passed through a magnetic field which is varied in density at audio-frequencies corresponding to music, voice, and so forth, as accomplished by the radio receiving unit. This varying field magnetizes the wire in spots and as the wire is of steel, the record is made permanent and will last indefinitely. Although the wire is wound in layers on the spools, the proximity of one section to another does not affect the magnetism in either section. An interesting feature of this device is that, unlike the phonograph or phonofilms, visibly there is no change in the wire. The wire keeps its own weight, size, shape, appearance, and physical strength and what happens is within the wire in the form of magnetic "lining up" of the molecules.

After the record is made, the wire is again passed through a magnetic field at the same speed and direction. This magnetic field this time is affected by the permanent magnetism of the steel wire and electric energy is created that corresponds to the signal previously recorded. The output of this field is applied to the audio amplifiers and a duplicate of the program is heard as loud as desired and as clearly. In this system there is the advantage of being free from mechanical or other noises as in the phonograph. A program recorded without interference, when reproduced gives out all of the familiar tones and characteristic styles of the announcers.

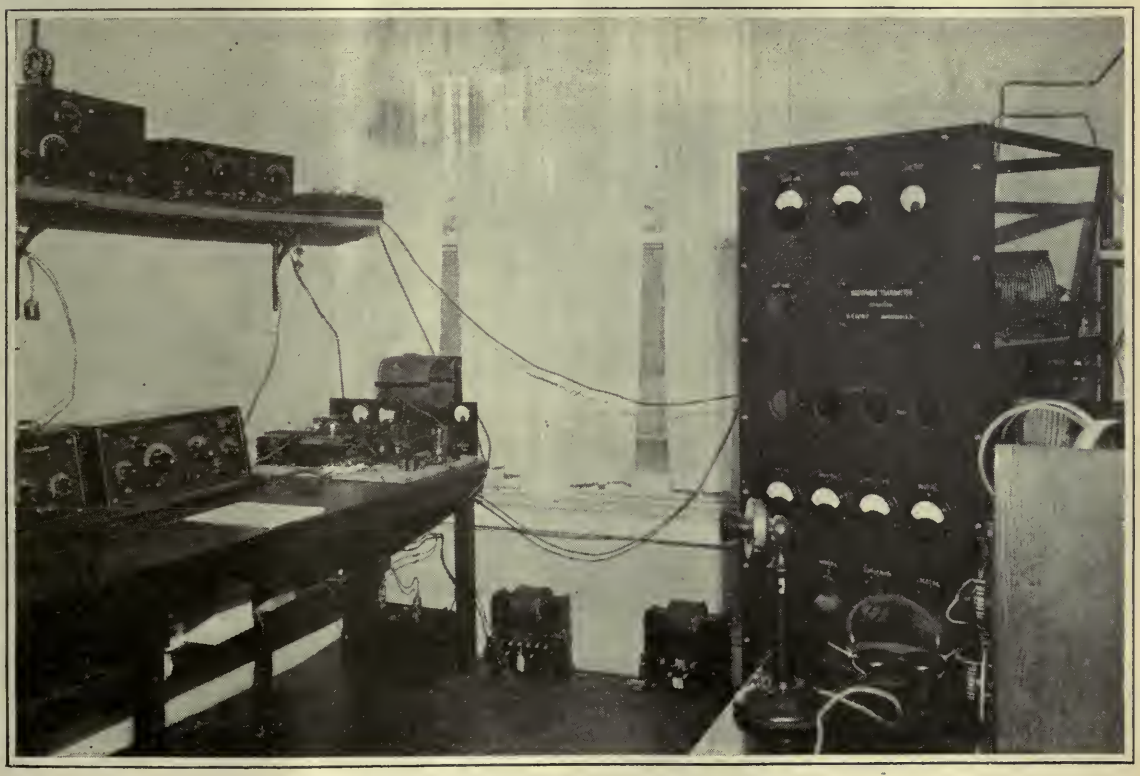
In making radio programs, the amplifier-control panel which we have developed, and the recording unit are connected to a receiving unit. In our experimental work, an ordinary

tuning circuit with detector was used, the output of which was applied to the amplifiers and then into the recording unit. For ease of control and simplicity of circuits, we found it best to use a three-stage power amplifier circuit with Western Electric type 216-A tubes and specially designed transformers.

PRESERVED PROGRAMS

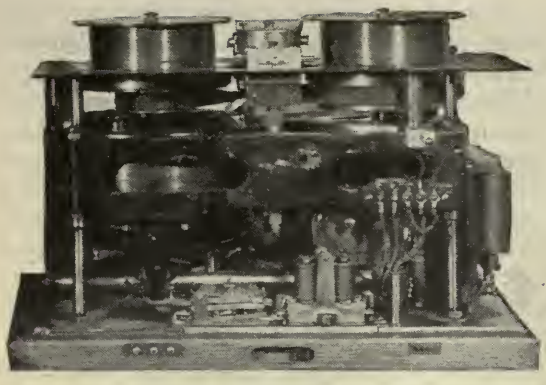
THE recording unit requires very little energy to make a record and in the case of local stations the volume was cut down in the tuning circuit to that required for the recording. This method was found to be more desirable than putting in jacks and plugging in less amplification for these powerful signals. When long-distance signals were recorded the tuning unit was worked to its full extent. It was often found that in recording from extreme long distances where the signal just came to audibility that the reproduction from the steel wire was much louder than could be accomplished in the radio reception itself and thus the device could be used as a booster of signals. It can readily be seen that a device of this kind would be of great value in long-distance radio telephone work in verifying reception and giving a means of checking some part of the conversation that was questionable due to some unlooked-for interference in the receiving room or otherwise. The control panel permits listening to a radio program while the record is being made, as the loud speaker can be cut in on the output side of the amplifier in shunt with a properly designed transformer that couples the amplifier to the magnetic field of the recorder.

Reproduction of a program is accomplished by applying the energy generated by the magnetized wire to the input of the three-stage amplifier. This is accomplished through a simple switching system which throws the transformer, that was used to couple the output of the amplifiers as the time records are made, to the input transformer of the amplifiers. It can therefore be seen that a minimum of apparatus is used considering the different operations of recording and reproducing. The same amplifier tube circuits are used for both



THE EXPERIMENTAL TRANSMITTER

At the Seigle laboratories. Reproductions of the recorded radio programs are frequently sent out on this amateur broadcasting station, of 200 watts power, known "on the air" as 2 BOH



THE RECORDING UNIT

The received audio-frequency energy is fed to this device where it is recorded directly on the thin iron wire shown wound on the spools at left and right. Three and one half miles of wire can be wound on them, which will record a radio program thirty-five minutes long

duties and also the same coupling transformer. The loud speaker can be used when a record is made and during reproduction of a program.

The amplifier-control panel is also designed so that it is capable of running the recording unit. The panel has three buttons which when pressed operate relays in the recording unit. The machine can be made to run in a forward direction for recording or reproducing. It can be stopped by pressing a button or it can be run backward so that it rewinds the recorded program and places it in a position again to be run forward for reproducing. In order to save time, the wire when being run backwards travels at twice the recording speed. The record can be listened to while it is running backwards at this high speed and some very amusing results are obtained. In some instances we have found that musical programs running backwards actually give out pleasing harmony.

SECRET BROADCASTING POSSIBILITIES

THE possibilities of secret radio telephone transmission also come within the scope of this device as it would be a simple matter to transmit a voice record backward and at a different speed than when recorded. Then at the receiving end, make a record with a machine running in the same direction and speed as the transmitter and when reproducing regulate these points so that they again correspond to the recording condition. Any one desiring to "tap in" on such radio transmission would have to develop similar machines and synchronize them completely.



WGY COMING IN OVER THE LOUD SPEAKER

W. R. Seigle, owner of the laboratories, where development work is now being done with the Phonowire, is standing with the microphone, and I. R. Lounsberry, in charge of the laboratory, is at the left. The recording device is at the right, the amplifiers in the large center cabinet, and the radio receiving apparatus at the extreme left



TALKING THINGS OVER
J. J. MacDonald, a laboratory assistant, W. R. Seigle, owner of the laboratory, and I. R. Lounsberry, author of this article

This would indeed be a difficult bit of work and it would, of course, always be possible for those transmitting such signals to change the speeds of their machines from time to time. To the human ear this kind of transmission would be absolutely unintelligible.

In addition to the recording of radio programs, the amplifier-control panel is equipped with a microphone circuit which will allow the making of records of the operator's voice. In this way records may be dated, weather conditions and other things of interest regarding a program may be noted. The instrument as a whole could therefore be used to considerable advantage in checking long test programs of broadcast transmitters. Later one could correctly ascertain what the adjustments on the transmitter accomplished. Such listening tests could be run off at a time when the broadcasting transmitters are not allowed to test and in this way considerable valuable time would be saved and less congestion of the ether result.

The spools which hold the wire are capable of taking three and a half miles of wire and this amount run in a forward direction will permit a thirty-five-minute continuous record. This long record makes it an admirable device for recording public speeches.

THE PHONOWIRE RECORDS IMPORTANT ADDRESSES

WE have had excellent results in making records of President Coolidge which were broadcast from the White House through station WEAF. After the novelty of a certain type of record, such as the substance of a speech, a musical selection or a prize fight, becomes of no further interest, the wire can be cleaned or magnetically erased. This is accomplished by simply pulling a snap switch which is located on the amplifier-control panel and allowing the wire to run either forward or backward. It is also possible, in order to save the time of running the machine for erasing purposes alone, to erase at the same time a record is being made. This results, however, in a slightly inferior record. When a record is erased the wire is passed through a magnetic field of unvarying density and the previous magnetic charge is broken up, making the

wire once more in a condition to have a record accomplished. This recording and erasing has no affect on the physical strength of the steel wire and it will last indefinitely. This is quite an advantage over the cylinder form of phonograph record where part of the wax is shaved off for erasing. This permanency offsets the original cost of the wire which comes in the neighborhood of twenty dollars for spools and wire.

In our experimenting we have often logged a number of different programs from long-distance stations on the phonowire. It is possible by means of an indicator, which is also incorporated in the amplifier-control panel, to make notes of what stations and nature of programs are recorded on the different portions of the three and a half miles of wire. For instance, the indicator reads from zero to one hundred and WGY orchestra may be recorded from zero to fifteen, WTAM with jazz music from fifteen to thirty, WEAF with a talk by some eminent person thirty to fifty and so forth. While the record is being made, these positions may be noted by pencil and then later the operator will know just where to run his wire to get the type of program he desires. This indicator works in synchronism with the spools on the recording unit and will also work backwards when the wire is being rewound.

PRACTICAL APPLICATIONS

THE long-record feature together with the fact that this device works on the magnetic principle, places it within the range of a number of practical applications. It could be used to great advantage in educational institutions where the assembly halls of schools were equipped with the amplifier-control panel and recording unit. Speeches, music, lectures, all sorts of programs of educational value can be reproduced by this method right in the class room. These lectures and educational features could be sent in the mail and rotate around to the different schools. This lecture feature could easily be worked in conjunction with illustrated lectures where stereopticon slides were used. It would place the prominent lecturers in touch with a much larger field and at the same time mean a considerable saving of time and traveling expense. This method has already been used in medical work where permanent records of cardiac and respiratory sounds have been made and reproduced. In this work a sensitive microphone together with a stethoscope is used for picking up these sounds and then the "signal" is put through the amplifier-control unit and recorded in the same way as described for radio recording, and, of course, the record once made would be reproduced in the standard method. Heart and lung sounds have actually been recorded and reproduced so as to fill a large room with their sounds. By means of pick-up systems similar to broadcasting transmitters, records of public lectures, music, court proceedings, and so forth could be recorded and used at will. In our laboratory we have retransmitted radio programs using the phonowire coupled to our transmitting equipment. Thus the device could be used to help the broadcasting station that is located where radio talent is limited by mailing programs taken near some large city with its abundance of excellent talent and then retransmitting the program.

A PORTABLE SUPER-HETERODYNE

COMPLETE description and data for building a portable super-heterodyne using seven UV-199's will appear in an early number of RADIO BROADCAST. *This receiver is highly compact, using standard and available parts, and can easily be built by the average radio constructor. It is an extraordinarily good receiver. Articles on the super-heterodyne have been printed in this magazine since February, 1924. This is absolutely the first workable portable super-heterodyne described in any magazine.*

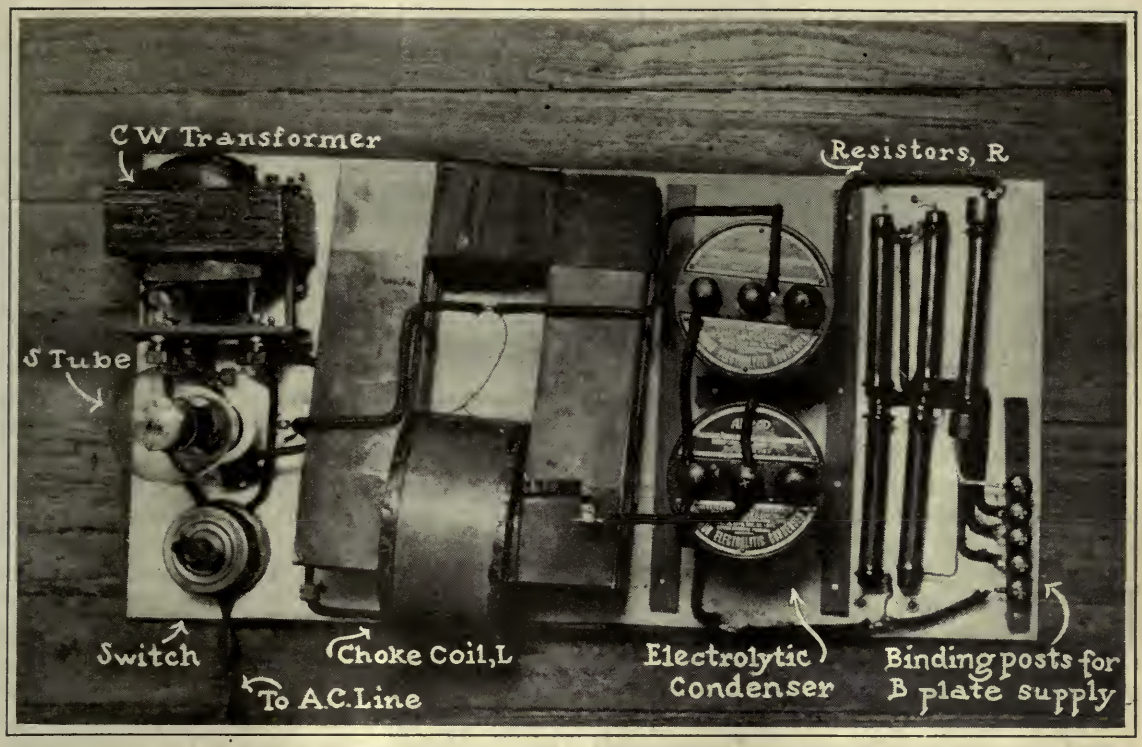


FIG. 1

The experimental layout of the B battery substitute. In most cases, the large choke coil can be eliminated

A B-Battery from Your Lamp Socket

How to Build a Simple Rectifying Circuit Giving Absolutely Pure Direct Current from an Alternating Current Source at a Cost not to Exceed $35—For any Number of Tubes and any Type of Receiver

By C. J. LEBEL

THE radio tendency of late has been toward larger and larger sets. A few years ago the average set used one or two vacuum tubes, and the plate current never exceeded two or three milliamperes. To-day, we have five tube neutrodynes, eight tube super-heterodynes, nine tube super-pliodynes, and power amplifiers of all sizes. The average radio outfit of to-day may consume as much as forty milliamperes. Under such conditions the life of a dry cell B battery decreases enormously. As a result, the purchase of storage B batteries and a special rectifier-charger is often resorted to. This is a rather expensive practice. There is also the inconvenience of frequent charging, and worst of all, some fifty or sixty storage cells to water carefully. The demand for a device to replace B batteries has steadily increased, hand in hand with the increase in the size of sets. Why rectify the current, charge a battery, and then draw current from the battery? This is a highly inefficient practise. It is far better to use the rectified current directly and eliminate losses necessarily associated with the battery. The outfit to be described will supply plate current for as many tubes as the average listener will ever use at once.

No hum can be heard in the phones or loud speaker.

The plate current supply outfit consists of few parts, and is easy to assemble. However, it would be well to group these parts, and explain their functions so that the reader may thoroughly understand the principles of rectification and filtering.

First there is the transformer (T in the circuit diagram). Inasmuch as the average house current is supplied at 110 volts, A. C., it is necessary to step it up somewhat. This the transformer does. The theory of the transformer is too well known to need explanation. It suffices to say that the output is at a pressure of 500 volts. If this A. C. were to be sent directly to the set, the only result would be a terrific hum, and the set would not operate.

HOW THIS ARRANGEMENT WORKS

HOWEVER, the alternating current is passed through a rectifier (S) which changes it to a pulsating direct current. The average reader is probably not familiar with the action of the rectifier employed by the author—the Amrad "S" tube. The principle of operation is quite new. The shape of the two electrodes (anode and cathode) is such that the helium gas in the tube can ionize only when the current tends to flow in one given direction. As the tube can conduct only when the gas is ionized, rectification results. The reader who wishes to learn more about this most interesting tube is referred to an article on it in the August, 1922, issue of the magazine, *Q S T*. The Proceedings of the Institute of Radio Engineers for February, 1922, may also be consulted.

The pulsating direct current, however, is almost as undesirable as the A. C. (though it resembles more closely the steady direct current delivered by a battery), so it is sent through a unit known in electrical parlance as a filter. The final output is a pure, smooth direct current, at a pressure of 350 volts. The condensers (C) are, likewise, a departure from the conventional types. They are of the Mershon electrolytic type, also an Amrad product, and have a capacity of about 30 microfarads. As every fan knows, the thinner the insulating material between the plates of a condenser, the greater is its capacity. Why not use a dielectric a few thousandths of an inch thick? Ordinarily, mechanical difficulties interfere. Howard Mershon solved the problem by using an aluminum sheet, covered with an oxide layer, as one plate, the oxide covering as the dielectric, and a liquid in which the aluminum is immersed as the other plate. The nickelled container is the means of connecting to the liquid.

In order that the current may be supplied at any potential from 0 to 350 volts a drop wire (D) is used. This drop wire is the same in principle as the potentiometer, which is a well-known piece of apparatus. Instead of a moving contact, however, a fixed resistance is employed, divided into sections so that the voltage drop across any amount of resistance may be selected.

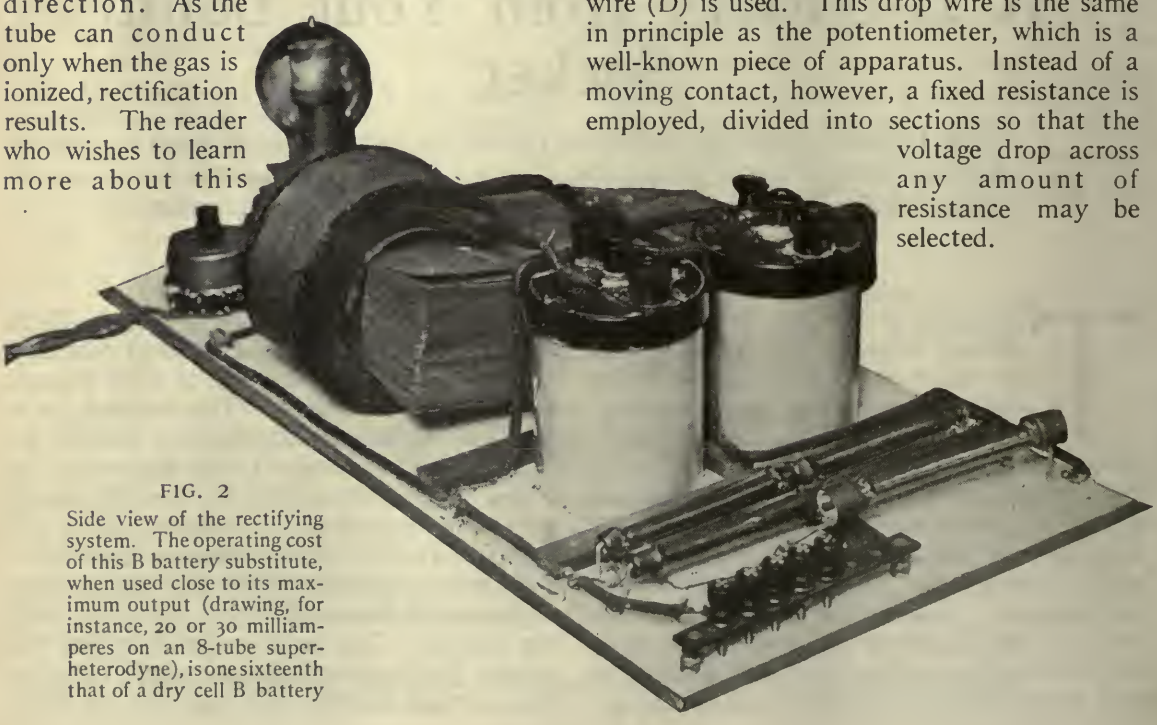


FIG. 2

Side view of the rectifying system. The operating cost of this B battery substitute, when used close to its maximum output (drawing, for instance, 20 or 30 milliamperes on an 8-tube superheterodyne), is one sixteenth that of a dry cell B battery

VALUES OF THE PARTS

THE transformer (T) has an output rating of 500 volts, 100 milliamperes. Its construction is so difficult that the man without adequate facilities, the average fan, is advised to buy a 75 or 100 watt C. W. transformer. The expense is not great.

The inductance L has a value of 30 henries. Here, again, the construction is somewhat difficult, and it would be well to purchase it. Under some conditions it is possible to omit the inductance (L) from the circuit without decreasing the effectiveness of the filter to a perceptible degree.

For the sake of the technical man who has the facilities to construct it, the specifications of the choke coil, L, are as follows:

CORE

Cross section 2" x 2"
Long core piece 2" x 5.5"
Short core piece 2" x .95"
Wt. 14 lbs.
Material 14 mil, or thinner silicon steel
Air gap $\frac{7}{64}$"
All butt joints

WINDING

No. 30 enamelled wire
Wt. 1 lb. 6 oz.
4100 turns
B 18,000 lines to the sq. in.
Permissible continuous overload, 10 per cent.—for short time, 25 per cent.

It is by far the best practice to use an Amrad S tube as a rectifier. Having no filament, it cannot burn out, and the wiring is very simple. The ordinary porcelain incandescent lamp receptacle is used as the socket. Under special conditions it may be necessary to use another type of rectifier. In such a case, a 20 watt kenetron, type UV-216, may be used. The filament winding on the transformer should be of the value of 7.35 volts. The number of turns must be determined experimentally, though it probably will be about 25. The outfit will work as well in either case, inconvenience and limited life being the only objectionable features of the kenetron.

The potentiometer must be capable of carrying 50 milliamperes continuously. The neatest way to build it is to order a 20,000 ohm type C Ward-Leonard resistor, tapped at 1000, 1400, 3000, 6000, 15,000, 20,000 ohms. This will give plate voltages from 20 to 350 volts, in small steps.

The next neatest, but equally efficient method, is to assemble it from standard Ward-Leonard or any of several makes of lavite resistance units. The cheapest method is to use a carbon rod with movable wire loops for connection. The fan who would like to try such a method should write Joseph Dixon & Co., the graphite manufacturers located in Jersey City, for information.

When buying these parts do not go to a "gyp" radio shop. They are never carried there. A shop run by an amateur, or an old firm which has handled radio apparatus for some time will carry them in stock, or can get them very promptly. So, if you are told by the proprietor of a radio store, as I was told by one, that he never heard of such apparatus before, set him down as one who is a salesman, not a radio man, and patronize more reliable stores thereafter.

Having gathered the parts, hook them up as shown in the diagram. Unlike most radio

Simplifying Radio

The need for replacing B batteries often diverts the attention of the experimenter with a laboratory full of receiving sets with varying numbers of tubes—and very often decidedly limits his field of experiment. There is an undoubted need for a simple and not too-expensive device to rectify and smooth alternating current from the usual household 110-volt lines so that it will be suitable for use as a plate supply. This supply must be free from "hum" or "ripple," as well as constant in voltage, dependable, and cheap. This arrangement described by Mr. LeBel meets all these requirements. It can be used as a 350 volt supply for one or two five-watt transmitter tubes as well.—THE EDITOR.

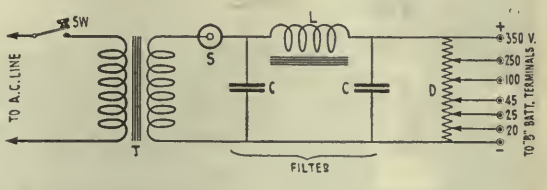


FIG. 3

The circuit for connecting the rectifying arrangement using the S tube. The choke coil L can be made by the constructor with the facilities according to specifications in the accompanying article

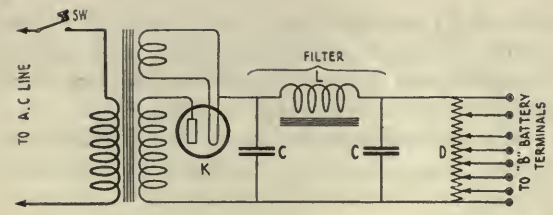


FIG. 4

The circuit of Fig. 3 altered for the kenetron tube as rectifier. The values of the parts remain substantially the same. Note the extreme simplicity of both arrangements

hookups, this is simple. Be sure to fasten the 350 and 500 volt wires firmly. One suggested design is shown. The only necessary thing is to keep the transformer and choke coils at right angles. No other special precautions need be observed.

This outfit is as near fool-proof as anything made by human hands can be. If the outfit fails to operate, look first for poor connections to the coils. If this produce no result, test for open circuits. Next, test the resistances for "opens" or short circuits. As a last resort, replace the S tube by another, to see if the first is defective. For the first hour or so of operation of the condensers they will have to "form," and as a result both condensers and transformer will probably run hot. After that period, however, they will cool off, and stay formed indefinitely.

In conclusion, I should like to emphasize the versatility of this plate supply outfit. It will supply any voltage up to 350, and any reasonable current. This means that the number of sets that a fan owns is limited by his pocketbook, and the room available, not by how long his B batteries will last. To the man who has learned the code, and has a small transmitter, I should say that this outfit, minus the drop wire, will supply one or two five-watt "bottles." The C. W. produced will be so pure that interference with the neighboring receiving sets will be nil. So the man who builds this apparatus will find that his time was spent in the best possible way.



HOW A CONNECTICUT RADIO SHOP COÖPERATES WITH LOCAL RADIO AMATEURS

The Lyford Company, Torrington, Connecticut, owners of this shop, recently conducted a prize contest for the best home made receivers

Radio—A New Field for Investment

An Analysis of the Industry and Three Companies Whose Shares Are in the Public Eye

By JOHN MORROW

THE radio industry in the United States is still young enough, still so exuberant as to make a few statistics of its growth interesting rather than wearisome. According to Vice President Sarnoff of the Radio Corporation, the public will be spending $500,000,000 a year on radio within a few years. It is estimated that $150,000,000 was so spent in 1923.

Just a few years ago it was predicted that the growth of the wireless industry would be slow, because it was thought then that progress depended upon the development of wireless for commercial messages, mainly transoceanic. Then came broadcasting, and with it the revolutionizing of the industry. At the present time there are about 600 broadcasting stations in the United States, of which about 10 per cent. are important. The number of radio sets is estimated at 2,500,000, which means a daily radio audience of perhaps 10,000,000 persons.

Within five years it is estimated that these audiences will increase fivefold. At first it was predicted that radio was going to be a craze—that it would soon die out, amount to little. Now the same prophets realize that the industry is more or less a serious competitor of the phonograph business and the moving pictures. Naturally in a new industry where there is so much experimentation to be done; where fresh discoveries are made almost by the minute, there is bound to be constant change and what may be regarded as instability; but it is the instability of growing pains.

From a corporate standpoint there are not many soundly established companies that depend for all their revenues upon the radio. The big manufacturers of electrical equipment were quick to see the possibilities in the manufacture of wireless sets and parts and became interested in what is now the Radio Corporation of America, and recognized as the leading company of its kind. Two other smaller corporations which recently have come into prominence, and which are attracting quite a little speculative attention, are the Hazeltine Corporation and Dubilier Condenser. These companies are purely manufacturing concerns, are new, but progressing along proper lines. In a pioneer industry it is, of course, not possible to have an opinion on stocks representing that industry backed up by a mass of statistical and historical data, but the radio business has grown so fast that public participation in those radio stocks which are upon the open market is increasing to substantial proportions, mainly because of the known facts of the developments in the industry as a whole. Therefore, an attempt to line up and to individualize the best known companies appears of pertinent interest.

RADIO CORPORATION OF AMERICA

WHEN the Radio Corporation of America was incorporated in October, 1919, practically all of the assets of the Marconi Wireless Telegraph Company of America were purchased, and the latter company dissolved. At that time, while the War had given a great impetus to wireless communications, operations were confined to interchange of messages largely between ships and shore, and even the interchange of commercial messages was small.

As late as 1921, the gross income of the Radio Corporation was five million dollars. In 1923, the gross income was more than twenty-six million dollars, and of this total more than twenty-two millions came from the sales of radio apparatus. It is obvious that the whole nature of the business of the Radio Corporation has been revolutionized in the last three years. The company operates nine international radio communication circuits with the leading European countries, and with Japan. The rates of transatlantic commercial messages are on even terms with cable rates, but on the Pacific Coast the wireless rates are somewhat lower than those of the cables. It is expected that China will soon be added to the list of international communication circuits.

Another branch of the business is radio service between ships and shore and the sale and rental of radio equipment for use on ships of American registry. However, to show what a

small proportion of the total revenue is derived from this department, may be cited the fact that the gross total for 1923 was less than one million dollars.

Early in 1924, the Radio Corporation put a complete new line of receiving sets on the market with prices ranging from $30 to $425. Without going into technicalities, it may be said that the prime object of the apparatus is to eliminate the increasing amount of interference in the ether and to simplify operation so that the novice can enjoy broadcasting entertainment, which is fast becoming a feature in American homes.

There is, of course, considerable expense incidental to the maintenance of the large broadcasting stations such as the Radio Corporation operates, but the company feels that these activities are justified because they are really essential to the development of sales of radio apparatus.

When the Radio Corporation of America was organized, the General Electric was prominent in the organization and really was one of the prime movers. A year ago, the General Electric was the largest individual stockholder, holding almost two million shares of common and six hundred and twenty thousand shares of preferred. The Westinghouse Electric was the next largest shareholder; followed by the American Telephone & Telegraph and United Fruit Companies. During 1923, it was understood that both the General Electric and the United Fruit sold some of their holdings, while the American Telephone & Telegraph liquidated its entire shares. A majority of the outstanding stock is not held by the big electrical equipment manufacturers, but naturally they exercise a considerable influence.

Is There Any Money In It?

When wireless first dawned on an unbelieving public back in the early years of the present century, many were the stocks sold in many companies which made claims which, in those days, were to say the least extraordinary. And many were those who fell by the financial wayside. The public thought that the great claims made for this marvellous new science were going to come true and their dreams of untold wealth would materialize. They didn't. Then came the skeptics who were sure no one could make any money out of radio investments. Very little stock was sold—generally speaking—between 1912 and 1921. But when broadcasting came into being, the story was different. Mr. Morrow reviews the present investment situation quite ably, we think. He does not attempt to cover the field completely, but he analyzes the three concerns receiving the chief present attention.—The Editor

CAPITALIZATION AND EARNINGS OF THE R. C. A.

THE capitalization of the Radio Corporation of America has been unwieldy. There are outstanding almost four million shares of preferred stock of par value of $5, and nearly six million shares of common stock having no par. At no time has there been a funded debt. Early in May of this year, stockholders approved a recapitalization plan. By this plan the preferred stock will have a par value of fifty dollars, and will be exchangeable on the basis of ten old shares for one new and the old common stock will be exchanged on the basis of five shares for one share of the new "A" common. When this change is complete it is believed that application will be made to list both classes of stock upon the New York Stock Exchange. The market to date has been upon the New York Curb.

At the time stockholders approved the capitalization plan, J. G. Harbord, President of the company and who incidentally was a Major General with the American Expeditionary Force in France during the War, said the outlook for 1924 was very encouraging. Business to-day is ahead of last year with production still behind orders on the books. There is as yet no basis for determining what is a profitable margin of operations, that is, normal overhead. It may be mentioned that the introduction of a complete new line of radio apparatus at the beginning of this year added considerably to expense, and also necessitated the withdrawal of older sets from the market. It is explained, however, that depreciation charges, figured in the income of 1923, adequately took care of this contingency.

There are only two classes of Radio Corporation of America securities to consider; the 7 per cent. preferred which will have a par value of fifty dollars and which is cumulative from January 1, 1924, and the common. It is now expected that in July of this year dividends upon the preferred, covering the period from January first, will be paid. To pay 7 per cent. upon the proposed amount of outstanding preferred stock, as it will be when the recapitaliza-

tion is effected, will require approximately 1.4 million dollars. Net income in 1923, after all proper charges, was about 3 millions, or more than twice annual preferred requirements. Assuming that dividends will be instituted within the next month or two, the preferred stock is selling to yield almost 9 per cent. at the annual rate of 7 per cent. To be conservative, the stock is a promising semi-speculative commitment, suitable for those who can afford the risk.

There is no apparent thought of a dividend on the common stock at the present time, and it is frankly speculative. On the new basis it is selling equivalent to less than 20, and at that level has not altogether discounted the establishment of the preferred in the dividend ranks. The outlook for the stock primarily depends upon the continued growth of the radio industry, but even with present volume it is demonstrated that the junior shares can show an earned surplus, and the prospects seem more than fair for larger volume and increased stability.

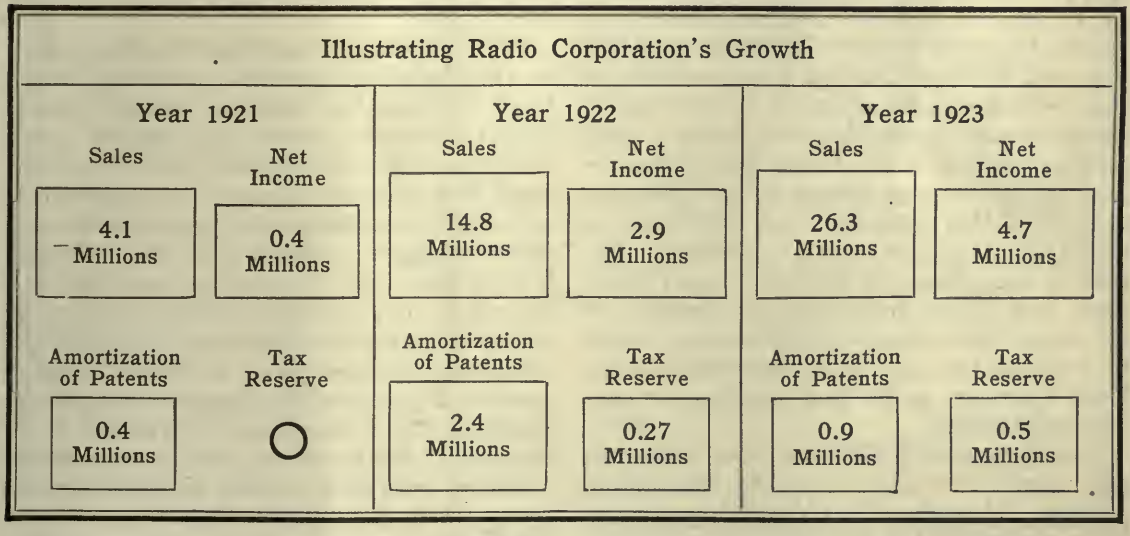
HAZELTINE CORPORATION

WITH proper sponsorship it has already been demonstrated that the public will buy radio securities. The growth of the industry is enough to inspire the imagination and to make pretty plain the fact that a big field for profits is rapidly being opened up.

The Hazeltine Corporation has been in existence but a few months, and in that period revenues have grown from nothing. The Hazeltine Corporation is the sole exclusive owner of the trade marks "Neutrodyne" and "Neutrodon" and all the patents covering these developments. The corporation takes its name from Professor L. A. Hazeltine of Stevens Institute, who is the holder of the patents which the corporation controls. There are no other large assets, no plants, no physical possessions.

When the Hazeltine Corporation was formed, the Independent Radio Manufacturers, Inc., was also organized. This association consists of some thirteen radio equipment manufacturers, and these thirteen have exclusive rights to manufacture and sell the Neutrodyne Receivers, Neutrodon Condenser and Neutroformer coils and will pay royalty to the Hazeltine Corporation, based on the percentage of the sales value of equipment.

Commercial production of Neutrodyne receivers began in the summer of 1923, and five of the thirteen manufacturers were in substantial commercial production at the beginning of the current year. Back in January, it was estimated that the gross sales by the licensees manufacturing Neutrodyne apparatus for the first quarter of 1924 would approximate 5.6 million dollars. It is reported that actual sales for the first three months of 1924 exceeded



FROM 1921 TO 1923

The Radio Corporation of America has shown extraordinary growth. The table shows that the increase in sales has been accompanied by a proportionate increase in net income. Brokers are of the opinion that the future listing on the New York Stock Exchange of both preferred and common stocks will do much toward broadening investment interest in the radio industry

The Position of the Hazeltine Corporation

— Year 1924 —

Capitalization	Estimated Earnings Per Share	Recent Quotation	Earned on Market Price
175,000 Shares	$3	16	18.7%

THE HAZELTINE RADIO CORPORATION

Controls the manufacture and sale of the neutrodyne receiver. Their stock has received considerable attention from the radio investor

the estimate by 2 million dollars. This rather startling growth may be better emphasized by comparing the sales of the first three months of this year with the sales for the quarter ended September 30, 1923, when the total was less than 500 thousand dollars. Furthermore, sales for the first quarter of 1924 do not represent the activities of the entire thirteen licensees, as not all of them were in production. No estimates are available to show the actual earnings of the Hazeltine Corporation from the royalties received, but it has been estimated that for the current year the corporation ought to earn at least $3 a share upon the 175 thousand shares of capital stock outstanding.

LITIGATION

WHERE there are patents, particularly patents in a new and unstabilized industry, there are likely to be law suits, litigation, and already Hazeltine Corporation is at odds with a well known radio manufacturing company—the Freed-Eisemann Radio Corporation. Early in April, Hazeltine brought injunction proceedings against Freed-Eisemann to prevent that company from continuing to manufacture certain radio appliances. The trial of the action will probably occur fairly soon, and in the meantime by direction of the court, the Hazeltine Corporation must turn over to the court all monies received from Freed-Eisemann to be held pending the outcome of the trial.

Freed-Eisemann is alleged to have refused to pay royalties for the use of the Neutrodyne patents. The value of the Neutrodyne patents is not a question, but the case seems to revolve around the point as to whether the Freed-Eisemann people should pay royalties on a complete receiver or only on patented parts. The impounding of the royalty money, pending the outcome of the suit, may upset to some extent estimates of Hazeltine's earnings, but it does not appear as if the litigation is basic or in any way threatens the operations of the Hazeltine Corporation in the use of the Neutrodyne patents.

EARNINGS POSSIBILITIES

HAZELTINE CORPORATION has outstanding 175 thousand shares of stock, of which 140 thousand shares were offered for public subscription at 10 dollars a share. The issue was oversubscribed. The offering houses are well known members of the New York Stock Exchange, and in view of all the circumstances the new company was considered to have conservative and well based sponsorship.

When the corporation was formed it had no funded debt, notes, bank loans or other usual and ordinary corporation liabilities. Obviously, it is impossible to present statistics to prove that the shares of the Hazeltine Corporation are either one thing or the other, but it can be shown that since the stock was sold early in the current year, it has maintained a price upon the New York Curb well above the public subscription price of 10 dollars a share, and the current market appears to be a natural one.

It is intersting to note that the radio shares on the Curb have moved against the general trend of speculative securities prices since the first of the year. There is nothing said about the possibility of a dividend upon Hazeltine stock, but operating expenses will be nominal and, under the circumstances, stockholders can expect a larger proportion of per share earnings than is usual with the ordinary manufacturing company. In an industry which has moved as fast as the radio industry it is impossible to anticipate developments. It is possible that someone might develop apparatus which would supersede the Neutrodyne receiver and limit the market, but those who are interested in the company believe it is very improbable that there will be a radical development to offset the Neutrodyne receiver in usefulness, simplicity, and efficiency.

Obviously the shares of the Hazeltine Corporation are speculative. There has been no

attempt made to show that they are not. The stock is up considerably from the offering price, but it has no discounted entrance into the dividend paying class, and it would seem within the range of possibilities that later in 1924 a rate of, say, $2 might be established.

There is no promise on this point, but the trend of earnings is pronounced enough to invite the speculative assumption that at current levels the shares have certain possibilities as a purchase for those in a position to assume speculative risks of this character.

DUBILIER CONDENSER & RADIO CORP.

DUBILIER Condenser & Radio Corporation shares have been one of the "sensations," to use a much abused word, on the New York Curb since the first of the year. They have risen from ten dollars a share to thirty-five dollars and, in spite of general market conditions, are still near their top price.

The Dubilier Corporation, as it is constituted to-day, has been in business about two years, and according to all reports is increasing net earnings to a point where the common stock is considered to be in line for dividends. The company owns twenty-three patents issued in the United States, and has made applications for additional patents. The chief product is the Dubilier mica condenser. This fixed condenser ranges in size from those a little larger than a postage stamp to condensers more than six feet high.

The Dubilier condenser was perfected during the World War by William Dubilier, an American engineer. The Dubilier condenser revolutionized condensers from the ones used prior to 1915, but it did not come into wide use until the amateur radio craze developed.

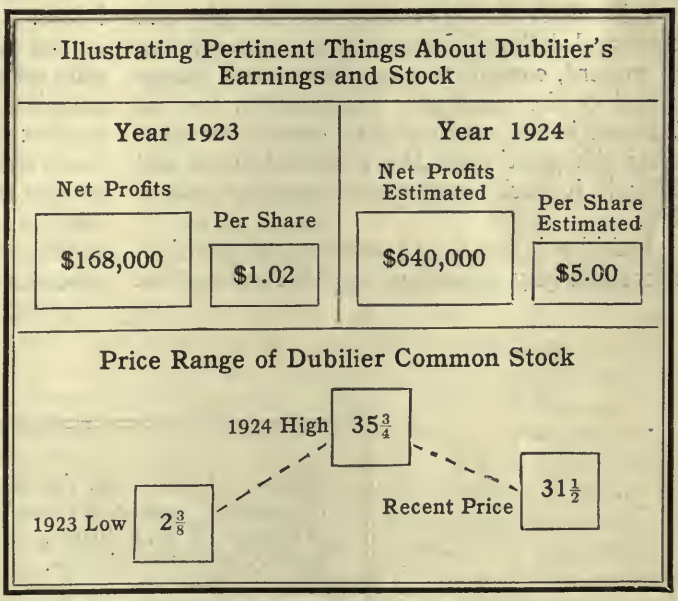
GROWTH OF EARNINGS

DUBILIER has its own factory located in New York City, and early this year output of condensers is said to have been twenty-five thousand a day. The manufacturers of Neutrodyne receiving sets are large users of the Dubilier condenser, and the development of the "neutrodyne" sets has been a big earning asset to the Dubilier Company.

Dubilier devotes its entire operations to the manufacture of radio devices. It does not make complete sets. To give an idea of the price range of its products, it may be mentioned in the twelve months ended April 30, 1923, gross receipts were made up of radio parts which sold from thirty-five cents to five dollars each. In those twelve months, sales amounted to 516 thousand dollars. In 1923, net sales were 726 thousand, and it is currently reported that since the first of January, 1924, sales have been running at the rate of more than one million dollars a year.

The margin of profit seems to be most satisfactory. A margin of 20 per cent. was indicated in 1923, and in some months so far this year, a margin of more than 30 per cent. is indicated. It is stated that the company devotes a substantial part of earnings to research and experimental work, but exact figures are not available. In the year ended December 31, 1923, earnings were equal to about one dollar a share on the outstanding common stock, which was not remarkable, and which did not indicate anything except to those who were especially close to the company's affairs.

As a matter of fact, practically all the outside interest in Dubilier has been created during the last four months. If current estimates of monthly earnings are correct, earnings on the



THE DUBILIER CONDENSER AND RADIO CORPORATION

Is another large radio concern whose stock interests the investor in the radio market. Like all radio stocks, it has been in the field only a very short time

common stock must be running along at an annual rate of about five dollars a share. The per share figures themselves are not as impressive as the fact that the company showed a net profit of less than 100 thousand dollars for the year ended April 30, 1923, but may show a net profit of three quarters of a million dollars this year.

Recently it has been reported that Dubilier will put on the market a new patent radio device which will add substantially to earnings. It is well to remember, however, that when a stock enjoys a rise like that enjoyed by Dubilier common, and when earnings apparently are making such remarkable strides, there are likely to be all sorts of reports about expansion. A growth in business, as demonstrated by the success of known production, is enough ground for recognizing the possibilities which the stock possesses. This does not mean that the company may not introduce any new radio devices to a waiting market; it is stated to show that it is not necessary to look for some mysterious revolutionary product to explain the appeal which Dubilier stock has made, assuming that the estimates of earnings are to be taken at face value.

Dubilier has eight per cent. cumulative preferred stock of 390 thousand dollars preceding the common. Dividends have been paid upon the preferred for a year and a half, but the total requirements on the senior issue are only 31.2 thousand dollars, and as earnings are running at present, constitute a relatively small charge ahead of the common. Incidentally, the big increase in net revenues has greatly strengthened the position of the preferred stock and brought it much nearer to an investment standing.

Dubilier is purely an earnings proposition, success largely depending upon the work of the engineering force to keep abreast of new developments in the industry. To date, the management has proved its right to be considered entirely competent in a field which is highly technical. The market for its products is much broader than it was two years ago, and judging by the increased interest in radio, limits of distribution have by no means been reached, or perhaps even approached. The common stock, of course, has discounted the change in earnings and is now apparently approaching the point where dividends may be considered, possibly at the annual rate of three dollars. On that theory the shares are a speculative purchase on a good-sized reaction. It should be considered, in any case, however, as nothing more than a speculation and should not be bought except by those who can afford speculative risks.

In conclusion, it is pertinent to point out that all the securities representing the radio industry are still in the speculative class, which is to be expected in view of the recent origin of the industry. For that reason, it is considered inadvisable for any one to purchase these securities, regardless of their outlook, unless the speculative nature of these issues is clearly recognized.

While it is true that great profits have been made by investment in securities in their early stages, it is also true that there have been great losses.

The radio stocks, herein analyzed, undoubtedly represent the best of their class. Nevertheless, their speculative nature militates against their being given our whole-hearted endorsement. Our purpose has been merely to outline the position of the industry and securities. It is consequently for those who are in a position to assume speculative risks to say whether they should make the commitments.

"Radio—A New Field for Investment" is reprinted from a late number of the Magazine of Wall Street, *through the courtesy of that publication.*

Radio Broadcast's Knock-Out Four-Tube Receiver

By JOHN B. BRENNAN

LAST year Walter Van B. Roberts did a considerable amount of independent investigating with various circuits and about the first of this year, evolved the arrangement which has gained unusual popularity as the Roberts circuit. That circuit, as most everyone now seems to know, if we are to judge by the tenor of the enthusiastic correspondence piling into the office daily, is sensitive, selective, uses a minimum of tubes for a long range receiver, and *does not radiate*. The extraordinary efficiency of this set is caused by its use of reflexing, regeneration, and proper tube-neutralization. Mr. Roberts described his set in this magazine for April and May. Two construction articles appeared on the receiver, one by Zeh Bouck telling how the circuit might be used for very short-wave reception, and the other by J. E. Roberts describing a layout with three tubes in our August number. The receiver described here is without doubt the best, for the constructor who is looking for results, that we have ever seen.—The Editor.

BY DEVELOPING his two-tube reflex circuit, Mr. Walter Van B. Roberts has contributed to radio a receiver of inestimable value and importance. The claims for this receiver made by Mr. Roberts have been fully borne out by the many reports from those who have lost no time in building it, as well as by the further research work conducted by Radio Broadcast's laboratory.

Combining the advantageous features of radio- and audio-frequency amplification through reflexing, regeneration, and neutralization, this circuit is particularly desirable since it does not radiate.

However, an attempt is not made here to repeat the theory of the operation of this circuit as given by Mr. Roberts (Radio Broadcast, April and May, 1924), but to supply the radio fan with the data sufficient to enable him to construct this receiver with the addition of an efficient push-pull amplifier.

The ordinary amplifier unit will not consistently operate efficiently with this receiver unless special corrective features are incorporated to control the resultant distortion, howling, or overloading.

The push-pull amplifier unit has been found to supply the desired stability, faithfully amplifying over the average audio-frequency range without distortion.

When a signal is applied to the grids of the tubes (Fig. 1) by the inductive relation of the primary to the secondary, one grid becomes positive while the other is negative. Naturally an alternate push and pull action of the currents flowing between the plates of the tubes through the primary winding of the output transformer takes place. When the current is increasing in one section of the windings and decreasing in the other it would be expected that the resultant current in the secondary would be small. But the natural polarities of the two sections oppose each other, for the B battery current flows through the end leads of the coils out through the center tap. This causes the two currents induced in the secondary to add up, and the maximum current is delivered to the loud speaker as alternating current.

In the ordinary type of amplifier the current in the plate circuit is pulsating "direct current" with the loud speaker winding in series. When a heavy current is passed through this circuit the diaphragm does not readily respond to the minute changes of current intensity.

By inductively coupling a secondary to the primary and removing the loud speaker connections to the secondary terminals (as in the push-pull unit), the pulsating direct current is transformed to a modulated alternating current.

In the push-pull amplifier, we have a primary delivering energy to two tubes through a split secondary, a C battery to supply the proper negative bias to the grids, a split primary delivering the sum of the output of the two tubes

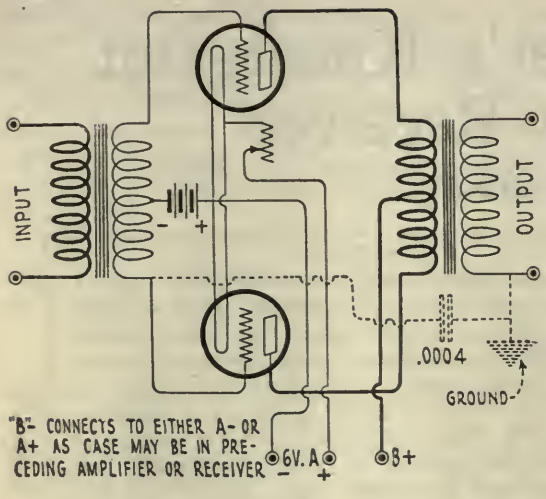


FIG. 1

A standard push-pull amplifier circuit. Usually this unit is used as a second stage but with the Roberts circuit the first audio stage is reflexed and its output passed into the circuit shown here. Exceptional volume and tone quality result

in pulsating direct current, and the secondary delivering alternating current to the loud-speaker. Each one of these features helps in its own way to prevent the possibilities of distortion and overloading.

The value of the C battery varies with the value of the B battery used as the following table shows:

B BATTERY—VOLTAGE—	C BATTERY
80	3.0 to 4.5
100	4.5 to 6.0
120	6.0 to 9.0
150	9.0 to 12.0

It follows, that if the ordinary type of amplifier be added to the Roberts Two-Tube receiver, the resultant signal produced will be greatly distorted unless special corrective measures are incorporated in the general layout. Due to the loud speaker volume produced by the Two-Tube set these corrective controls are frequently ineffective because of the subsequent excessive overloading of the extra stage of amplification and the peculiarities of various transformers.

Taking these obstacles into consideration it was evident that some means of effectually surmounting them would have to be provided. After a series of elaborate tests the push-pull type of amplifier proved entirely satisfactory.

Fig. 2 and the several photos show the general appearance and layout of the RADIO BROADCAST Four-Tube receiver.

MATERIALS

The parts used, with the approximate cost, are listed as follows:

1 Panel 7 x 21 x $\frac{3}{16}$	$2.00
1 Base-board	.50
1 Set Turney Coils	8.00
2 Variable Condensers .0005 mfd. $2.50 ea.	5.00
3 Vernier Dials, $2.00 ea.	6.00
1 Switch Arm	.25
7 Switch Points	.10
2 Switch Stops	.05
4 Sockets, $1.00 ea.	4.00
1 Transformer (ratio approximately 5-1)	7.00
2 Push-Pull Transformers (set)	12.50
3 Rheostats, $1.00 ea.	3.00
2 Jacks (Open and double circuit)	1.25

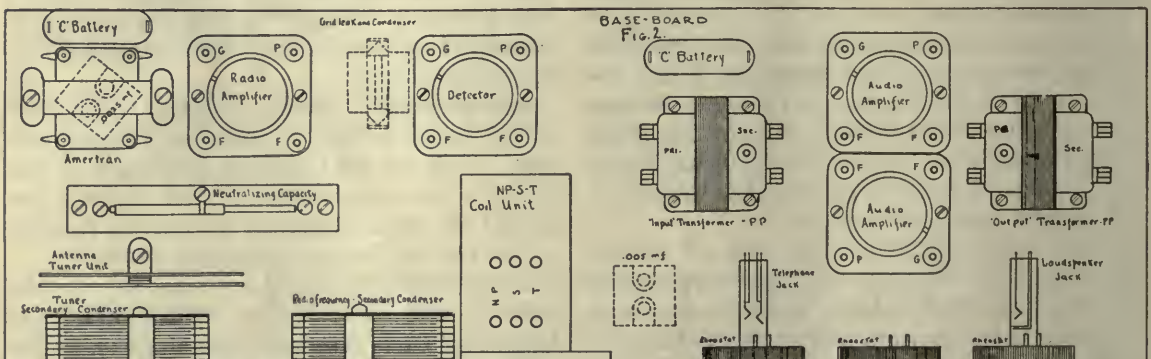


FIG. 2

This base layout shows the general placement, spacing, etc., of the units. On account of the difference in size of the various manufactured parts that may be used, no dimensions are given, which allows the constructor to use his own judgment. Room enough has been allowed for all types of apparatus designed for the functions necessary as units in this circuit

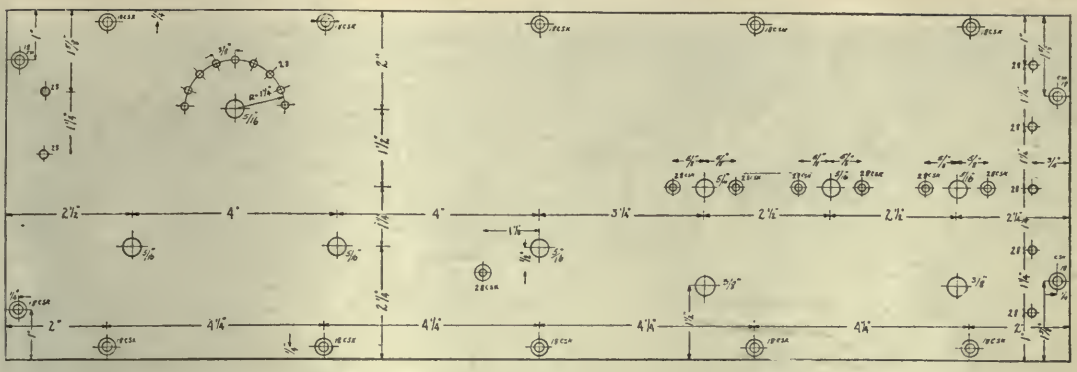


FIG. 3

The panel layout shows the mounting holes on the panel on a small scale, the actual location with dimensions

7 Binding Posts $.20 ea.	1.40
1 Neutralizing Condenser	1.50
1 Grid Leak (3 to 7 megohms)	.60
1 Grid Condenser .00025 mfd.	.40
2 Micadons .005 and .0025 mfd. $.40 ea	.80
2 C Batteries 4½ volts $.40 ea.	.80
—Miscellaneous bus wire—spaghetti—screws—bolts—nuts— lugs, etc	2.00
Total	$57.15

The prices given here are high enough to admit of the purchase of parts of good quality.

PREPARATION OF PARTS

IN PREPARING the various parts for assembly, the tri-coil unit, and the neutralizing condenser require alterations.

That part of the wooden section of the coil mounting protruding at the left (looking at it from the front) and containing the bearing for the shaft of the NP coil control is sawed off flush with the bakelite base. This is shown in Fig. 6. The dial control for this coil is discarded and the separation between the NP and S coils is maintained by the bolt and nut as shown. The coupling between these coils is varied to the correct value by means of this screw and is quite sharp in adjustment, effecting the tone quality and quantity to a marked degree.

The neutralizing condenser must be taken apart and the two lengths of bus wire replaced with one continuous piece. Great care must be exercised in performing this operation so as not to break the glass insulating tubing. If, however, the tubing is broken, a length of spaghetti tubing will serve as a substitute.

Tighten all the bolts and nuts on the sockets to insure a positive contact. This is done by first removing the round knurled thumb-nut and tightening the nut and bolt with screw driver and pliers. In doing this be sure that

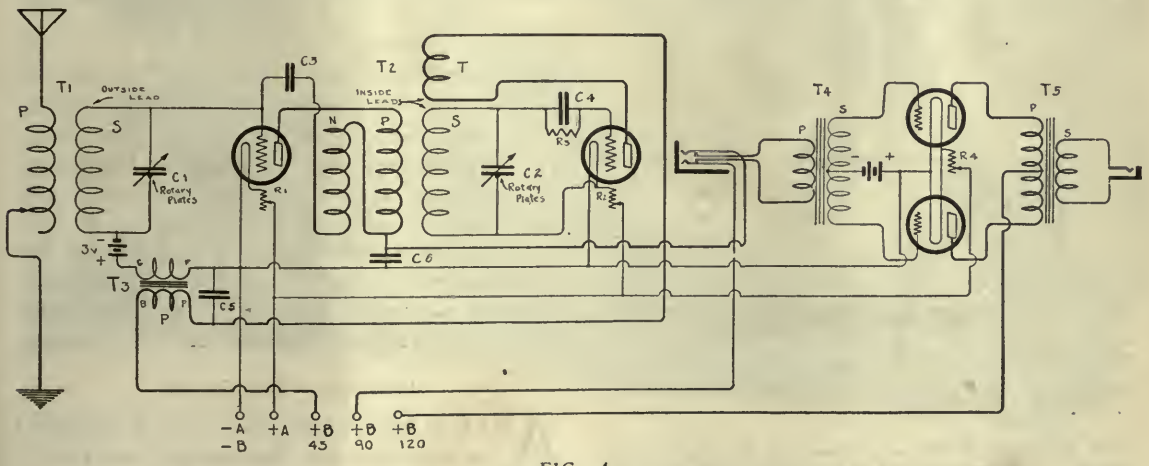


FIG. 4

In this schematic circuit diagram the original Roberts circuit may easily be identified and the push-pull amplifier is also strikingly evident. The left-hand jack forms the dividing line

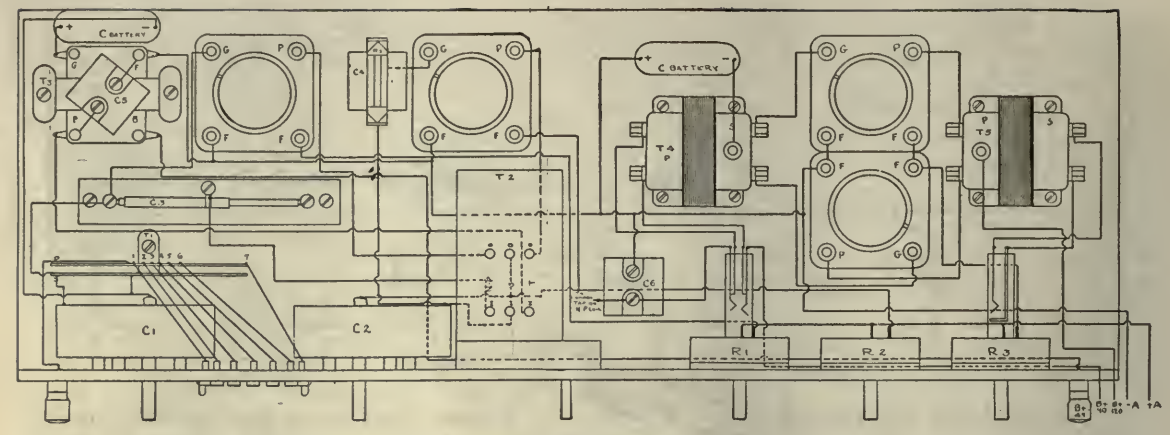


FIG. 5

Shows the actual wiring diagram of the receiver as applied to the base layout shown in Fig. 2. In wiring the set it is advisable to make frequent references to Figs. 4, 5 and 8

the contact blade of the socket does not move out of place.

Lugs are placed at all connection points wherever possible.

DRILLING THE PANEL

TO PREPARE the panel for drilling, lay out the various center points by direct reference to Fig. 3. With a light hammer and centerpunch mark these points and after securing the panel substantially, drill all the holes first with a No. 28 drill. Once drilled, the holes may be enlarged to their proper size. All the holes for mounting the parts on the panel should be countersunk.

The screw holes around the edge of the panel for fastening it to the cabinet are drilled with a No. 18 drill and countersunk. A No. 28 drill is used for the binding post, switch points, coil mount, and rheostat holes. The latter two are countersunk. All center holes such as condenser shaft, rheostat and switch arm holes are drilled with a $\frac{5}{16}$" drill. The jack bushings take a $\frac{3}{8}$" hole. The holes for the condenser mountings obviously differ with the type of condenser used, but for the Duplex condensers a countersunk No. 28 hole is drilled.

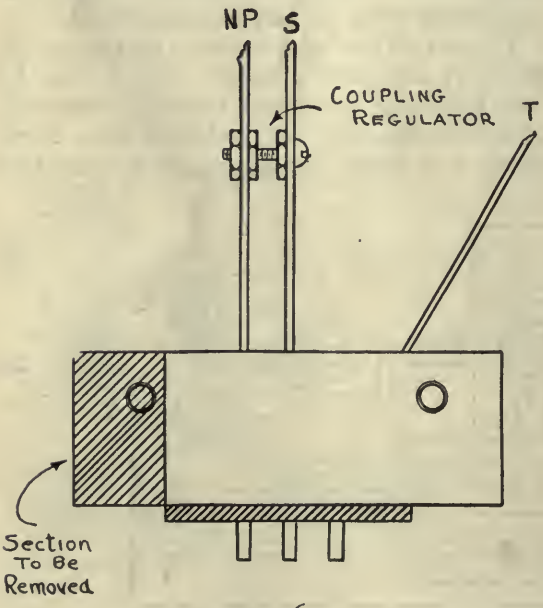


FIG. 6

The alterations of the 3-coil mounting are clearly indicated. The manufacturer of this type of coil has since produced a unit in which similar features have been permanently included. As may be seen by referring to Fig. 9

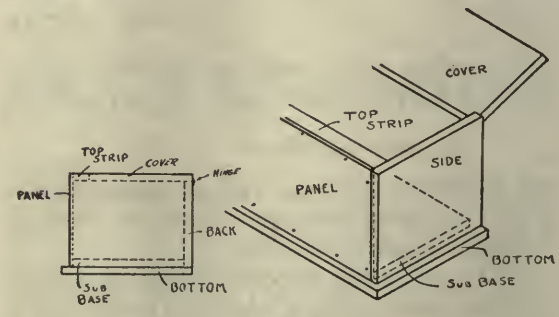


FIG. 7

Although there are many cabinets of standard panel size procurable, the builder may construct his own from the details shown here

GRAINING THE PANEL

A VERY fine panel appearance is obtained by adopting the commercial practice of graining. Firmly fix the panel on a bench or table and with a sheet of No. 00 emery cloth

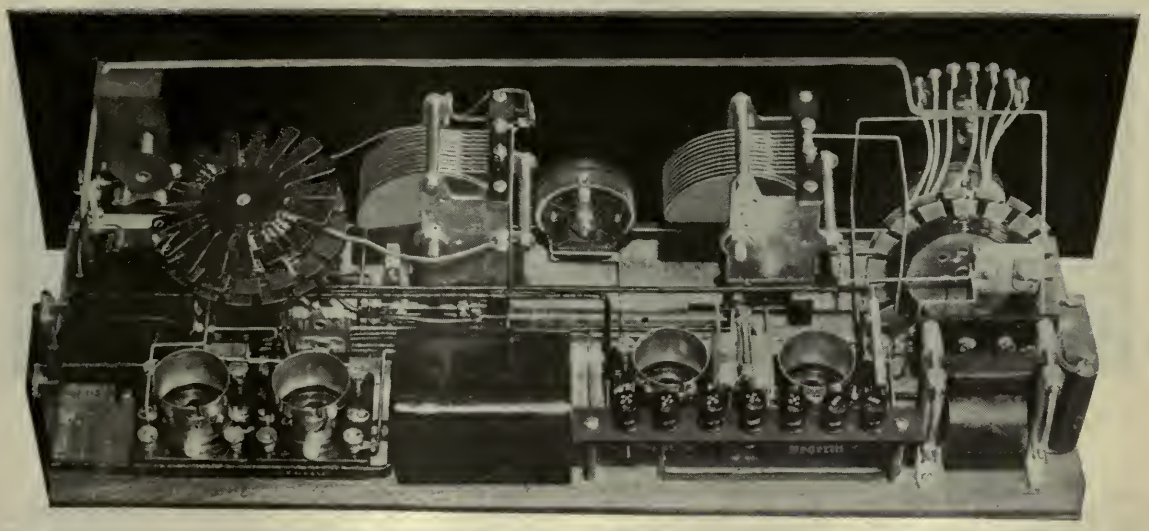


FIG. 9

Another view showing more compact placement and construction, where a standard panel and cabinet have been used. A good job, well done, by the Radio Research Laboratories

wrapped around a block of wood, rub down the panel, removing all the "high lights." The direction of graining is parallel with the long side rather than with the width of the panel. When all surface marks have been removed, a few drops of machine oil may be rubbed in by the same graining process. A finely grained, highly finished panel surface results.

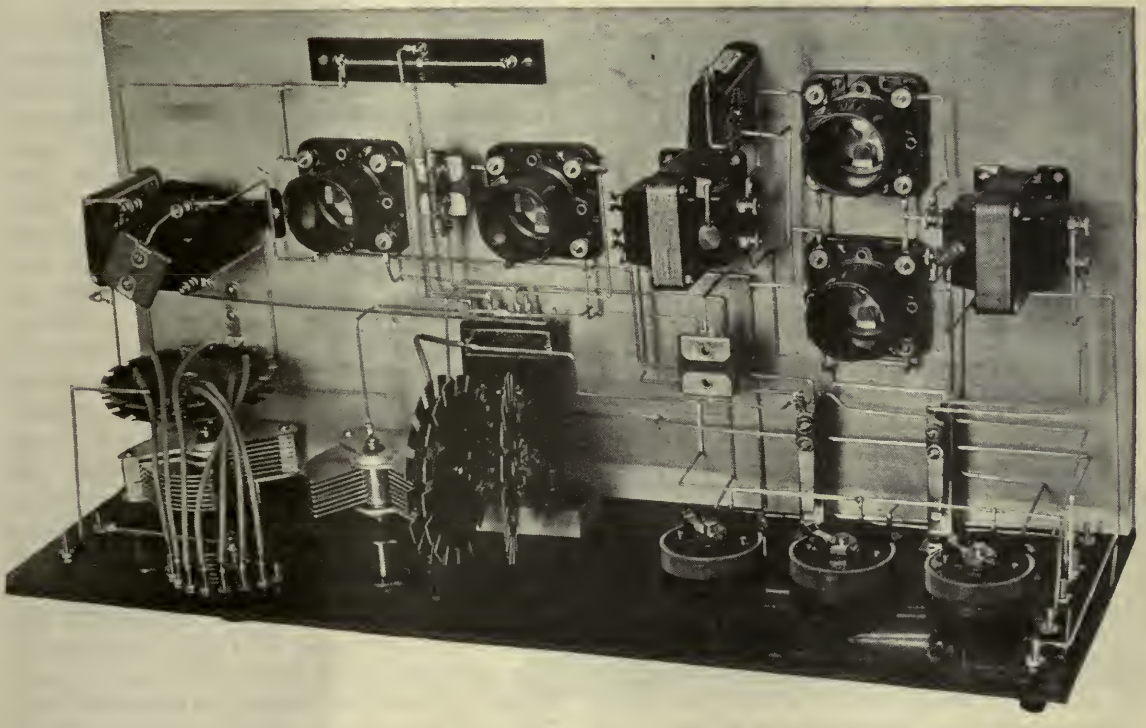


FIG. 8

A base of our test set photographed in RADIO BROADCAST's laboratory. In this receiver generous spacing of the parts is the distinguishing feature. An arrangement of this kind is simple to wire, but it will not fit in a standard cabinet

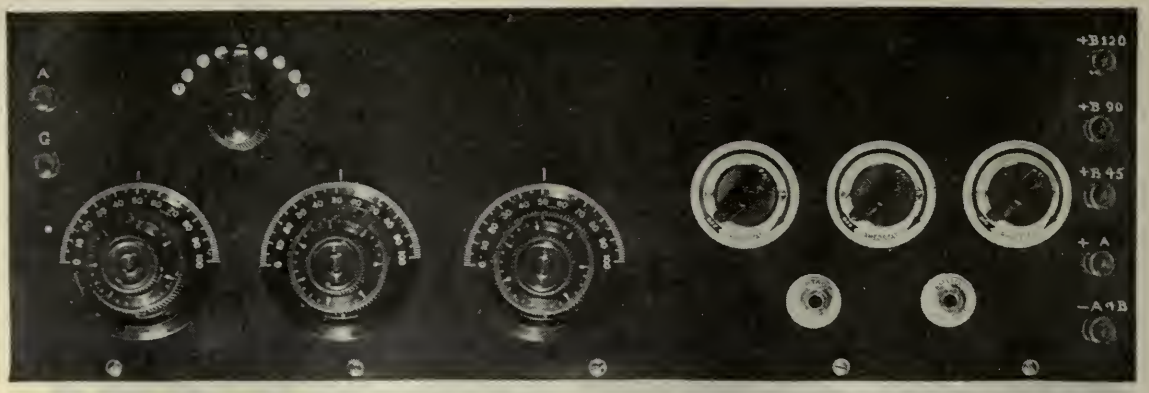


FIG. 10

The panel view of the set shown in Fig. 8. The vernier dials greatly facilitate sharp tuning

Countersink the heads of screws slightly under the surface of the panel so that they will offer no obstruction to the turning of dials or knobs.

ASSEMBLY

THE next operation is in assembling the parts upon the panel. The switch points, stops, and arm are first mounted so that there is no interference to the hand motion which might be caused by the proximity of the other units. Before mounting the remainder of the units, attach the panel to the base. This supports the panel in a rigid manner facilitating the assembling of the condensers, tri-coil unit, jacks, rheostats and binding posts in the order named.

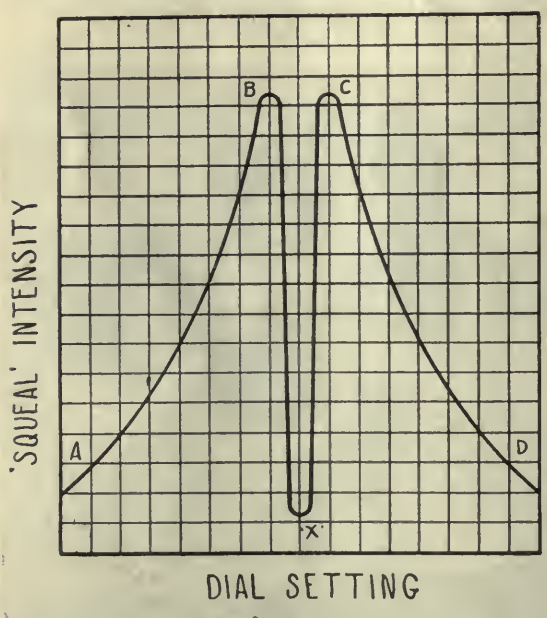


FIG. 11

Graphically explains the system and theory of proper neutralization in the Roberts Circuit

The base layout is shown in detail in Fig. 2. It will be noticed that no dimensions are given. This allows the use of other types of apparatus with the same layout scheme. Round head wood screws, $\frac{1}{2}$", No. 5 are used to fasten the parts to the base. Where the base of the sockets is thicker than $\frac{1}{4}$", longer screws are necessary for this purpose.

In a receiver of this type, the electromagnetic and electrostatic fields set up by the several units unquestionably have their effects on the successful operation of the receiver. Whether this is detrimental or not depends largely upon the crowding or generous spacing of the various parts. Naturally there is a safe medium at which both crowding on one hand and the possibility of extra long leads on the other are reduced to a minimum. Fig. 4 shows such a layout with the actual wiring circuit. Both variable condensers C1 and C2 are of .0005 mfd., while the fixed condensers C5 and C6 are of .005 and .0025 mfd. respectively. The grid leak condenser C4 is .00025 mfd. For the grid leak, several values are recommended ranging from 3 to 7 megohms. C3 is the neutralizing capacity. The inductances are of the standard Roberts design and are of the manufactured type. Dimensions for the home-made coils have appeared in the April and May issues of RADIO BROADCAST. The filament circuit of the first tube is controlled by a 20 ohm rheostat as is the detector. The two push-pull amplifier tubes have their filaments in parallel with a 15 ohm rheostat in series with the supply.

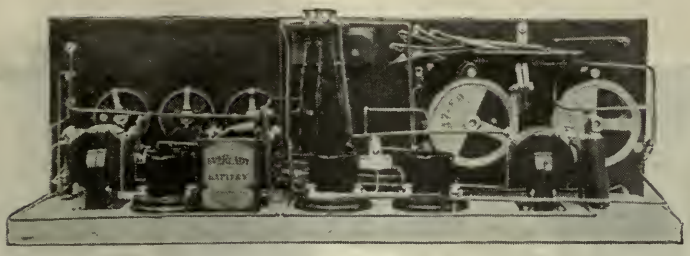


FIG. 12
A rear view of another Roberts experimental model

The photograph Fig. 8 shows the first laboratory model built and strongly indicates the generous spacing of the elements. The photograph Fig. 9 is a revised layout showing the more compact construction.

In following the panel template of Fig. 3 it will be noted that the position of the jacks is slightly altered so that the socket may be brought nearer to the panel.

WIRING THE SET

THE actual wiring of the receiver is shown in Fig. 5. The schematic circuit is shown in Fig. 4. Together with the base photos these wiring layouts clearly indicate the attempt to keep the wires short, parallel to the length and width of the base, and to make all turns at right angles to each other. The observance of these few rules add to the workmanlike appearance of the finished job. Soldered connections were made to the lugs attached to the various parts. Half and half strip solder and a solution of resin mixed with Carbona or alcohol to the desired liquid consistency, was used, resulting in a clean, permanent connection. The use of spaghetti insulating tubing is optional excepting where there is danger of short circuiting, then its use is absolutely necessary.

OPERATING NOTES

WE USED UV-201-A tubes throughout, but any standard tube may be substituted providing the necessary changes in value of the filament rheostats are made. The grid leak resistance of the detector tube controls to a large degree the volume output of the receiver. The value of this resistance will vary according to the tube used, from about 2 to 7 megohms.

If all the batteries etc., have been connected and the set is otherwise ready to operate, the following proceedure of tuning is followed. Turn the tubes on to normal brilliancy and listen-in on the first jack. Turn up the tickler control so that the coupling between the secondary and the tickler is quite close. Now, set the tap switch on the middle point and simultaneously rotate the two condenser dials slowly. Gradually the squeal of a station will be tuned-in until it reaches its loudest point. Let these controls remain at this setting and then slowly reduce the coupling between the tickler and the secondary until all the squeal vanishes and the music or speech is clear. The quality and quantity of the reception can be increased by clearing up the tuning with a further adjustment of the rheostats and the switch taps.

The operation of the push-pull amplifier is entirely controlled by its filament rheostat. It is important to observe that a loud speaker be used that is capable of handling the large output volume without distorting the tone quality. Signals from this receiver are so loud that some loud-speakers can not carry them when the set is turned on full. Undue oscillation or howling that seemingly cannot be controlled by any of the tuning units may be eliminated (providing the correct connections to the coils have been made) by reversing the leads to the primary of the audio-frequency transformer used for reflexing. It is also necessary to vary the detector B voltage to its proper value, depending upon the individual tube used.

Fig. 12 shows how the tuning squeal would appear if visualized. When the cylindrical tubing on the neutralizing condenser has been adjusted so that at a certain point on the dial of the first condenser there is a comparatively quiet spot a few parts of a degree either side of this point, but gradually and equally in-



FIG. 13
A panel view of Fig. 12. A manufactured inductance switch, shown at the left-top has replaced the ordinary switch arm and contact points

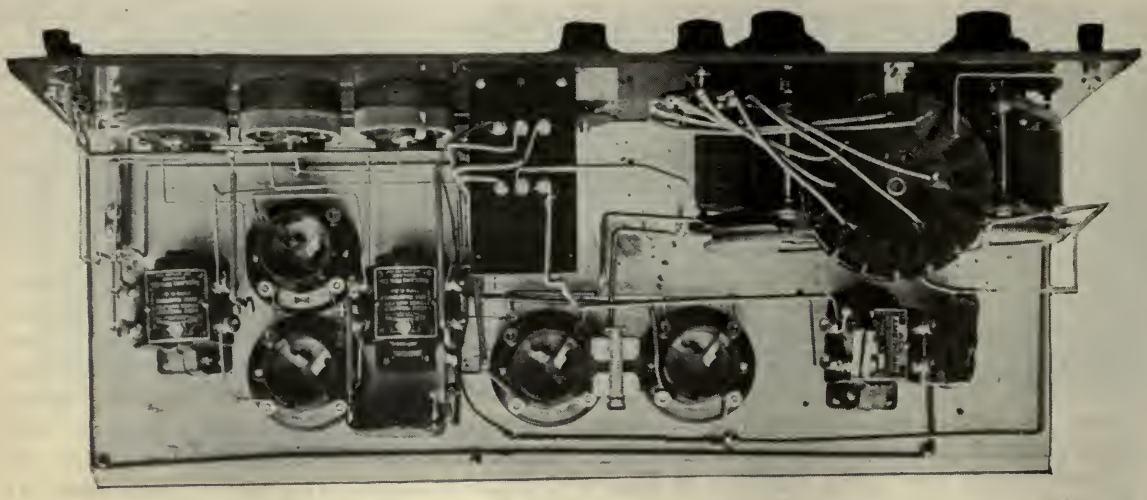


FIG. 14

Another base view. Other parts and a different base and panel layout prove the wide flexibility of design

creasing then decreasing in a whistle as the dial approaches and passes this point, it may be assumed that the correct location of the tube has been determined. But, if it so happens that the squeal first increases gradually, then quickly slumps down, then quickly increases and quickly decreases, it is evident that the proper balance has not been obtained. Try sliding the tube in the opposite direction of its original position for only a short distance and repeat the variation of squeal intensity. In Fig. 12, X shows the silent point extending from B to C, while A-B indicates a gradual increase in intensity and C-D indicates a gradual decrease in squeal intensity. This constitutes the proper squeal adjustment.

The tapped primary allows the use of practically any size of antenna. In the RADIO BROADCAST laboratory two hastily constructed antennae were used, both not being more than ten feet in height. One was 18 feet long, the other about 150 feet long. No great difference in volume or in sharpness of tuning was noticeable in the use of either.

The use of vernier dials is a decided aid in the tuning of distant stations.

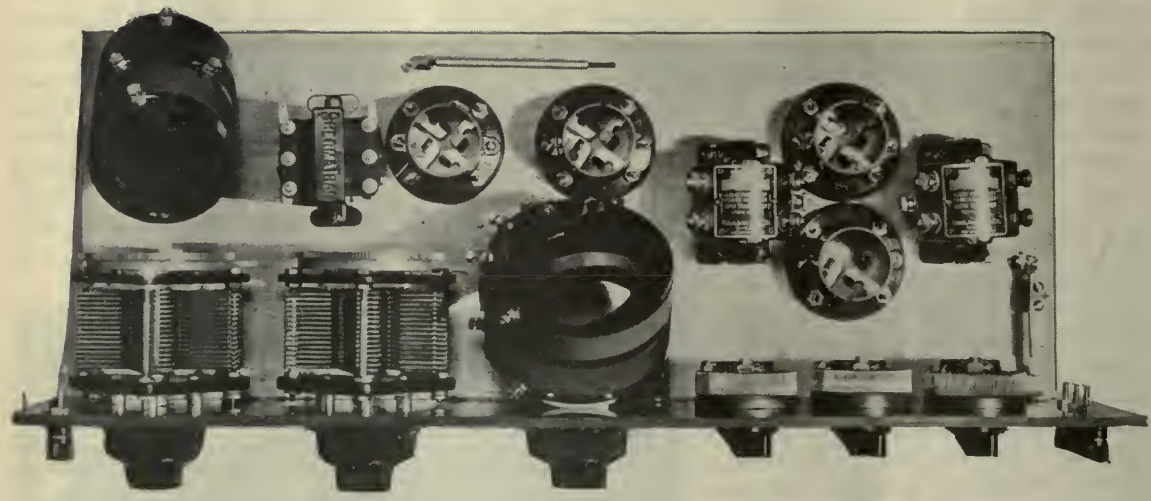
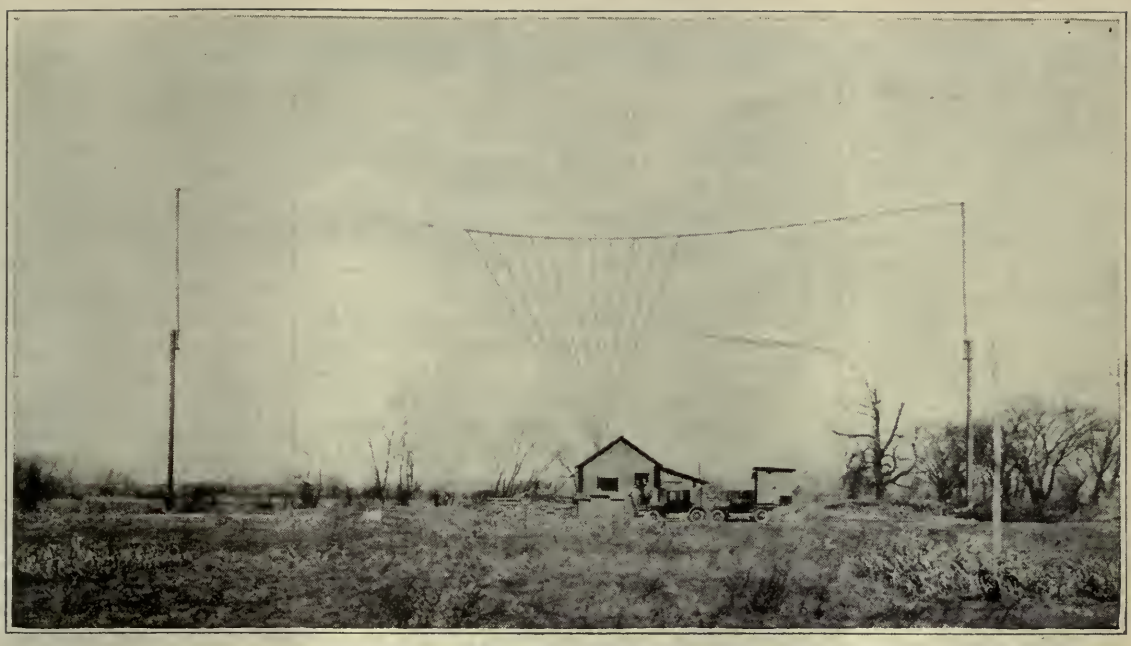


FIG. 15

Adapting the circuit to tuning units of a more standard nature. A 180° coupler is rewound to take the place of the spiderweb NP-S-T coils and the antenna inductance is wound on a cylindrical form mounted at right angles to the coupler. No matter what type of apparatus is used, it is well to make a permanent, complete layout of this character before doing any of the wiring



THE SPECIAL INSTRUMENT HOUSE AND ANTENNA

Used at WGY for sending their programs out on 107 meters for rebroadcasting. A special heavy mast is used to prevent swinging and consequent changes in wavelength. The antenna itself is made of $\frac{3}{8}$" hemp wound with many fine bare copper wires

The Rebroadcasting Set at WGY

Behind the Scenes of the High Power 107 Meter Transmitter at the Schenectady Station—The Novel Electrical Arrangements Which Have to Be Made Where the Powerful Short Waves Are Produced

By W. J. PURCELL

Engineer in Charge, Station WGY, General Electric Company

ONE of the most interesting contributions to radio during the present year has been the development and successful operation of the short wave transmitter. By its use distant places heretofore only occasionally reached on long wavelengths become readily accessible with a fair degree of reliability. Signals are transmitted so clearly and with such volume that it is possible to pick them up 3,000 miles away and successfully rebroadcast them.

For several months past, WGY, the Schenectady station of the General Electric Company, has been experimenting with a short wave transmitter, and on April 5, these experiments, carried on in coöperation with the British Broadcasting Company in England, reached a climax. On that day, every station in England relayed or rebroadcast the WGY short wave signals. One radiogram received from London during the progress of the concert enthusiastically proclaimed it "all as clear as if played in London." The concert broadcast was held in the Wanamaker auditorium in New York, and consisted of organ, tenor solos, trumpet selections, and speech. The program was conveyed by line circuits to WJZ in New York, from which point, after amplification, it was conveyed over wire to the control room of WGY in Schenectady. There it was twice broadcast, once on a short wavelength of 107 meters, and on 380 meters from the regular transmitting equipment. The short wavelength signals, inaudible on most receiving sets, crossed the Atlantic and were picked up on a sensitive receiver by 2 LO and were then fed by wire to all the stations making up the British Broadcast-

ing Company group. Crystal set owners in London, Manchester, and other English cities, and near-by English transmitting stations, all reported excellent reception of the music played in New York.

WGY was informed recently on excellent authority that the Gilbert & Sullivan comic opera "The Mikado" produced in the Schenectady studio and broadcast on both 107 and 380 meters had been heard in Johannesburg, Africa, May 15. The short wave signals were received. This constitutes a new distance record for WGY as Johannesburg is 8,034 miles from Schenectady.

The Importance of Rebroadcasting

Many of the prophets among those radio men who ought to know, say that broadcasting eventually will mainly be done by super-power broadcasting stations, located in leading cities of this country, where excellent speakers, excellent music, and the other bone and sinew of radio programs are easily had. The smaller local stations will not be disposed by this scheme of things, these forecasters say, for they will be able to pick up the super programs and rebroadcast them. KDKA and WGY have been doing some extensive and quite successful experimental work with transmitters for rebroadcasting. Before the finished commercial product must come the experiments. This story by Mr. Purcell of the special set at WGY should interest the host of amateur operators and broadcast listeners who have heard the surprisingly penetrating waves of WGY on 107 meters. "Broadcasting Complete American Programs to All England" in this magazine for March, told of KDKA's experiments in rebroadcasting.—THE EDITOR.

NEW RADIO WRINKLES AT WGY

WHILE the design of a short wave transmitter is similar to that of any broadcasting set, the enormously high frequency involved—2,803 kilocycles—requires the use of some unusual and novel apparatus. As shown in the accompanying picture, the antenna used is of the fan type, but it differs in some respects from the conventional antenna. In order to decrease resistance losses, its conductors are made of three-eighths inch hemp, over which is braided many fine strands of bare copper wire. The two wooden poles supporting the antenna are much larger than necessary to support structure of this size, but they are essential to prevent the antenna from swinging. A swinging antenna would cause unfortunate frequency changes.

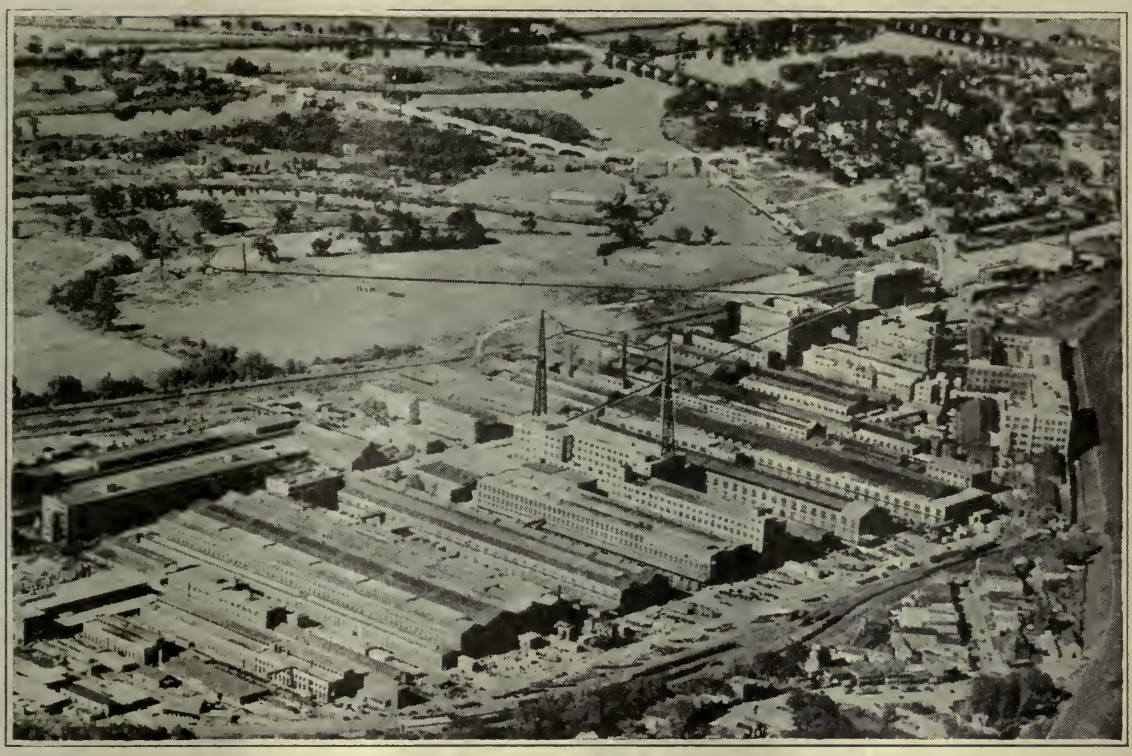
The building sheltering the transmitter proper is located slightly to one side, allowing the counterpoise to come directly underneath the center of the antenna, greatly increasing the radiating efficiency of the system. The antenna is eighty feet high and sixty feet in width at the top portion of the fan. Its fundamental wavelength is 160 meters. When the antenna is operated below the fundamental period, its current seems very low. Measurement, however, shows a much higher field strength and radiating efficiency on the short wave adjustment than when a smaller antenna and a higher antenna current are employed.

In order to secure maximum radiation, the transmitter is located on level ground, a mile from the nearest building. The instrument house is located near a bend in the river and the conductivity of the soil in that vicinity is therefore comparatively great.

The oscillating system is of the conventional coupled-type in which the frequency is controlled by a tuned circuit rather than by the antenna circuit. This method greatly decreases the possibility of frequency change due to the swinging of the antenna in the wind. The primary coil consists of one and a half turns of copper ribbon two inches wide and this is tuned by an air condenser made of aluminum plates three feet square. In solving the problem of a spacer for these plates that would not break down it was decided to use very thin hard rubber strips. The power tubes are water cooled and are connected to a pump to a large radiator which insures an uninterrupted supply of water. Coupling to the antenna is secured through a single turn of copper ribbon clearly shown in the photographs.

Because the wavelength used is extremely low, we have had some odd electrical effects in the operating room. When a transmitter is built, the usual practice is to connect all metallic objects, such as iron frame work, transformer cases, and motor generator frames together with copper ribbon. This procedure, we discovered, could not be followed in our short wave transmitter because, while the inductance of a conductor only a few feet long is very small, it is great enough to allow a considerable voltage to be built up across it at this frequency.

Because of the intense field about the transmitter it is necessary to be very cau-



WGY AND WGY II.

Seen from an airplane. The retouched photograph shows the towers of the main station a-top one of the buildings at the Schenectady works of the General Electric Company. Both transmitters, the 107 meter one and the 380 meter one, are connected to the control room and studio which serves for both

tious while the set is in operation. Two men standing on insulated stools, each holding a metal rod in his hand, can draw an arc six inches long between the rods. No shock is felt because current of this nature travels through the skin rather than through the body. However, if the bare hands were used instead of the metal rods, a severe burn would be the result. Arcs will jump from the stove to the shovel when adding coal, and care is necessary to prevent the body from coming in contact with any metallic objects. It is possible to light an ordinary sixty watt electric lamp to full brilliancy by holding the glass bulb in the hand. Metal pencils, watches and like articles cannot be carried on the person because of the small sparks which jump to them. Shoes with metal nails cannot be worn because of the sting one feels when he steps on the nails in the wooden floor.

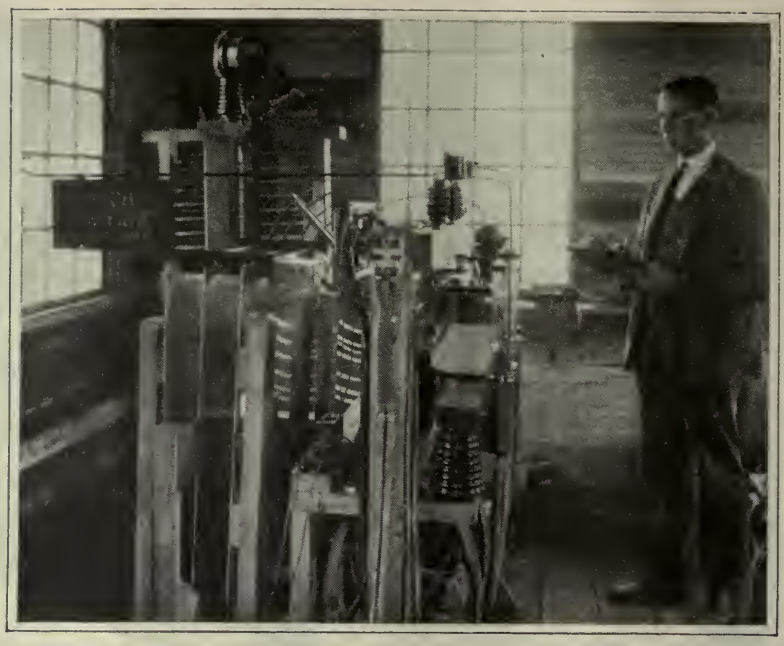
The modulator tube is water-cooled and it is connected to the same cooling system as the oscillator. The speech power amplifier is a 250 watt radiotron, and, because of the intense field from the oscillator and its associated apparatus, it is shielded by a copper box to prevent regeneration and the resulting loss in quality. All wires connected to the amplifier are shielded, and the lines to the studio and control room are covered with lead and are buried to prevent the radio signal from getting back into the input circuit.

The plate power supply to the water-cooled tubes is a three phase full wave rectifier capable of supplying thirty kilowatts at fifteen thousand volts. Filaments are lighted by special direct current machines to eliminate the ripple which results from the use of alternating current on tubes employing a high filament current.

The results obtained from a series of tests conducted with the coöperation of the British Broadcasting Company from January to April 5 have been extremely gratifying. The signals have been heard consistently in Los Angeles with loud speaker strength using only two tubes, and this at times when daylight covered the western half of the country. Tests have shown that the signals are remarkably free from fading which is very common on the longer waves.

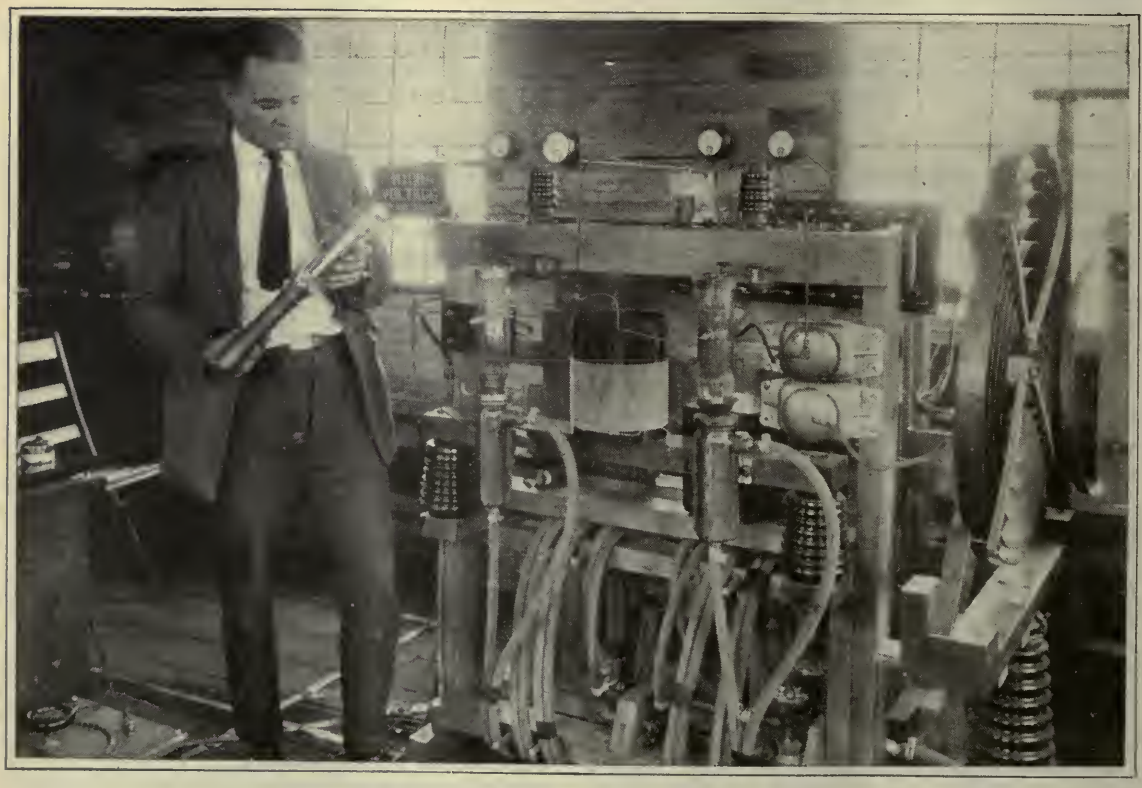
At the annual dinner of the Massachusetts

Institute of Technology alumni, in New York, WGY, connected to New York by a special circuit, broadcast the music and speeches on 380 meters wavelength and on 107 meters. The signals on 107 meters were so strong and clear that Pittsburgh picked them up and sent them to Hastings, Nebraska, which again rebroadcast. Finally KGO, the General Electric Company at Oakland, caught the three-times-relayed signals on delicate receiving apparatus and again put the dinner program into the air. The only wire used was that between WGY and WJZ in New York.



THE SHORT WAVE OSCILLATOR UNIT

Showing the special aluminum plate air condenser, at the left. Many difficult radio engineering problems were involved in getting this transmitter to work perfectly



THE 107 METER TRANSMITTER

With the short wave oscillator and modulator unit. The two water cooled tubes are in the foreground. One tube is used as an oscillator and the other as modulator



For and Against the Woman Radio Speaker

BETWEEN receiving expressions of opinion from six men associated with broadcasting stations, and hearing by radio nearly all of the speakers at the Republican and Democratic national conventions, quite a bit of light has been thrown on the question discussed in this department last month relative to whether or not a woman's speaking voice is always displeasing over the microphone. The discussion started from the statement of a writer in RADIO BROADCAST that his experience in the phonograph business, and the experience of many others in this business, had proved conclusively that the public finds a woman's speaking voice displeasing unless she can be seen as she speaks. Therefore, women should never be allowed to talk over the microphone either as announcers or lecturers.

Mr. Martin P. Rice, manager of broadcasting station WGY at Schenectady, disposes of this moot question briefly and with emphasis. Here is what he has to say:

"It would be about as logical arbitrarily to condemn all women's voices for radio broadcasting as it would be to ascribe all the known virtues to women and all the vices to men. Women, as a class, have not had opportunities to adapt their voices to varying audiences and auditoriums. An insistent high-pitched voice may readily develop unpleasant characteristics, but this is just as true when the speaker appears in person as when she addresses a large audience by radio. Women have decided to take a part in public life as well as in domestic life, and they will master the technic of radio if they have not already done so."

That scores one for the women.

Then along comes Mr. W. W. Rogers, of the publicity department of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, and associated with station KDKA since the day it sent out the first program ever broadcast.

"Women as radio entertainers were pioneers at KDKA," he tells us. "They have had a definite place on the radio schedule since, and I cannot remember one radio program presented by KDKA which did not have at least one woman participating. As I remember, the worst lecturer and the best singer I ever heard by radio were women.

A Woman is Rarely a Success

BUT a woman speaker," goes on Mr. Rogers, "is rarely a success, and if I were a broadcast manager, which I am not, I would permit few women lecturers to appear. The reason is that their voices do not carry the appeal, and so, whatever the effect desired, it is lost on the radio audience. One of the chief reasons for this is that few women have voices with distinct personality. It is my opinion that women depend upon everything else but the voice for their appeal. Their voices are flat or they are shrill, and they are usually pitched far too high to be modulated correctly.

"Another reason is that women on the radio somehow don't seem able to become familiar

with their audiences, to have that 'clubby' feeling toward the listeners which is immediately felt and enjoyed. Still another thing that is lacking in most women before the microphone is summed up in that trite old phrase, 'sense of humor.' I didn't believe this at one time, but now—well, I think it's true. We need quite a bit of light and airy stuff, or humorous quirks by radio. To sum the matter up, women who are heard by radio seem unable to let themselves go. They are too self-contained to carry a real friendly feeling out past the transmitting station, through the ether, and into the homes of the radio audiences."

Passing from the opinion of one expert to another we come to Mr. Corley W. Kirby, director of station WWJ at Detroit. As do the majority of the others, Mr. Kirby rather brushes aside the premise that no woman under any conditions whatsoever can be acceptable to a radio audience when she is speaking. He states his position without equivocation.

"Women Are Not Fitted for Radio Announcers"

I DO not believe that women are fitted for radio announcers. They need body to their voices, and this is the most important thing, I think. I grant though that some of the women announcers have better sense than some of the men announcers. I look at an announcer in very much the same light that I would consider the old show announcer. He has something to tell the people, and what he has to tell them they want to hear. His announcements should be short, business-like, and to the point.

"When women announcers try to be congenial in their announcements, they become affected; and when they attempt to be business-like they are stiff. There also seems to be an



—Trinity Court Studio

AS THEY WOULD HAVE LOOKED IN 1860

No, the girls are not wearing a new style of bloomers. They're wearing what was the style back in 1860, and you know what they called 'em. Here, from left to right, are Raymond Griffin, baritone, Mabel King, contralto, Irma Carpenter, soprano, Roy Strayer, tenor, and Earl Mitchell, pianist. They took part in the concert of old-time melodies given at Carnegie Lecture Hall, Pittsburgh, staged and broadcast by station KDKA. This was the first of a series of costume recitals to be broadcast by this station and given before a public audience.

offensive nasal quality in their announcements. Their voices are pitched too high. As for women readers, they are as a rule simply terrible. This applies both to those we have had at our station and those I have heard from scores of others."

That is so clear that he who runs may read. So we will pass on to the next, Mr. J. M. Barnett, director of station WOR at Newark, which probably features more women speakers than any other station in the country.

"To my mind a woman's voice on the radio is not generally considered uninteresting," says Mr. Barnett. "It depends upon the work that she is doing and the way she does it. It is the same with a man's voice. There are many male voices that are very uninteresting. For certain types of radio work I consider that a woman's voice is very essential; but for announcing, a well modulated male voice is the most pleasing to listen to. I have absolutely nothing against a woman's announcing, but really do believe that unless a woman has the qualifications known as 'showman's instinct,' it really does become monotonous. As a general thing, a woman's voice is considerably higher pitched than a man's voice and sometimes becomes distorted. This, of course, is simply my personal opinion in the matter."

This leads one to conclude that WOR has not been deluged with complaints against women speakers.



—Knight, New York

EDWIN FRANKO GOLDMAN

Conductor and founder of the Goldman Band, whose summer night concerts in Central Park, New York, have been a bi-weekly feature of WJZ and WJY programs

Mr. Charles B. Popenoe, manager of stations WJZ and WJY, New York, disposes of the subject with few words, confining his statements wholly to the quality of transmission of a woman's voice. He says:

"We use, of course, just as every other station, a great many women speakers on various subjects, but in no case does the female voice transmit as well as that of the man. As a general thing it does not carry the volume of the average male voice. As far as women announcers are concerned, we have never used them with the exception of Miss Bertha Brainard, who occasionally broadcasts theatrical material or announces a play being broadcast directly from the stage. In this case she is used because she knows a great deal about the theater."

Humor Has No Place in Radio Announcing

AS FOR Mr. M. A. Rigg, manager of station WGR at Buffalo, announcing and voice are in most instances, "concerned chiefly with the individual and not with sex." He goes on to explain, "Although we have a woman announcer at this station, it is not my intention to feature a woman in this capacity. There are many reasons why, to my mind, it seems advisable to use a man as announcer, especially during the heavier part of the work."

Mr. Rigg also has something to say about the try-to-be funny announcer.

"Listeners-in will remember when it seemed

to be the policy of the various companies operating broadcasting stations to have a comedian as announcer. He would continually make supposedly bright remarks about the performers and every one in general during his announcing. WGR is especially watchful to keep all phases of entertainment out of announcements. We plan to make them simply as statements of facts. In other words, we believe in letting the performers do the performing."

The present writer has never yet heard a woman announcer who thought it her duty to entertain her listeners by constant jollying, and that, at any rate, is one thing in the women's favor.

It is clear from the consensus of opinion expressed by these six broadcast managers that women as microphone entertainers have come to stay, although they are not at present considered the equal of men in this capacity chiefly because of the defects in their voices.



THE ARION TRIO

A frequent and always popular feature of the programs given at KGO, the Pacific Coast broadcasting station of the General Electric Company. Left to right they are, Margaret Avery, Josephine Holob, and Mrs. J. H. Barthelson

When Woman Radio Speakers Surpassed the Men

AND then—there are the memories of the speakers at the Republican and Democratic national conventions to upset this verdict.

Speaking before the microphone during those conventions were many men (far too many), all of whom should have proved that they knew something about the use of the voice and about diction when addressing an audience. But it was quite otherwise. The large majority of them pitched their voices high, adopted a booming aggressive tone, and never, during one sentence, changed either its pitch or quality. This meant not only that the voice was absolutely lacking in individuality, but intolerable to hear. But that was not all. These men talked on the back of their tongues, swallowing all of their consonants and spreading all of their vowels. Many of them gave the impression that they were talking through whiskers that had been allowed to go uncut since the last election.

No wonder that at both conventions many speakers were not allowed to finish, being ragged off the platform by the bored audience. Many a seconding nomination never got so far as to let the audience know who was, "the man I am about to name." The speaker was boo-ed off the stage.

With marvellous fidelity a good receiving set reveals such faults in tone and diction. Probably millions of listeners-in passed judgment on those men speakers and called them uncomplimentary names. But the moment someone rose to speak who had even a halfway idea of enunciation, and how to poise the tones, that speaker so far as this writer's experience goes was as plainly understood as if he had been in the very room where the listeners sat.



—Colegrove, Buffalo

GEORGE ALBERT BOUCHARD

Organist for WGR at the Hotel Statler, Buffalo, where he gives a daily program, Sunday excepted, from 12.30 to 1 P. M.

asphalt after being jolted unmercifully over cobblestones.

These conventions proved conclusively that if a woman knows her business when she tries to speak before the microphone she can create a most favorable impression. All who listened-in to these conventions must have felt the pleasing personality of some among the women speakers. And, by the same token, they must have felt just the opposite regarding many of the men.

Good Radio Drama from KGO

AT KGO, the General Electric Company's Pacific Coast station, at Oakland California, they use a good many women as speakers and readers and also in the casts of their dramatic productions, as those who keep track of their programs know. So far as the present writer can discover, more dramas are given at KGO than at any other station in the country, with the exception of WGY, also a General Electric station. Among the plays

Which brings us back to women radio speakers. At these conventions some of them had it all over the men. Occasionally one heard a woman who talked through the top of her head—or shall we say through her hat?—and the opening seemed small. But there were others who came near to being ideal orators. Voices perfectly poised, flexible in pitch, and faultless diction.

The managers of both these conventions seemed to think that the calling of the roll of states for votes should be done by a man chosen only for the size of his voice. Diction was apparently not taken into consideration. One heard—"Wan" for one—"twarnty" for twenty—"saxty-sax" for sixty-six, and so on. Not from all the clerks, but from altogether too many of them.

The Democrats had a woman clerk who followed a man at times who spread all his vowels and was not on speaking terms with any consonant. After trying to understand what this man was saying, listening to the perfect diction of the woman clerk was like riding along



MARJORY GARRIGUS SMITH

Wife of Fred Smith, director of the Crosley radio station, WLW, was recently heard in a piano recital at the Cincinnati Conservatory of Music. She is the artist pupil of Marcian Thalberg and accompanist for Mme. Reiner, wife of Fritz Reiner, conductor of the Cincinnati Symphony Orchestra

recently given at KGO were, "Passing of the Third Floor Back," "Kindling," and "Peg O' My Heart"—a trio of titles that shows the standard aimed at in matters dramatic. Some of the best planned musical programs given by radio in the entire country come from this station, as note the following composers taken from a program that happens to be at hand: Handel, Grieg, Sinding, Leschetizky, Arthur Foote, Chadwick, Mendelssohn, Landon Ronald, Cadman, Huhn, Mrs. H. H. A. Beach, Massenet, Coleridge-Taylor, Lieurance.

Many of these musical programs are interrupted by an address absolutely foreign to music, as is the case with practically all broadcasting stations. The reason for this aggravating and inartistic custom is an unfathomable mystery to many listeners-in.

One of the outstanding features at KGO during the last months was the performance of Mendelssohn's "Hymn of Praise," given by chorus, soloists, and the KGO Little Symphony Orchestra, the entire production under the direction of Mr. Carl Anderson. This was not the broadcasting of a public concert, but a program prepared wholly for the purpose of radio listeners, something that few broadcasting studios have the enterprise or faith in the public to undertake.

This choral performance was preceded by Mendelssohn's overture, "Ruy Blas," and a short biography of the composer. All other music played during the performance, such as interludes, was also by Mendelssohn. It is not often that a musical program of such standard, and kept so throughout, is given at a radio studio.

The Radio Audience Likes Regular Radio Features

EVERY week day, at 12.30 P. M., in the dining room of the Hotel Statler, Buffalo, George Albert Bouchard gives a short organ recital which is broadcast by station WGR. While the lighter numbers predominate in Mr. Bouchard's concerts, he manages to give a goodly number of standard works as well. This half hour program has proved one of the best liked regular features of WGR.

People who listen-in to programs given in hotel dining rooms have the advantage over those who are right there on the spot where the music is played. The radio audience does not suffer from the confusing sights and sounds that inevitably distract the attention when one is surrounded by diners and those who serve them.

People like it when a certain station features a certain kind of program at a given hour daily, as these programs of Mr. Bouchard's are featured. If they enjoy the feature they like to tune-in on it whenever the mood to do so prompts, and always find it at hand. According to Mr. M. A. Rigg, manager of WGR, Mr. Bouchard has a very large following of daily listeners.



ROBERT A. MUNN

In addition to being an announcer at station WGR, Buffalo, Mr. Munn, who is an accomplished musician, is frequently heard as organist from that station, and he could also present an excellent program of baritone solos if he so desired. He is the lone bachelor of the WGR staff, but doesn't look at all worried about it

The Radio Pianists Play Good Music

CONSIDERING in retrospect the music that has been heard by radio since this department was started, it has been decided that to the



BERTHA BRAINARD

Of the staff of station WJZ and WJY, New York. Miss Brainard is heard on the air regularly from "Broadcast Central" in her talks called "Broadcasting Broadway"

pianists goes the credit for giving the largest number of selections taken from the standard composers. Of these composers Chopin and Liszt have been played the most often, with, perhaps, Rachmaninoff coming third, although he is seldom represented except by one of his two well-known preludes. Beethoven has been by no means neglected by these pianists who have broadcast, nor have Mozart or Grieg. Indeed very few poor compositions are played before the microphone by pianists who are capable of playing something better.

Violinists and 'cellists come next in the quality of their selections, but are not on a plane with the pianists. Let it be understood that this refers to the quality of the works they play and not to the quality of the playing.

Singers do only fairly well when it comes to presenting numbers that are really worth the hearing. Some numbers they sing little better than Annie or Susie, Joey or George next door could. Singers' programs are monotonous because they are so often made up of the same numbers one hears night after night, from broadcasting stations, east, west, north, and south.

Orchestras play more trash than all the other musicians broadcasting combined. The same thing, night after night, in the same places—which means everywhere. But, before another year has passed, radio orchestras will be giving us real music. A few of them do now. But how many? This is what the present writer is trying to find out.

IT IS so unusual to get a thoroughly good musical program these days when you tune-in, meaning by this the sort of music you would be willing to pay to hear, that when WSAI was tuned-in some time ago and some really stunning music came through the horn, astonishment was on the faces of all who heard. Soon we learned from the announcer that the graduating exercises of the Cincinnati Conservatory of Music were being broadcast. Which accounted for our surprise and pleasure.

IT IS a question whether it is desirable to prelude each number of a musical program broadcast by an explanation of the number or an analysis of its mood. We doubt it. But it is being done. We wonder how many people actually like it.



—Swan, Buffalo

HELEN M. WHITE

Who is secretary to M. A. Rigg, Jr., the manager of station WGR, and is also sometimes at the microphone making announcements



J. ANDREW WHITE

Who announced the proceedings of the Democratic National Convention for stations WJZ and WGY. He is shown before the microphone in his sound-proof cabinet in Madison Square Garden, New York

THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

Excellent Broadcasting of the Political Conventions

JUNE and July have passed and with them the nominating conventions of the two great political parties. National nominating conventions are always a test for the party holding them. Conventions test men and they test principles. But at both the Republican and the Democratic conventions, radio broadcasting was also on test. For the broadcasters and the politicians were acute enough to see, almost before the campaigns for the various candidates were much more than a breath in an otherwise pretty calm political atmosphere, that radio, linked with the Presidential nominating convention and campaign would be extremely valuable.

The Republican Convention at Cleveland was the first task the broadcasters faced and they did a good job. The broadcasting stations as far west as St. Louis and Kansas City and as far east as Boston and New York were linked up with that beautiful Public Auditorium in Cleveland by special land wires.

More stations were linked together for the Democratic Convention, and, as everybody knows, they were linked for a much longer time. Eighteen stations used the wire telephone links of the American Telephone and Telegraph Company, and WJZ and WGY of the Radio Corporation, used separate Western Union connecting lines and their own announcer.

During the short span of the Republican convention—which went off with neatness

and dispatch—and the dull, dreary succession of balloting of the Democratic convention, radio demonstrated its ability to spread information as no other medium possibly could. It is bromidic to speak of "atmosphere" from the conventions being one of the chief charms of the material that emanated from loud speakers in uncounted homes practically all over the nation, but unavoidably, that was one of the most compelling bits about this new political broadcasting which has people talking about radio as people have never talked before.

There is no doubt that the convention broadcasting was a success. To the small army of A. T. &. T. engineers and maintenance men who were constantly on the job much approbation should be given. For their complete arrangements and constantly exercised skill, the gratitude of the vast radio audience is due. But to Graham McNamee, chief announcer of WEAF, whose voice has undoubtedly been heard by more people than any other living man, goes honor and credit for a most thoroughgoing and able task, excellently accomplished. He had tact, keen observation, and a charm of manner which has made radio listeners quite willingly sing his praises. J. Andrew White, who announced for WJZ-WGY during the Democratic convention, earned his share of the announcing honors by his careful observation and extraordinarily fine descriptive powers.

The convention broadcasting was a great and an interesting lesson to millions of people in this country in practical politics; and, what is more important, the millions liked it.

The Radio Orator Must Be Good

THERE is no doubt whatever that radio broadcasting will tend to improve the caliber of the speeches delivered at the average political meeting. Radio oratory is obviously much different from oratory on the platform, as a recent editorial on the quality of political harangues points out. Personality will count for nothing as far as the radio audience is concerned. Ill built sentences express-



RADIO ABOARD THE S. Y. "VANADIS"

Owned by C. K. G. Billings. All hint of a radio receiver has been removed from the cabin with the exception of the loud speaker at the lower right. It is a small yacht indeed these days that does not have its radio receiver aboard

ing weak ideas cannot succeed with the aid of forensic gesticulation. The flowery nonsense and wild rhetorical excursions of the soap box spellbinder are probably a thing of the past if a microphone is being used. The radio listener, curled comfortably in his favorite chair is likely to criticise the vituperations of the vote pleader very severely Woe be unto the candidate who depends for public favor upon wild rantings and tearings of hair. Political campaigns of past years have been liberally supplied with artificiality of this sort.

The Blind Should Have Radio Sets

EQUALLY to be recommended with Roxie's campaign for disabled soldiers is that originated by Alfred M. Caddell, Secretary of the American Radio Association, to obtain radio sets for all the blind children who come to the attention of the American Foundation for the Blind. Thousands of blind people maintain their principal contact with the world in which they move, by sound—by messages which reach them through the ears. Near the larger cities there is now available a more or less continuous program throughout the day and evening so that the blind BCL may really know as much of the goings-on in the world as the rest of us who get it from the printed page.

It is eminently fit that such a movement should receive the support of Helen Keller who has already done so much for her blind companions, not only in a material sense but also by her practical example. It is possible to get much enjoyment even without the use of eyes. The radio set conveys to the blind listener messages by electromagnetic vibrations, just the kind which the defective eyes of the sightless listener cannot perceive without such a translating device as the radio set. How fine it would be if something could be devised to make the blind aware of light waves, which are just the same kind as the radio waves, and for which our eyes ordinarily act somewhat as the radio receiver does for the blind.

The American Radio Association, 50 Union Square, New York City, has arranged with the American Foundation for the Blind mutually to coöperate in their coming campaign to secure radio sets for the blind. It is fortunate that the A. R. A. which is doing such able work for the broadcast listener, is to lend its aid to this good cause.



SENATOR PAT HARRISON

Of Mississippi, delivering the keynote address at the Democratic National Convention at Madison Square Garden, New York City. Two of the four microphones were used for energizing the battery of twenty loud speakers which were clustered above the speaker's platform, while the other two were divided one each to WJZ-WGY, and the other to the 17 other stations connected with WEAF

"Radio Reaching Out Farther"

CONTINUALLY we hear of the increasingly remarkable feats of radio transmission. There seemed to be a preconceived notion that short waves could reach only to correspondingly short distances, but such ideas are now being discredited rapidly nowadays. It is becoming an every day ac-

complishment for a few watts, radiated at a wavelength of a few hundred meters, to span thousands of miles of land and ocean. Of course the transmission of these waves is no better to-day than it was a few years ago; the advance has come about in the better receiving sets which have been introduced in the short wave receiving station.

We must always discount the statements of publicity and advertising managers because of their well paid enthusiasm, but we are much startled to see in an English radio journal, "Get America every night." If we discount this claim 50 per cent. and think of the English boys getting America only every other night, we can realize what tremendous progress is taking place. It's only two years ago that this was accomplished for the first time by the best amateurs and apparatus America could afford!

It won't be many years before many of us consistently hear English programs, if they will run their stations sufficiently late at night for us. Incidentally there must be lots of sleep lost by the enthusiastic British listeners, who wait until about three o'clock in the morning to hear our speeches and jazz.

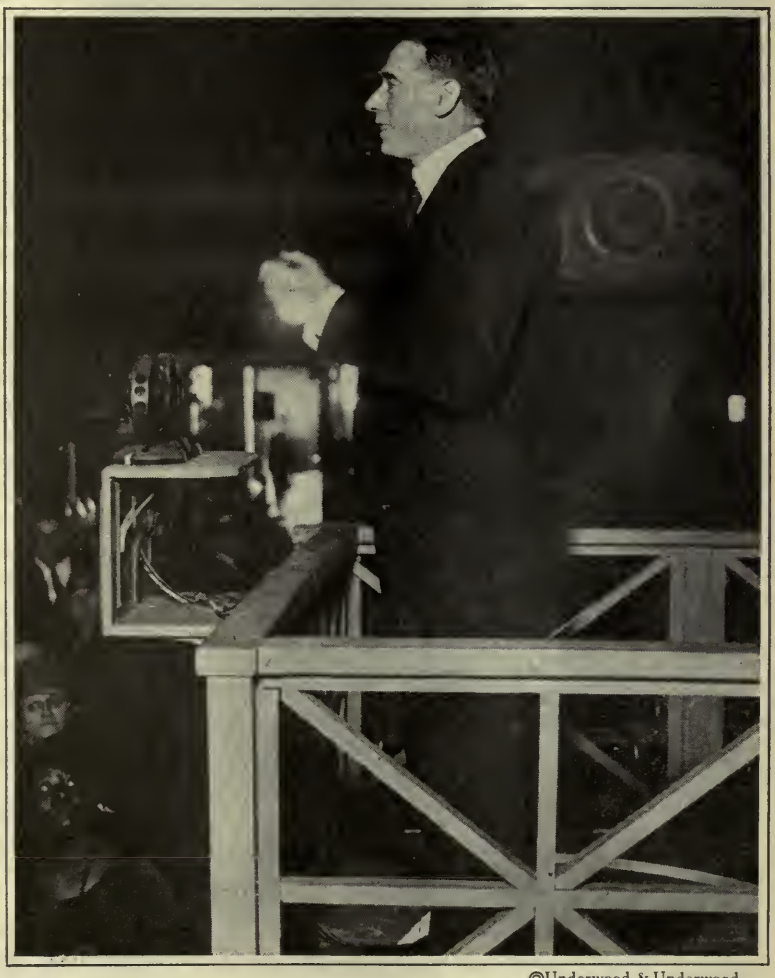
And not only in the British Isles are our stations being heard, and even used for modulation of local stations, but from far off Cape Town, 8,000 miles from our eastern coast, we get reports of the reception of WEAF and WGY.

How Broadcasting Reached a Balloon

THE Springfield station of the Westinghouse Electric and Manufacturing Co., WBZ, is reaching out and up. During the recent James Gordon Bennett Cup races for free balloons, held in Europe, the pilot of one of the entries, Mr. Van Orman of balloon *Goodyear III*, picked up its radio messages and sent to station WBZ the following cablegram from Amsterdam.

"Heard call letters 2:37 Monday morning—Van Orman."

It may seem odd that a balloon perhaps two or three miles high should be able to pick up earth-conducted radio signals, but from what we know of radio transmission and its relation to airship reception it seems sure that he would have received them almost as well had he been ten or twenty times as high—which is of course impossible for a machine which depends upon the supporting power of the air to keep it aloft.



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DR. MARION LEROY BURTON

President of the University of Michigan, nominating Calvin Coolidge, his former neighbor at Northampton, Massachusetts, for President of the United States at the Republican National Convention, at the Public Auditorium, Cleveland, Ohio. The microphones which picked up the proceedings of the convention are on the lectern in the foreground. Fourteen stations were linked to broadcast it

International Broadcasting

AT THE same session of the electrical dealers where our favored word, broadcast, was being legislated out of existence, David Sarnoff, general manager of the Radio Corporation of America, predicted that within the next year the farmers in Kansas and Missouri, as well as the city dweller, *might* hear radio programs from Paris, London, South America, and other parts of the world, according to a press despatch. International broadcasting which will link up the farthermost corners of the earth is closer at hand than the public imagines, said Mr. Sarnoff. Greatly increased power of our broadcasting stations and more completely developed rebroadcasting schemes, he thought, would enable programs to be heard simultaneously over large parts of the earth's surface.

Mr. Sarnoff was careful in his choice of the right word. The word *may* denotes either a permission or a possibility, it by no means tells the man from Missouri that he *will* be hearing European stations next year but that he is allowed to listen for them and take a chance on the possibility of hearing something.



REX F. PALMER. CHIEF ANNOUNCER

Of the British Broadcasting Company's nine stations. His voice is one of the best known in England, for when S. B.'s, or simultaneous broadcasts, occur in which all the stations in the chain are linked together, the announcing is done from London with Mr. Palmer in charge

Radio is a Career for the Trained Man

APPARENTLY there are still many boys and young men to whom radio holds out the glamour and lure which the gold fields of '49 held out to their grandfathers—offers so wonderful a field of opportunity and advancement that the long hours of study and application, and the natural aptitude required, seem entirely to escape their notice. It is easy to comprehend this unwarranted judgment of the newcomers in the field. The radio art is not yet sufficiently old to have put into their proper perspectives the few dominant figures which rose more or less automatically on the tremendous wave of popularity which has swept radio along during the last year or two. Marconi, DeForest, Armstrong, Sarnoff: in a few years one of them jumps from wireless operator to General Manager of the Radio Corporation—another from a poor student to a wealthy man—another from an embryonic scientist to the popularly acclaimed founder of the art claiming millions of devotees. With such feats accomplished before his eyes, it is no wonder that the young man with ambition (even though he has nothing else) should think of turning to radio.

It is well to strike a warning note. The gold of to-day is not picked up as large nuggets by the lone prospector ignorant of metallurgy, geology, engineering and the like, but is obtained by the careful working of low grade ores which the 49'er would have passed by without a second glance. Staffs of skilled engineers and technicians, who have had education and experience, are getting our gold for us to-day and a very similar change has taken place in radio during the last few years.

To-day there are hundreds and hundreds of men who can be truthfully designated as radio engineers, working night and day in intense competition with each other to capture the rewards which radio still offers. But these men are well educated in the principles of radio. Most of them have had engineering school training as electrical engineers or physicists before specializing in radio. They have accurate knowledge of the past development of radio and of the needs of the future, and their training enables them to attack new problems as they arise. While new ideas will pop up occasionally from the activities of an untrained experimenter, most radio advancement must come from the activities of these trained engineers.

What then should be our advice to a man, say thirty years old, who comes to us to find out how to get into the radio field, his previous training having been in agriculture, his ambition to become a radio engineer or technician being so intense that he had already given up his job on the State Agricultural Staff? To kill high ambition is unworthy, but what else is to be done in a case like this? His chances of success are not more than one in a million and they are growing less each year as the knowledge of radio becomes more systematized and the technically trained workers more numerous. Any one who wants to have reasonable chances of success in radio to-day must travel the long and arduous path of high school and technical school.



MASANAO HANIHARA

Former Japanese Ambassador to the United States, listening to the activities of the Democratic convention in his office at Washington, just before he left to return to Japan

Short Radio Beams Probably Are Not Satisfactory for Voice

SOMEONE in the British Isles is trying to carry on long distance radio telephone communication. At a frequency in the region of 3,000 kilocycles we have frequently heard, in unmistakably English accents, inquiries for a certain Mr. Thomson who, presumably was located somewhere in Canada, from the manner in which the one sided conversation was carried on. We have also heard tales of tens of kilowatts of power being sent out from Poldhu at these high frequencies so we are not surprised to hear the announcement from London that Signore Marconi has been able to talk directly to Buenos Aires from Poldhu, Cornwall. According to the London despatch the radio beam system was used. A listener in the United States would have been in the edge of the beam so it is possible that "Mr. Thomson" instead of being in Canada as we guessed, was in South America.

While we are not yet supplied with sufficiently accurate data to make the statement definitely, it seems likely that these very high frequency channels will not be as suitable for radio telepone traffic as we had thought. The prospects, as has been many times pointed out, seemed very bright for using wavelengths between 50 and 100 meters for radiophone channels. This energy can be reasonably well directed and there are as many channels between 50 meters and 100 meters as there are at present in the whole broadcasting range. Excessive fading of these short waves was prophesied by some engineers, but Mr. Pickard's measurements showed this to be incorrect. The fading, which the investigations of Mr. Pickard showed, was of the kind that makes the signal wax and wane perhaps several times a minute, or at longer intervals. Fluctuations which occur several times per second could not have been detected by the apparatus which Mr. Pickard used. But in listening on some of these short wave channels a peculiar quality of the speech is noticed, which might be due to very rapid fluctuations in the signal strength, perhaps 50 to 100 times per second.

This apparently short period fading of the high frequency channels will make no difference in radio telegraphy, but it may very seriously limit their application to speech-modulated waves.

The I. R. E. Medal for Pupin

AT THE last meeting of the Institute of Radio Engineers the Medal of Honor of the Institute, awarded annually to that scientist or engineer whose contributions have been influential in forwarding the radio art, was given to Prof. M. I. Pupin. of Columbia University. In a brief speech of acceptance Professor Pupin (the same man who recently



DR. FRANK H. VIZETELLY

Editor, The New Standard Dictionary

"Steps should be taken to regulate the radio nomenclature before it becomes so unwieldy as to make it impossible to reduce it to simple terms. Nothing is going to help the plain people more than the use of simple terms wherever that is possible. Radio has won its way to the hearts of the people; it is a boon and blessing to men and women in all conditions of life. I don't know how many homes are already hooked up with our vast system of broadcasting stations, but I should not be surprised to learn that ten millions of them already tune-in somewhere. The skeptic "shallows" have written down radio as a passing fancy, and I have no patience with such silly nonsense. Personally, I hail radio as a God-given remedy to our modern paganism, and I hope it will continue to spread until it shall be found in every household from which love and happiness have been driven by the neurotism of the times. My faith is as strong as my hope that radio will survive as long as truth lives."

gained nation wide attention by the appearance of his remarkable autobiography *From Immigrant to Inventor*) reviewed the advent of radio, from the standpoint of the scholar and scientist. From Joseph Henry to Heinrich Hertz, with the intermediate work of Maxwell and Kirchoff, Pupin traced the development of the new thought in electrical theory which served as the basis of knowledge in this branch of science when the young Marconi began his remarkable experiments on the application of the art, which up to his time had been regarded merely as an interesting laboratory demonstration.

Radio Technicians Should Not Attempt Philology

DEALERS in radio receiving sets, recently assembled in solemn conclave in Atlantic City, made the shocking discovery that, according to the dictionary, the word broadcast was already used by the farmer, in the sense of broadcasting seed as contrasted to drill sowing. Having thus been shown by some embryo philologist that the very foundation of their trade was based upon a misconception, they immediately cast about for another more suitable term and happily (as they thought) alighted on the excellent term—radiocast. It was perfectly proper, and to the best of their knowledge, not used by farmers or any one else, so they solemnly decreed that hereafter they would cater to the needs of the radiocast listener and ignore that other formerly valuable customer, the broadcast listener.

It so happens however that this new word radiocast, is etymologically an unnatural hybrid and shocking to him who studies the origin and composition of words. If the man on the street wants to talk about broadcasting the dealers cannot say him nay—they will willingly sell him broadcast apparatus rather than keep their shelves stacked high with uncalled for radiocast apparatus.

Further, why do the dealers let us "radiate" energy from our antennae when some folks, fat, jolly ones like Irving Cobb, have been "radiating" good humor for quite some time past? Hasn't the fat man been seriously imposed upon by our thus appropriating his terminology and shouldn't the electrical dealers in special session take up the matter at once?

French Transmission of Pictures by Radio

PARIS is reported to be much elated over the successful radio transmission of a picture of General Ferrié, director of the Eiffel Tower Wireless station. The picture was sent by a process said to be the invention of Edouard Belin, who has been engaged in the development of picture transmission since 1912. Undoubtedly the picture transmission was carried out by practically the same process as that used by the A. T. & T. Co. for transmission over wires. It consists essentially of light-sensitive cells and synchronized sending and receiving apparatus. If the ap-

paratus at the two ends of the wire (or radio channel) stay in synchronism, and if no interfering currents step in to blur the picture, the reproduction is really quite truthful, and a reasonable reward for the great efforts which have been expended on this problem. Transmission by wires, it seems, is somewhat more reliable than by radio as the disturbing currents can be better controlled.

The *Matin* seems overenthusiastic about this scheme of Belin; its editor at once jumps to the conclusion that teleview, or long distance seeing, will soon be accomplished. To those who know how the picture transmission is carried out, however, long distance seeing is still far from a solution and apparently not to be attained by the methods at present used, if at all.

"Building Your Own" Requires Care

AT THE request of one of our friends we throw out a word of caution to those radio enthusiasts who spend most of the time formerly devoted to the theatre, cards, and billiards in dabbling with radio apparatus. It is really very instructive and satisfying to build a good radio set and the fewer the parts bought "ready made" the greater is the satisfaction—if it works.

There are radio experimenters who want a "push-pull" amplifier to operate their loud speaker. This unit requires special transformers. These special transformers are not legitimately on the market, we are informed, as they apparently infringe patent rights of the American Telephone & Telegraph Co. You can buy them from the company—providing you buy the rest of the amplifier unit. As the transformers are practically the whole thing in the amplifier it is quite in line for the enthusiast to try and wind his own.

So this experimenter with another devotee, decided to build his own push-pull transformers and thereby acquired experience—of a sort. To wind a suitable transformer it is advisable to use wire insulated with enamel only. Silk or cotton insulation takes up so much room in these small sizes of wire that a compact transformer with silk insulated wire is impossible. Many thousands of turns are required on a transformer. After calculating the design of the transformer in the proper way, they wound them, using up several afternoons which, it turned out afterward, might have been spent on the golf links to much better advantage. For after finishing the tedious winding job, the transformer wouldn't work. Tests showed that many turns were short-circuited—evidently due to weak spots in the enamel insulation and somewhat careless winding. If, during the winding operation, one turn of such a transformer is pulled so tightly that it imbeds itself deeply in the winding already on the core, a short circuit is probable. And so we received the suggestion, "Tell your readers of my experience. They had better make layer-wound coils if they are going to wind thousands of turns of small enamel covered wire."

WGY Finishes Its Dramatic Season

THE Schenectady station of the General Electric Co. can well claim the distinction of being the pioneer among dramatic broadcasters. This type of radio



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CARL W. MITMAN

Curator of Engineering, of the National Museum at Washington, holding what is believed to be the first radio tube. It was made in 1898 by D. McFarlan Moore of New York. Waves from this tube were used to blow up a miniature of the battleship *Maine*

entertainment was put on the air at Schenectady as far back as 1922. The development of this phase of broadcasting has been under the direction of Mr. E. H. Smith who has obtained unique and valuable experience from his work. What kind of play does the BCL want, how many people should there be in the cast, how long should it be, etc.?

It is realized at once that a good deal of alteration must be made in the ordinary play before it is suited to radio broadcasting. Gestures, scenery, lighting, and all such artifices are of no avail. The intonation of the voice must be developed to the limit as the only way of projecting the atmosphere of the scene to the radio listeners. New noise-producing pieces of apparatus have been called upon to help out the listeners' imagination. The broadcast director has a real task to carry his radio audience along with him as the melodrama unfolds itself. It has been found that not more than five characters can be used in the cast since it is practically impossible to recognize a greater number of actors as the quality of the voice is the only way the BCL has of telling who is doing the talking.

The WGY players have produced eighty-three plays since they first came on the air, most of them adaptations of stage successes. During the summer the radio players, like their confrères of the legitimate stage are taking a vacation, and will open their season in September.

Interesting Things Interesting People Say

MANSEL KEITH (New York City, addressing the recent Convention of the Associated Manufacturers of Electrical Supplies): "There has been a reduction of 41.7 per cent. in juvenile court cases in the United States during the past year due to the influence and growing popularity of radio. Radio has supplied the necessary interest and romance needed by the youth. He is now spending his time in tuning-in, or in making sets, rather than getting into mischief. Radio is helping to develop the boy's mind, and is a contributing cause which should make him a more intelligent man than his father."

ALFRED M. CADDELL (New York City; Secretary of the American Radio Association): "There are now more than 3,000 manufacturers of radio supplies in the country, ranging from the



H. J. WALLS, ASSISTANT RADIO ENGINEER

Of the Bureau of Standards, Washington. He is shown adjusting the radio relay mechanism which sets the clock by Naval Observatory time from station NAA at Arlington. By a system of relays controlled by the clock, Mr. Walls can set noisy alarms, turn on and off any number of lights. By the use of this device, domestic electric stoves can be regulated while the housewife is out shopping—or at the movies

makers of radio sets and tubes to the manufacturer of radio jacks and coils. There are about 1,000 distributors and 27,000 retailers. More than 250,000 people are connected directly or indirectly with the manufacture and distribution of radio supplies. All told, it has been estimated that a $350,000,000 radio business was done in the United States last year, and $50,000,000 of this was done in vacuum tubes alone. Judging from the volume of business done so far this year, it seems safe to predict a business aggregating $500,000,000 for the year 1924.

"Our figures show that there are probably between 3,500,000 and 5,000,000 tube sets now in use. Probably 5,000,000 to 7,000,000 crystal sets are owned in this country.

A. C. MILLS (New York City; Executive Chairman of the Society of Authors, Composers and Publishers, commenting on the attitude of his society toward commercial broadcasting): "The entire industry of public amusement, depends on the man who creates music. We have to start with music and the man who creates it.

"If we had not asserted our rights at the inception of commercial broadcasting about three years ago, we should now be supporting those broadcasting stations. Instead, a good many of them are now paying the music publishers for the use of their copyright works."

E. B. MALLORY (New York City; Chairman of the Radio Section of the Associated Manufacturers of Electrical Supplies): "Three million people listened-in on the Republican Convention. ". . . Radio is a great educational medium. During the Conventions, many schools discontinued regular classes so that students might receive first hand knowledge over the radio of how a Presidential candidate is nominated."

F. C. MORTIMER (New York City; writer of "Topics of the Times" in the New York *Times*): "While the radio did magnificently that part of the work of reporting the convention that was entrusted to it, not only to the telephone, but also to the telegraph should due credit be given. That simpler means of communication still is far from being superseded by its younger rivals. Their competition did not prevent the telegraph companies from preparing on a greater scale than ever before at a political convention to serve the press. More wires, more instruments, more operators than the newspaper men ever saw at a previous gathering of this kind had been provided in anticipation of increased demand for the familiar service, and these increased facilities were used exactly as if there were no such thing as a telephone or a radio.

"It is true that radio beat both of its rivals by several minutes—five, perhaps—in conveying the action of the culminating moments, but it was not from these that the compositors "set up" the long and numerous dispatches that appeared in print.

"The radio has its own domain, and is unapproachable there, but neither the telephone or telegraph is in any danger from it so far as yet can be seen."



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CAPTAIN W. A. MOFFETT, U. S. N.
Chief of the Bureau of Aeronautics, U. S. Navy

"I believe the day is not far off when commercial dirigibles will carry mail across the Atlantic in two days. Of course radio will play an important part in such a venture. An airship equipped with radio compasses, radio receiving and sending stations, and loud speakers all working in coöperation, with landing fields having mooring masts, radio sending and receiving equipment, loud speaker and beacon lights on captive balloons shining above the fog which may prevail, will have little difficulty in finding her home port and promptly anchoring to her mooring mast."

M. B. BARTEK (Saunders County, Nebraska; winner of a prize contest conducted by *The Nebraska Farmer* on the benefits the farmer secures from radio): "We do not have to go farther than our neighbor's house to see that radio is not merely a fad, but a reality and more or less of a necessity to the farmer and his family. Among the things that radio offers to the farmer are help in operating his farm more profitably, and educational and social advantages. . . . I have found the weather reports of inestimable value. . . . After the chores have been finished and supper is over, it surely is great to be able to listen-in on your choice of programs, be it lecture or a good instrumental or vocal selection. . . . To the farmer who has trouble in keeping his boys on the farm, I say buy them a radio set."

The Super-Heterodyne and Its Intermediate-Frequency Amplifier

A Thorough Discussion of the Design, Function, and Importance of the Intermediate-Frequency Amplifier in the "Super"—Should it be Used for High or Low Frequencies?

By A. J. HAYNES

IN SPITE of the many articles that have been appearing on this receiver there has been little or no discussion on one of its most important units, the intermediate-frequency amplifier.

The super-heterodyne may be for convenience's sake divided into three distinct portions. In the first section we may place the input tuning apparatus, the frequency-changing and oscillating tubes, together with their auxiliary apparatus, such as oscillator coupler, tuning condensers, etc.

The function of this first section is to receive the incoming signal and change its frequency by means of the heterodyne or beat method to some predetermined intermediate frequency at which it will be amplified.

The second section is composed of the intermediate-frequency amplifier, whose function is to amplify the intermediate beat-frequency which is passed on to it from the first unit.

The third division is composed of a detector tube and audio-frequency amplifier, the amplified intermediate-frequency is fed into the detector tube from the second unit where it is rectified and changed to an audio-frequency. It is then passed on to the one or two stage audio-frequency amplifier, as the case may be, and amplified at this audible-frequency, which of course is familiar to all of us.

Thus, for the sake of convenience, we can separate any super-heterodyne into these three parts, each having its own function to perform.

THE HEART OF THE SUPER

NOW the heart of this receiver is the middle unit, the intermediate-frequency amplifier. It is this section which we depend on to furnish us with the enormous amplification peculiar to the super-heterodyne, which should be given the most attention and consideration. Strange as it may seem however, there is very little public information available as to the proper design and functioning of this high-frequency amplifier. Indeed there seems to be considerable confusion about just what form this amplifier should take, whether long wavelength is best here or whether it is more beneficial to operate with a short wave intermediate amplifier. It is this phase of the super-heterodyne which I propose to discuss, and I will attempt to point out some of the facts that should govern the design of the intermediate-frequency amplifier.

TWO FUNDAMENTAL REQUIREMENTS

IN ANY radio-frequency amplifier there are two basic general requirements that must be met, these are roughly as follows:

1. In order to build up maximum voltage and maintain maximum selectivity, the transformers should be designed to tune as sharply as possible.
2. The received signal must not be distorted as it passes through the amplifier, which means in the case of the intermediate-frequency amplifier that the side band frequencies which compose the modulated component of the received signal must not only be passed through the transformers, but must also receive approximately uniform amplification.

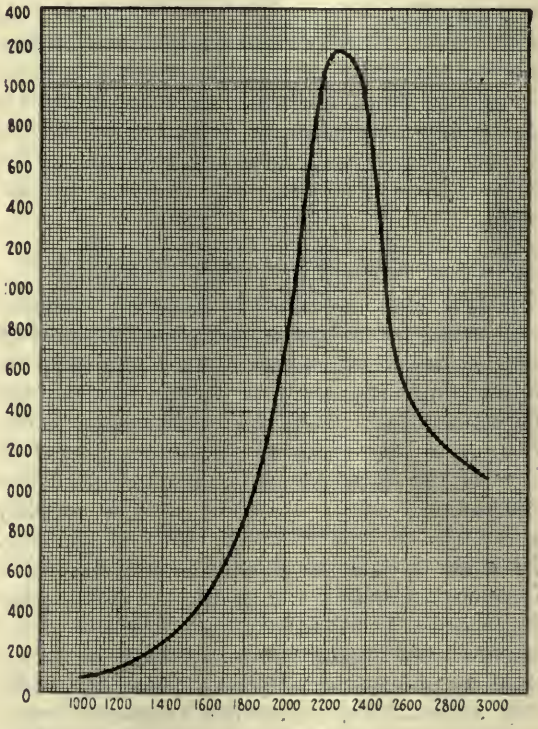
This latter consideration is of the utmost importance when considering an amplifier for use in the super-heterodyne, for here we must handle frequencies that are relatively low where it is comparatively easy to cause distortion. We are considering the reception of radiophone signals where quality of reproduction is one of the first considerations.

SHARP TUNING VERSUS DISTORTION

NOW, in order to maintain quality of a received signal, we must pass through the amplifier not only the fundamental wavelength or frequency of the carrier wave, but we must amplify as well one side of the so-called side band frequencies. This means that if our intermediate-frequency amplifier is tuned to a frequency of 50,000 cycles or 6,000 meters, that we must pass through the amplifier with equal

intensity frequencies from 50,000 cycles to 60,000 cycles. In other words, our amplifier must be tuned sufficiently broad to amplify equally over a band of approximately 1,000 meters. These are round figures. This, of course, is very broad tuning and an amplifier designed with a sufficiently flat characteristic curve to include this band of wavelengths with practically even amplification would necessarily amplify to a considerable degree over a very broad band. On the other hand, as we come down in wavelength, that is as the frequency increases, the side bands group themselves closer and closer to the fundamental wave until if we consider an amplifier with a wavelength of 2,000 meters, it is only necessary for this amplifier to pass a wavelength band of from 1,875 meters to 2,000 meters, or 125 meters in order to include 10,000 cycles below the fundamental. Therefore it is quite obvious that the lower we go in the intermediate-frequency amplifier wavelength, the sharper the tuning of this amplifier may be without destroying the tone quality of the received signal. As a matter of fact, at any wavelength below 3,000 meters, the side bands cover such a narrow wavelength that we need not worry about this type of distortion when using the ordinary form of transformer-coupled amplifier as long as excessive regeneration is not used.

Off-hand this seems to be a very strong argument in favor of very low wavelengths in the intermediate amplifier and it is. There is a very good reason however, why we should not carry this too far, for as we cut down in wavelengths here, while it is true that we can tune sharper without destroying our tone quality, at the same time it is true that the separation between the different stations after they have been heterodyned is decreased. This may be a bit confusing if the reader is not thoroughly familiar with the action of the super-heterodyne. Suppose we have two stations with a ten meter separation, one being on 300 meters and the other on 310 meters. In other words, the first one has a wave frequency of 1,000,000 cycles and the second a frequency of 967,700 cycles per second. Now let us suppose that we have two intermediate-frequency amplifiers, one operating on a wavelength of 2,000 meters and the other on a wavelength of 3,000 meters. Let us take the case first of the 2,000 meter amplifier. In order to heterodyne our 300 meter signal to 2,000 meters, we must set our oscillator at approximately 354 meters. Now, when we do this, we create a beat note with the 310 meter signal as well and it is also heterodyned to a higher wavelength. In this case when the 300 meter signal is heterodyned to 2,000 meters, the 310 meter signal will be changed to approximately 2,650 meters. In other words, the separation between these two signals is now 650 meters rather than 10 meters, as was the case originally. Now if our intermediate amplifier is capable of tuning sharply enough to separate these two wavelengths, it means that we can get absolute separation between 300 and 310 meters and of course it is a comparatively easy thing to build an amplifier that will tune within this degree of sharpness, in fact as noted above, we have a leeway of practically 525 meters here, that is we can tune as sharply as we choose, as long as we do not eliminate frequencies over a 125 meter band, but now let us see what happens if we take the other amplifier which is adjusted to 3,000 meters and heterodyne the 300 meter



AUDIBILITY CURVE OF THREE INTERSTAGE TRANSFORMERS

As used in intermediate frequency amplifier. This curve was made using the interstage transformers only without input or filter transformer. The potentiometer was retarded well back from the critical oscillation point so that there should be no excessive regeneration. Note the sharp tuning characteristic of these transformers even without input or filter transformer

signal to this. We find that to heterodyne the 300 meter signal to 3,000 meters our oscillator must be adjusted to a wavelength of 332 meters. While at the same time this adjustment heterodynes the 310 meter signal to a wave length of 4,433 meters. Now it is seen that the separation between these two stations when heterodyned to 3,000 meters is considerably greater than in the first case and while at 3,000 meters we cannot tune quite as sharply without causing distortion, at the same time it is not necessary as the wavelength difference here is so much greater. It of course follows conversely that if we use an intermediate wavelength below 2,000 meters the two heterodyned frequencies will be correspondingly closer together and the lower we go the closer they will approach one another, until at their former wavelengths of 300 and 310 meters we reach the original separation of 10 meters. It can easily be seen that if we place the wavelength of our intermediate amplifier too low, we will have difficulty in building our filter circuit for the amplifier sufficiently sharp to separate the two waves, therefore, all other considerations aside, it is quite obvious that there is a lower limit also beyond which it is not practical to carry this intermediate wavelength. Before we draw conclusions, let us consider a few of the other factors that enter into our amplifier design.

TUBE NOISES AND STATIC INTERFERENCE

THE limiting feature of distance reception with a super-heterodyne can be summed up in the one word—noise. We could keep on amplifying indefinitely if it were not for the fact that tube noises and atmospheric interference, hold us to a practical limit. Therefore it is of the utmost importance that our intermediate-frequency amplifier should amplify this type of interference as little as possible. In other words, it should be a pure radio-frequency amplifier and should not pass audio-frequencies with increasing volume.

Now, the higher the wavelength which is used, the lower the frequency becomes, gradually approaching an audible frequency. Accordingly, the higher the wavelength to which the amplifier is tuned, the greater is its tendency to amplify audio-frequency noises. In fact a radio-frequency transformer which is designed for wavelengths of 6,000 meters or greater, is a fair audio-frequency amplifying transformer and a 3-stage audio-frequency amplifier, even if its efficiency per stage is not great, can build up quite a volume of sound. This of course may be overcome to some extent by the use of an air core filter transformer in the amplifier output, but this does not correct it entirely. The real solution to this problem, as I see it, is to reduce the wavelength for the intermediate amplifier to such a point that comparatively low impedence air core transformers may be used which will not allow a large audio-frequency potential difference to build up across them and will accordingly give a considerable increase in the signal-noise ratio.

HAND CAPACITY EFFECT

THERE is another consideration which further justifies the use of a low wavelength for extreme amplification. This is the well-known and troublesome hand capacity effect.

The higher the frequency (the lower the wavelength) that is used in the intermediate amplifier, the less shielding is necessary. In fact if a frequency higher than 200,000 cycles (wavelength lower than 3,000 meters) is used, shielding may be entirely eliminated. This is due to the fact that changes in either the local oscillator or incoming wave frequencies due to capacity effects from the operator's hands on the tuning dials, etc., cause a smaller percentage of change in the heterodyne or beat frequency as this frequency is increased. In other words, the shorter the wavelength which is used in the intermediate amplifier the freer the set will be from hand capacity effects, resulting in more stable operation and easier tuning.

IMPORTANT TUNING CONSIDERATION

THERE is still another important point in favor of the low-wave amplifier. In heterodyning the incoming signal—changing its wavelength to the one which we are to use in the amplifier—we may use either the sum of the local oscillator frequency and the incoming wave frequency, or their difference. In actual practice there will be at least two places on the oscillator dial where any station may be received, providing the loop or antenna tuner, as the case may be, is not detuned from the station and also providing that the oscillator has sufficient range to cover both of these two points. Now, as the wavelength of the intermediate amplifier is increased, these two points at which the station will be reproduced come closer and closer together on the

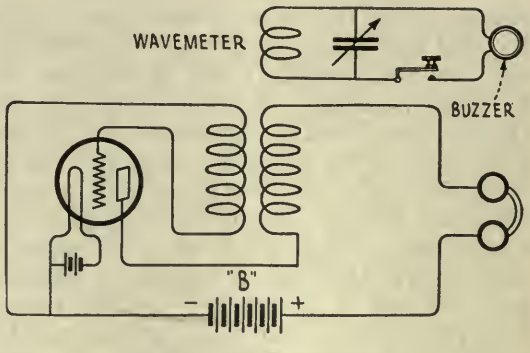
oscillator dial, until when we amplify at a wavelength of 10,000 meters. These two points, let us say, are separated by only a very few degrees on the oscillator dial and in fact are so close together that when tuning the set, the antenna tuner is not sufficiently out of resonance by the time the second one is reached and consequently the station is brought in at two points close together. This is confusing to the operator. It often happens that the station will come in again on its upper point exactly on top of the lower point of some other station, thus causing needless interference. Now the cure for this situation is to reduce the wavelength of the intermediate-wave amplifier to such a point that a low wave station will not be heard again until the high broadcasting wavelengths have been passed, or at least until the two resonance points are so far apart that by the time the upper one is reached, the antenna or loop tuner is far enough out of resonance to prevent it from coming through again, thus the local oscillator or heterodyne may be so designed as merely to cover the sum or difference of the oscillator frequency and the incoming wave frequency. Then the operator is not bothered by having the low wave stations repeating on him when he is attempting to receive those on high wavelengths.

STABILITY AND EFFICIENCY

THE super-heterodyne owes its existence to the well-known fact that high wavelengths are easier to handle at radio frequencies than the low ones. In other words, as we go up in wavelengths it becomes easier to build the radio-frequency amplifier and obtain stability and efficiency. However, this problem is not a serious one at any wavelength over 1,000 meters. In fact at any wavelength greater than this, even a resistance-coupled amplifier shows good efficiency, and while we can obtain a greater efficiency per stage as the intermediate wavelength is increased, at the same time we do it at a sacrifice of other desirable features, as have been pointed out above. If the transformers are properly designed and the leads are kept short, particularly the grid leads, the question of stability should not be a troublesome one.

BUILDING YOUR OWN

FOR the benefit of any readers who may contemplate building their own transformers, here is some advice about their construction. In the first place, if you are going to wind your own, choose a low wavelength, something in the neighborhood of 2,000 or 3,000 meters. This is not only on account of the points brought out above, but also because it is more practical to build a transformer for these wavelengths with the limited facilities and equipment available to most of us. This is mainly due to the fact that when the higher wavelengths are used it is almost imperative that an iron core in some form be used. This is done in order to flatten the curve sufficiently to prevent the transformers from distorting, which would be the case if they tuned too sharply at the higher wavelengths. While an iron core at radio frequencies introduces a considerable loss, if the construction is careful, thin laminations being used, each insulated from the other, this loss is well compensated for by the step-up ratio which may be used in the transformers themselves. The design of such transformers and their construction is rather difficult and the materials are hard to obtain, therefore if one wishes to experiment with them, by all means buy a set.



A WAVEMETER CIRCUIT

For testing the wavelength of intermediate-frequency transformers in the super-heterodyne

On the other hand, it is possible for the average person to build a set of fairly efficient transformers having their resonance point in the neighborhood of 2,000 or 3,000 meters, and while this work is by no means simple, and I do not recommend it to any one who has not had some experience along this line, at the same time it is a good experiment for the man who takes pleasure in this sort of work. Instructions for winding such transformers have already appeared in the April issue of this magazine. These transformers are comparatively sharply tuned and it is necessary that their natural wavelength should fall within

approximately 100 meters of each other. It is a physical impossibility to wind two coils so that their natural wavelength will be the same, due to slight variations in the wire, insulation, etc. On the other hand, if the mechanical dimensions of the forms are all the same and exactly the same number of turns are wound on each, the error will not be serious and they will almost always come within 25 or 30 meters of each other. However, it sometimes happens that one coil is wound considerably tighter than the others, or that wire from another lot or from a different manufacturer is used, which results in a considerable difference in resonance. A simple test for the transformers after they are wound may be made as follows: place the transformers in an oscillating circuit by connecting its secondary to the grid and filament of a vacuum tube and its primary to the plate and B battery of the same tube, placing a pair of phones in series with the plate circuit. We now have the transformer hooked up as it is in an amplifying circuit, with the exception that both primary and secondary are being used on a single tube instead of between two tubes. As the primary acts as a feed-back or tickler coil, the circuit will oscillate providing of course the primary polarity is correct. Now, by taking a wavemeter and placing the wavemeter coil over the transformer, that is, just above it (the wavemeter should be taken from its case to do this) the natural resonant frequency of the transformer may be measured by moving the wavemeter condenser until a click is heard in the phones. When the wavemeter is tuned to resonance with the transformer, it absorbs the energy in the oscillating circuit and at one point stops the circuit from oscillating. This registers as a click in the phones. If there are two distinct clicks, the wavemeter is too close to the transformer and should be lifted until this narrows down to a single one or two clicks which are very close together, in which case the proper wavelength is one half way between the two clicks. When the wavelength is noted on the meter, the other transformers may be tested similarly in operation. If the transformers are not in resonance, turns may be decreased until the transformers are all approximately matched.

It is not necessary to go through this procedure with the input transformer, as the condenser which is used across its primary can be made to throw the wavelength of this transformer one way or the other to coincide with the rest. While it is not necessary to have the transformers closer in period than 100 meters, at the same time, due to the fact that when placed in the circuit, variations in tube capacities, sockets, wiring, etc., will make them vary, it is well to have them matched fairly accurately, then any slight variations will not be noticed.

It can be seen that manufacturing transformers of this wavelength on a commercial scale is no small matter, and while if they are carefully made and wound they will run sufficiently accurately for all practical purposes, the danger is that someone may occasionally procure a set which combines the two extremes of variation and while of course this would only happen occasionally, it will give them trouble when it does occur. It is of course a considerable problem to measure the individual wavelength of each transformer and match them into sets on a production basis, at the same time keeping the cost within reason, but I have come to the conclusion that this is the only satisfactory method to use and the results obtained are well worth the additional labor.

FILTER TRANSFORMERS

A FILTER transformer is very necessary when the higher wavelengths are used and in this case it is best used in the output, immediately preceding the final detector tube. There are two reasons for this—first, as it is necessary to build the high wave interstage transformers so that they will cover a wide wavelength band, they are of course in themselves very broad tuned and it becomes necessary to have a sharply tuned air core transformer to determine the frequency at which the amplifier will function and to exclude other frequencies. Second, due to the higher impedence of the longer wavelengths to audio-frequency impulses, such an amplifier will amplify static and other disturbances at an audio frequency and this becomes very disagreeable when carried through three stages. This objection, however, can be somewhat overcome by using an air core filter transformer in the last stage coupled to the detector tube, which will have a tendency to reject the audio frequencies.

On the other hand, in the case of the short wave amplifier, a filter transformer is not strictly necessary, as the amplifier itself is sharply tuned and the degree of sharpness can

be perfectly controlled with the potentiometer, which controls the degree of regeneration in the amplifier. Therefore a special input transformer with a tuned primary is usually an advantage, because the condenser acts as a by-pass in this circuit to the two other frequencies which are passing through it. These frequencies are the incoming wave and heterodyne frequencies. This condenser can be adjusted at the same time to compensate for the variation of load which is imposed on this first transformer, due to the characteristics of its primary circuit and apparatus in series with it being somewhat different from the interstage transformers.

WHICH SHALL WE CHOOSE—HIGH OR LOW?

THERE are one or two considerations which would seem to indicate that the high wavelengths are best in the intermediate amplifier. On the other hand there are sufficiently strong arguments on the other side to make it well worth while to sacrifice something in order to gain the beneficial results which the low waves will give us. If we use a high wave intermediate amplifier, we will obtain good stability and large amplification per stage. On the other hand, to get this we have somewhat complicated the tuning and have decreased our signal-noise ratio, which after all seems to be the answer. Amplification, sharpness of tuning, and all other considerations are of little avail if our receiver brings in such a quantity of noise together with the signal that it is either unpleasant to listen to or even impossible to do extreme distance work when conditions are not perfect. This one consideration alone is sufficient in my mind to indicate a comparatively low wavelength as the best. However, if we carry this too far we are going to sacrifice our sharp tuning, which is such a valuable characteristic of this receiver and on account of this latter consideration I would not recommend a lower wavelength than 1,500 meters. With the other points in view, I would not recommend a higher one than 6,000 meters. I believe that the ideal wavelength lies between these two extremes. What it is depends to a large extent on the individual conditions. If a receiver is installed in a noisy location (and this is the case in or near most of the large cities) I would pick a comparatively low wavelength. On the other hand, if extreme sharpness is a consideration and the receiver is to be used in a neighborhood where there are several powerful broadcasting stations which must be worked through, it will be necessary to choose a higher wavelength to obtain that razorlike sharpness which must be had under these conditions. I believe that the most satisfactory all around wavelength for an intermediate amplifier lies in a compromise between these two extremes of 1,500 and 6,000 meters.

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THE HARBOR AND TOWN OF NANTUCKET

In the old trading days, Nantucket was a considerable port, but its importance has steadily declined. The wireless station at Siasconset is seven miles south of Nantucket on the southerly side of the Island

Historic Days at a Famous Wireless Station

Stirring Times at Station SC, Siasconset, Long One of the Best-Known Wireless Outposts on the Atlantic—The Shore Operator Tells His Story of the Wreck of the *Republic* and Jack Binns' Heroic Work

By JACK IRWIN

NANTUCKET ISLAND, Massachusetts, small in circumference, has not always been geographically or industrially insignificant. In the years immediately following the Revolution it might have been described as an island without a country, because at first it was not included in the new United States of America. The defeated Mother Country did not claim it, either. However, it was not long before Nantucket Island was to assert itself, and become as well known as the name of Rockefeller is to-day. It developed into the greatest whaling port in the world, when the world used whale products as Rockefeller products are now used. Nantucket ships and Nantucket men sailed the seven seas.

Gradually the whaling industry, through the substitution of cheaper and more readily acquired oils, dwindled almost to extinction. Hundreds of great ships, many claiming Nantucket as their home port, scattered into more

lucrative trades. Nantucket again slept. With the advent of the steamship, it became more or less known for its pilots. The lightship *Nantucket* anchored off its shoals, was one of the few reminders of a once famous port. As the cities of the neighboring states became more and more congested, Nantucket developed into a most exclusive summer resort, far from the madding crowd, and so it is known to-day, one of the most delightful and restful spots upon our coast.

A BIT OF HISTORY

MESSAGES dated from its shores were destined to make history in a new industry and science. When Marconi commercialized wireless, a company bearing his name was organized in the United States. The general public were sceptical of results, but no more so than the shipowners. This struggling industry and the young company had a strenuous financial existence for many years. Early in its history, the Marconi Wireless Telegraph of America rediscovered Nantucket Island. On the eastern shore of the island, in the village of Siasconset, this company established one of its wireless stations.

At this period (the beginning of the present century), the New York *Herald* was world famous because of its excellent shipping news. Its owner, the late James Gordon Bennett, was quick to see the significance of the new wireless service in its relation to shipping. He obtained permission from the United States authorities, and after making coöperative arrangements with the Marconi Company, installed a radio station on the lightship anchored off Nantucket Shoals. This was 40 miles due south of Siasconset where the new Marconi station had been installed. Primarily the lightship station was to be utilized for reporting passing vessels to the *Herald*. The lightship sent the messages to SC, as the new station was designated in the call list, reporting passing vessels to the *Herald*. However, a reciprocal arrangement was made whereby the lightship station was to relay any messages to or from steamships equipped with wireless. The operators at Siasconset and other Marconi stations alternated with the operator on the lightship, changing off in this duty every month or six weeks when the vessel was visited by a tender or relieved by another lightvessel. The distance separating the lightship and Siasconset, approximately 40 miles, was just about the limit of wireless transmission in those early days, when the coherer receiver was used. The operator could either read by sound, or from the tape which registered the message in dots and dashes. Thus, early in the history of radio was Siasconset placed on the map. For many years it was considered the most important shore station in the world. Ships outward bound from New York used it as the last station to which a message could be sent, while ships bound westward found it the first station they could communicate with on this side of the Atlantic. As the transmitting range of wireless was steadily extended through improvements in the apparatus, notably the substitution of the Marconi magnetic detector for the coherer, the importance of the station grew until it was working directly with transatlantic liners instead of employing the lightship as a relay station. Eventually Mr. Bennett withdrew from the wireless business and the lightship was equipped by the United States Navy and manned by navy men. Meanwhile, wireless had demonstrated its possibilities to steamship owners, especially the large English and other European companies, until every vessel of any importance was equipped, but the general public knew little of the new science, heard little about it, and used it even less. It remained for one of those great dramas of the sea, which seem to occur periodically, to advertise and to impress upon the world overnight, the great scope of Marconi's development. It was ordained that this great

"Time Was—When . . ."

Since the earliest days of wireless—now refined as radio—the wireless telegraph station at Siasconset, Nantucket Island, has been known to ship operators, ship travelers who filed their messages via that station, avid listening amateurs, and that other scattering few of the public who "just happened to know." Many famous messages have gone out from station SC, *later* MSC, *and many famous wireless men have pounded brass under the tall wooden masts on that picturesque little island. Jack Irwin tells of that famous night he picked up the* CQD *signals from Jack Binns on the* Republic *when those faint radio beams saved 1,400 people. This is a capital story, written by one of the earliest and best-known of old timers.*—THE EDITOR.



THE TOWN LANE

In Nantucket, near the famous old wireless station MSC, at Siasconset, Massachusetts. The operators when off duty at the wireless station used to wander in town through charming spots such as this

demonstration of the life-saving power of radio was to occur in the immediate vicinity of Siasconset.

A HISTORIC RADIO DAY

ON JANUARY 23rd, 1909, the writer was on duty as operator at Siasconset, assigned to the midnight to 8 A. M. watch. It was Friday night and there was very little business in the air. Few ships cleared from New York on that proverbially unlucky day. I relieved Operator Jack Cowden who had informed me at midnight that there was only one ship, the *Republic*, to be heard from. She had been scheduled to sail from New York, at 10 A. M. Friday and ordinarily should have communicated with us that evening. Realizing that there was only one operator on board, I deduced that he had turned in by midnight and that I would not hear from him until early in the morning. Events subsequently proved that the vessel did not leave New York, until 3 P. M. and therefore the *Republic* was not within the range of SC when I relieved the watch. During the early hours of my watch I occasionally exchanged messages or signals with the two or three vessels within our zone. There was the *Baltic* inbound for New York, who had passed Nantucket and was then in communication with the Sagaponack station on Long Island. About two o'clock there was the *La Lorraine*, 230 miles east of Nantucket who was cleared of traffic and who informed me that he would "turn in" until 6 A. M. The steamers *New York* and *Furnesia* were also coming within range of Siasconset and I knew they would be calling me about daybreak.

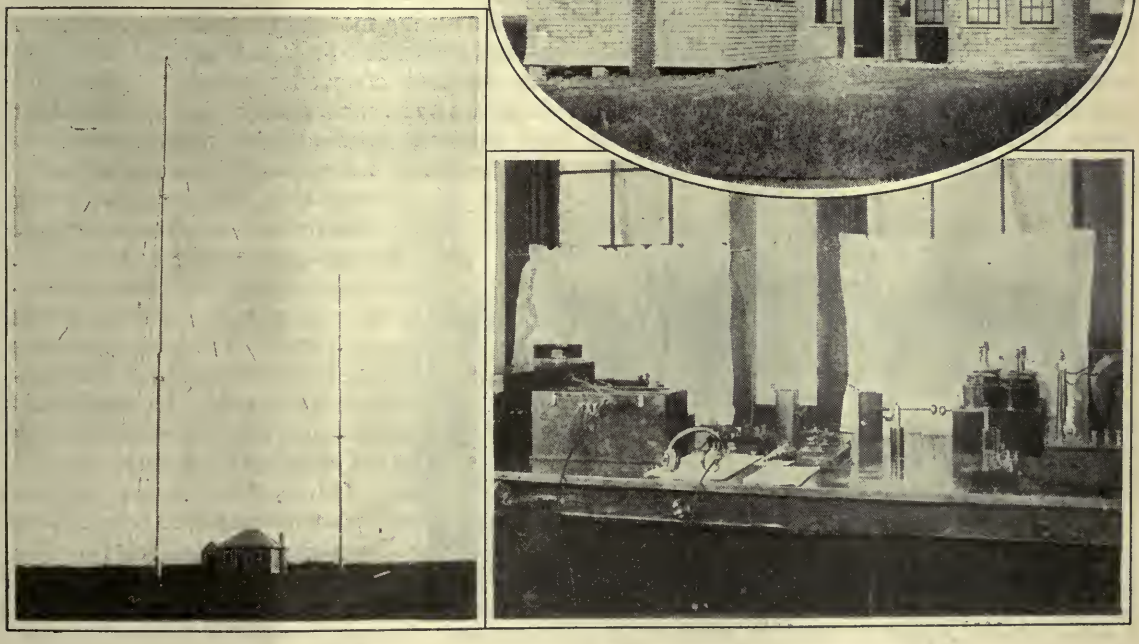
FAME COMES TO WIRELESS —AND SC

IT WAS a bitter cold night and the small coal stove was going to its full capacity. With nothing to do and a clear station file, I read and dozed, then dozed and read in my chair. I had not had much sleep the previous day, having gone into the town of Nantucket on errands. The fire in the stove became low and I suddenly became fully alert, chilled. I arose to heap some coal on the fire but as I did so I heard a faint signal and paused to listen. Dimly I could hear what sounded like a station calling CQ, meaning "all stations." This is the call ship operators broadcast when they came on watch after being away from their apparatus and wish to learn who is within their range. Listening intently I could not hear him sign his call letters, so at the moment, I paid no further attention. The fire was replenished, the work of a minute or two, I was again listening-in, lazily stretched in my chair. This time I detected something clearer coming into my head phones. CQD, CQD CQD-MKC MKC MKC.

It flashed upon me in a second that here was a ship in distress. Throwing in my switch I started the dynamo and answered him.

Faintly came the message that it was the *Republic* in distress, rammed by an unknown ship and rapidly sinking and assistance needed immediately. This message was rapidly followed by his position which placed the scene of the disaster about 60 miles south of Nantucket. I immediately answered that assistance would be forthcoming. With my log in front of me I was able rapidly to estimate the nearest ships to the *Republic* with which I was in wireless communication. I sent out a general call and broadcast the particulars. The first to answer me was the Frenchman, the *La Lorraine*, who true to his word was on the job, it then being after 6 A. M. He came back with the news that his captain was proceeding at full speed (better than 20 knots) to the scene, he also gave his distance from the *Republic's* position as 180 miles. That long stretch was not very promising to a ship in dire distress. I then turned my attention to the *Baltic* who had passed us early in my watch. After a few minutes he answered and stated they had turned about and were proceeding to the *Republic*. All this information was passed to the *Republic*, whose operator, Jack Binns, was hard at work at her key. Then, in turn, I passed on the information to the *New York* and *Furnesia* who were now within range of sc. Having done what I could to obtain assistance from the seaward side, I now turned to the land wire which connected us with the mainland at Woods Hole, Massachusetts. I knew that this was a base for revenue cutters and that the U. S. S. *Acushnet* lay there. Calling that office, I left word for the cutter to proceed to aid the *Republic*. Subsequently I learned that the *Acushnet* in passing out of Vineyard Haven to aid, found a four masted sailing vessel on the rocks and was compelled to stop to rescue her crew. This revenue cutter, therefore, did not reach the *Republic*.

After doing everything possible to get aid to the sinking liner, I proceeded to take several messages from the *Republic*. Captain Sealby sent full details of the situation to his owners the White Star Line. The wireless signals from the *Republic* were very weak considering the distance between us, and Binns told us that he was



STATION MSC

Showing the tall masts, guyed heavily against the ocean winds, the wooden operating building through which so much radio history passed, and the transmitting and receiving table. A ten-inch spark coil is at the extreme right, and next to it a battery of Leyden jar condensers, connected across an open spark gap

working off his storage batteries. The ship's dynamo was under water. This accounted for the fact that none of the ships rushing to the rescue could hear his signals, for on the reduced power of the batteries they were out of his range. For several hours we acted as a relay station for the frequent interchange of messages between the captains of the various vessels involved. The CQD had been received about 6 A. M. Since I was alone there was nothing to do but wait until my relief, Mr. E. T. Edwards arrived at eight o'clock. Upon his arrival we got Mr. A. H. Ginman, the operator in charge of the station on the job and we also called Mr. Cowden, the other operator. From that time on all four of us were busier than any operators since radio was invented. One held down the wireless circuit, another the land wire to the mainland, a third started the engine and kept it running.

THE RESCUE

SEVERAL hours had elapsed since the first call of distress had reached us. A dense fog prevailed and seemed to be so general that all the vessels concerned were enveloped in it. The vessel which had rammed the *Republic* turned out to be the Italian freighter *Florida*, unequipped with wireless. She had managed to grope her way back to the scene of the collision and although badly crippled herself, she took 1,400 of the *Republic's* passengers off safely. The *Baltic* and other rescuing vessels were now in the vicinity of the wreck, but owing to the fog were unable to locate the distressed ships. The story of the ultimate rescue of all has been told by Alfred M. Caddell in the April number of this magazine. Suffice to add here, that the *Baltic* eventually reached the side of the *Republic*, as did the *New York*, *Furnesia*, and several other vessels. The passengers were re-transferred to the *Baltic* which proceeded to New York. The *New York* stood by the *Florida* and escorted her into New York, where she was safely docked. The *Furnesia*, together with the revenue cutters *Seneca* and *Gresham* attempted to tow the *Republic* into shallow water, but failed. Forty eight hours after the collision the big liner sank. The only casualties were caused by the impact of the ships. Two passengers were crushed to death in their berths amidships on the *Republic*, while four sailors in the forecastle of the *Florida* met a similar fate. The remainder of the hundreds in danger were safely on their way home.

During the forty-eight hours that the events just chronicled were occurring, we, at Siasconset, were deluged with radiograms and telegrams. The news of the disaster had leaked out and the newspapers, shipowners, relatives of passengers were demanding news from us. We gave the right of way to the ships involved. Between times, we answered, as best we could all the messages coming in over the land lines. We sent hourly bulletins to the newspapers, sent reassuring messages to relatives, and gave general information to the steamship line as to the progress of events. For 72 hours we slugged away, each taking his turn at either the wireless, the land line, or the engine. It was necessary to run the engine constantly, something the water cooling system of the kerosene engine had not been designed for. The water supply was only obtainable from a deep well so it was hard work for the engine tenders to draw water and refill the engine water tank. In turn, whenever possible we would snatch an hour or two of rest.



THE OLD JAIL—NANTUCKET

Which succeeded in amusing rather than terrifying the wireless operators who were handling traffic at MSC, the famous old station of the Marconi Company

During those three days we found that we had handled 22,000 words in that small station. Not an inconsiderable amount of work for any telegraph office with greater facilities than ours. The newspapers we had served not only showed their appreciation in their columns but sent

us substantial checks. These aggregated a good sum and we could not help but remember the old adage about the ill wind.

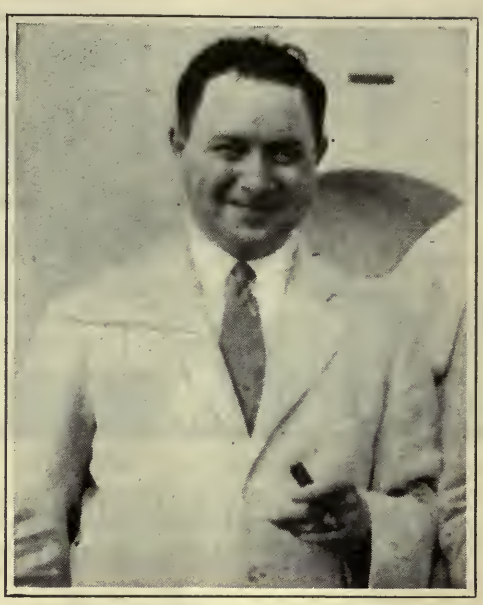
The episode just described was the first time that a ship in distress had utilized wireless to save life at sea. It brought home to the world in such a forceful, dramatic manner that wireless was a necessity, that within a very short period laws were enacted that compelled ships not only to carry wireless, but to carry not less than two operators in order that a constant watch might be kept. Those laws are international to-day. The maritime nations of the world gathered in convention in London (1912) and made a treaty which has been the base of radio regulations in every civilized country. Binns, the operator in the ill-fated *Republic* arrived in New York to find himself a hero, and proclaimed in every newspaper printed.

SIASCONSET DEVELOPED REAL RADIO MEN

SIASCONSET through this publicity became well known generally, but to the old-timers in the radio field it was even better known as a training school for wireless men, and some of the operators who at one time or another passed some of their days there are well known in the radio field to-day.

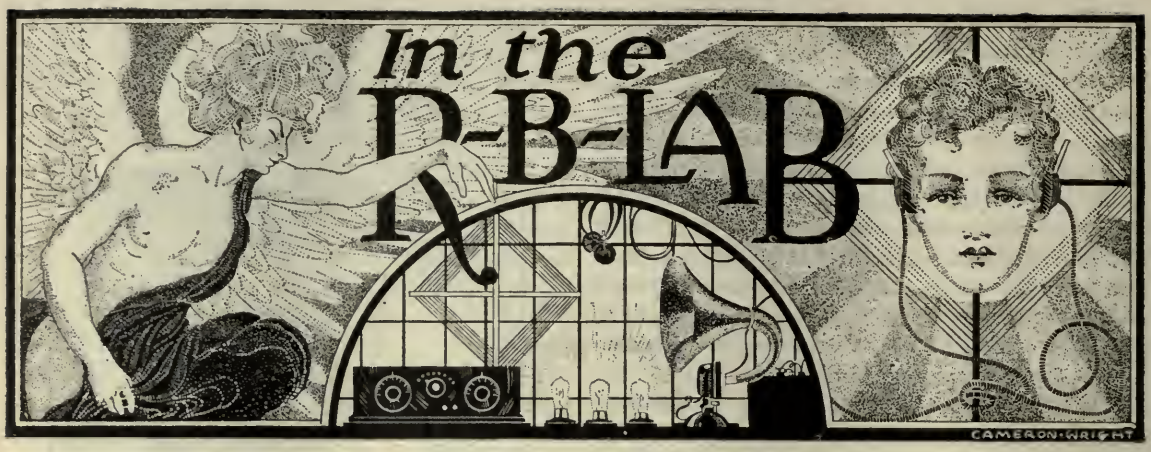
At that period in the history of wireless telegraphy there were no schools for training personnel. The company selected operators from the ranks of the commercial telegraph and cable companies, especially the latter. Cable men were familiar with both the Continental and the Morse codes, therefore able to take the messages from the ships in the Continental code and then handle it on the land wires in the Morse code, and vice versa. When they joined the Marconi Company's service they were invariably sent to a shore station to break in. At that time there was no governmental regulation of wireless and consequently licenses were not required to operate a station.

So well known was Siasconset as a training center, that the Marconi Company of Canada sent a number of their men there to break in. Mr. A. H. Ginman, who now has charge of the English Marconi Company's extensive interests in the Orient was manager for a great many years at Siasconset. He was the dean of the old-timers. He taught the fundamental principles of radio to many of the men who have reached prominence to-day. Young David Sarnoff, now the Vice-President and General Manager of the Radio Corporation of America, received his early training at this station. After commencing his career as office boy at the head office of the Marconi Company he was sent to SC as an operator. I particularly welcomed Sarnoff. He was so enthusiastic about radio that he stood a great part of my watch, voluntarily, and thereby allowed me to play tennis and otherwise enjoy the summer advantages of Nantucket! Other radio men to spend a portion of their time there were the late E. T. Edwards, later superintendent of the Eastern division, Jack O'Neill now an official of the Federal Telegraph Company, John C. Cowden, now supervisor of the Radio Corporation, Charles J. Weaver, now superintendent of the R. C. A., Algernon Cruttenden, assistant traffic manager of the Radio Corporation. Many of the operators of that time will remember the lovable late Neil MacIntyre, who helped pass many pleasant hours at SC. Matt and Tom Tierney, Oxenham, Charles Burgess, and many others passed through the mill at SC. The call letters MSC have been deleted from the official lists of radio stations, but it is indelibly listed in the memories of those who spent their youthful radio days on old Nantucket.



DAVID SARNOFF

Now Vice-President and General Manager of the Radio Corporation of America. Mr. Sarnoff received much of his early radio training while a junior operator at station MSC, exchanging messages with the ships entering and leaving Atlantic Coast ports



A HOME-MADE RECTIFIER FOR CHARGING A AND B BATTERIES

FIGS. 1 to 5 inclusive show an attractive and efficient battery charger built by a reader, Mr. F. H. Horning of Toledo, Ohio, from specifications given in the November and December, 1923, issues of RADIO BROADCAST. Revised data on the building of the rectifier is herewith presented for the benefit of our many interested readers.

The charger is designed for the standard Tungar five ampere rectifying tube with potentials supplied by a step-down transformer operating from 110 volt 60 cycle alternating current. Reference to the circuit diagram, Fig. 4, will show that the transformer has three windings, primary, a filament lighting secondary (Sec. 2) and a higher voltage charging secondary (Sec. 1). The primary is wound on one leg of the core with 495 turns of No. 16 double cotton covered wire. The filament winding is placed next to the core on the opposite leg and consists of nine turns of No. 9 double cotton covered wire. The charging secondary is wound over the filament lighting winding, with 230 turns of No. 12 double cotton covered wire. Adequate insulation in the form of two layers of empire cloth or tape should separate the secondaries, and the core from the primary and filament lighting windings.

The core is rather a variable factor, for different grades and sizes of core material will be conveniently available to different fans. Many enthusiasts will have cores already built up which can be adapted to the charging rectifier. In the October number of the RADIO BROADCAST Lab Department, empiric and theoretical data will be given for building and designing small transformers, showing how the number of primary and secondary turns may be determined, for any purpose, in reference to the size of the core and the core material (the two variable factors with a given applied voltage and frequency). However, many enthusiasts will be content to build up a core in accordance with stated specifications, and they are referred to Fig. 5 which is reproduced from the original December article. The sizes given are for the ordinary grade of core iron which is easily secured from dealers in sheet metals. The core should be built up to a height of 1 $\frac{3}{4}$ inches.

What the Lab Offers You This Month

—How to build a home-made rectifier for charging A and B batteries.

—How to change over several types of three-circuit regenerative sets to one using a stage of radio-frequency with reversed feed-back stabilization, tube detection, and regeneration.

—How to increase the effective range of your portable voltmeter.

—A suggestion to the owner of a home laboratory.

—Hints on radio operating and construction.

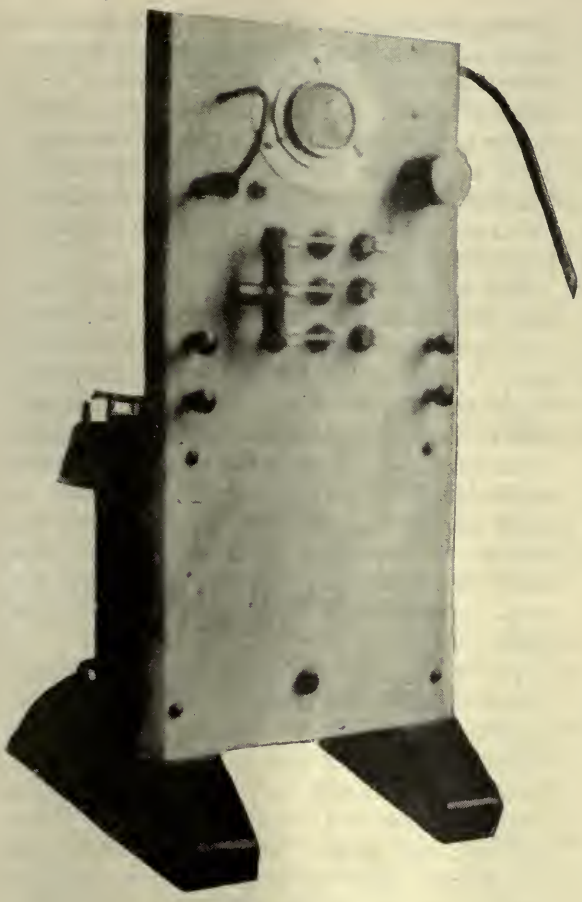


FIG. 1
A neat panel style storage battery charger built by a reader of the Lab Department

If silicon steel is obtainable (which is by far the better material) the core need be built up to only two thirds this height, or the dimensions affected in any other way so that the cross section area will be two square inches, rather than three square inches as specified for the less efficient material.

For more detailed descriptions of the manner of core construction and winding, the reader is referred to the December Lab Department already mentioned.

The following bulk materials will be required in making up the transformer:

Twenty pounds of core iron, or fifteen pounds of silicon steel.

Three pounds of No. 16 D. C. C. wire (primary).

One half pound of No. 9 D. C. C. wire (filament secondary).

Three pounds of No 12 D. C. C. wire (charging secondary).

All connections behind the panel should be made with nothing smaller than No. 9 wire.

The three pole double throw switch, S, makes the operation of the charger particularly convenient, for the battery and the filaments are permanently wired to the panel. Throwing the switch to the right connects the battery to the set. When thrown to the left, the receiving apparatus is disconnected, the battery is placed in the charging circuit and the 110 volts is turned on.

A charger constructed according to the specifications here given should charge at from five to eight amperes, be very silent, and, with the exception of the bulb, exhibit little heating.

This charger may be adapted to charging storage B batteries according to the directions given in the article by Mr. Bouck in the July RADIO BROADCAST.

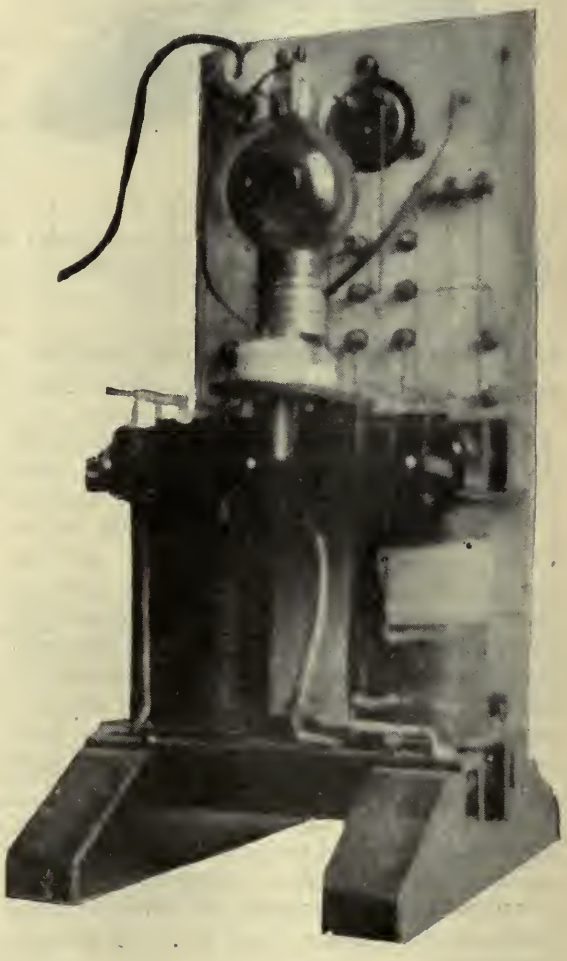


FIG. 2
Behind the panel of the home-made bulb rectifier

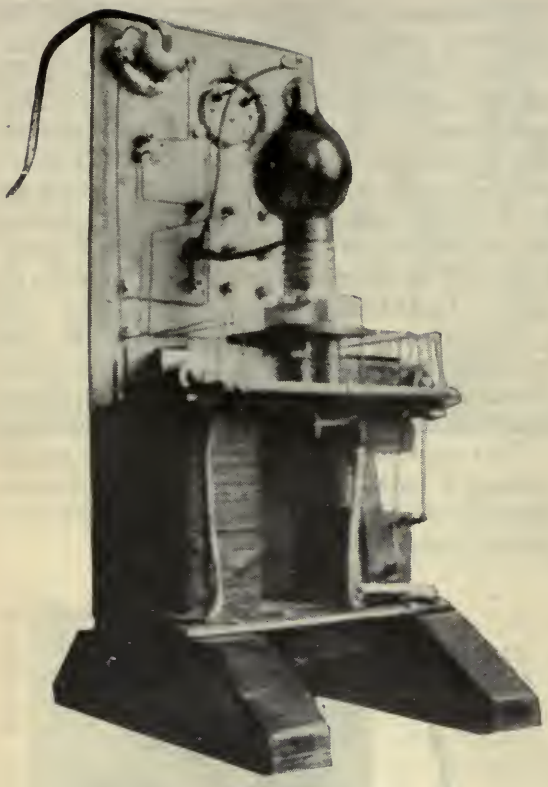


FIG. 3

Meter and fuse are at the top of the panel. This charger may be used for charging storage B batteries, as explained in the August article by Zeh Bouck

A STANDARD TUNER IN A NONRADIATING STABILIZED R. F. CIRCUIT

MANY readers have built three-circuit receivers utilizing manufactured coils marketed under various trade names, such as "The Trans-Continental", "The All Wave Tuner," "Ambassador," etc. These coils are characterized by three windings, a primary (generally semi-periodic or untapped), a secondary, and a rotating tickler. While receivers made up from these coils are comparatively efficient, they are inferior to receivers employing a single stage of R. F. amplification, and, regardless of the semi-tuned primary, are often disturbing radiators.

Sets of this type can be made over, with the addition of an extra coil and tube, into much more efficient apparatus employing one stage of radio-frequency amplification with reversed feedback stabilization, bulb detection and regeneration.

The circuit is shown in Fig. 6. The discerning enthusiast will comprehend that the additions of the new coil and tube are the only variations from the circuit with which he is already familiar. The tickler coil is still the tickler coil in the detecting circuit, the secondary remains the secondary with the conventional connections, and the primary is still the primary only that now it is also the output or plate coil of the R. F. tube.

The additional coil, L, is wound on a three inch form with 100 turns of about No. 22 or 24 insulated wire, tapped at the 60th and 80th turns. (This coil can also be purchased, both singly and attached to the tuning and tickler unit.) The taps compensate for antenna variations, and in operation should be experimented with. A permanent connection is made to that tap which gives the closest approach to identical readings on the two condenser scales at mutually resonant settings (causing both condensers "to tune the same").

The extra coil is mounted at the primary end of the standard tuner by means of a small right-angled bracket. This arrangement is illustrated in photograph Fig. 7. At first glance it may appear that there is no coupling whatever between L and the primary. However, the axes do not intersect—the added coil is mounted a little below the center of the main tuning unit, and sufficient feedback is generally effected to prevent oscillations in the R. F. circuit when the connections to L are in the right direction. In the preliminary operation of the receiver, it may be necessary (it's a

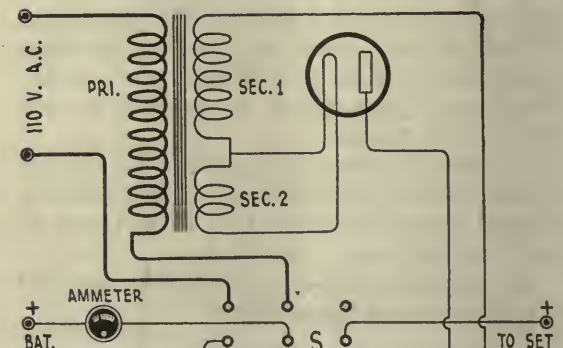


FIG. 4

The circuit for the charger. The set and battery are wired permanently, charge and discharge being controlled by the three-pole double-throw switch

fifty-fifty chance) to reverse the antenna-grid and ground-filament connections.

In a few cases, with very high plate voltages and a particularly active tube, it will be necessary to increase the coupling between the antenna coil, L, and the primary. This is easily done by tilting L upward—bending the bracket.

When testing for oscillations in the R. F. circuit, the detector tube should be made to oscillate by increasing the positive tickler coupling, and the condenser C1 twirled at various settings on C2. If the R. F. circuit oscillates, a beat-note will be produced. Oscillations, if any, will be manifest on the higher frequencies (lower waves).

Both condensers are forty-three plate variables—having maximum capacities of .001 mfd. The remainder of the circuit and values hold no mysteries for the readers familiar with the three circuit, tickler regenerator.

Figs. 8 and 9 are photographs of the complete receiver shown in the circuit diagram. The set tunes more sharply than the three-circuit regenerator, and is quite superior to its predecessor in sensitivity. Both these qualities, however, are capable of improvement through the elimination of the binding-posts and other metal fixtures which are prodigally distributed about such manufactured coils. This very prevalent and inefficient practice increases the $\frac{R}{E}$ ratio—or less technically, the effective resistance of the circuit. This cannot be overcome by regeneration, and results in loss of selectivity and sensitivity.

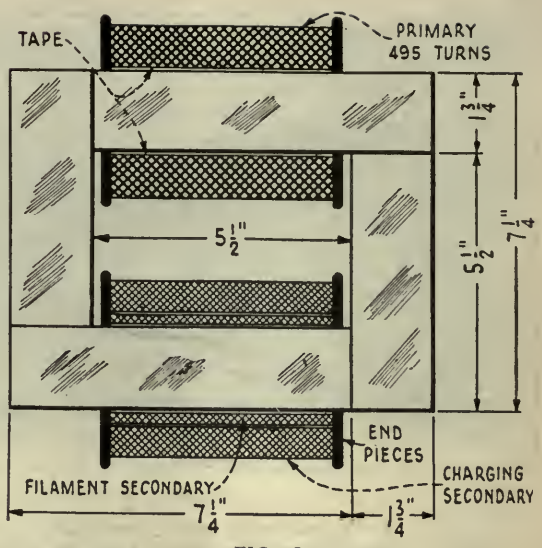


FIG. 5

Showing how the core is built up of iron strips and how the two windings are placed. The primary and secondary windings are shown cut away on the side nearest the observer, so as to show the iron core over which the turns of wire are actually made

INCREASING THE RANGE OF A VOLTMETER

IN MANY cases if the range of a small portable voltmeter could be doubled, tripled, or quadrupled, its value to the owner would be increased as many fold. This is one of the easiest things in the world to do, and may be accomplished by the beginner without resorting to mathematical calculations or expert assistance.

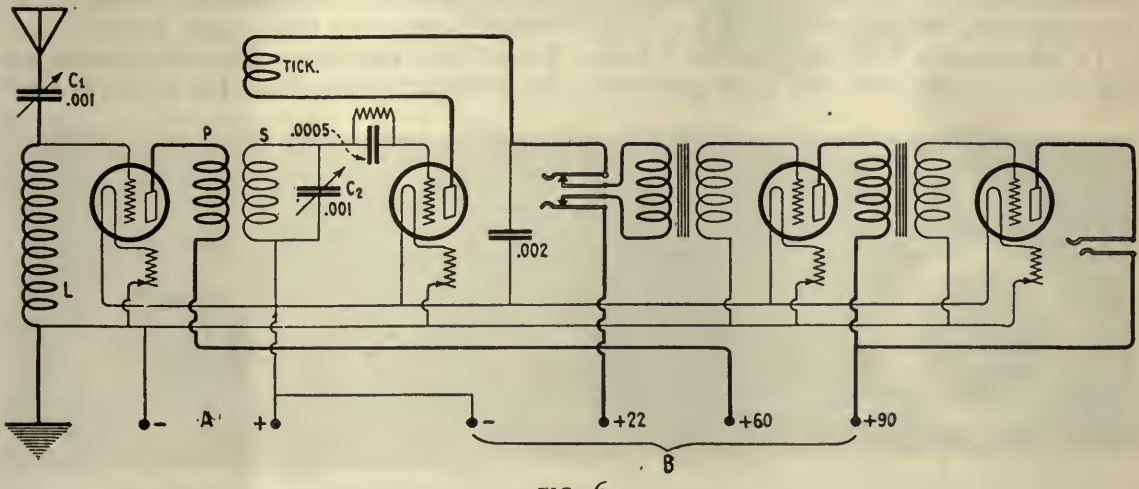


FIG. 6

The circuit for the reversed feedback R. F. receiver. The first tube, and inductance L are the only additions to the standard tickler feedback three-circuit regenerator

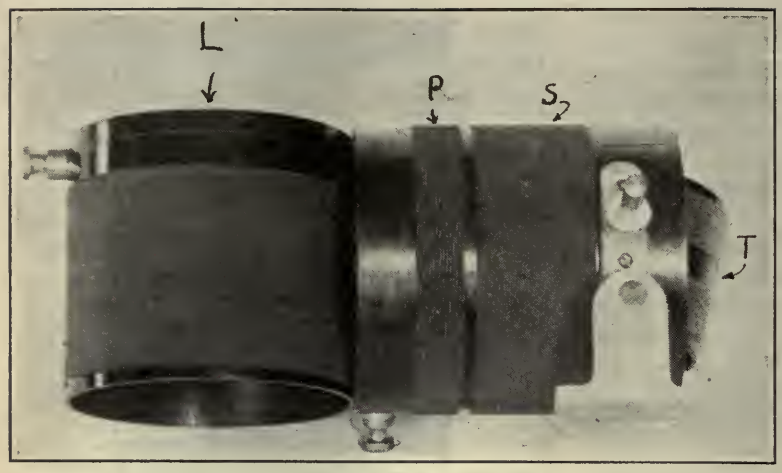


FIG. 7
A "Trans-Continental" commercial coil unit, with the extra winding adjusted on the primary end

The voltmeter is a current operated device. The gradient of the controlling force (a coiled spring) and the flux density of the permanent magnets are so arranged that the needle deflection is strictly proportional to the current passing through the windings, and even scale graduations are possible. Hence, if the current is halved, for instance by doubling the resistance of the circuit (Ohm's Law), the reading on the voltmeter will be just half the voltage applied to the resistance circuit. More specifically, refer to diagram 10. If the external resistance R equals the resistance of the voltmeter, the reading on the voltmeter will indicate one half the voltage applied to the terminals A and B. In the case of the specific demonstration, the meter would read 55 volts.

To get down to brass tacks, place a fairly high resistance in series with your voltmeter, and apply a voltage within the original scale of the instrument and which has already been measured. If the meter now reads 1-10th, 1-16th, 7-8ths, 3-13ths etc. of the original voltage, it will always show a similar fraction of any applied voltage. In the case of a ten volt meter, the extra resistance should be about 1,000 ohms for half voltage—a telephone receiver for instance. The Bradley-Ohm, with a 10,000 ohm minimum resistance makes an ideal variable resistor for higher range meters. Being variable, it is possible to secure any desired even fraction of the original scale.

Experimenters may count on an original meter resistance of 100 ohms to the volt. Thus if it is desired to halve the reading on a fifty volt meter, 50 times 100, or 5000 ohms should be added.

BUILDING YOUR OWN LAB

OUR addition for September is probably the most useful suggestion we have yet made to the proprietor of the growing laboratory—a Stevens Workchest, type 3015. This is made by the Stevens Company, New York City, and sells for $11.00. It is a most desirable substitute for the infinite and inefficient array of cardboard boxes, cigar boxes, baking powder tins, and tobacco boxes that clutter up the average amateur lab. The saving in time



FIG. 8
Front view of the completed four-tube set. A perhaps better design would dispose of the dials closer to one end, with the filament controls and jacks at the other

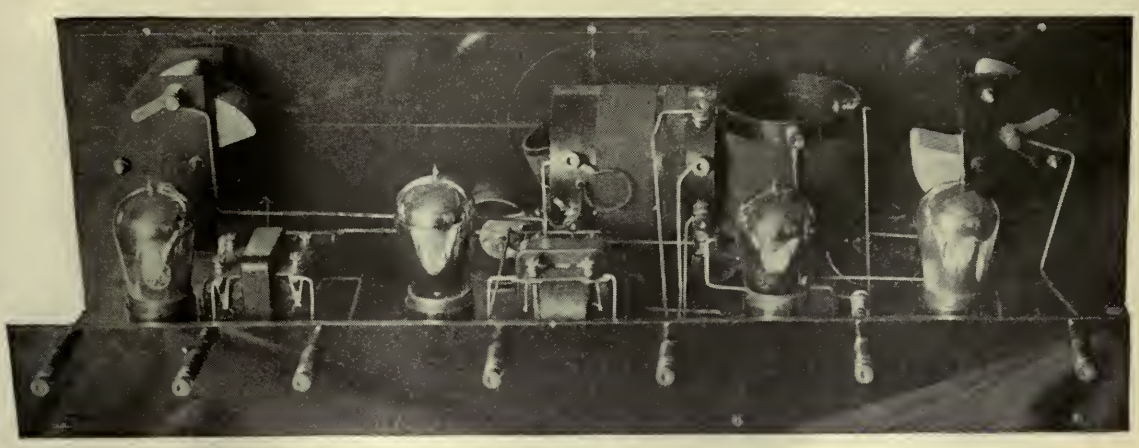


FIG. 9
Behind the panel, again showing the right-angled mounting of the coils

and labor effected by this systematic cabinet is best appreciated by the fan who is at present handicapped by the aforementioned collection of boxes—the haystack that hides the needle for which he is ever hunting.

These cabinets are made in various types, but number 3015 is probably best adapted to the needs of the radio experimenter. In the R. B. Lab, the large lower drawers contain the most used small tools, such as wire-cutters, pliers, screw drivers, scriber, oil stone, six inch square, folding rule and dividers, as well as the equally necessary and often employed fuses. The upper and smaller drawers are individually given over to resistances, condensers, jacks and jack washers, insulating strips, metal ends, binding-posts, miscellaneous, wood-screws and machine-screws. These last two drawers are divided into compartments by close fitting pasteboard boxes. The machine-screw drawer separates 6-32, 8-32 and miscellaneous nuts and bolts, while also providing a compartment for washers.



FIG. 11
The September addition to the growing lab. A cabinet that will save the experimenter time, profanity and labor

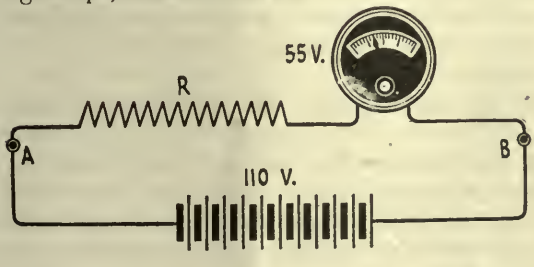


FIG. 10
How to halve the reading on a voltmeter by doubling the resistance of the circuit. Following out this principle, a twenty-volt meter can be made to measure potentials up to one hundred, or even much higher voltages

One drawer should always be left for a temporary miscellaneous receptacle, into which all odds and ends, bolts, nuts, washers, etc. are thrown when cleaning up and rebuilding. The contents of this drawer should be assorted into the proper places once a week.

The Workchest represents a fundamental neatness and system which, in the long run, contributes similar qualities to radio design and construction.

Radio Broadcast's Laboratory

The Story of an Attempt to Improve the Quality of Radio Apparatus for Home Use and Home Construction as Well as to Bring About a Point of Contact Between the Manufacturer and the Public He Serves

By ARTHUR H. LYNCH

STUNG again! I guess I'll leave radio alone for good!" How often have we heard that expression! The unfortunate part of it is that in many cases the resolution was carried out and so radio has actually lost some of its most enthusiastic devotees. Usually, the reason behind the resolution was nothing more serious than the action of some unscrupulous or uninformed dealer selling apparatus which could not live up to the claims he had made for it.

Those of us who have followed the radio business for any length of time know that this difficulty is not new, nor is it likely to die very shortly. In "the old days" of wireless there were those who, by their mail order catalogs and magazine articles, created a demand for a lot of almost worthless junk. And so it was that when the craze for broadcast receiving sets came into being a comparatively short time ago, it was very evident that the same danger of slightly dishonest practices was greatly increased.

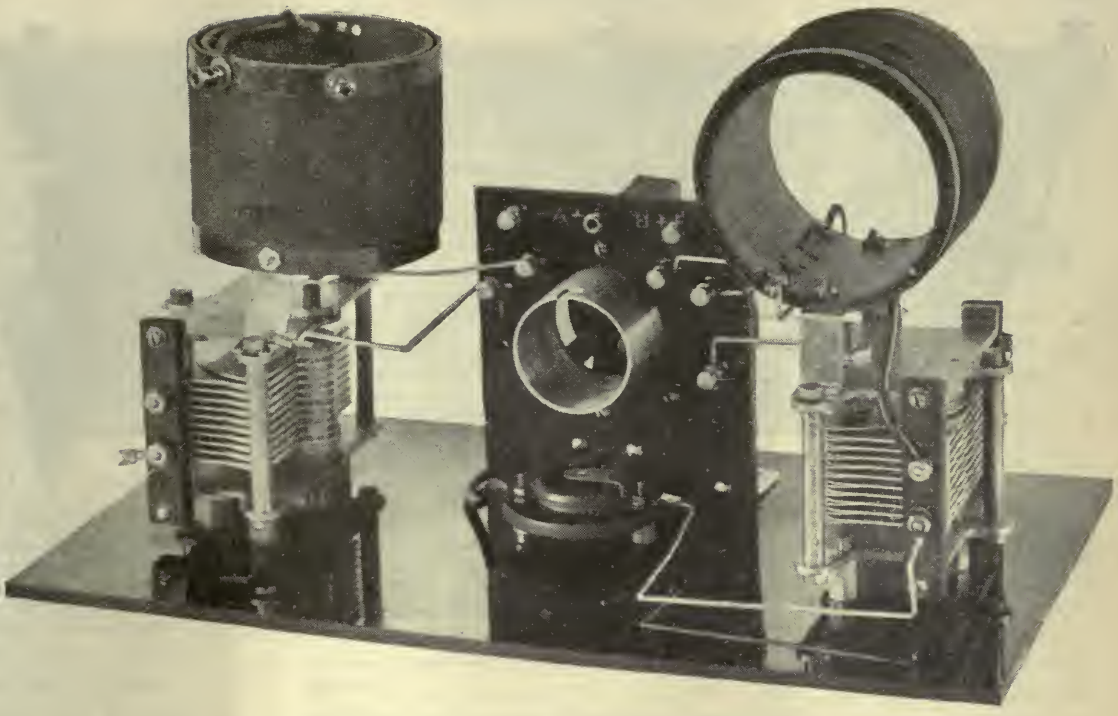
For the lasting good of the business itself as well as to identify ourselves with a policy of absolute reliability, upon which we could feel that exaggeration and statements of a misleading nature would not appear, this magazine determined to try every piece of radio equipment, in its final form, before bringing it to the attention of our readers through our text pages. We decided to test in our own laboratory, under actual operating conditions, radio apparatus appearing in the advertising section of Radio Broadcast.

This policy has worked out particularly well. We have been able to build up a reader confidence which we treasure very highly. We have been able within the past two years to secure the co-operation of many advertisers in cutting out the false and exaggerated claims sometimes made for their devices and have proved to them that they can do a greater volume of business by confining their statements to the truth than was possible when it was the practise to carry on most of their descriptions with a generous helping of superlatives.

A READER SERVICE

SUCH campaigns are not easy to win and we had considerable opposition, especially among those merchants whose business seemed to be flourishing. We felt sure that there would be a reaction when enough purchasers had been deceived, willfully or otherwise. The unreliable dealer or manufacturer then could not long succeed. We were criticized more than once for daring to say such a thing to some of the manufacturers whose business we knew could be saved and made permanent if they would cease taking a tremendous profit from the sale of poorly designed and inefficient apparatus and give the public an even break. We have seen several of those who persisted in taking too large a profit spend most of that profit in an attempt to get back some of the business they lost, by dashing into extravagant advertising campaigns that proved almost fruitless, because the people to whom they desired to sell their goods had not received quite fair treatment and could not be led to believe that their statements—which were actually true—could be relied upon. In some instances, the merchant suffering from such a setback had sense enough to change the name of his company when he changed his method of business. Several such revived merchants have done a tremendous business at a fair profit.

We have always held that the most important person in the radio business is the person who spends his good money for radio apparatus. If it were not for the man who buys there would be nothing to sell, since we thought that a great number of our readers were among those who bought, we figured that it would be well for us to do everything in our power to see that the readers of Radio Broadcast were kept informed of facts and not fed on half truths.



THE BEST SINGLE TUBE RECEIVER WE KNOW

Which was first described in this magazine last November, with slight modification in succeeding numbers. Some two dozen different models of this set have been made up under the Laboratory's direction. Readers of this magazine have shown tremendous and justified enthusiasm over this excellent set. It is the famous one-tube Knock-out

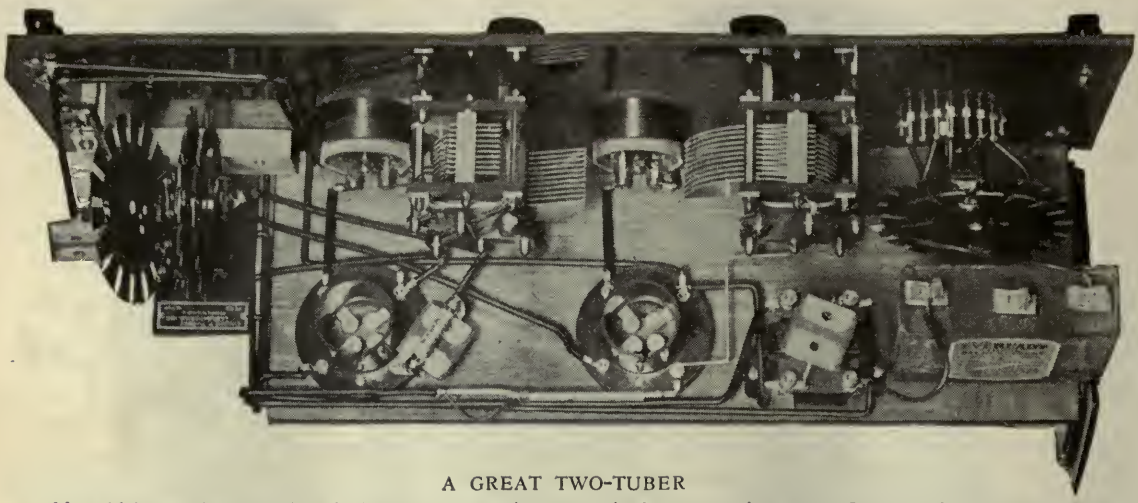
To follow this policy, it became necessary for us to do a great deal of testing. The staff of this magazine has spent many, many nights testing tubes, transformers, coils, and all manner of parts, to say nothing of about every type of receiving set, in an effort to present, through these pages, nothing but the truth.

In carrying on this work, we came across a situation which is at once serious and hardly just to the purchaser and the reader.

Certain radio authors, whose technical how-to-make it articles have been printed by many periodicals, are known to receive regular retainers from manufacturers, presumably in return for publicity these writers give their circuits. The authors then are paid by the interested manufacturer and the periodical publishing their work.

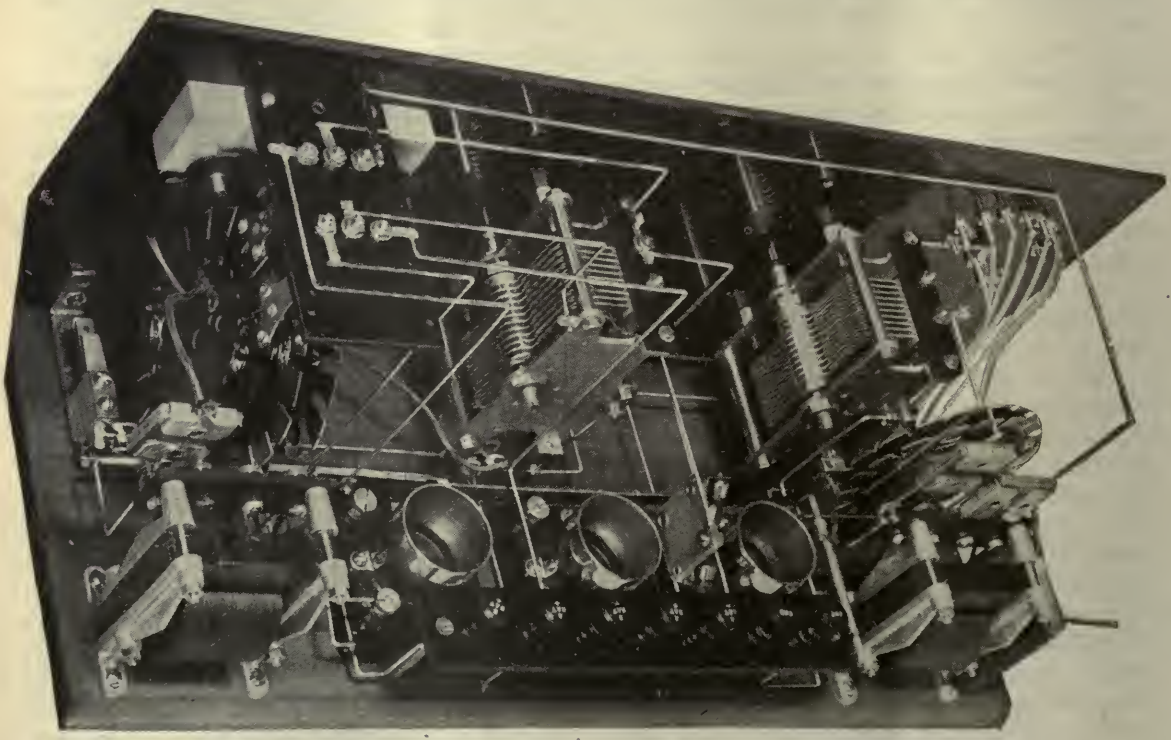
In instances of this sort, it is very difficult to draw the line between the good and the bad, because some of the authors who are so subsidized are really conscientious and think more of their good names than the few dollars they may get for a "puff" of a few thousand words written for the sole purpose of unloading what might easily be called junk. Many such articles have been received by this magazine for publication, but they have never appeared. We have our own ideas about radio receivers for the use of the public. When we publish articles by independent authors they are articles which are agreed upon before they are written. Where there is any possibility of a receiver or piece of apparatus of any particular type operating more satisfactorily because the parts from which it is made have been selected and are thought to be better than the regular run of parts of the same make, we purchase a set of parts from regular stock, build a similar unit and check the results obtained from one against the other.

Work of this kind requires a great deal of labor and consumes much more time than is generally believed and it is anything but inexpensive—but, in the final analysis, it pays and pays well. Can you imagine the thrill we get from receiving hundreds of unsolicited letters, after the publication of technical information concerning some new or improved circuit, with which we have labored months? The thrill the broadcast artist receives from the mail he gets after a performance that



A GREAT TWO-TUBER

Is this, which combines tuned radio frequency, capacity-neutralized, regeneration, and reflexed audio-frequency amplification in a system that is at once easy to build, easy to operate, extremely economical, and selective. It compares most favorably in selectivity with the best super-heterodynes, to say nothing of its ability to operate a loud speaker. This phenomenal receiver was described in the April, May and August numbers. It was developed by Walter Van B. Roberts, of Princeton, and we have spent months and much effort to reduce it to its simplest form



WHEN YOU WANT TO DANCE

The Roberts with an additional stage of audio fills the bill. This is only one of a number of receivers which we have made employing this circuit. All work splendidly and the mechanical arrangement has formed the chief difference in them

meets with public approval is nothing compared to the thrill we get. We're not merely turning out a lot of radio hodge-podge in an effort to fill a certain number of pages, we're telling you the story of our own experiences with different kinds of apparatus and we get as much fun out of tinkering with radio circuits as any of our readers.

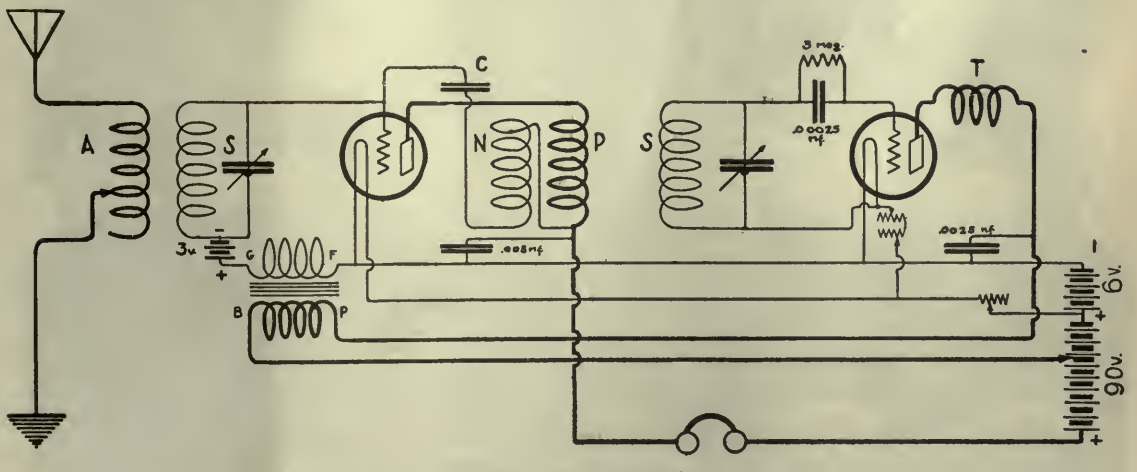
All Honor to Royalty

Tube for tube, ampere for ampere, volt for volt, and dollar for dollar, RADIO BROADCAST's Four-Tube Knock-Out is the best receiver for home construction we have ever seen. It is a combination of the famous Roberts circuit and a push-pull amplifier. A complete description of this receiver written by John B. Brennan, editor of The Grid, appears in this number. A photograph of one of the best lay-outs of this circuit is printed on page 383 of this number. This receiver is the result of a series of experiments during which more than a dozen trial sets were built, which is the process which always occurs when the laboratory is developing a receiver to be described in our pages. Every effort is made to refine the work and by careful tests make certain that the descriptive material is absolutely reliable and accurate.—THE EDITOR.

SERVICE TO MANUFACTURERS

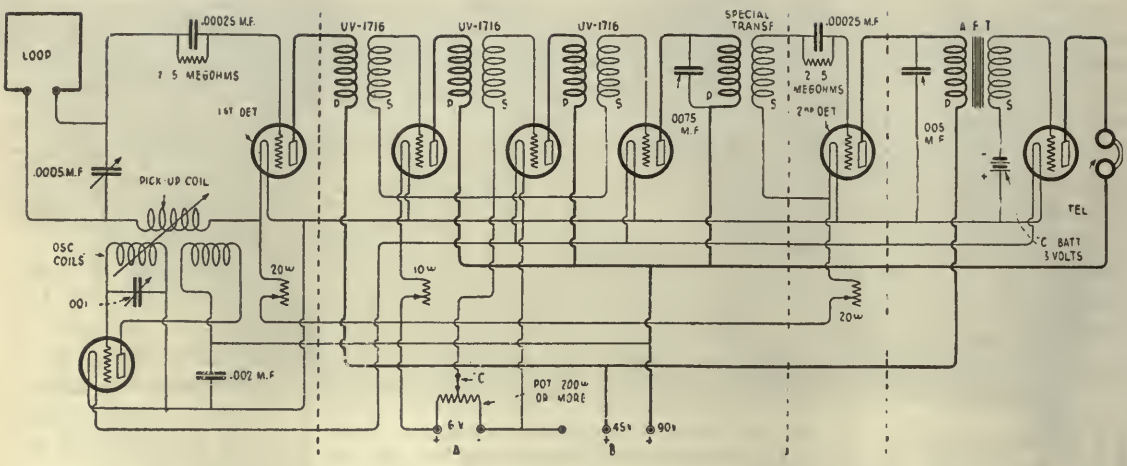
IT IS practically impossible to carry on a lot of experimental work without running across little kinks here and there that would be of value to the entire industry, if they were brought to the attention of interested and progressive manufacturers. By keeping in close touch with such manufacturers we are able to keep them informed of our work and are frequently able to suggest devices of a very efficient nature that might be merchandised in large numbers, at a fair profit. Many instances of this kind have occurred within the past few months and several more are under way. Our services are as free to any responsible manufacturer as they are to our readers; we make no charge for our work and play no favorites. We want our readers to be able to procure the best possible radio equipment at a fair price and will not leave a stone unturned in our effort to bring about this result.

There have been instances, within the past few months of manufacturers, who have been in financial distress before they took our offer of co-operation seriously and who are now doing a very fine business. We believe that the manufacturer who is willing to play the game with the fellow who has money to spend for good radio equipment deserves serious consideration and we want to be of as great assistance to him as possible. We have no time for the man who is merely trying to "clean up." And this service is free of all strings. The people who take advantage of it need not even be among our advertisers. We want our readers to be able to get the best and if the best happens to be the product of a non-advertiser,



THE ROBERTS CIRCUIT

Which was originally described by Walter Van B. Roberts, who developed it, in this magazine for April and May. As can be seen, the circuit is very simple, and when properly built up produces results so far beyond any other combinations using two tubes that radio constructors everywhere are finding it immensely worth their while to build it. This circuit is one of several sponsored by RADIO BROADCAST in an effort to give the broadcast listener a sensitive, economical, and efficient receiver to take the place of radiating single-circuit regenerators



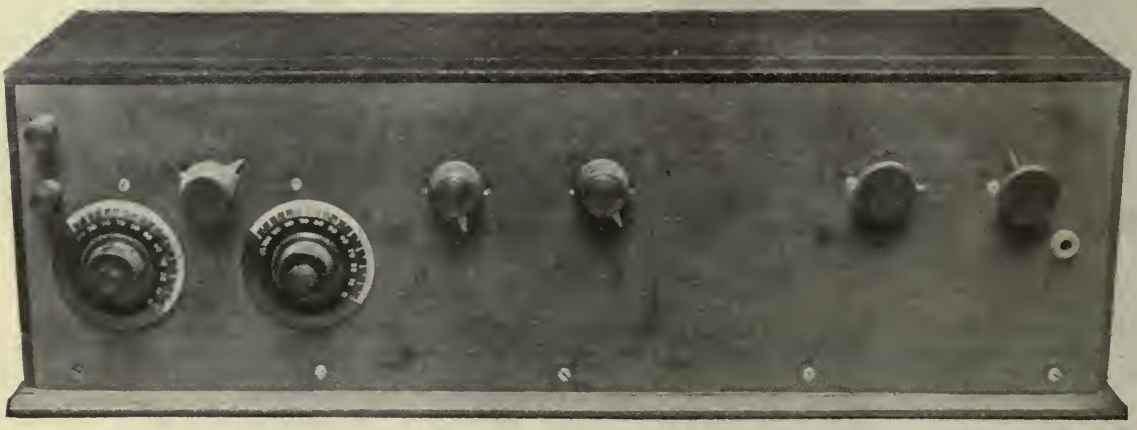
SOME SUPER-HETERODYNE HISTORY YOU MAY NOT KNOW

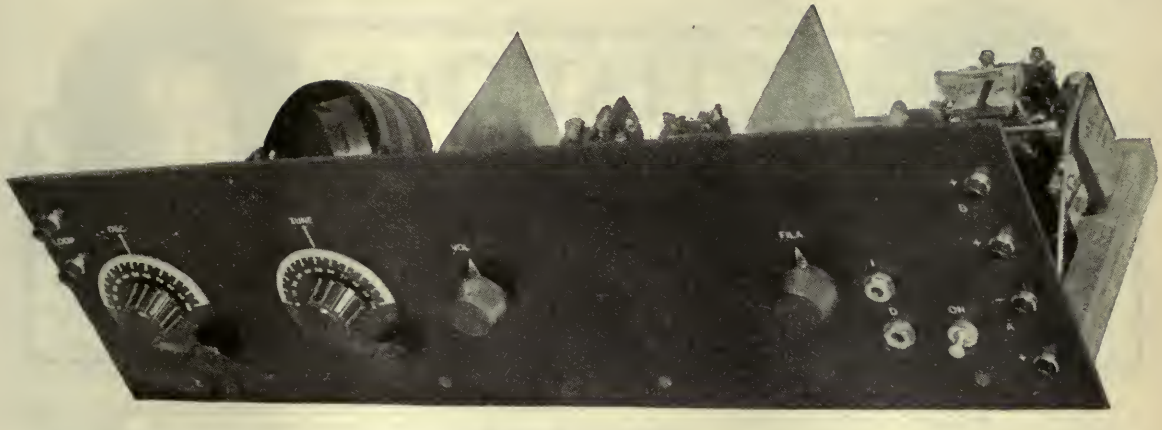
The super-heterodyne illustrated and its accompanying diagram appeared in this magazine for November, 1923. This was the first practical transformer-coupled super described in any magazine. The design is excellent, and those who have since capitalized on the super, have not greatly improved this design. There is little doubt that the great popularity of the super is due to the impetus given by the descriptive articles first printed by Radio Broadcast.

The UV-1716 transformers used for the intermediate-frequency amplifier coupling are now difficult to procure and it was for this reason and at the suggestion of this magazine that other manufacturers brought out transformers to replace them.

There is no more complete, practical, and easily understandable information on the super than can be gleaned from the following list of articles by authors who are authorities, and much of whose work has been done in close coöperation with Radio Broadcast.

February, 1923: *A Supersensitive Long-Range Receiver*, Paul F. Godley.
August, 1923: *A Practical Super-Heterodyne Using 199's*, Walter Van B. Roberts.
November, 1923: *How to Build a Super-Heterodyne Receiver*, George J. Eltz, Jr.
December, 1923: *Using What Junk You Have in Building a Super*, George J. Eltz, Jr.
January, 1924: *A Simplified Super-Heterodyne*, A. J. Haynes.
March, 1924: *Shooting Trouble in the Super*, A. J. Haynes.
September, 1924: *The Super and Its Intermediate-Frequency Amplifier*, A. J. Haynes.
July, 1924: *The Story of the Super-Heterodyne*, Edwin A. Armstrong.
September, 1924: *The Super and Its Intermediate-Frequency Amplifier*, A. J. Haynes.





FRONT PANEL VIEW

Of the simplified super-heterodyne. A large number of these sets have been built by readers and are giving great satisfaction in all parts of the country. Captain Jack Irwin has one of these receivers aboard the RADIO BROADCAST COVERED WAGON

we feel, that we would not be serving our readers best if his products were not given attention in our columns.

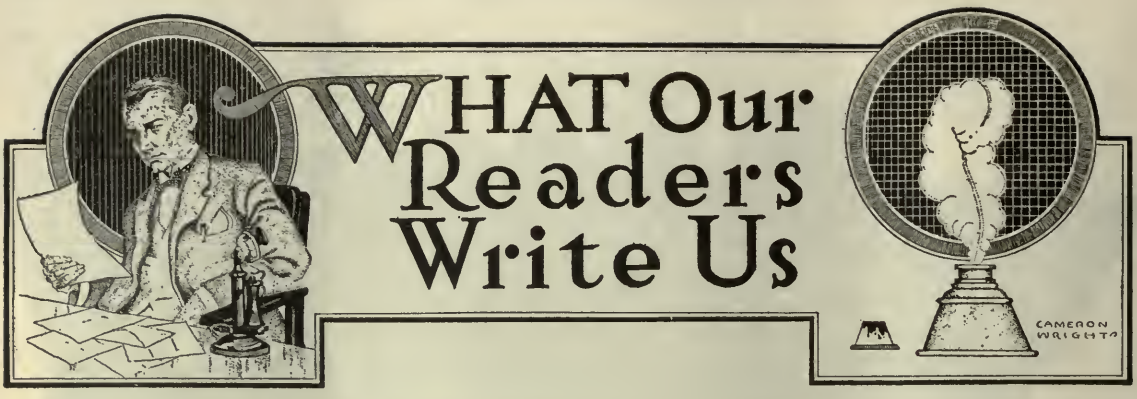
In co-operating with one manufacturer in this fashion, we were lead to believe that he would place devices on the market that we recommended to our readers. He did so. For a time he maintained the good quality we had insisted upon. Then the quality began to fall off as the demand increased. He can not now advertise in RADIO BROADCAST at any price and his devices are not mentioned in our pages.

RADIO BROADCAST'S Laboratory is more than a laboratory, it is an honest attempt to serve those who find interest in the radio game and those who are making their living by honestly trying to serve those who are interested. The radio business is growing and growing very rapidly. There is plenty of room for more and more radio apparatus of quality. The more people there are who are satisfied with their receivers the greater the business will be for everyone, including ourselves. We are doing our best to increase the number of satisfied radio fans.



THE INS AND OUTS OF THE SIMPLIFIED SUPER

Which was the first to appear with a specially designed transformer for the intermediate-frequency amplifier. There are but four controls and once the filament rheostat and potentiometer have been set, only two controls—the condenser in the oscillator circuit and the condenser across the loop—are actually used. This receiver is the first of a long line of supers and when properly built is hard to beat. Since the publication of the Haynes article describing it in RADIO BROADCAST for January, 1924, many similar articles have appeared in other publications. If you really want to know who is responsible for the great popularity of the super, try to find some sound information about it in any other radio publication prior to the dates given on the preceding page



Wanted: Chorus Girls

A GREAT tempest in a newspaper occurred in New York recently when WHN lent itself to broadcast an appeal by a certain theatrical producer for "fresh" chorus girls who aspired to life under the permanent wave. There were those who thought, and delayed not in expressing themselves, that to use radio thus in invading homes with an appeal of that sort was nothing short of criminal. And there were those who did not take the matter very seriously, and trusted to the judgment and balance of the girls and their mothers. The two letters below discuss both sides of the subject.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR.

The First Amendment to the Constitution prohibits Congress from "abridging the freedom of speech," and surely this includes broadcasting. Even when advertising is broadcast it should not be censored, unless we are to censor advertisements in the Sunday papers and in weekly periodicals.

Yet scores of mothers have appealed to prohibit a broadcasting station in New York City from announcing that a theatrical producer will give tryouts to girls who aspire to be actresses. Do the mothers actually think that their daughters will be tempted by the unseen spokesman of the devil and will depart the home in order to earn their own living? If the opportunity of thus giving pleasure to countless multitudes appeals to the daughters, surely the mothers, who brought them up, have only themselves to blame.

G. N. B., Montclair, New Jersey.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR.

Twice a day, during the morning and in the middle of the evening, an appeal has been broadcast from a New York station for girls with "good figures, pretty faces, and neat ankles" to appear arrayed in bathing suits on a theater roof where they are to be photographed as entries in a contest, in which 116 will be chosen as members of a chorus for a Broadway musical comedy. It is said that several hundred respond to the invitation every day.

There is no doubt about the legal right of a broadcasting station to lend itself to such a scheme. But this is a question of morality and of good taste, not of law. The greatest blessing of radio is at the same time a great danger, and surely such an appeal to the public, in the privacy of their homes, suggests that society approves of the life of the chorus girl. The bad influence which results from this will appear in children's thoughts if not in their actions. It is surely another case of misplaced emphasis, by which the younger generation decides that the chorus girl (as previously it had decided that the movie actress) is a more admirable member of society than is the social worker or the missionary. We have had enough publicity for the acting profession, with the sordid details of their life, without this, the latest and most degraded form of it.

B. R. D., Cold Spring Harbor, New York.

The Busy Wordsman

THE peculiar imagination of those self-appointed and highly enthusiastic souls who take unto themselves the task of naming this new radio circuit and that, is—to judge by the results before our eyes every day—never at rest. The quiet observer on the radio sidelines is growing more mystified and befogged every day. We have little sympathy with the eager chaps who do the naming, but indeed we don't envy the task of him who compiles the next dictionary, and, honestly enough, tries to put in the radio terms.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

Some years ago a fat and weighty volume issued from the press under the name of Dr. Mencken, who gave us the benefit of his research in the field of the American language. If this learned critic considers revising his work he will be greatly perplexed when he comes to deal with a large and recent addition to our vocabulary.

Probably it is safe to say that most radio terms are Greek, at least to many of us. But our intelligence is wantonly insulted and perspicuity needlessly violated in he case of the word commonly used to describe an overabundance of the other (ἕτερος—was it not the New England essayist who defined heterodoxy as the other doxy, that is, *not* my doxy?) kind of power: and from the prefix we conclude that the other kind of power is presumably Latin.

And if ever an inventor comes upon a still greater su, ply

of the other kind of power, we must expect, as a description of it, some such linguistic atrocity as hyper-super-heterodyne.

ALEXANDER VAN SANTVOORD, New York.

"Lord, What Fools These Mortals Be"

RADIO BROADCAST for January contained a letter written by N. A. Brown which bemoaned the failure of radio dealers to use intelligence in the ordinary course of merchandising. Here is another wail from Pittsburgh about the dealers there, who, apparently, are too busy to bother with any except those who spend great quantities of radio money.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

I should like to give three cheers for N. A. Brown, whose letter about radio dealers I read with great interest in a recent issue of RADIO BROADCAST.

All Mr. Brown says is true, but he did not go far enough. My first set was an amateur home made crystal set. It did very well as a starter. Later, I bought a high priced crystal set which worked very well indeed and did all and a bit more than might have been expected of it. Then Mrs. Wife and I decided we wanted to wander in realm of long distance receiving. Unfortunately, I am no Rockefeller, due to a money loving landlord, hungry life insurance companies, and a few others operating along similar lines. Therefore, a moderate priced tube set was the best I could afford. I wandered into a score or more of department and radio stores. I got scant attention from the clerks when I mentioned that $50 was my limit. They were so gol durned anxious to sell $250 and $350 sets that they didn't have time to talk to me about mere $50 outfits. Yes, they would sell such sets, that is, the parts to build them. But what I wanted was a set all ready-made. Everybody seemed particularly anxious to sell parts, but no one appeared at all eager to sell moderate-priced built sets.

Finally, I went in to an old established reputable electrical house where the clerks answered me civilly, strange to say, and listened to me long enough to find out what I wanted. I told them I knew the cheaper priced sets would not reach out to Europe, Asia, or Africa, but I did hope to get out as far as Cleveland—300 miles away. I bought a set for $39.50, and got satisfactory results from it.

I now find that the department stores handle this set as do some of the other stores I visited in vain. All this leads to the question: why do radio dealers try to force high priced sets on customers able to buy only those of moderate price? I think that if the dealers would as cheerfully sell those of moderate price as the costly ones, they would do far more business and in the end, the profits from the sale of several cheaper sets would equal the profit from the sale of one of the more expensive ones which they failed to unload on one of us poor devils.

When I get the money to do so, I expect to buy the best on the market—perhaps a $500 or $600 set with all the frills ever made, but I can't stand the pressure now. There are lots like me, I am sure.

W. C. M., Pittsburgh, Pa.

Broadcasting on the Pacific Coast

WE FREQUENTLY do not realize the influence of the newspaper outside its especial function of gathering and printing news and merchandising it to the public. Not a few newspapers have entered heartily into broadcasting, and their influence is a great factor in elevating the standards of program excellence. The letter which follows contains some tributes to newspaper broadcasters on the West Coast which are apparently deserved. Which reminds us that it is certainly desirable for the radio listeners to pass around more considered bouquets than they are in the habit of doing. The broadcasters want your opinions, and two cents invested in a stamp is not much to spend. Carl Dreher wrote in "Pity the Poor Broadcaster", (June) you recall, that "they may broadcast beautifully for weeks, and nothing is thought of it, but let there be a two-minute difficulty, and a score of listeners who never thought of giving them a word of praise, let fly with both fists."

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

I was interested in reading Mr. Winfield Barton's article in a recent issue of RADIO BROADCAST about the place of the newspaper in broadcasting.

For six months past I have listened regularly every night two to four hours on the main stations on the Coast from Los Angeles to Edmonton, Canada, and unhesitatingly state that the best station on the Coast is the Los Angeles *Times* (KHJ). The managers of that station apparently have a definite purpose in view and carefully arrange their programs not only to cover entertainment, but educational and instructive features well calculated to appeal to all classes of listeners. And they cover the field with remarkable consistency, with the result that no single evening's broadcast but leaves the listener-in realizing that he has been benefited as well as entertained. Whether or not the *Times* is benefited financially is unknown to me, but as the object of the managers of the station is to benefit and entertain the masses as a whole, I should say that they have made a great success of their efforts.

And the second best station on the Coast, according to the evidence of my ears is KLX, the Oakland (California) *Tribune*, with CKCD, the Vancouver *Daily Province* third. You may ask, how about KGO, the new General Electric station. That is a wonderfully equipped and powerful station with splendid programs of a certain high class, but the people in general do not especially care for them. They are not interested in cantatas, radio dramas, or operatic singing. When listening-in with me, visitors often ask me to shift from KGO to KHJ, KFI, or KPO, and are better satisfied with what they receive.

E. M. B., Gold Beach, Oregon.

WHAT Makes the Wheels Go 'Round", the instructive and readable technical serial by Walter Van B. Roberts, is unavoidably omitted from this number because of lack of space. Mr. Roberts' next article, in RADIO BROADCAST for October, is more than usually interesting and deals with the functioning of the vacuum tube in oscillating circuits. It should interest every radio enthusiast.

The How and Why of the Radio Broadcast Covered Wagon

A Famous Radio Man Is Traveling Across the Country on a Mission of Radio Aid and Radio Exploration—All the Knock-Out Receivers Are On Exhibition

By CAPTAIN JACK IRWIN, U.S.A.S.R.C.
Formerly Radio Editor, New York Herald-Sun Syndicate

COINCIDENT with the first appearance of the RADIO BROADCAST COVERED WAGON, converted into a mobile radio laboratory, came the opening of the National Democratic Convention in New York City. The first orders I, as the pilot of the wagon, received from the Editor were directions to cover the radio features of the convention.

As my orders were very vague and I was instructed to use my own discretion, I thought I would give the natives and visitors on Broadway a treat and broadcast Senator Pat Harrison's opening speech from the wagon. Undoubtedly I provided them with a treat, but not the one I had in mind. I had just tuned in WEAF on our super-heterodyne when an unmistakable voice wanted to know "how I got that way." New York's finest was giving me my "on your way."

I will say this, however, that the large crowd that had gathered round the COVERED WAGON resented his zealousness more than I did. As the convention progressed I was to discover that the New York police force developed such an interest in the proceedings that I was seldom requested to "move on."

One of the objects of this COVERED WAGON is to provide entertainment for readers of this magazine. After delivering the broadcast reports of the convention for two weeks it is obvious that if entertainment was the sole mission of the expedition the result has been most successful. Wherever the car parked in a very few minutes it was surrounded by interested listeners. Glancing out of the wagon occasionally, I would find fans pushing their way through the throng to learn the type of apparatus used and the make of the loud speaker. During the two weeks that the convention was in session it is safe to say that tens of thousands grouped themselves round our "rolling laboratory."

THE ITINERARY AND PURPOSE OF THE TRIP

FOR the period of the convention we used one of the super-heterodynes built in the RADIO BROADCAST LABORATORY, employing a small collapsible loop and a power loud speaker. This receiver gave such volume that it could be heard for several city blocks, even above the roar of traffic, yet always with wonderfully clear quality. So clear was the reproduction that it was often amusing to find skeptical persons searching for a gramophone or some other hoax.

The Story of the "Covered Wagon"

THE "Covered Wagon" has been a-planning for a number of months and most radio men who have known of it are highly enthusiastic. Briefly, several months have been spent in preparing a truck with a canvas covering which greatly resembles the covered wagon of days gone by. Inside the brown canvas top is a copy of every receiver designed and built in the RADIO BROADCAST Laboratory. The pilot is Captain Jack Irwin, one of the best known men in radio and a true pioneer. He and the Wagon have started across the country on their way to California. He will stop in the large cities, and this town and that, exhibiting the Knock-Out series of receivers and the super-heterodyne, will coöperate with radio clubs in reducing interference from "man-made static," and advise and aid radio fans along the way in how to get the best results from the receivers they have, or help them decide what receiver is best for their locality. The receivers are aboard the wagon, so it will not take long in the proving. The story of Captain Jack's journey will appear month by month in this magazine. Watch for his national radio observations.—THE EDITOR.

The convention is over, and the writer is now on his way to California, In the quiet camps to come I feel sure my sleep will be disturbed by the shout of "ALA-AA-BAAMA votes 24 for Underwood." With the scattering of the delegations, it was but the work of a few days to load the remainder of the laboratory equipment on the wagon and pull out on our original mission

The COVERED WAGON is now equipped with the most complete outfit of receivers ever installed on an automobile. One each of the Knock-Out receivers developed in the RADIO BROADCAST LABORATORY is included in the equipment. In other words we carry a one tube, two tube, three tube, and a four tube receiver, while the super-heterodyne alluded to above will provide us with a "kick." With such an array of sets we will be able to ascertain for any of our readers just what type they will require to obtain the results they look for in any given locality. It is to assist those so situated that this wagon will tour the country. Other objects will be the elimination of unnecessary interference, so far as persuasion and preaching such radio gospel will prevail, also to ascertain, for the information of our readers, just what sets should be carried on an automobile tour to any of the National parks. We hope to visit all of them in turn. This last mentioned object will undoubtedly provide valuable information for those in doubt as to what to carry. We can conceive of no greater disappointment to a radio experimenter than to pack a weighty set into some inaccessible region only to be disappointed with no results.

There will be many other less specific objects in view in undertaking this journey. What I look forward to most is discovering for myself what radio is doing for the people in the so-called "wilds" of our country. Those of us who live in cities know that radio has become amazingly popular and almost indispensable. I want to learn first hand just how far radio keeps a real farmer amused and informed. Is he a radio brother of the man who has spent, say, eight hours in a city business house and several hours more coming and going in crowded transportation? In other words, are rural, surburban, and urban "radio bugs" all alike?



THE COVERED WAGON

Outside of the RADIO BROADCAST offices in Garden City, Long Island. Captain Irwin is standing by the front wheel. The picture was taken just before the WAGON started on its transcontinental trip

The chief impression I anticipate is reiteration of the wonderful effect radio is producing in our daily contact with each other. And so I go, fully armed with my car load of "n'everything" into the various camps of neutrodyne, heterodyne and every radio dyne! Many of my friends envy me my trip after seeing the arrangements made aboard the wagon for my comfort. I have crossed this continent a number of times in a Pullman car, and like many of you, detest the experience. I have also crossed by airplane, and enjoyed that even to wishing to duplicate the air trip. However, I can candidly say that I have never started on any journey with prospects of all the comforts than I do upon this COVERED WAGON trip. Built on a standard chassis is a house eight feet long by five wide and six feet three inches high. By dropping an extension on the back and extending the telescopic rear curtain I obtain another three feet of space when in camp. The wagon is fully equipped with a complete camp outfit. In fact everything that a comfortable bungalow possesses is there—even to a two-burner gas stove! The latter is a most ingenious affair supplied with fuel from a large Prestolite tank slung out of the way under the floor of the car. To make camp and "turn in" requires no more effort than to steer into some parking place and go to bed!

Supplemental List of Broadcasting Stations in the United States

LICENSED FROM JUNE 14 TO JULY 18 INCLUSIVE

CALL LETTERS	LOCATION	KILOCYCLES	WAVE-LENGTH	POWER (Watts)
KFAJ	Boulder, Colo.	1150	261	100
KFCL	Los Angeles, Calif.	1270	236	500
KFQM	Austin, Texas	1120	268	100
KFQN	Portland, Oregon	1060	283	5
KFQO	Russell, Kansas	1150	261	10
KFQP	Iowa City, Iowa	1340	224	10
KFQR	Oklahoma City, Okla.	1200	250	10
KFQS	Manitou, Colo.	1220	246	10
KFQT	Denison, Texas	1190	252	10
KFQU	Holy City, Calif.	1280	234	100
KFQV	Omaha, Nebraska (portable)	1300	231	100
KFQW	North Bend, Wash.	1210	248	50
KFQX	Seattle, Wash.	1290	233	250
WBL	Anthony, Kansas	1180	254	100
WDBX	New York, N. Y.	1290	233	5
WDBY	Chicago, Ill.	1160	258	500
WDBZ	Kingston, N. Y.	1290	233	5
WEBA	Highland Park, N. J.	1290	233	15
WEBC	Superior, Wis.	1240	242	10
WEBD	Anderson, Ind.	1220	246	10
WEBE	Cambridge, Ohio	1210	248	10
WEBJ	New York, N. Y.	1100	273	500
WFBH	New York, N. Y.	1100	273	500
WNYC	New York, N. Y.	570	526	1000
WTX	Chicago, Ill.	1120	268	10

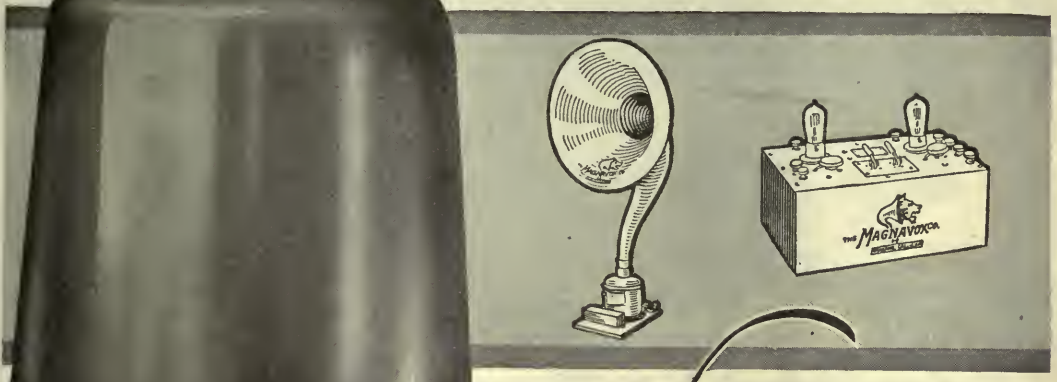
LIST OF BROADCASTING STATIONS DELETED JUNE 1 TO JUNE 30

CALL	LOCATION	CALL	LOCATION	CALL	LOCATION
KDYX	Honolulu, T. H.	KFNH	Springfield, Mo.	WIAJ	Neenah, Wis.
KDZQ	Denver, Colo.	KFOF	Marshfield, Oregon	WJAT	Marshall, Mo.
KFAF	Denver, Colo.	KFOH	Portland, Oregon	WJX	New York, N. Y.
KFAJ	Boulder, Colo.	KFOP	Dallas, Texas	WKAY	Gainesville, Ga.
KFAN	Moscow, Idaho	KFOV	Sioux City, Iowa	WLAJ	Waco, Texas
KFAU	Boise, Idaho	KGN	Portland, Oregon	WLAK	Bellows Falls, Vt.
KFCY	Le Mars, Iowa	KZV	Wenatchee, Wash.	WMAB	Oklahoma City, Okla.
KFDA	Baker, Oregon	WABA	Lake Forest, Ill.	WMAJ	Kansas City, Mo.
KFDO	Bozeman, Mont.	WABN	La Crosse, Wis.	WNAN	Syracuse, N. Y.
KFDV	Fayetteville, Ark.	WABS	Newark, N. J.	WNAQ	Charleston, S. C.
KFFO	Hillsboro, Oregon	WABV	Nashville, Tenn.	WNAS	Austin, Texas
KFFQ	Colorado Springs, Colo.	WBBF	Atlanta, Ga.	WNAV	Knoxville, Tenn.
KFFV	Lamoni, Iowa	WBBO	Rogers, Mich.	WNJ	Albany, N. Y.
KFFZ	Dallas, Texas	WBBQ	Pawtucket, R. I.	WOAP	Kalamazoo, Mich.
KFGV	Utica, Neb.	WBBS	New Orleans, La.	WOK	Pine Bluff, Ark.
KFHB	Hood River, Oregon	WCAM	Villanova, Pa.	WPAT	El Paso, Texas
KFHF	Shreveport, La.	WCAS	Minneapolis, Minn.	WQAD	Waterbury, Conn.
KFHX	Hutchinson, Kansas	WCM	Austin, Texas	WQAW	Washington, D. C.
KFJV	Dexter, Iowa	WDAO	Dallas, Texas	WRAA	Houston, Texas
KFLH	Salt Lake City, Utah	WFAF	Poughkeepsie, N. Y.	WRAH	Providence, R. I.
KFLP	Cedar Rapids, Iowa	WFAJ	Asheville, N.C.	WRAY	Scranton, Pa.
KFLR	Albuquerque, N. M.	WFAQ	Cameron, Mo.	WSAG	St. Petersburg, Fla.
KFMS	Duluth, Minn.	WFAT	Sioux Falls, S. Dak.	WSAT	Plainview, Texas
KFMU	San Marcos, Texas	WGV	New Orleans, La.	WSAW	Canandaigua, N. Y.
KFMY	Long Beach, Calif.	WHAB	Galveston, Texas	WWAC	Waco, Texas
KFMZ	Roswell, N. M.	WIAF	New Orleans, La.	WWAF	Camden, N. J.
KFNC	Corsicana, Texas	WIAI	Springfield, Mo.		

TOTALS

Number of U. S. broadcasting stations	546
Number of Canadian broadcasting stations	44
Number of Cuban broadcasting stations	34
Number of Mexican broadcasting stations	4





Now a ★ MAGNAVOX Radio Tube

INTO the design of this new Tube have gone over two years' research and experiment along original lines, culminating in discoveries which made possible an entirely new principle of tube construction.

One trial convinces the most exacting user that the Magnavox will replace ordinary tubes to great advantage in any receiving set.

Magnavox Radio Tubes and other Magnavox Products are sold by reliable dealers everywhere

THE MAGNAVOX COMPANY

New York Oakland, Calif. San Francisco

Canadian Distributors:
Perkins Electric Limited, Toronto, Montreal, Winnipeg

Magnavox Radio Vacuum Tube Type A is a storage battery tube for use as audio frequency and radio frequency amplifier in all standard circuits. Highly recommended also for detector use.

This tube is not critical of adjustment either as to plate or filament. Filament consumption one quarter of an ampere. $5.00

9R

★ Tested and approved by RADIO BROADCAST ★



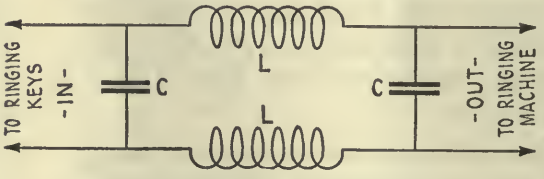
QUESTIONS AND ANSWERS

QUERIES ANSWERED

How Can I Make A Filter Unit to Eliminate Interference From Telephone Ringers? *J. L. C.*, Salem, Mass.
Can Six-Volt Tubes Be Used Throughout in the Roberts Set? . . . . . *H. E. Z.*, Lincoln, Nebraska.
What Is the Formula for Calculating the Wavelengths of Coils? . . . . *S. B.*, St. Louis, Mo.
How Can I Sharpen the Tuning of My Knock-Out Reflex? . . . . . *J. A. C.* Albany, N. Y.
Give Me a Circuit Applying the Roberts Neutralizer to a Straight Two-Stage Radio-Frequency Receiver . . . . . *H. E. S.*, Porterville, Calif.

MAKING A FILTER UNIT WHICH ELIMINATES INTERFERENCE

IN HIS article on Man-Made Static appearing in the May issue, Mr. Van Dyck shows on page 44, Fig. 1, a circuit for eliminating the troublesome interference caused by telephone ringers. Herewith is given the data for constructing one's own unit at a comparatively low cost. The materials needed are: 1 base-board, 4 binding posts, 2 1500-turn honeycomb coils, 2 1 to 8 mfd. condensers, and sufficient heavy insulated wire for connections. The drawings in Fig. 1 are self explanatory. They show the placement and wiring of the parts. Any condenser within the range stated may be used advantageously. This same fundamental circuit may be used for eliminating the interference caused by motors, etc. Of course the values of the parts differ with the type of motor whose interference is to be eliminated. Your local electrician should be consulted to insure the proper design and construction of the unit.



C- 1 TO 8 MFD. CONDENSERS
L- 1500 TURN HONEYCOMB COILS

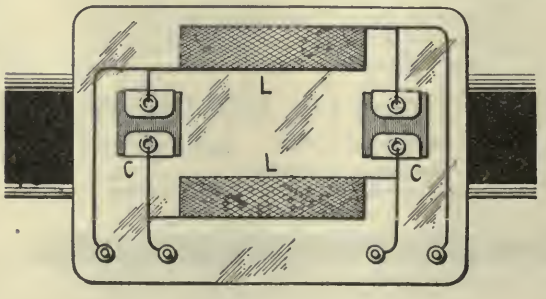


FIG. 1

USING 6-VOLT TUBES IN THE ROBERTS SET

THE question has been asked: "Can 6-volt standard tubes be used throughout, in the Roberts set?" Our answer is, "Yes." The reason for the original arrangement was primarily economy of operation. By using the UV-199 tube, a saving of .19 amperes is effected equalling about one watt. When other tubes are to be used, the only change necessary is to replace the filament strips with a standard rheostat of the proper value for the tube to be used.

HOW TO CALCULATE THE WAVELENGTH RANGE OF COILS

OFTEN the question arises as to how many turns of wire should be wound on such and such a form to secure a certain range of wavelengths. The mathematical formula for this problem would no doubt answer, but its use might result in incorrect, and lengthy calculations. This kind of business, we can leave to the engineers, especially since we can arrive at the same conclusions more quickly and easily.

The method is this: Supposing it is desired to know how much wire is needed on a spiderweb, honeycomb or bank-wound coil to respond to the 200-600 meter wavelength. By referring to the chart on page 485 of the April 1924 issue of Radio Broadcast we see that a No. 50 Duolateral type coil shunted by a 43-plate condenser tunes from 220 to 690 meters. Now, if we arrange these and other parts as in B. Fig 2, we will have a wavemeter with which we can calibrate or at least determine the maximum and minimum wavelength settings of the coil to be measured. To explain Fig. 2: B comprises the standard No. 50 coil, 43-plate, .001 mfd. variable condenser, buzzer and battery. A switch may be included to control the buzzer. This circuit is a miniature transmitter, the wavelength range as stated above, being controlled by the variable condenser. In A, we have the listening circuit. *X* is the coil to be measured. Ordinarily for this wavelength range, the number of turns for this coil



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To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. Ultraformers are guaranteed so long as this seal remains unbroken.



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No ordinary standards of distance can be applied to the Ultradyne Receiver. The "Modulation System" of radio reception, used exclusively in the Ultradyne, completely revolutionizes all previous conceptions of range.

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This "Modulation System" is a decided departure from the detector arrangement used in all other Super-Heterodynes. It causes the incoming signal to modulate the oscillations produced locally just as the voice modulates the carrier wave of a broadcasting station. Provides greater rectification and produces greater signal strength which is far more noticeable on weak signals.

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should approximate the number of turns used on the standard coil in the transmitter or wavemeter circuit.

To operate, set the buzzer going and turn the condenser dial C, to one half its full scale reading, 50 or 90 according to the type of dial used. Then, listening in on the A circuit, closely couple the two coils together, adjusting

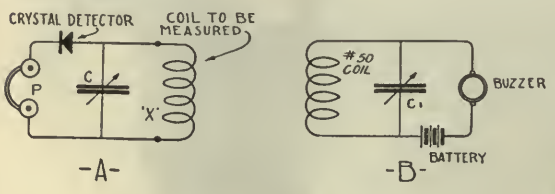


FIG. 2

the crystal detector for the signal. Rotate the condenser C for maximum signal strength and note its position. It should read very nearly like C1. If its reading is higher, this indicates insufficient wire on X; if the reading is lower, there is too much wire on X. The correct point can be ascertained by removing or increasing the number of turns on X until equal readings on both condensers are obtained.

SHARPER TUNING FOR THE KNOCK-OUT REFLEX

WHERE the addition of an extra control is not an objectionable feature, the reflex can, in many cases, be made to tune more sharply by winding the primary of coil unit T1 to about 40 turns tapped every 5 turns. In the original winding, this primary constituted an aperiodic circuit which responded to all wavelengths brought into resonance by the secondary and condenser. With the tapping arrangement, the primary circuit can be roughly adjusted to the wavelengths of the incoming signal, resulting in sharp tuning when the secondary circuit is brought into resonance with it. For experiment, a small variable condenser of about .00025 mfd. can be used either in series or parallel with the primary circuit. See Fig. 3.

And, while we are on the subject of Knock-Out reflexes, just a word about the crystal failing to act. We have received many inquiries asking why reception of signals still continues when the contact is lifted from the crystal. The

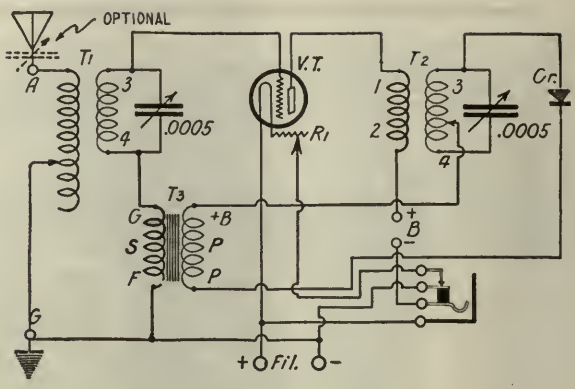


FIG. 3

answer is that the tube is acting as a partial rectifier, preventing the crystal and reflex audio transformer from giving any beneficial reflex action. This condition is due to any one of the following things:

1. Use of soft tube as an amplifier.
2. Poor composition of socket which provides an effective grid leakage resulting in detector action.
3. Poor reflex audio-frequency transformers.
4. Defective and poor crystals.

We have found it necessary at times to change crystals until a satisfactory piece was found. This resulted in sharper tuning, good quality and plenty of volume in the one-tube Knock-Out receiver.

NEUTRALIZING TUNED R. F. AMPLIFIER RECEIVERS

THE popularity of the novel neutralizing scheme employed by W. Van B. Roberts has become such that many experimenters are interested in its various applications. In Fig. 4, we show one of its many possible applications to the multi-stage, tuned radio-frequency amplifier circuits. Here is shown two stages of neutralized radio-frequency with a regenerative detector. The constructional details of the coils and neutralizing capacities have been explained in the April and May numbers by Mr. Roberts.

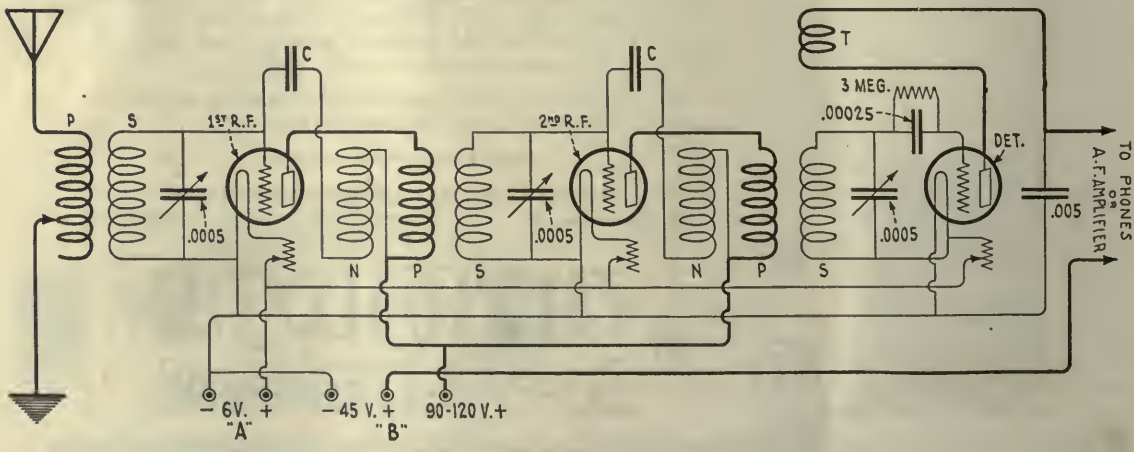
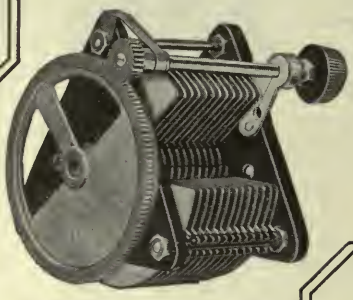


FIG. 4

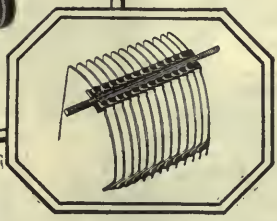
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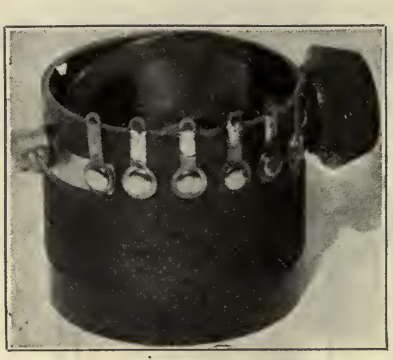
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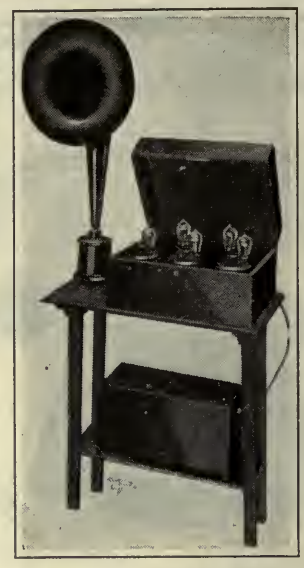
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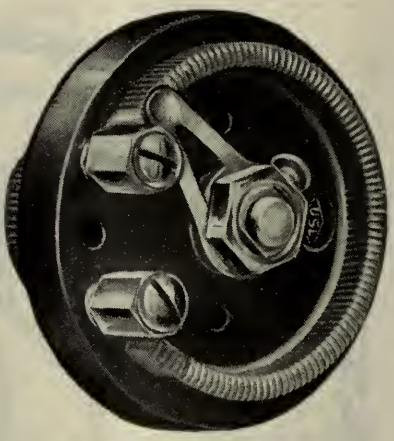
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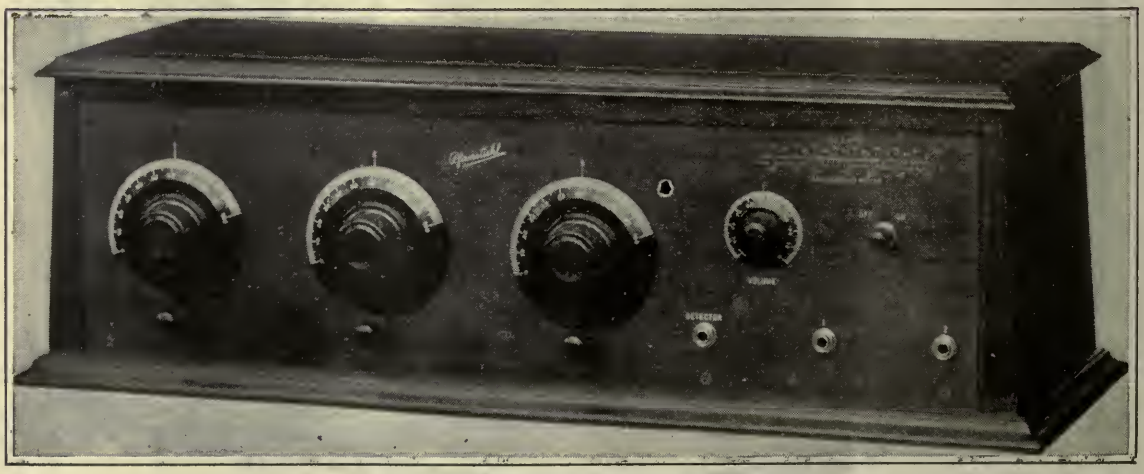
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Among Our Authors

HENRY J. Peck, who painted our rural cover this month, is doing most of his work at Warren, Rhode Island, until the snow begins to fly, and the artist colony again gathers in New York.

I. R. LOUNSBERRY has held an operator's and radio station license for eleven years and so is by no means new to radio experimenting. He writes from the laboratories at Mamaroneck, New York, that "at the age of twenty six, I can safely say that my business is radio and radio is my hobby. There may be some exception to the latter, because, since I have recently been married, there is a lot of work to be done around a certain new bungalow."



H. J. PECK

C. J. LEBEL is a junior at Massachusetts Institute of Technology and is spending his "vacation" working at the Lynn, Massachusetts, plant of the General Electric Company. He is a radio experimenter of some years standing, whose especial hate is radiating receivers. In the odd days between terms at Cambridge and arduous vacations, he may be found at his home in New York City.

AN ORATOR during the war recited 'Your Flag and My Flag' with such feeling that I ended in the job of chief radio electrician aboard the U.S.S. *Utah* for three years," writes W. J. Purcell from Schenectady, where he now is radio engineer in charge of the General Electric broadcasting station WGY. "Many interesting, yet futile early radio years I spent trying to get distant stations with coherers and electrolytic detectors," he concludes.



W. J. PURCELL

OF SOFT speech and shy manner is John B. Brennan, editor of The Grid in RADIO BROADCAST, and author of "Radio Broadcast's Knock-Out Four-Tube Set" in the present number. He is excellently qualified to write about the Roberts circuit, for his daily duties involve replying to many enthusiastic questions on this extraordinary circuit. Although much of his time is spent in the calm of the Doubleday, Page gardens where the RADIO BROADCAST Laboratory is located, when he is behind diagram or pliers, results have an odd way of appearing.

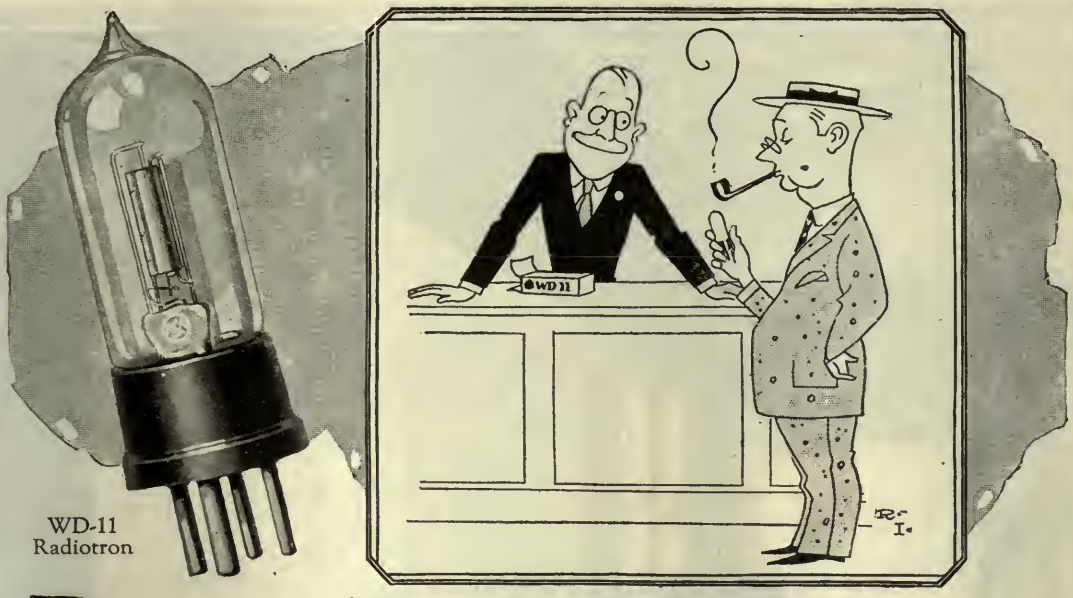
GENIAL J. H. MORECROFT, whose duties as professor of electrical engineering at Columbia University and President of the Institute of Radio Engineers are not too arduous to prevent him from writing that interesting and thoroughly authoritative review of matters radio for us each month.



A. J. HAYNES

MY PRESENT interest is keeping cool with Cal, or John W. Davis, or anyone else who can produce the desired result," writes A. J. Haynes, who has recently left on a five weeks' fishing and canoe trip through Northern Maine. He is Vice-President of Haynes-Griffin Radio Service, Inc., New York City. He is considered an authority on the superheterodyne.

FEW radio men, or indeed few men at all, have had the experiences in the air that Captain Jack Irwin has, whose "Historic Days at a Famous Wireless Station" appear in this number. It was in 1909 that the dirigible *Akron* which Walter Wellman was preparing for a voyage which he hoped would be more successful than that of the *America* (whose fortunes were described in this magazine last month) caught fire while in the air. Irwin, in New York at the time, was the sole member of her crew to escape. Captain Irwin has started on his transcontinental tour with the "Covered Wagon" and an article from him each month will tell of radio conditions as he finds them on his trip.



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—Roger B. Whitman, *Staff Photographer*

RADIO—WITH DR. LEE DE FOREST

In his home at Spuyten Duyvil, New York. Dr. De Forest, whose patent on the audion three-element tube dates back to the early days of wireless, is one of the pioneers in the art. A four-tube reflex receiver is installed in the panel at the left in the photograph. The panel doors are opened to show the receiver and loud speaker, which is about five feet high. The broadcast programs come through the grill near the ceiling