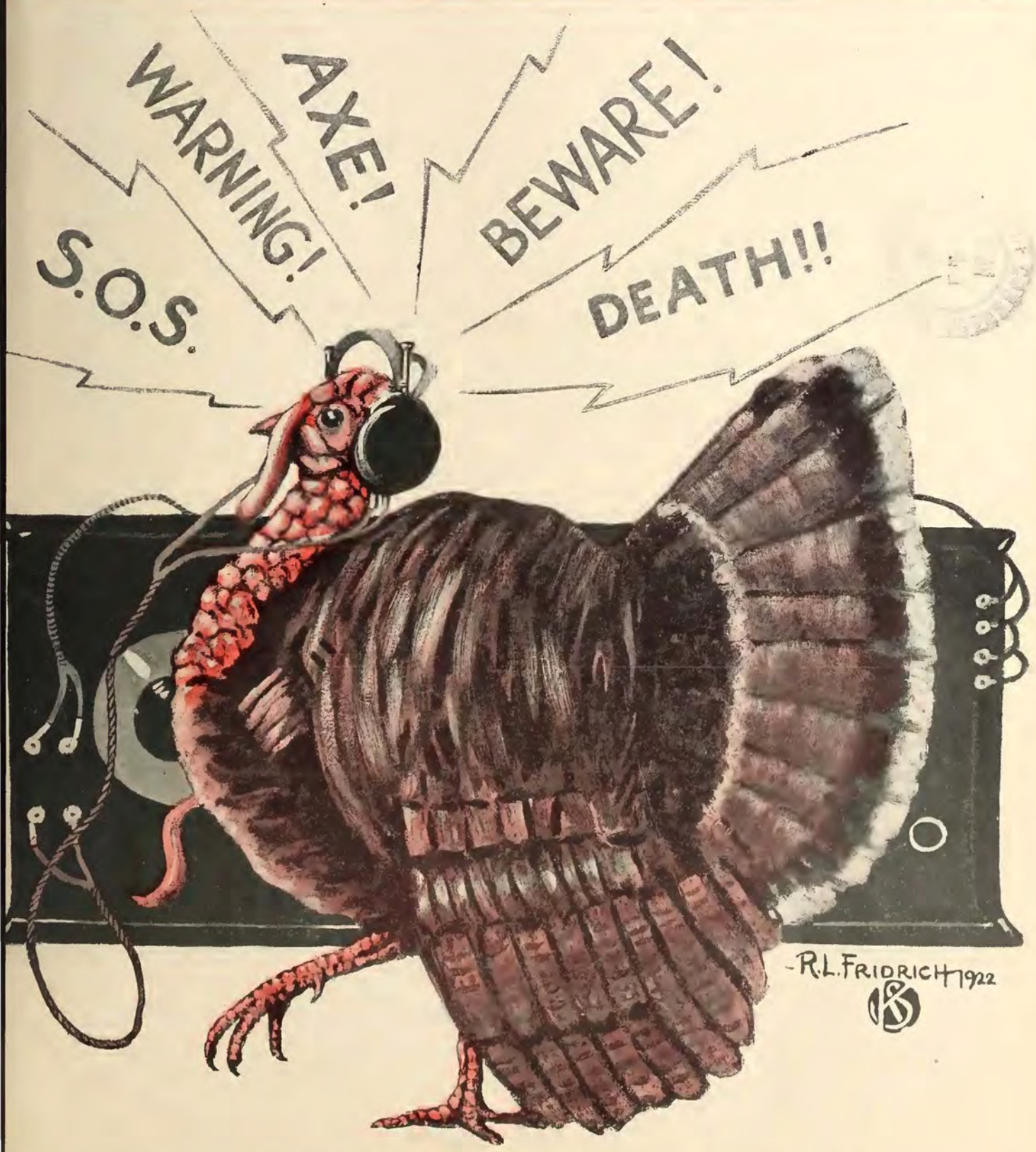
OUR BROADCASTING CRISIS—IN THIS NUMBER

RADIO AGE

The Magazine of the Hour

November, 1922 Price 25 cents



Official Medium for Service Bulletins of the National Broadcasters' League.

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RADIO AGE

The Magazine of the Hour

Volume 1 *Number 6*

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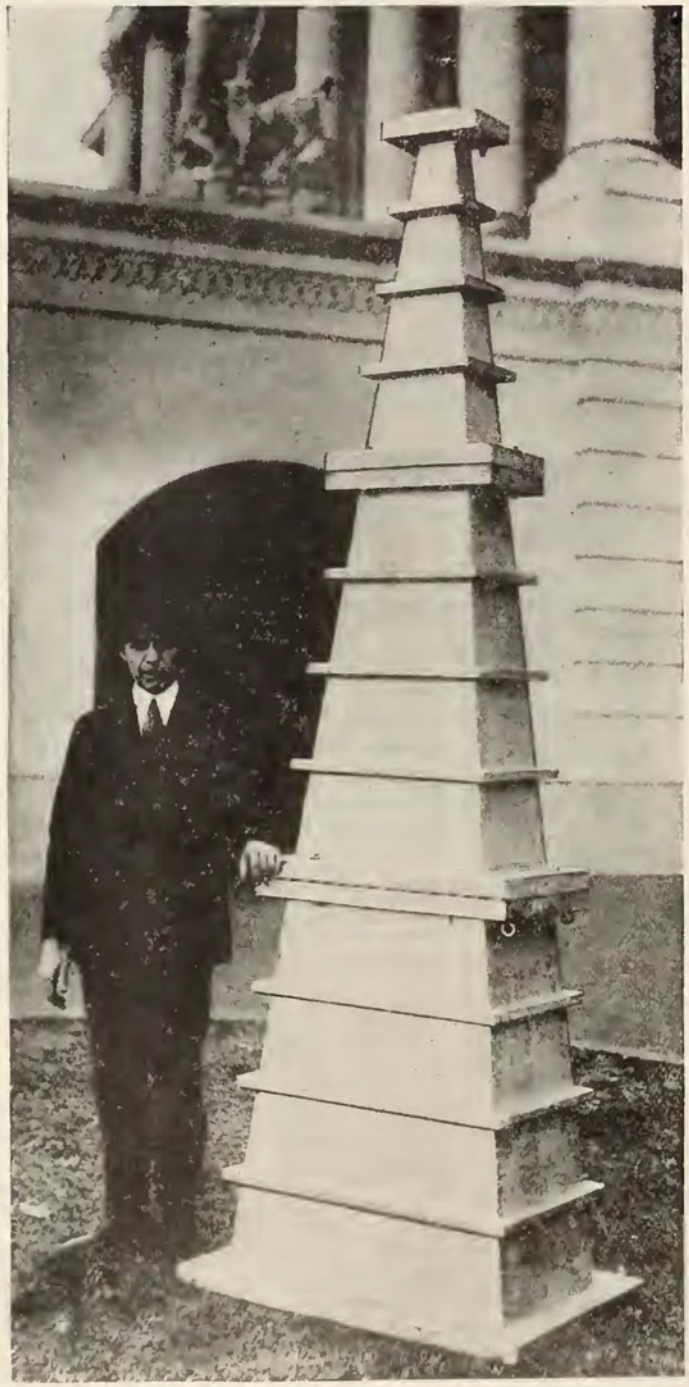
The Time Has Come to Stop Kidding Ourselves

WE ask broadcasters, owners of receiving sets, and manufacturers of radio equipment to give their earnest attention to the contents of this number of RADIO AGE. More than 500 broadcasting stations in the United States are beginning to wonder where and when they will get a return on their heavy investment. All these stations are confronted with the additional problem of interference in the air, in many localities this interference being persistent enough to practically nullify all efforts at transmission. Manufacturers of radio equipment are beginning to wonder where they will find a market for their goods if broadcasting becomes so disorganized that the fan will have no incentive to continue listening in.

This brings up the question as to the attitude and the rights of the hundreds of thousands of radio enthusiasts who have invested millions of dollars in radiophone receiving outfits. They bought their receiving sets on the presumption that satisfactory broadcasting was to be maintained.

Radio is on trial before the American public. Broadcasters have formed a National League and are preparing to meet the situation. Meanwhile needed legislation is tabled in Washington. Owners of stations are forced to consider the possibility that a monopoly will strive to take broadcasting service off their hands. Radio business has not come back as it was expected to do.

We are printing pages of news and views on this situation in this number of RADIO AGE. Every person, seriously interested in the advancement of Radio Art and of Radio Business should read every line of it.—The EDITOR.



Loud-speaking horn, used by city of Chicago in magnifying speeches and concerts at Pageant of Progress. Picture shows horn's size as compared with a man.
(By courtesy of Greater Chicago Magazine)

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH, EDITOR

Broadcasters Form National League

ORGANIZATION of the radio broadcasting interests of the country *for and by themselves* was accomplished in Chicago on October 16, when owners representing many of the more important stations assembled and launched the National Broadcasters' League. It is expected that the league eventually will include on its membership rolls practically all of the broadcasting station owners in the United States and Canada.

The purpose in organizing, as explained by speakers at the Chicago meeting, lies primarily in effecting a means of interchange of views and news between broadcasters. The general plan of the league might be condensed into the following outline:

1. To protect heavy investments owners of stations already have made and to find ways and means of obtaining some tangible return on that investment.

2. To establish a clearing house for information of value to all broadcasting station owners, so that they may be informed promptly of developments as to radio legislation; that they may work as a body for the elimination of interference in the broadcasting of programs; to improve programs; to present a united front against those persons and combinations of persons who are attempting to prey upon broadcasters; to convince the public and the government generally of the important position and strength of the broadcasting interests.

George S. Walker, President of the Western Radio Corporation, Denver, Colo., and owner of station KFAF, was elected president of the League. Arthur H. Ford, Professor of Electrical Engineering at the State University of Iowa, Iowa City, was made first vice-president. W. J. Baldwin, of the Alabama Power Company, Birmingham, Ala., was elected second vice-president, and Frederick A. Smith, of Radio Age, Inc., was chosen for secretary. Directors will include: Frank W. Elliott, WOC, Davenport, Iowa; T. B. Hatfield, Hatfield Electric Co., Station WOH; T. W. Findley, Minneapolis, Minn., StationWLAG, and owners of stations on the Atlantic and Pacific coasts and in the South.

It was decided to make the membership fee $10 a year, this nominal sum to be disbursed for postage, stationery and printing and distribution to all broadcasters of the periodical bulletins of importance to station owners. A complete view of the activities of the League will be published monthly in this magazine, which will give space for discussion of new problems by all or any members of the League who wish to thus communicate with their associates.

Executive offices of the League are located in the Garrick Building, Chicago, Ill., where communications from members or any others interested should be addressed.

From the outset the Chicago meeting made it apparent that broadcasters desired an association which should not be identified with any other radio organization. Cooperation, where cooperation was decided to be desirable, was generally agreed to be the purpose of the broadcasters. But the speakers were definite in their expressed opinion that the League should admit none but a broadcaster to membership and that it should not affiliate with any other radio group, whether manufacturers, tradesmen, or whatnot.

The meeting was called to order by Mr. Smith, who briefly explained that he had been asked by important broadcasting interests to bring about such a meeting. He said there were many problems confronting broadcasters at this time and that the interest in forming a union of station owners was evidenced by the large number of letters from station owners who could not be present but who wrote enthusiastic commendation of the plan and volunteered their services in making the organization a power for mutual progress and protection. Newspapers all over the country, having broadcasting stations in connection with their plants, were particularly quick to respond to the suggestion that a League was necessary.

Frank W. Elliott, member of the Iowa legislature, and vice president of the Palmer School of Chiropractic, at Davenport, Iowa, was made temporary chairman of the meeting. Mr. Elliott expressed the opinion that one of the most important subjects for discussion was that of interference.

T. B. Hatfield, of WOH, said:

"We are WOH of Indianapolis, Hatfield Electric Co. We have been broadcasting since March of this year. Our two problems are: First, Interference, on which something certainly must be done through an organization of this kind. I am here without any definite idea as to how the interference problem may be solved, but am eager to listen to whatever information we may get.

"Second: We are a commercial organization and it is costing us a pretty penny per month to run our broadcasting station, on which we get very little returns, unless advertising may count as such. But if we count advertising it is still costing us a great deal for that advertising. I am in favor of seeking some way of getting some return for our outlay. But primarily the thing to do is to find out how we can help each other to clean out the interference."

T. W. Findley, Station WLAG, Minneapolis, said:

"I bring to you a message from Prof. Jansky, of the University of Minnesota, who was one of the members of the Hoover committee which drafted the Kellogg-White bill. Here is Professor Jansky's letter, in part:

" 'Radio traffic is being regulated by the Department of Commerce, under the law of 1912. The Department is to a certain extent, handicapped by a lack of funds and personnel. To my mind the situation may best be remedied by early consideration of the Kellogg-White bill, which was prepared by the radio conference to give the Department of Commerce necessary authority to handle the present situation.

" 'The Department, under the present law, must proceed very slowly. The assignment of a wave band for broadcasting service in place of two single wave lengths will do much to prevent interference between stations. You can readily see that the allocation of wave lengths will be a very difficult one.' "

Mr. Findley went on to say that various men selected by Secretary Hoover to draft this bill spent a great deal of time on it. There has been opposition to the bills but Mr. Findley said Professor Jansky was convinced it was a step in the right direction.

It was suggested by the speaker that station owners broadcast a summary of the bill to their audiences and ask for expressions of opinion on the bill from the listeners. He urged that the users of receiving sets be enlisted in a move to induce congressmen to have the bill brought before the house without further delay. He said that some persons believed nothing could be accomplished until the senators got back to Washington but he disputed this, saying that the time to show the national legislators what was needed and what was wanted, was right now, so that when they returned to Washington they would be ready to act.

The bill referred to is the Kellogg-White radio bill, Senate Bill No. 3694. It was introduced April 20 and referred to a Senate committee on interstate commerce and to the House committee.

"This will slumber on the tables of the committee," said Mr. Findley, "unless the broadcasters get busy and bring about some action on it."

Ralph C. Watrous, former Governor of Rhode Island, representing the National Radio Chamber of Commerce, spoke next. Mr. Watrous explained that the Chamber was interested only in the common interest of all elements in the radio art. He said that only persons who would quarrel with the Chamber was one who had some selfish interest to promote. Mr. Watrous advised those present to get together for discussion and solution of the interference problem and other difficulties. He suggested a national conference. It was apparent that Mr. Watrous believed it would be best for the broadcasters to affiliate with the Chamber of Commerce, but when outspoken opposition to such a plan was expressed, he said that he hoped the League about to be formed would cooperate with the Chamber and that the Chamber would be glad to serve the broadcasters.

(Note—The Kellogg-White bill was published in full in the September issue of Radio Age.)

Radio Inspector E. A. Beane, of the Ninth District, next addressed the meeting on the subject of interference. As he is the air policeman for a territory covering an immense territory, his version of the interference situation was awaited with interest.

"It seems to me," he said, "that the only solution to local interference is the making of a definite program for each station and this can be done through organization. The plan I favor is to arrange a program of six days a week for each broadcasting locality. The seventh day would be called a "silent day" or "silent night" and on that night all broadcasting and local communications would cease, giving the listeners with the better class of equipment a chance to receive programs from a longer distance.

"The next night you would be in the air when some other location is silent and your broadcasting gets across. You can go to the amateur and say you are arranging a silent night to permit those with receiving outfits to listen in to outside concerts. If the amateurs will agree to stand by every night during your general broadcasting program from 7 to 10:30 o'clock you will stand by and give them a chance to send and receive long distance work.

"In Louisville we put such an arrangement through in a few hours' time. A committee was asked to take care of all complaints. I believe your organization should incorporate such a plan in your work. The public should be educated in the proper use of apparatus."

Thorne Donnelley, Station WD APF, Chicago, expressed the opinion that one national organization should assume the work outlined by the extra speakers. George Lewis, Secretary of the National Radio Chamber of Commerce, brought up the question of what rights, if any, owners of copyrights on music and songs had in the way of taxing broadcasters of such musicand songs.

C. B. Cooper, secretary of the Broadcasters Society of America, told how that body of a few eastern broadcasters had found difficulty in eliminating interference in New York.

George S. Walker said:

"We are broadcasting out in Denver at a great expense. I am wondering where we are at. I have made a big investment and would hate to lose it. I went into it at the request of my boy who is 18 years old. I believe there should be an organization of broadcasters to protect our investment if nothing else. We do not know at what moment we will be wiped out, with our investment.

"We are told that we can broadcast expensive programs but where do we get our compensation? I have a radio store in Denver, but when we broadcast music for the entertainment of radio fans at great expense we expect to be repaid by the sale of radio goods. Yet the next morning we find that the soft drink parlor has put in a receiving set to permit patrons to listen to our programs and the soft drink parlor is selling radio sets.

"We should form an organization that would not be the tail of any kite. I am in the radio business to make money, but it strikes me that the Radio Corporation of America are making the money out of radio."

Arthur H. Ford, State University of Iowa, said no matter what commercial Stations might do, the universities would go on supplying broadcasting service. He was in favor of an organization that would include in its scope newspaper stations, university and school stations and stations operated by individuals or firms engaged in the radio business.

On motion of John P. Tansey, secretary of the Radio Club of Illinois, the chair appointed a committee comprised of Messrs. Donnelley, Walker, Ford, and the secretary to draw up an organization plan, which resulted in the selection of the officers already named.

Present at the meeting were:

B. L. Moore, Vice President of the Federal Telephone and Telegraph Company, Buffalo, N. Y. (WGR)

Frank W. Elliott, Vice President, Palmer School of Chiropractic, Dav-

(Continued on page 30)

How to Add One Step of Radio and One Step of Audio Frequency to the Reinartz Tuner

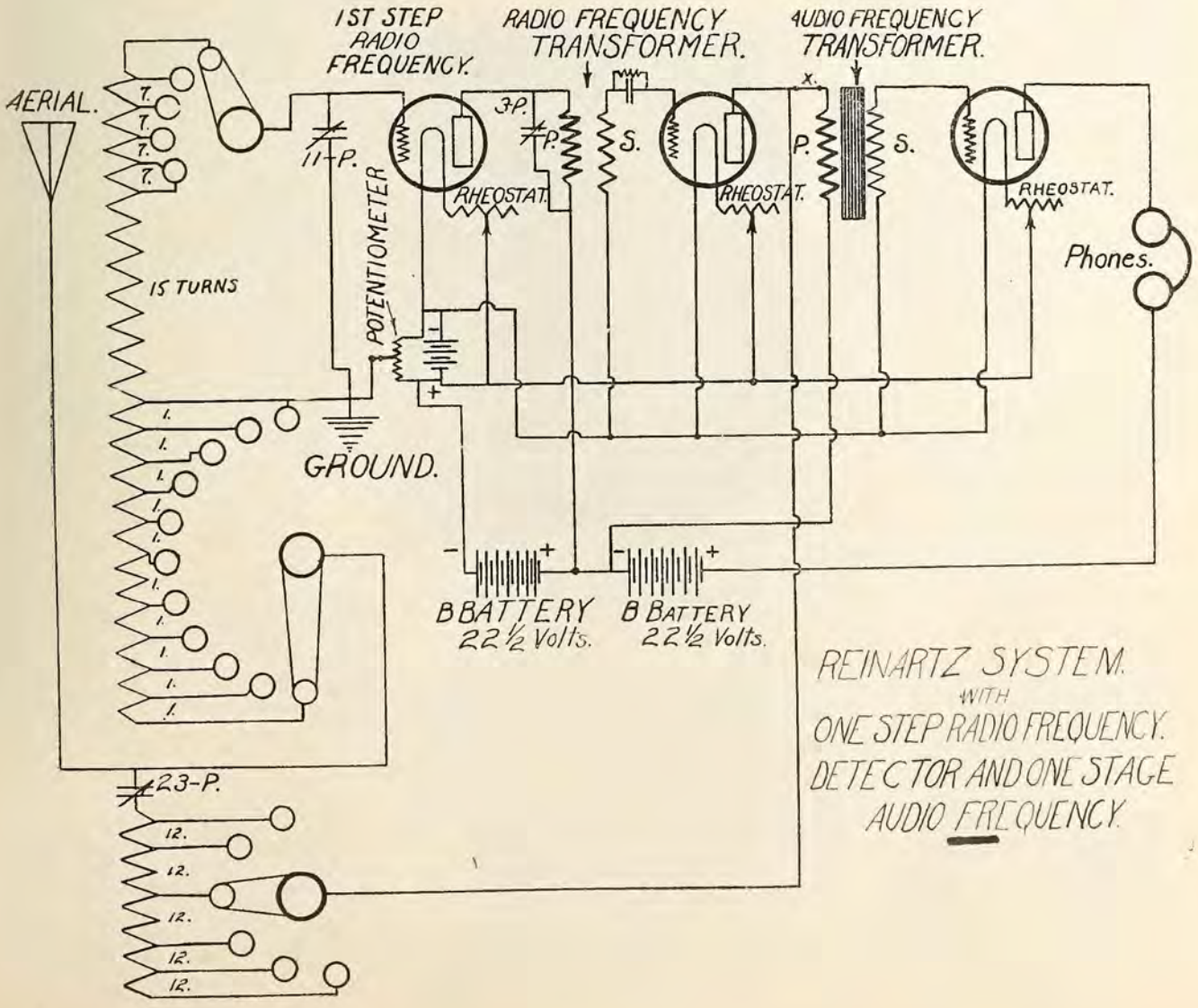
By **F. D. PEARNE**

WHILE wonderful results have been reported by the makers of the Reinartz set described in the September issue of this magazine and republished in this number, some of which showed reception from distances of 2,500 miles, still there are some of our readers who are anxious to see what this instrument will do with one or two stages of radio frequency added to it. Many amateurs seem to have an idea that radio frequency will add to the volume of the signals received, but this is an error, as I will show by a brief explanation.

Most all of our readers know that "radio frequency" is that in which the oscillations are too rapid to be heard by the human ear (usually calculated at 10,000 per second or more), while those frequencies which are audible (below 10,000 per second) are spoken of as audio frequencies.

The function of the detector tube is to rectify the radio frequency oscillations and bring them down to audio frequency. As the vacuum tube is also capable of magnifying the signals to some considerable extent, the detector may be termed both a rectifier and a relay.

Now let us consider a case in which one step of radio frequency amplification has been prefixed to the detector tube. An amplifier, or "hard" tube is used for this purpose. As all signals which are received upon the aerial come in at radio frequency and as they first enter the amplifying tube (the nature of which is to amplify, rather than to rectify) the signals are greatly amplified, or increased at



radio frequency. They are then carried to the detector tube, where they are rectified and brought down to audio frequency. From this it will be seen that radio frequency amplification will really magnify oscillations received upon the aerial and pass them to the detector tube for rectification.

This makes it possible to hear signals which otherwise would be too weak for detection in the detector tube. In other words, the radio frequency amplification will bring in weak signals from a great distance and strengthen them to such an extent that they can be heard after passing through the detector tube. Consequently it has been said that for long distance reception, use radio frequency amplification. After the signals have been rectified and brought down to audio frequency, they may then be amplified at this lower frequency to the desired volume, by means of audio frequency amplification. Here again the "hard," or amplifying tube is used, as the function of this part of the apparatus is to amplify only and as this amplification takes place at audio frequency, it is possible to listen in on one or two steps as desired. It would do no good, however, to listen in on the different steps of radio frequency, as at these points the oscillations have not yet been rectified and nothing would be heard. If properly designed and constructed, radio frequency amplification circuits will bring in signals from great distances.

The construction of the inductance, switches, etc., used in the Reinartz tuner is described in detail in this number, so only a brief description of that part of it will be given here and more detail will be used in describing the addition of the radio frequency amplification. The Reinartz tuner is due to the work of Mr. John L. Reinartz, of South Manchester, Conn., and consists of a spider-web winding, wound upon a slotted fiber, or bakelite disc, 1-16 of an inch thick and 6 1-2 inches in diameter. Eleven slots 1-8 of an inch wide and two inches deep are cut into it to accommodate the wires. The coils are best wound with No. 26 single silk insulated wire. The winding consists of two coils. The first, or inside coil has sixty turns, with taps taken off every 12 or 15 turns as desired. This coil is connected to the aerial through a 23-plate variable condenser, as shown in the drawing. The second coil contains fifty-three turns tapped and connected as shown. The inner coil of sixty turns is first wound in and out of the slots and the second coil is wound on the outside of it. These two coils are the only inductances used, thereby doing away with the expensive variometers and vario-coupler used in other types of regenerative sets. The adjusting is done by means of switches, the points of which are connected to the various taps shown.

The previous description of this set showed the tuner alone, with one step, and with two steps of audio frequency amplification, and to those readers who are familiar with the set, the arrangement of one step of radio frequency amplification will be seen at a glance. The additional apparatus used in this circuit consists of a potentiometer having a resistance of 400 ohms, a socket and amplifier tube, one additional "B" battery, a radio frequency transformer having a wave band limit of from 200 to 500 meters, and a rheostat.

These parts are the only additional material necessary to give a great increase in the receiving range. The revolving part of the eleven plate condenser must be connected to the ground, and the revolving part of the twenty-three plate condenser must be connected to the aerial. If particular care is not taken to see that these connections are made in this way, no results will be obtained. It has also been found that in case it is necessary to burn the filament of the detector tube at a very high temperature in order to get results when audio frequency amplification has been added, that an extra inductance consisting of a few turns of No. 26 wire connected in the circuit at the point marked "X" on the drawing, between the plate of the detector tube and the primary of the audio frequency transformer will make it possible to burn the filament at a much lower temperature.

This is not always necessary, but when it is needed, the builder should experiment and find out just how many turns are necessary for his particular set. In some cases, six turns will suffice and in others, more turns are needed. This inductance is usually wound on a miniature form similar to that used for the large coils. One "B" battery supplies the radio frequency and the detector tubes and the other takes care of the audio frequency tubes. The second set of "B" batteries can be omitted if desired, but it will be found that the set works better with a high voltage on the plate circuit of the audio frequency amplifier tube. In fact it is a good idea to use forty-five volts on the radio frequency tube, but if this is done it should be a separate battery with the negative terminal connected to the positive terminal of the "A" battery and the positive terminal connected to the plate side of the radio frequency transformer, which is shown in the drawing connected to the positive terminal of the first "B" battery.

The positive terminal of the first "B" battery is left connected as shown. A loud speaker may be substituted for the head phones to give greater amplification to the signals if so desired. The adjusting is done on the three switches and the two variable condensers as shown in the drawing. Any standard make of audio frequency transformer may be used, but in making the selection be sure that the transforming ratio is 10 to 1 for the first step and if another step is added, use a 3 to 1 ratio. Also in purchasing a radio frequency transformer, be sure that it is wound for the wave band which will cover the limit which you want to receive. The large inductance is usually mounted some distance away from the panel on which the switches and condensers are mounted, as this arrangement will give ample room for making the connections to the switch contacts and will also prevent interference caused by body capacity while adjusting the set. Another way to mount the coil is to use a sliding base to which the panel is attached, which will move in and out of the box when the panel is drawn out. The coil is then mounted horizontally on the base and the wires brought up to the switches for connection. It will take some little time and experiment for the operator to become acquainted with the adjustment of this set, as a difference of one point on either of the small switches will cut a station in or out, but after a little practice excellent results will be obtained.

Assistant Inspector

Lawrence E. Dutton, 1340 North Homan Avenue, Chicago, has been appointed an assistant to Radio Inspector E. A. Beane, of the Ninth radio inspection district. Mr. Dutton has commenced his work in the Federal building.

Photo-Electric Detector Tubes

By H. A. BROWN and C. T. KNIPP, University of Illinois

A YEAR ago the writers completed an investigation of the effect of various residual gases and various degrees of vacua upon the characteristics, constants and efficiency of detector tubes. The investigation showed that in the case of a low vacuum the optimum plate voltage for detector action decrease with the ionizing potential of the gas in the tube. The vapors of certain alkali metals have ionizing potentials of 4 volts and less, and some of these were experimented with. It was found that the vapor of potassium-sodium alloy, having an ionizing potential of 4 volts, when present in the ordinary three-element vacuum tube or Audion caused it to function as a very sensitive detector of high frequency oscillations at a plate potential of 5 to 10 volts. Tests in this laboratory have shown that this tube is from 3 to 5 times more sensitive on weak signals, with 8 or 10 volts plate potential, than is the same type of tube containing any of the commonly used gases, such as argon and helium, and which require 18 to 25 volts. This latter is the widely used "gas content" or "soft" detector tube. In spite of the extremely low plate voltages needed for this alkali vapor filled tube it is not "critical" in adjustment of plate voltage as is the conventional "soft" detector.

Fig. 1 shows this clearly, curves A representing three different tubes each primed with alkali vapor, and curve B for the conventional "soft" detector tube. Users will appreciate this advantage.

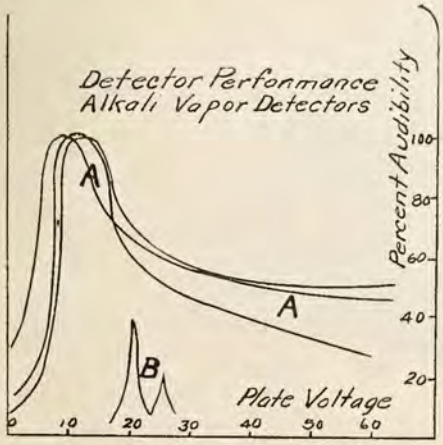


Figure 1.

Professor Charles T. Knipp, University of Illinois

H. H. Brown, Associate in Department of Electrical Engineering, University of Illinois

The most astonishing discovery about this tube is the fact that it operates efficiently at zero plate voltage.

Fig. 2 shows the characteristic curves for one of these tubes, the lower curve being taken at zero plate voltage. To do this the plate circuit return was connected to the negative filament terminals. The plate current flows through the vacuum from the plate to the filament in spite of the opposing effect of the filament drop. This curve shows the plate current to be about 1 milliampere at zero grid voltage. As is well known, the potassium-sodium alloy is used as the sensitive coating in the photo-electric cell, a device which furnishes a source of feeble electric current when light shines upon it. In all probability the source of plate current in these tubes at zero plate voltage is the photo-electric effect of the alkali vapor, the luminous and non-luminous radiation from the filament being the source of energy.

These photo-electric detector tubes function very well as detectors of damped and undamped waves and of radiophone modulated waves. As a test several of the tubes were tried out. Using one tube as a detector together with a "variometer" type of regenerative tuner, and an antenna 45 ft. high, the broadcasting stations at Schenectady, N. Y., Detroit, Pittsburgh, and Chicago were heard in this locality without an amplifier and with a directly measured audibility of about 30. When a plate voltage of 6 to 10 volts was applied the audibility increased to 150, this corresponded with the results of the carefully made laboratory tests shown in Fig. 1. At zero plate voltage the tube was used to receive the 17,000 meter station at Annapolis by the beat method, the tube oscillating very easily and steadily. It is equally efficient on short wave amateur C. W. reception.

The foregoing features in addition

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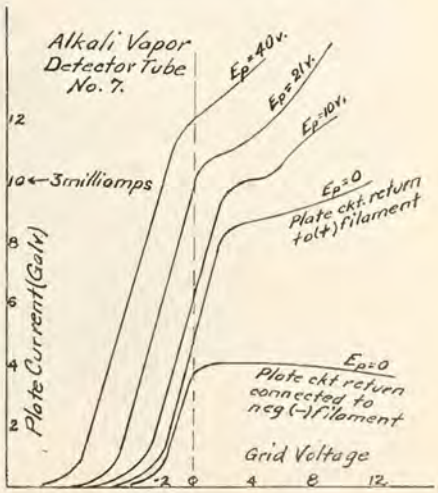


Figure 2.

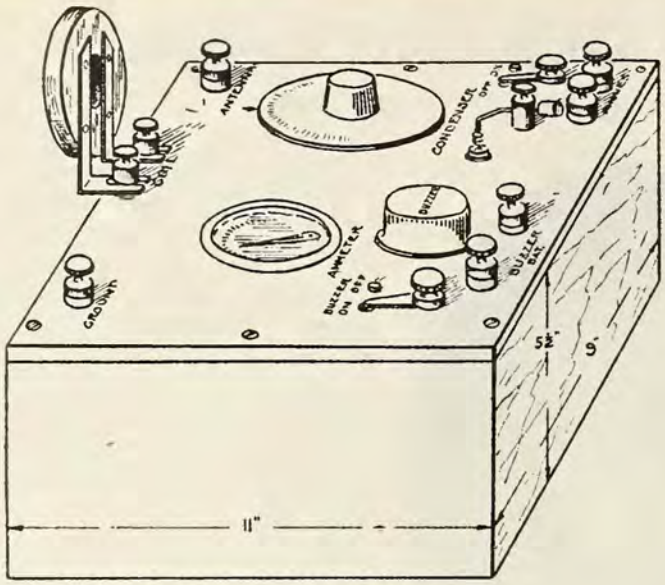


FIG. 1. ONE ARRANGEMENT OF WAVEMETER BOX AND ASSEMBLED UNITS.

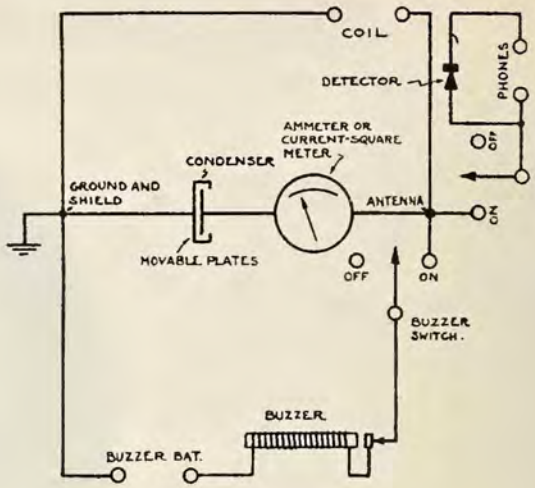


FIG. 2. WAVEMETER CIRCUIT.

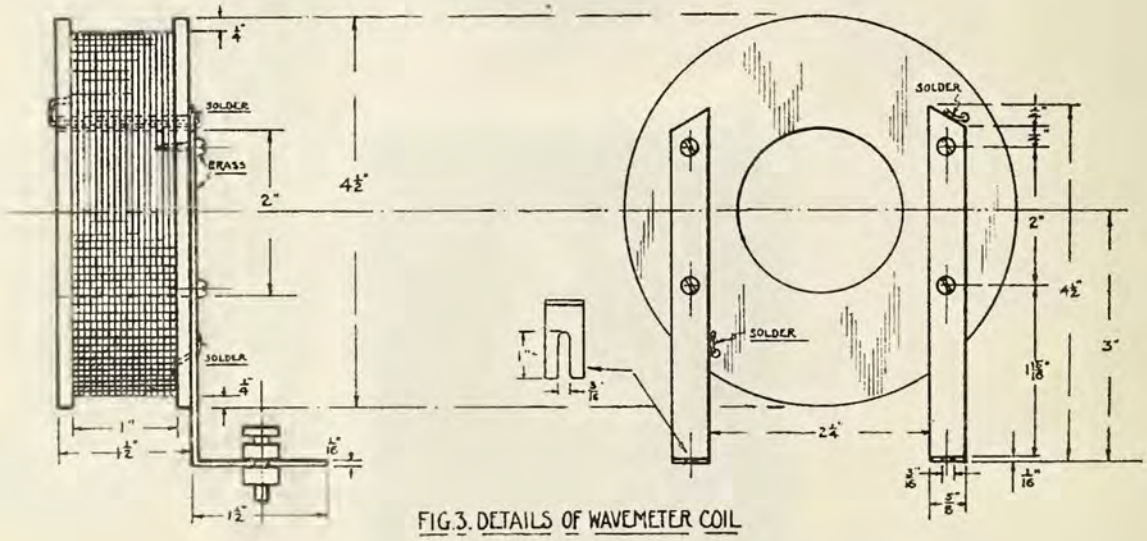
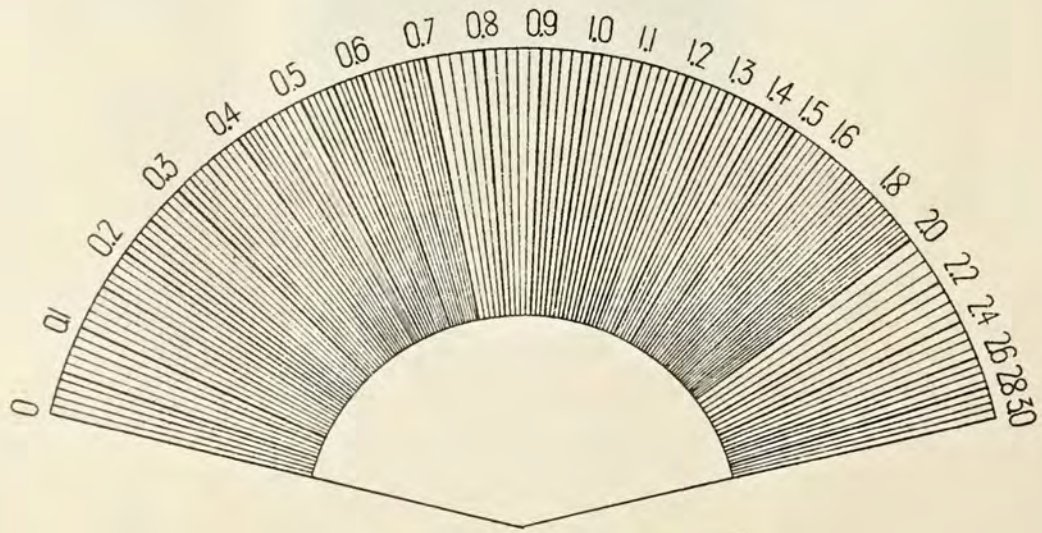


FIG. 3. DETAILS OF WAVEMETER COIL



DECREMETER SCALE.
FIG. 4.

Design of a Portable Short-Wave Radio Wavemeter

By U. S. Bureau of Standards

A WAVEMETER is a device for measuring the frequency or the length of radio waves. Radio waves always travel with the same velocity, and if the frequency is known, the wave length is also known.

Resonance is a most fundamental phenomenon of radio. When the inductance and capacity of a circuit on which an alternating electromotive force is impressed are adjusted so that the impedance of the circuit is a minimum and the current flowing in the circuit is a maximum, the circuit is said to be in resonance. For information regarding resonance and the measurement of wave length, reference may be made to "The Principles Underlying Radio Communication," Signal Corps Radio Communication Pamphlet No. 40, and to Bureau of Standards Circular No. 74. These publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price of the former is $1.00, and the price of the latter is 60 cents.

Amateur radio stations in the United States are at present required by law when transmitting to use wave lengths not exceeding 200 meters, and it is therefore important that amateur operators should have a wavemeter available so that they may adjust their transmitting sets to comply with the law, and it is necessary that this wavemeter should be adapted to measure short wave lengths such as 200 meters. Other comparatively short wave lengths such as 360 and 485 meters, are now used for radio telephone broadcasting, and it is important to have a wavemeter which can measure these wave lengths. The Radio Telephony Conference which met in Washington in February, 1923, recommended narrow bands of waves for particular services, some bands being only 10 meters wide. Stations which must work within such narrow bands must be provided with well-designed wavemeters if they are to comply with the requirements of the law. The design of a portable short-wave wavemeter is therefore a matter of importance. It is the purpose of this circular to point out the most important considerations in the design of such a wavemeter, and to describe the

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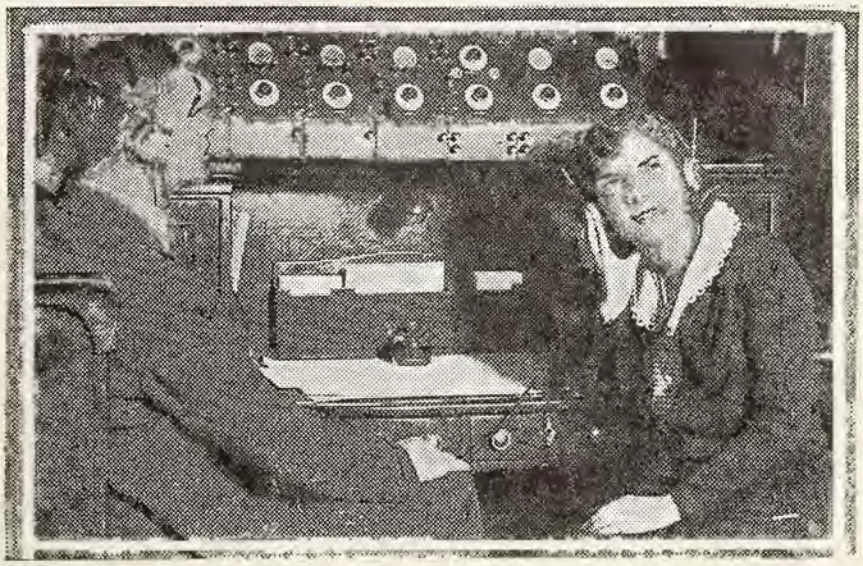


Operating radio receiving set inside steel car on speeding Pennsylvania train.

Receives in Speeding All-Steel Car

PIERCING the all-steel construction of a railway passenger car on the Broadway Limited, the Pennsylvania Railroad's crack flyer, radio signals were successfully received on October 13 by a set entirely within the car, without outside antennae, while the train was speeding between New York and Chicago.

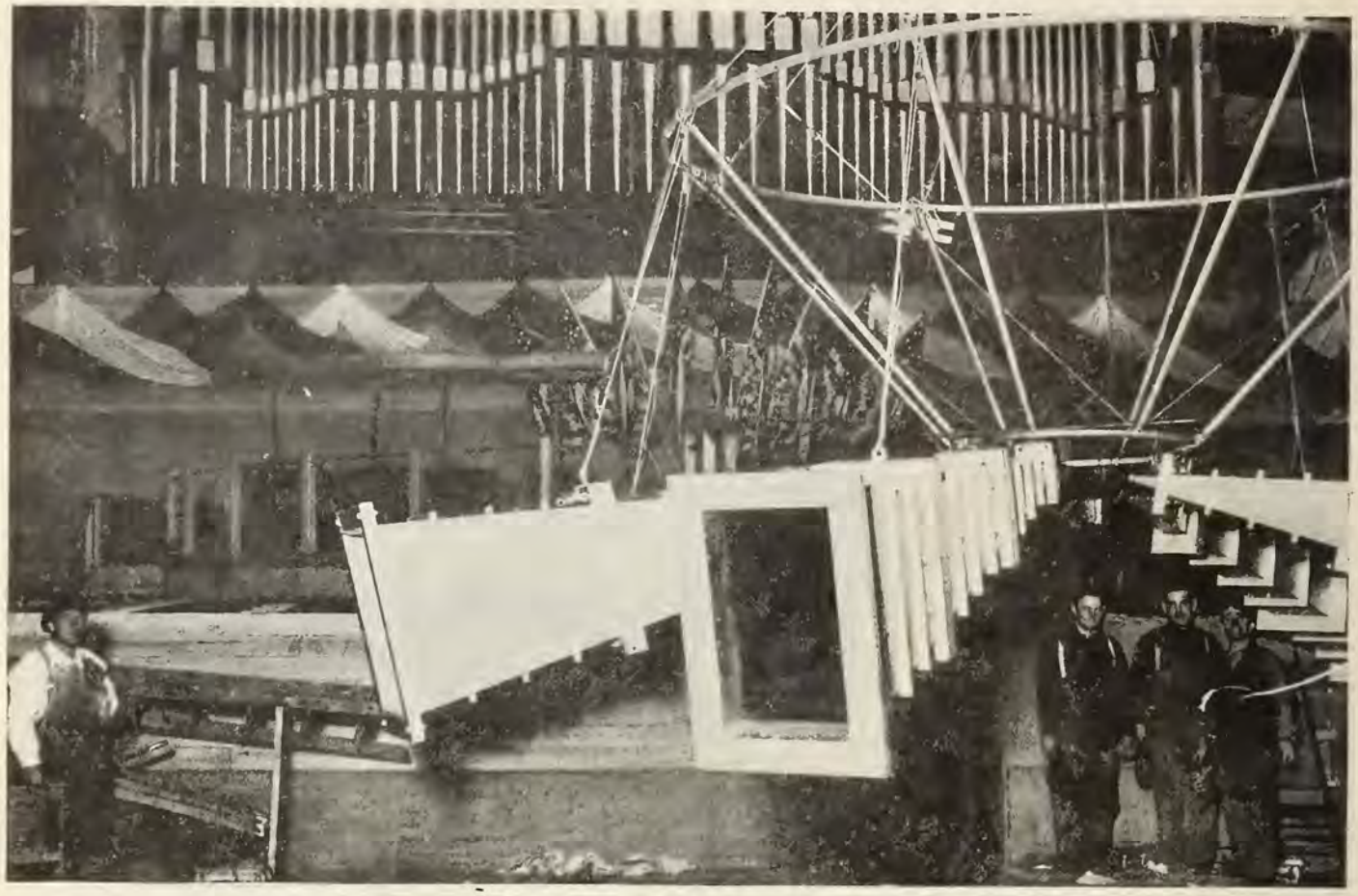
A few strands of wire around an eighteen-inch frame attached to the set served as the receiving apparatus by which music and speech were caught from half a dozen stations en route. The tests, the first to be made on a moving train without an outside aerial, were conducted by Arno Zillger, chief engineer for the E-D Manufacturing Company, of Philadelphia, enroute to the Radio Show in Chicago.

Mr. Zillger used an ordinary receiving set without any extra attachments or special parts, setting up the apparatus in 17 minutes as the train was about to leave Philadelphia and immediately tuning in to catch broadcasting from John Wanamaker's in Philadelphia. Even the 11,000 volt electric wires over the railroad tracks, where the Pennsylvania is electrified to Philadelphia suburbs, did not interfere with the receiving.

Continuing the test through the evening, Mr. Zillger listened to messages and concerts from Newark, Schenectady, an ore boat on Lake Erie, Pittsburgh and numerous other points.

J. D. Jones, superintendent of Telegraph and Signals for the Eastern Region of the Pennsylvania Railroad, was one of the most interested observers of the experiments. The possibility of the use of radio in giving and receiving train orders is at present a subject of investigations on several roads and the results of Mr. Zillger's tests threw considerable light on the problem. Since the initial tests, Mr. Zillger has designed a new set especially for use on moving trains. This set will be given a try-out soon.

The practicability of radio for use in communicating between the engine and the caboose of long freight trains, and between trains and stations along the line, is one of the angles which Pennsylvania railroad officials are watching closely. The results of last week's experiments, Mr. Zillger said, show that the idea is workable and that his set, with a few modifications, would prove successful in such work.



Arrangement of loud-speakers in Congress Hall, Pageant of Progress, Chicago. (By courtesy of Greater Chicago Magazine)

Expert Explains Radio Frequency Amplification

By CHARLES KILGOUR, Engineer, Crosby Mfg. Co.

RADIO Frequency Amplification is regarded at present as the most interesting subject connected with wireless telephony, and Charles Kilgour, who is in charge of the engineering department of the Crosley Manufacturing Company, Cincinnati, Ohio, operators of the radio broadcasting station WLW, has prepared the following interesting explanation of it. Mr. Kilgour has dealt in terms of the layman and made his explanation so simple that a beginner may understand every word of it. Mr. Kilgour said in part:

"A radio enthusiast is not satisfied with a mere definition of radio frequency amplification. He wants a plan of construction, for a great part of radios fascination is due to the ease with which it is possible to try out various schemes for making audible the infinitesimal waves of the ether which constantly are lapping upon our aerials.

"The first essential of a radio frequency amplifier is a proper vacuum tube. Any standard amplifier tube will serve. Upon the grid of this tube is impressed incoming alternating current. This is accomplished by connecting one side of the secondary coil to the grid and the other to the filament circuit. No grid condenser is used because the tube acts as an amplifier and not as a rectifier or detector.

"To cause a vacuum tube to amplify properly the voltage impressed upon its grid, it is necessary to place an impedance, or resistance, in the plate circuit, which is the connection between the plate and the filament. It is also necessary to hold the plate at a positive potential of about 45 volts with respect to the filament. This is accomplished by the familiar 'B' battery.

"The high impedance required in the plate circuit may be obtained in several ways. A high ohmic resistance may be used, but as this has a high resistance to direct current it opposes the action of the 'B' battery, thus introducing difficulties.

"An inductance or coil may be used to set up the necessary impedance. An inductance may have very low ohmic resistance and so not interfere with the proper action of the 'B' battery and at the same time, due to its reactance offer high impedance to an alternating current such as we wish to amplify. At the high frequency handled a condenser or capacity effect is always present in a coil. This is equivalent to connecting a condenser across the terminals of the coil. This capacity, together with the inductance of the coil, forms a closed circuit which has a natural period of oscillation or is resonant at a certain frequency. It is a peculiar quality of such a circuit that it offers a very high resistance to an alternating current of the natural frequency of the circuit.

"In other words such a coil introduced in the plate circuit of a vacuum tube will have a high impedance to one frequency and will cause currents of that frequency to be greatly amplified. It is essential, however, that the amplifier works properly on various wave lengths. For this reason the ohmic resistance of the coil may be increased, broadening the range of the amplifier but reducing its efficiency.

"By far the best solution of the problem is the use of a rather small inductance with a variable condenser connected across its terminals. The same sort of a circuit is formed as in the last case, but the variable condenser makes it possible to change the natural period of the circuit and so amplify a signal of any desired frequency within the range of the condenser and coil. The ohmic resistance of such a condenser and coil may be very low and paradoxically the impedence at resonance as a consequence will be extremely high.

How to Construct a Good Reinartz Set

(Republished in response to scores of requests)

By F. D. PEARNE

Chief Instructor in Electricity at Lane Technical High School

FOR the amateur who wants to build a real receiving set and does not feel that he can afford to spend the money, I submit the following specifications of the Reinartz tuner, which, according to my many correspondents, is giving far greater satisfaction than the well-known vario-coupler and variometer set. This set is claimed by many users, to bring in signals which cannot be heard with the other well-known types, and the small investment required to build it is one of the features which recommend it to the experimenter. All of the inductances are wound upon the same form, which are of the well-known "spider web" type.

Construction.

The mounting is made by cutting out a disc of fibre one-sixteenth of an inch thick and six and one-half inches in diameter. If fibre cannot be obtained, good heavy cardboard can be used, but it must be very carefully varnished with shellac before the winding is put on. Cut out the disc as described and divide the outside edge into eleven parts. Draw a circle two and one-half inches in diameter upon the disc to locate the bottom of the slots, then at each of the divisions cut a slot one-eighth of an inch wide from the outside edge to the inner circle so marked.

After all the slots have been cut, a coat of shellac varnish, or celluloid cement, is put on and, when dry, the form is ready for winding. It is a good idea to study the circuit as shown in Figure 3 before starting to wind. Note where the taps are taken off, as a great deal depends upon just the right number of turns being used. Leave all taps at least twelve inches long, so that no splicing will have to be done when the inductance is connected to the switches. The best wire to use for the winding is No. 26 cottenamel or silk enamel insulation, although plain cotton insulation will do if the maker is careful in his work. Begin winding at the bottom of any one of the slots, leaving an end at least twelve inches in length for connections. Wind in and out of the slots as shown in Figure 2 until fifteen turns have been put on. In counting these turns after they have been put on remember that only one-half of the turns will be visible on one side of the disc, so that when seven turns show on one side and eight on the other, it means fifteen complete turns.

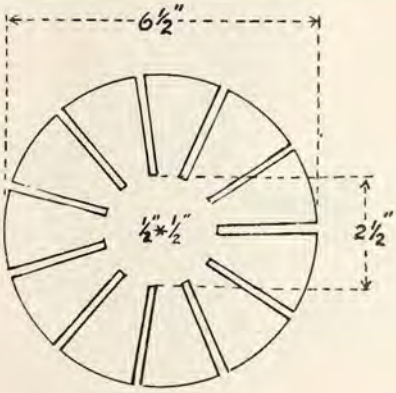


FIGURE 1.

When fifteen turns are in place, make a twelve-inch loop, twisting it together, so that this twist will come up tight to the slot, then the tap will not lose its identification among the numerous other taps to come. Continue the winding in this way, taking off a tap at every fifteen turns until sixty turns are in place. At the last turn cut the wire off, leaving the twelve inches for connection. If these instructions have been followed faithfully there will now be three taps and two ends projecting from the disc. It is a good plan to bring out these taps in different slots; that is, the first tap comes out in the next slot to the one in which the coil was started and the next tap in the next slot, etc., as this makes the identification of the wires much easier. This coil is shown at the bottom of the diagram in Figure 3, and is marked "inside coil."

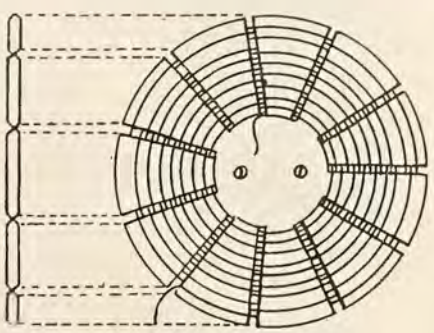


FIGURE 2.

Now start the next coil in the next vacant slot, leaving the customary twelve-inch end; wind one turn only and bring out a loop. Continue in this way, taking a tap off at every turn until you have ten turns. Instead of cutting the wire at the end of the tenth turn, bring out another tap and wind fifteen more turns before you bring out the next tap. After the tap on this fifteenth turn, wind twenty-eight more turns, tapping them at every seventh turn, except the last one which will be a single end, as it is the finish of the winding. Now check up the number of turns with the diagram Figure 3 and see that the correct number of turns have been put on. There should be sixty turns on the inside coil and fifty-three on the outside coil. Now after the winding is completed, paint the coil all over with some insulating varnish, such as shellac or celluloid cement. Both of these windings together will just about fill the form. The best way to mount the coil is to cut off a piece of curtain-pole (wood) about one inch long, place it against the center part of the disc and fasten it to the panel with two brass screws. (Do not use iron screws, as they will tend to dampen the oscillations.)

If the set is to be mounted in a cabinet, it will be better to mount the coil with a piece of curtain-rod on a separate piece of wood, in an upright position, as this will give better access to the wires when it comes time to make the connections. The switches and contact points can be purchased at any radio supply store. Two variable condensers are necessary, one shown at "C" in Figure 3 should have a capacity of .001 M. F. and the one shown at "D" in the same figure should have a capacity of .0005 M. F. The rest of the apparatus required is the same as that used in any other regenerative set, viz.: One grid leak and condenser, one detector tube and socket, one storage "A" battery (6 volts), one plate, or "B" battery (twenty-two and one-half volts), and one pair

of two or three thousand ohm receivers.

Figure 3 shows how all the connections are to be made, and the builder can mount the outfit as he pleases, either in a box with a panel front, or on a table or base-board. The method of winding the coil is shown at "B" in Figure 2. If this set is carefully constructed, the results obtained will surprise the most skeptical reader and with one step of amplification it will produce results equal to two steps of amplification on the vario-coupler and variometer set. The amplifier, however, should be of a specially designed circuit, which will be explained for those wishing to add it to their sets.

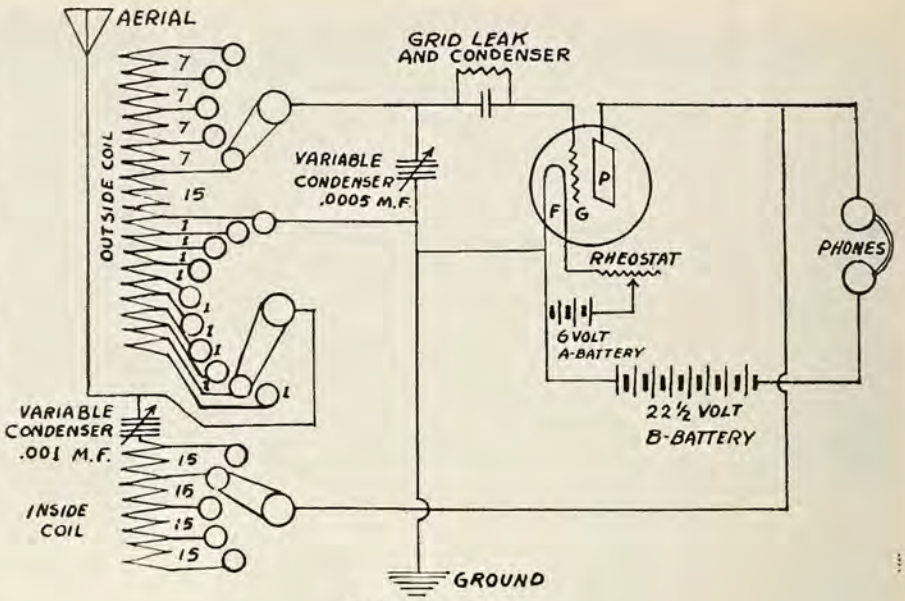


FIGURE 3

Amplification for Reinartz Tuner.

Figure 4 shows the method of adding one step of amplification to the Reinartz tuner. In this circuit a variable condenser is shown in place of the grid-leak and condenser. The use of either of these is optional with the builder. The variable condenser will give better tuning effects, but the set will work very well if the grid-leak and fixed condenser is used; in fact, the set from which these specifications were taken used the fixed condenser and grid-leak. The method of connecting the amplifier to the circuit is similar to that of the ordinary circuit. The head phones are removed from the circuit shown in Figure 3 and replaced with the primary winding of ten to one ratio audio amplifying transformer. In the set from which these specifications were taken, this primary winding of the transformer furnished enough reactance to make the tube oscillate properly, but this is not always the case. If it is found that the filament has to be burned at a dangerous degree of brilliancy to produce the oscillations, then an extra inductance should be inserted in the circuit at the point marked "X" in Figure 4. If however, the tube is found to oscillate without crowding the filament, then this extra inductance "X" should not be inserted.

If it is found that the inductance is necessary it can be made by making a small form similar to the one on which the two coils are wound, but much smaller, and winding six turns of wire of the same size as that used on the large coil. This has been found by experiment to be the correct number of turns and should not be changed. The secondary of the transformer is connected to the grid and filament circuit as shown in Figure 4.

The circuit shows only one set of "B" batteries used for both the detector and amplifier tube plates, but stronger signals may be obtained by adding another twenty-two and one-half volt "B" battery between the head phones and the battery shown on the drawing. This is shown in Figure 6. It is absolutely necessary to see that the positive side of the "B" battery is connected to the part of the circuit, which eventually gets to the plate, and the negative side must always be connected to the filament. Another important thing is to see that the rotating part of the condenser "C" is connected to the aerial, and that the rotating part of condenser "D" is connected to the earth. The set will not give good results unless this is done.

The connections to the aerial, ground, and batteries are taken out through the back of the case, to avoid using binding posts on the front of the panel, as this always makes an unsightly wiring job. If

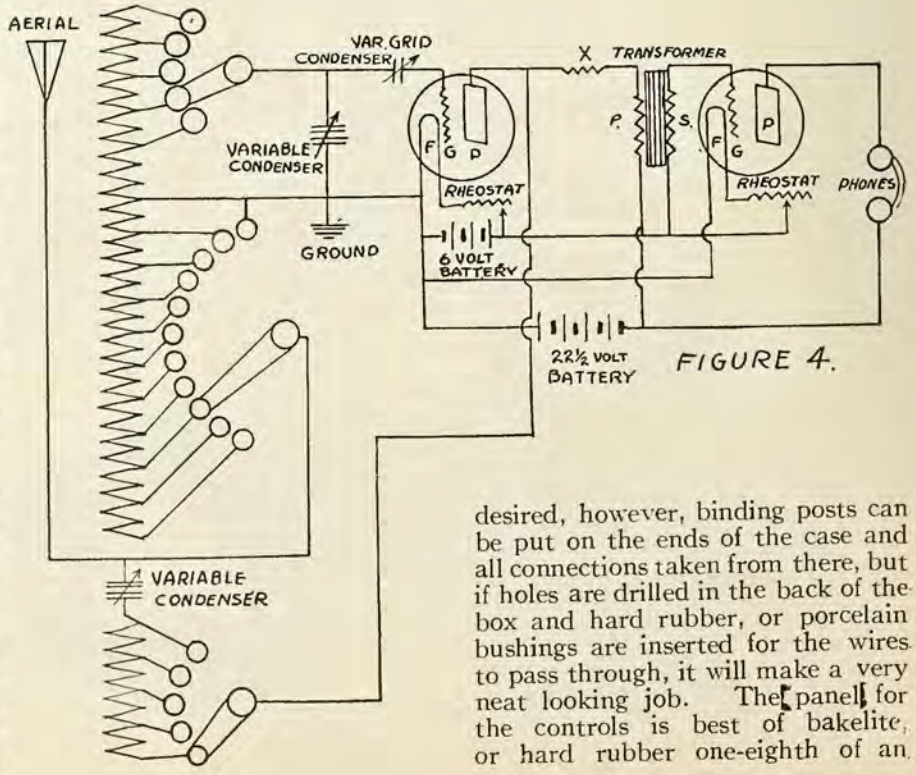


FIGURE 4.

desired, however, binding posts can be put on the ends of the case and all connections taken from there, but if holes are drilled in the back of the box and hard rubber, or porcelain bushings are inserted for the wires to pass through, it will make a very neat looking job. The panel for the controls is best of bakelite, or hard rubber one-eighth of an

inch thick, eighteen inches long and eight inches high. The sockets and tubes are mounted directly behind the controlling rheostats and the holes in the panel shown above the rheostats are for the purpose of watching the brilliancy of the tube filaments.

The two dials shown are used for the purpose of adjusting the variable condensers and if a variable condenser is used in place of the fixed condenser and grid-leak, then another dial must be used for this purpose and the arrangement of the panel will have to be altered to suit the case. The spider-web coil is mounted as far back in the box as possible and is placed directly behind the switches to facilitate the connections. The addition of this amplifier will make a wonderful addition to the set, but if it is desired to carry the amplification farther, another step of audio frequency amplification may be added.

Addition of the Second Step of Amplification.

Figure 6 shows the method of adding two steps of audio frequency amplifications to the Reinartz tuner. While this addition is very seldom necessary, still there are some fans who can not get signals too loud to suit them and this circuit is shown for the benefit of those who want to go the limit. When I say limit, I think I have found a good word, for this is about as far as the amplification can go with this set without injury to the receivers, or loud speakers.

The diagram shown in this figure will be clearly understood without going into details, if the reader has carefully followed through the preceding circuits. The only changes shown are in the addition of the second step, and the addition of two more "B" batteries of twenty-two and one-half volts each. These batteries must be connected in such a way that the positive of one of them connects to the negative of the next, etc. This is clearly shown in the diagram. If a loud speaker is to be used in any of the circuits, it is placed where the receiver is shown in the different diagrams. The transformers used may be of the ordinary audio frequency type, the one used in the first step to be a ten to one ratio, while that used in the second step is a three or three and one-half to one ratio. Any one of these circuits will give great satisfaction to the user and with a little patience and care in adjusting he should have no trouble in receiving signals from 1,500 miles in the winter time.

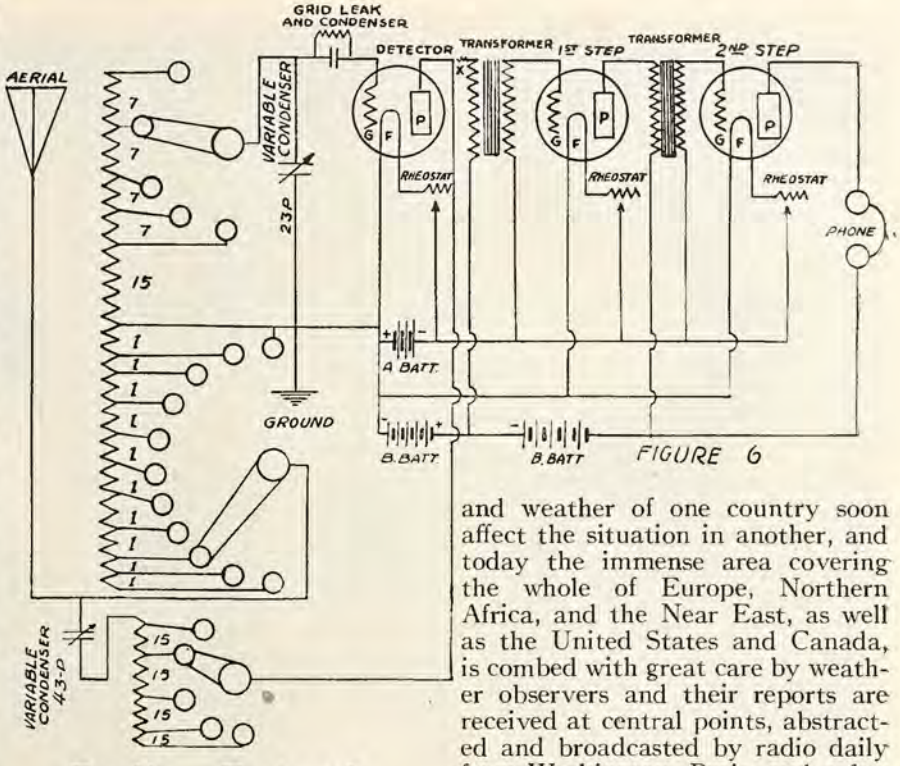


FIGURE 6

Radio Extends Weather Forecasts

With the perfection of radio communication great progress has been made in another science, which is perhaps of equal value to the world at large, particularly the seafaring and agricultural nations; meteorology has advanced with leaps and bounds within the past few years, due chiefly to the use of radio the outposts of meteorological knowledge have been pushed far afield into distant and unpopulated wilds where previously lack of communication has withheld local weather conditions from the world.

Last winter, an American engineer, Hagbard D. I. Ekerold, spent many months on a barren rock 400 miles north of Iceland, in the Arctic Ocean, as the leader of a meteorological expedition backed by the Bergen Geophysical Institute. His observations were believed so important to the rest of the world that an observatory was established by the Norwegian government at Jan Mayn—this lonely spot of rock in the Arctic sea. Needless to state, this new northern observatory has a wireless station, so that weather observations can be broadcasted as fast as noted. Scientists hold that this, the station farthest north, is the beginning of a new epoch in the history of science, admitting that credit is due to radio in a large measure.

Meteorology is fast becoming an international study, for the storms and weather of one country soon affect the situation in another, and today the immense area covering the whole of Europe, Northern Africa, and the Near East, as well as the United States and Canada, is combed with great care by weather observers and their reports are received at central points, abstracted and broadcasted by radio daily from Washington, Paris, and a few sub-stations. Thus it has become possible for meteorologists to obtain within twelve hours of the taking of the observations, a representative meteorological situation over the greater part of the Northern Hemisphere, extending from the Pacific Coast of America in the West to Russia and Egypt in the East.

Professor Bjerknes of Norway, who has done much to advance our knowledge of cyclones, forming in the temperate zones, holds that weather conditions there depend chiefly upon the conflict between two streams of air—a cold current flowing southward from the north Polar regions and a warm current drifting northward from equatorial sources already well-known. These air streams, he believes, meet along a wavering front in the Temperate Zone, and in their intermingling give birth to those mysterious swirls in the atmosphere which are called cyclones.

To study these possibilities, he desires to establish a chain of radio equipped observation stations around the Pole, from the records of which the tracks followed by the Polar current southward and the centers of conflict with the warm currents may be definitely determined. Such a series of circumpolar meteorological posts will have more than theoretical importance when regular forecasts for the North Atlantic are required in connection with daily air flights between Europe and America, he says.

Radio and Law Enforcement

JAMES M. DAILEY, Democratic nominee for sheriff of Cook county at the November 7 election, is the first aspirant to the office of chief law enforcer for a great metropolitan district, such as surrounds Chicago, to recognize the radio as a real and effective aid to protecting the public and capturing criminals. He tested out the wonders of radio broadcasting through a terse talk sent out from Station WDAP, the de luxe plant of the Midwest Radio Corporation atop the Drake Hotel on October 14.

Speaking on "Highway Safety" Mr. Dailey carried his campaign to thousands of radio users in Chicago and Cook county and concluded by saying:

"I am not in favor of fancy stunts in law enforcement and believe generally in the single policy of Common Honesty and Common Sense —but radio is not a stunt nor a new toy. It is a real working force in the modern world and I can foresee it can be used to communicate quickly with the entire citizenry of a city or county to carry messages of great public importance. In emergency cases it will be invaluable as an aid to law enforcement and as Sheriff of Cook county I intend to use every means to make this the cleanest community in the country."

Public Education in Radio Urged

Dr. Alfred N. Goldsmith and Paul F. Godley Tell How to Popularize Art of Wireless Communication

By GEORGE R. HOLMES, I. R. E., A. J. E. E.

Special to Radio Age

NEW YORK, October 4.—"One of the greatest problems we have to face today in radio is that of educating the public at large in the intelligent use of radio apparatus, if we are going to keep alive interest and stop people from becoming disgusted with their sets," declared Dr. Alfred N. Goldsmith, secretary of the Institute of Radio Engineers before a large gathering of radio engineers and enthusiasts, at the Engineering Societies Building this evening.

"The time is past when anyone can take a cardboard tube, wind it with wire, use a piece of crystal and any old head phone and expect to get real satisfaction from radio," he said. "It will work sometimes, any old time, but it won't work all the time and especially when the user knows little or nothing of tuning and uses an antenna that is entirely out of proportion to the needs of the set.

"The same holds true of vacuum tube sets, where the average user has a sad lack of knowledge of plate and filament currents and voltages, and aerials that are entirely to big, long and of freak construction. The result is poor selectivity, improper regeneration and general dissatisfaction with the set.

"At the present time there is much talk that the change in having two broadcasting wave lengths does not solve the problem of interference. The truth of the matter is a lack of education on the tuning of the set.

"If the average user cannot tune out between stations using the two wave lengths, what will he do when we are using broadcasting wave lengths within a few meters of each other? That time is soon coming and with separation in broadcasting wave lengths about 12 per cent, it will be possible to hear any station individually without interference if the person really knows how to tune a set. By this we will have not only one or two programs to listen to but possibly a dozen with greater diversity and the listener can choose from a wide range his evening's entertainment.

"With the rapid strides being made in broadcasting the subject of paramount importance is education in the proper tuning of sets. When this is accomplished we will have made a great step forward and an important step."

Expressing his views on the subject Paul Godley, famous for his trans-Atlantic work said, "In trying to popularize radio we went back to the simplest forms of equipment and now that we are progressing we have fallen into hot water, through the fact that there is a lack of education on how to intelligently operate radio receivers. It is high time that intensive education be employed to help users of radio sets get over the small difficulty of tuning on 360 and 400 meters without interference.

"The same condition exists today in radio as existed in the auto industry when they changed from the car of simple adjustments to the present day complicated mechanisms. The public must understand that they cannot do with a $5 receiver the things that can be accomplished with a $200 receiver and there is a need of education to let them know what they should expect for the money they give out. The public at large should learn that it can't expect results and selectivity unless they do a little tuning. If they would take a third of the time used to learn how to run their new car, to learn about the operation of a radio set there would be less trouble but—they won't make the effort to learn.

"In selling radio sets the thing to do is not to push anything on the public but what is the best from an engineering standpoint. I seriously think that the radio publications of the country should be willing to promote and cooperate in organizing an educational campaign, as thousands have been disgusted through the junk they bought, fully believing that it would operate the same as the most expensive sets. What the people want is quality and real service from their radio sets just the same as they look for it in their phonographs.

Here's the First Central Exchange for Radio Calls

WHAT is said to be the first radiophone exchange in the world was recently opened at Croydon, England, the point from which the air lines to the European Continent take their departure, according to Consul Linnell.

The chief use made of this exchange is to connect the serial traffic controller, who has his headquarters in a control tower at Charing Cross, London, with the pilots of the air expresses flying between Croydon and the Continent.

This wireless exchange can also connect the phones of the airships and airplanes, while in flight, with any office at the aerodron at Croydon, making direct telephone conversation possible.

The pilot of each aerial transport is now required to report his position to the traffic controller every fifteen minutes, so that the progress and position of each plane is known throughout its journey. The controller is of particular value in directing the course of the aircraft in cases of fog, and in giving them special directions for landing.

A Boost from Boston

Among the letters received commending the article on the Reinartz tuner, written by Mr. Pearne for the September issue, we take space for reprinting only one. It is addressed to Mr. Pearne and reads as follows:

I was very much interested in reading your article relative to the Reinartz receiver which appeared in the September issue of Radio Age.

Please allow me to compliment you upon the excellent manner in which you have handled the description and method of construction. This is the first article on the Reinartz circuit and its practical application that is concise enough to be of any practical value—at least the first which I, myself, have noted.

Sincerely yours,

EVERETT P. GORDON,

Advertising Manager, Atlantic Radio Company.

Tube Set Operates Across Atlantic

ACCORDING to announcement made by officials of the Radio Corporation of America another scientific accomplishment looking toward trans-oceanic telephony and the use of vacuum tubes for trans-oceanic telegraphy was made yesterday, when an experimental, high-powered tube set at Radio Central, Rocky Point, L. I., was operated continuously sixteen hours, handling commercial trans-Atlantic traffic with Great Britain and Germany, on a wave length of 19,000 metres.

The statement reads that plans for the development of the new electron tube experimental set were completed in December, 1921, by representatives of the Research and Engineering Departments of the General Electric Company and the Radio Corporation, and the manufacturing of this highly delicate and specialized set was immediately started in Schenectady, N. Y. So fast did the work progress that in May of this year the temporary installation of the set was started at Radio Central, and when Senator Marconi visited the station in July, preliminary tests were in progress under the direction of W. R. G. Baker, of the General Electric Company, and C. W. Hansell of the Radio Corporation.

The set itself is for the time being composed of three 50 kilowatt, 15,000 volt, water cooled, metal vacuum tubes, known in the engineering world as kenetrons, used as rectifiers, and six 15,000 volt, 20 kilowatt, water cooled, metal pliatrons, used as high-frequency converters. For the experiment with the tube set one of the new mile and a half long antennae suspended from six towers, 426 feet high, of the Rocky Point Station, was used, and the tube set succeeded in developing and sustaining in the antennae a current strength of 350 amperes.

So successful was the set in operation that the operators actually controlling the automatic sending keys at 64 Broad Street in New York City did not know that they were controlling a tube transmitter rather than an alternator until after the test was completed. An official of the corporation said:

"The operators on the English and the German circuits, if they noticed a change in the quality or the strength of the received signal, did not comment on it, so we assume the signal was favorably comparable to the alternator signals. Of course, this is the first time in the history of wireless telegraphy that a high-powered tube transmitting set has operated for so long a period over as great a distance as that between New York and Germany."

The British Marconi Company have in their station at Carnavan, Wales, a tube set made up by paralleling 60 air cooled, fragile, glass vacuum tubes, of approximately two kilowatt input capacity each, but as explained, the Americans have reduced the number of tubes necessary for a set from sixty to six, by increasing their capacity from two kilowatts each to twenty kilowatts each. The American metal water-cooled tube is of great advantage because it makes it possible to develop tubes of larger capacity than is possible where it is necessary to rely upon air as the only means of cooling. The building of these partially metal tubes was only accomplished as the result of American research and inventive genius which showed the way to a successful method of welding glass and copper together.

It was said that while the set in its present stage was far from being a reliable commercial transmitter, the tests just concluded show that an alternative type of equipment to the Alexanderson alternator is on the way to aid America in building up its world-wide wireless communication system. It also further substantiates Marconi's prediction that once reliable international telegraphy is established by using tubes telephony must follow in its wake.

When Dr. E. F. W. Alexanderson, Chief Engineer of the Radio Corporation of America and inventor of the Alexanderson alternator, was informed of the success of the experiment, he made the following comments over the telephone:

"Trans-Atlantic telegraphy has become a routine business, but the importance of this demonstration is the bridging of the ocean by a few powerful vacuum tube units. In this case only six tubes were used and we can safely predict that the same feat will some day be performed by a single tube. But what is the next? We have here seen a new physical principle reduced to practice on a large scale. Shall it fulfill the dreams that Edison's dynamo has not yet fulfilled to carry Niagara's power to New York? Ten years ago I became acquainted with the little device known as the Audion. Then it was a detector of signals and an amplifier, and then arose the question why not amplify some more and then some more and use it for transmitting signals as well as for receiving? Dr. Langmuir of the Research Laboratory of the General Electric Company gave the complete answer to this question, although it has taken ten years to get to the point where we have today a trans-Atlantic tube transmitter. In these ten years the energy of the vacuum tube has been increased more than a million times. A few more years of the same rate of improvement would bring us beyond our wildest dreams, but all we need to say is that science and engineering have received a new tool. It marks a turning-point like the steam engine and the dynamo. It will certainly give us trans-Atlantic telephone but it will undoubtedly give us much more."

Dr. Langmuir, when reached at his summer home at Bolton's Landing on Lake George, said, "I am greatly pleased but not surprised at the success of the tubes. It is a stepping-stone in the progress of many years' development. We will make larger tubes when larger tubes are needed and we will make them of greater efficiency for the principle on which this development has gone forward is a *sound* one."

Atwater Kent Tuner

The Atwater Kent Manufacturing Company of Philadelphia, have developed this tuner with the idea of simplifying operation and still retain maximum performance. It takes the place of a variometer and variocoupler in a coupled circuit receiver, accomplishing the results with but one adjustment.

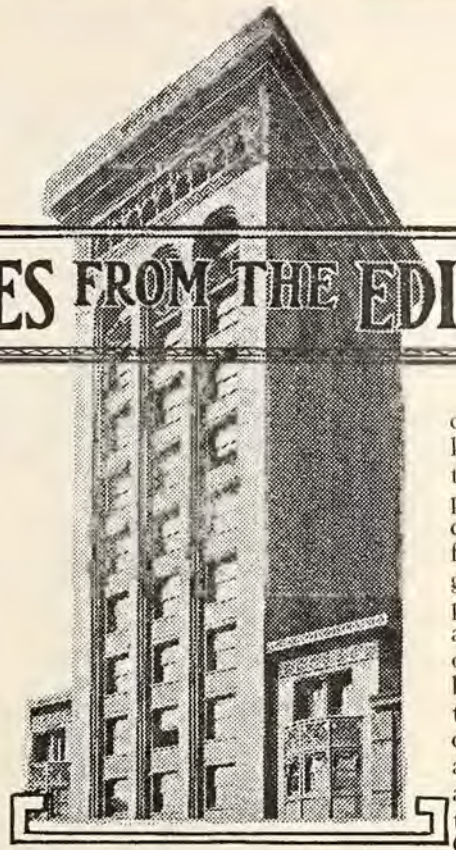
Tuning of antenna circuit is unnecessary. Three binding posts are provided on the back for adjusting the instrument to the particular type of antenna being used. Once this adjustment is determined, no further adjustment is necessary for broadcast reception.

It is absolutely unaffected by body capacity at the dial knob.

All insulating parts are sturdily made of moulded condensite and the workmanship throughout is of the highest quality.

The manufacturers state that at their summer laboratory in Kennebunkport, Maine, using this tuner, in conjunction with a standard circuit and two stages of audio frequency amplification, broadcast concerts have been clearly received from Porto Rico; Davenport, Iowa, Chicago, Ill., and many other distant points.

The instrument can be used with a crystal detector and the crystal detector later discarded when a more pretentious set is desired.



THOUGHT WAVES FROM THE EDITORIAL TOWER

1 How shall the broadcaster recover on his investment?

2 What is going to be done about interference that is ruining broadcast programs?

3 What is the public going to do about interference that threatens to make receiving sets useless?

4 What is going to be done about inducing musical artists to continue their broadcasting work?

ANSWER the foregoing questions and you have solved a mighty difficult and important problem. It is a vital problem. Radio became a craze in this country a year ago and the interest was expected to revive with the passing of the summer slump. It has revived only partially. At a recent national radio exposition, manufacturers held a meeting and told each other something had to be done.

The current issue of "Editor and Publisher" tells of a convention of newspaper circulation managers at Fresno, Calif., and the following paragraph appeared in the article:

> Use of radio as a feature of interest to the amusement-loving public was scouted as being a thing of the past by several of the delegates. It was declared that radio's sole value now is as a utility, and not as an amusement.

Newspapers have been cutting down their radio departments. In many instances this has been a blessing to the radio art. But it shows the trend of things. Radio can thrive without extravagant publicity. But it is going to the bowwows, so far as the independent broadcaster and the average receiving set owner are concerned unless there is immediate and intelligent cooperation.

There is interference between amateur senders of code messages, interference between amateurs and broadcasting stations, and interference between the broadcasting stations themselves. This is not a time to spare anybody's feelings. The truth about the whole matter is that amateurs and broadcasters have at times been too eager to use the air. Federal inspectors have failed to clear up the situation.

The question as to how the broadcaster can recover on his investment is an individual problem, affected by local conditions. The problem of interference is one, however, that can be solved with a little intelligent cooperation. The question was fully discussed at the initial meeting of the National Broadcasters' League in Chicago on October 16. One plan suggested was the arrangement of a "silent night" for broadcasters in each locality. The amateur has his distinct position and his distinct rights in radio as well as the broadcasters. He may be depended upon, of course, to make concessions to the program senders and receivers as well as to ask concessions for the code senders and receivers.

Progress of the radio business generally depends almost entirely upon the attitude of the owners of the receiving sets. Manufacturers are not going to build a market for their goods in neighborhoods where disgusted owners of sets have grown weary of trying to pick something amusing or entertaining out of an aerial bedlam.

We learn that a great many musical artists, having given their services free to broadcasting purposes for whatever publicity they could derive from it, are not so keen about continuing these gratuitous concerts. There is a notice posted in the leading Chicago Musical College: "Do not broadcast, free. Make them pay you." Who's going to pay? If the broadcasters pay, it will only be adding to their already stiff investments. Members of the broadcasting audience might be willing to pay a trifling sum for the pleasure they get from these concerts, but whom could they pay and under what conditions? Would a broadcaster be permitted under the law to accept contributions? On the other hand if the musical artist is not paid, quality of programs will be deteriorated.

Expenses of broadcasting should be paid by those who are deriving benefit from it. Manufacturers favor broadcasting because it extends the demand for their goods. Many broadcasting stations are established in the definite and generally vain, hope that the service rendered will result in orders for radio merchandise from the owner of the broadcasting station. Of course, this does not apply to the university stations, supported by state tax funds.

Rumors of plans by the Westinghouse Electric & Manufacturing Company to monopolize broadcasting in the United States seem to have some confirmation, although a statement of the committee which framed the Kellogg-White Radio Bill explicitly assured the country that no monopoly would be permitted. In this connection the following statement by H. P. Davis, Vice President of the Westinghouse Electric & Manufacturing Company, may be interesting:

"I have always maintained that, like the telephone and the telegraph, the service is inherently monopolistic in character, and to get the best results, the best programs, the greatest development, the activity should be confined to two or three companies of established reputation, having the neces-

sary facilities and incentive to develop it; that they should be under Federal control and be allowed this privilege as long as they have acceptable service."

The above statement was made in an interview sent out from the Westinghouse offices for publication. Mr. Davis went on to say that he believed five or six large, well-located and powerful stations would be sufficient to cover this continent; that these stations should be licensed that would in any way be capable of interfering with the transmission from these large stations. For local purposes there should be a network of low powered local stations on non-interfering wave bands. These stations should be capable of relaying the big stations' service for their immediate vicinity, and should be able to furnish for their locality matters of local interest."

The owner of a broadcasting station in Omaha which was put out of business on the ground that it exceeded its wave length has sued the Radio Corporation of America, charging that the big fellows are in a conspiracy and, in collusion with minor government officials, have b e e n trying to eliminate troublesome competition.

All these facts prove a necessity for cooperation and the broadcasters are to be congratulated upon having formed a League through which they can act in concert. Radio is on trial before the American public. It needs all the cooperation its friends can summon in its behalf.

Wireless for Health

Setting-up exercises by radio, beginning at 7 o'clock each morning, is the latest use to which the radio has been put. On September 5, a series of weight-reducing and weight-gaining exercises for various members of the family was inaugurated and broadcasted from the Amrad Station W G I at Medford Hillside, Mass., as a regular feature of its program.

The object of this course is to place at the disposal of all radio users the most approved methods of securing physical efficiency. Three exercise classes lasting 15 minutes each are held every morning.

While this latest use for radio is entirely an experiment, being the first time such a course has ever been attempted by radio—in fact, the first time a radio broadcast has been given at this hour of the day—reports indicate that the exercises are being tried by people all over the New England District.

The Three sets of exercises are graded as follows: The first for the normal business man or woman who wishes merely a set of toning-up exercises; the second for those who are overweight, and wish to reduce; and the third for those who are underweight and wish to build up.

New Broadcasters Licensed

Twelve licenses were issued by the Department of Commerce to 360 meter broadcasters and seven to Class B stations operating on 400 meters between October 14 and 21.

Supplemental List of Limited Commercial or Broadcasting Stations for 360 Meters, Licensed Between October 14 and 21, 1922.

Call Station

WMAY—Kingshighway, Presbyterian Church, St. Louis, Mo.

WNAT—Lennig Bros. Co., Philadelphia, Pa.

WNAH—Manhattan Radio Supply Co., Manhattan, Kansas.

WOAV—Pennsylvania National Guard, Erie, Pa.

WMAW—Wahpeton Electric Co., Wahpeton, N. D.

WTAW—Agricultural and Mechanical College of Texas, College Station, Texas.

WPAA—Anderson & Webster Elect. Co., Waco, Nebraska.

WNAJ—Benson Co., Chicago, Ill.

WMAN—Broad Street Baptist Church, Columbus, Ohio.

KFBV—Clarence O. Ford, Colorado Springs, Colo.

WMAX—K. & K. Radio Supply Co., Ann Arbor, Mich.

WSAV—Clifford W. Vick, Radio Construction Co., Houston, Texas.

The Following Class B Station Licenses Were Issued to Operate on Wave Lengths of 400 Meters, Between October 14 and 21, 1922.

Call Station

WDAF—Kansas City Star, Kansas City, Mo.

WOC—Palmer School of Chiropractic, Davenport, Iowa.

WHB—Sweeney School Co., Kansas City, Mo.

KDKA—Westinghouse Electric & Manufacturing Co., East Pittsburgh Pa.

WSB—Atlanta Journal Co., Atlanta, Ga.

WFI—Strawbridge & Clothier, Philadelphia, Pa.

WBAP—Wortham-Carter Pub. Co., The Star Telegram, Fort Worth Texas.

Three broadcasting stations were licensed during the week ending October 15: A cathedral in Boise, a college in Springfield, Ohio, and a city in California:

KFDD, St. Michaels Cathedral, Boise, Idaho.

WNAP, Wittenberg College, Springfield, Ohio.

KFEB, the City of Taft, California.

Better Field Radio

Signal Corps radio engineers are perfecting a better field radio set for Army infantry units. The present spark set, SCR 105, developed during the war has become practically obsolete and continuous-wave sets are desired.

A board of Signal Corps officers, which met at Camp Vail recently, has recommended that surplus sets such as SCR 79-A, 127 or 130 be issued to infantry regiments for training purposes until continuous-wave sets can be developed and distributed to replace the old 105s. Recently the continuous-wave sets were adopted for all Army radio communication.

The old 105 sets are quenched-spark sets used for transmitting and receiving between headquarters, usually not more than five miles apart, but, if an amplifier was employed by receiving stations, it was useful up to about thirteen miles.

The SCR-79-A, one of the sets recommended by the Board as a temporary substitute, is a vacuum-tube set designed for transmitting undamped waves and for receiving either damped or undamped signals. The transmitter delivers about ten watts to the antenna, and the messages will carry about twenty miles on waves between 500 to 1,100 meters. This set was designed for use at command posts or at headquarters where transportation is available.

Details of the new sets are not completed, but it is understood that they have a range of about ten miles, and may be used between regiments and brigade headquarters.

Bank Radio a Success

The Union Trust Company, the largest bank in Cleveland, Ohio, has inaugurated its system of broadcasting market, stock and financial reports to other banks in the Fourth Federal Reserve District. A description of the Cleveland bank's transmitting station and of its plan for broadcasting general, financial and commercial news was published in September number of Radio Age.

One of the first Ohio banks to report satisfactory operation of the service was the Citizens' Banking Co. of Sandusky. The Sandusky bank has a Grebe outfit installed by Harold Caswell.

Foreign exchange quotations are also sent daily in addition to news of the day. The local bank is equipped with printed blanks covering the various stocks and markets and the operator has only to fill in the spaces.

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

George S. Walker
Western Radio Corporation
President

Arthur E. Ford, E. E.
State University of Iowa
First Vice President

Frederick A. Smith
Radio Age Inc.
Secretary

Founded to promote the best interest of Radio Broadcasting stations in the United States and Canada.

Executive Offices, Garrick Building, Chicago, Ill.

New Federal Rules

Regulation 57, page 55 (Radio Communication Laws of the United States), amended August 8, 1922, to read:

Class 2.—Limited commercial stations are not open to public service and are licensed for a specific commercial service or services defined in the license. Stations of this class must not transmit to or accept public messages from other stations. No rates are authorized. Licenses of this class are required for all transmitting radio stations used for broadcasting news, concerts, lectures, and such matter. A wave length of 360 meters is authorized for such service, and a wave length of 485 meters is authorized for broadcasting crop reports and weather forecasts, provided the use of such wave lengths does not interfere with ship to shore or ship to ship service.

Class B, Radiotelephone Broadcasting Stations

A new class of radiotelephone broadcasting station license is hereby established to be known as class B.

A license will not be issued for a station in this class which does not comply in every respect with the specifications hereunder.

Specifications covering the requirements governing the construction licensing, operating and service of class B radiotelephone broadcasting stations:

Station

Wave Length.—The wave length of 400 meters only will be assigned for the use of stations of this class which must be reasonably free from harmonics.

Power.—The power supply must be dependable and nonfluctuating. The minimum required will be 500 watts in the antenna and the maximum shall not exceed 1,000 watts in the antenna.

Modulation.—The system must be so arranged as to cause the generated radio frequency current to vary accurately according to the sound impressed upon the microphone system.

Spare Parts.—Sufficient tubes and other material must be readily available to insure continuity and reliability of the announced schedule of service.

Antenna.—The antenna must be so constructed as to prevent swinging.

Signaling System.—Some dependable system must be provided for communication between the operating room and the studio.

Studio.—The radio equipment in the studio must be limited to that essential for use in the room. The room shall be so arranged as to avoid sound reverberation and to exclude external and unnecessary noises.

Service

Programs.—The programs must be carefully supervised and maintained to insure satisfactory service to the public.

Music.—Mechanically operated musical instruments may be used only in an emergency and during intermission periods in regular program.

Division of Time.—Where two or more stations of class B are licensed in the same city or locality a division of time will be required if necessary.

Forfeiture

Licenses issued for the use of the 400 meters wave length shall specifically provide that any failure to maintain the standards prescribed for such stations may result in the cancelation of the license and requiring the station to use the 360 meters wave length.

Charges Conspiracy Closed Station

BROADCASTERS throughout the country are showing keen interest in a suit filed against The Radio Corporation of America, the General Electric Company, and others, by John O. Yeiser, Jr., of Omaha, who complains that his station was closed as the result of a conspiracy.

The substance of the suit is contained in the following Associated Press dispatch, published in newspapers of the country on October 19:

Omaha, Neb., Oct. 18.—A charge that the Radio Corporation of America, the General Electric company and others have entered a conspiracy to obtain a monopoly of wireless service and prevent individual use of the radio, is made in a suit filed in United States District court today by John O. Yeiser, Jr., of Omaha, who asks an injunction to enjoin the defendents from interfering with his right to broadcast.

Yeiser alleges that "there are 25,000 wave lengths that may be used in transmitting distinct non-interfering radio service and yet the said defendants, by conspiring with unknown underlings in the department of the government, assume to exercise authority over the radio service, have crowded all broadcasting stations sending music, lectures and educational matters to waves of 360 meters."

The Radio Corporation, General Electric company, the American Telephone and Telegraph company, the Northwestern Bell Telephone company, and the Westinghouse Electric Manufacturing company and other persons and corporations unknown to Yeiser, he avers "intend to erect distinct sending stations and commercialize the same by charges for broadcasting."

He alleges his own radio station was closed recently because he was operating slightly above 360 meters wave length, and that the first amendment to the constitution which says "congress shall make no law abridging the freedom of speech or of the press," is being violated. A jury to determine damages, which he alleges to be $25,000, is requested, with treble damages under the Sherman antitrust law, and an attorney's fee of $25,000.

Yeiser's action cites that "interference was undertaken with a powerful and clear station in Atlanta, Ga., which has been giving wonderful concerts nightly, enjoyed by people in every state in the union, and to avoid conflict, was a shade above 360 meters, and in pursuance of said conspiracy a radio inspector connected with the Western Electric company, compelled said station to get back exactly to 360 meters where its efficiency is but a small part of what it would be if given an honest freedom of the air under rules that would be in no way interference to others."

Plan "Radio Week"

A National Week, to be observed from November 26 to December 2, is being urged upon manufacturers, retailers, broadcasters and the great radio public, by a group of eastern enthusiasts, who see in such a week the possibilities of mutual benefit.

The plans proposed include a variety of suggestions to make the ether of the nation throb with broadcast treats, so that radio parties may be held in the homes of the fans every night of the week. The retailers will be asked to devote more space to window displays and to other demonstrations and each of the interested groups will make it a "Boost Radio Week."

Limitations of Radio Bill

(By Washington Radio News Service.)

CONGRESSMAN White, of Maine, father of the Radio Bill, calculated to improve radio in this country commercially, in broadcasting, and for amateurs, has returned to the Capital and believes that the bill will be taken up by his committee early in December.

The enactment of this long-looked-for legislation will benefit all branches of radio, but officials of the Department of Commerce. say that it will not entirely eliminate interference in broadcasting. There are some features in connection with radio which cannot be corrected by legislation, it is pointed out by experts of the Government, such as the mastering of one's own set.

Even if there were enough waves to give each station an exclusive band, and there are not nearly enough, interference would still be encountered or at least reported by fans endeavoring to receive the news and entertainment offered by 522 stations, many of them in one community. This would be so because many receiving sets are not capable of fine adjustment and cannot be properly tuned to a specified wave length.

In spite of possessing excellent sets, many enthusiasts are not able to tune properly; they do not know how to manipulate their sets and eliminate interference within a prescribed band. Already reports have been received by the Department that broadcasting on the new 400 meter wave is interfering with that on the 360 wave, which should not be the case with 40 meters between.

If transmission is good, first-class receiving sets should be capable of tuning within a variation of from 5 to 10 meters, inspectors say; unless one station broadcasting was in the immediate vicinity of the receiver.

Although Secretary Hoover will probably receive authority in the Radio Bill to limit the number of transmitting stations, it will be difficult to accomplish this in congested areas where several broadcasting stations are already located. Municipal authorities and organizations of listeners-in may have to aid the Secretary when the time comes by indicating which stations are the best and what services are most desired. The listeners-in are organized in Washington and such a body might become a censor of the air, so to speak, endorsing the good stations and reporting those which are unsatisfactory, thus aiding in establishing better service. In any event, it is hoped that both wave lengths and time schedules will aid the broadcasting in congested districts.

Distributors of radio equipment capable of fine adjustment should instruct purchasers carefully and when possible assist them in setting up their sets and tuning in. It is evident that a large percentage of those interested in radio will have to be educated in the use of their sets, and this may devolve upon the broadcasters themselves, who are interested in having their programs clearly heard, or on radio associations. The Bureau of Standards has been giving information along this line for some time.

It is expected by Department of Commerce experts that the loop receiver, possessing directional qualities, will aid in the selection of broadcasts and help in eliminating the other stations' programs, when used in conjunction with tube receiving sets. The cost is not excessive in comparison to an aerial and as the indoor coil can be installed in a corner of a room, the disfiguring overhead aerial may eventually disappear from housetops. It is part of the question of experimentation and education in radio.

Appeals to Hoover

AMONG other interesting developments of the month relating to broadcasting and to the growing impression that the very life of radio is menaced by interference in the air and by lack of cooperation between the government and the radio broadcasters and listeners-in, was a letter addressed to Herbert Hoover, Secretary of Commerce by William B. Duck.

The letter follows:

September 29, 1922.

Mr. Herbert Hoover,
Secretary of Commerce,
Washington, D. C.

Dear Sir:

Can you not, Mr. Hoover, at once assume the initiative and end the intolerable existing situation on radio by reason of the existing order that all broadcasting be done on 360 meters? The business of every radio house has suffered incalculably and at a time when they could ill afford to stand the strain, because of this unnecessary situation. We have been patient, hoping and hoping that the law would quickly be changed. Had the contemplated law been passed a few months ago the radio business would have been wonderful and none of us would have had to endure the financial strain that we have endured this summer. To me it is utterly inexcusable that an intelligent body of men would allow such a condition to exist for such an unreasonable length of time. I know all the alibis and, to be frank, they mean nothing. It would not take five minutes to put this law through.

Why, then, should we be compelled to wait month after month until the endless debates on tariff, bonus and other matters have had their run? You have stated under your signature that everyone is in favor of the law because no one is interested in disturbances. The Government was quick to take measures to stop the stress of the coal and railroad strikes and yet it deliberately punishes all radio manufacturers and causes unnecessary disturbances to a million people by allotting a pin point in the Heavens for the broadcasting of radio entertainments.

I am a lawyer by profession and in the course of my studies I have familiarized myself with much that has taken place in Congress for a long number of years but there is nothing in the entire history of the proceedings of Congress remotely approaching the indifference that has been manifested on a matter so urgent and vital and yet so simple to remedy. I do not believe that there would be a single objection when a proper explanation is made for immediate action on the bill now pending.

If there is some good reason for not passing the bill in its entirety, it would be no trouble at all to pass a bill covering that feature only which would permit broadcasting on different wave lengths. In fact, I do not believe that any law is necessary to change the existing conditions. I do not believe that any bill was passed giving the Department of Commerce authority to assign wave lengths of 360 meters for broadcasting, although I may be mistaken in this. I am certain that no bill was passed for the recent ruling assigning wave lengths of 400 meters for the more powerful stations. I cannot help but remark that this latest ruling has not benefited the situation a whole lot. There are wonderful concerts going on in every part of the country every evening and also many instructive talks. The grand opera season will soon open in Chicago. Here in Toledo we can hear no station but Detroit between seven and ten o'clock except when using an extremely selective set and then not clearly.

We criticize the existing conditions in Russia and yet we have a parallel case in the ether in this country and those in authority are responsible for it.

It has always been my understanding that you are one of the few men in this blessed country of ours that does things and without a whole lot of red tape. You can make yourself the eternal benefactor of a million fans and the radio manufacturers and dealers by taking the initiative in this matter. Will you not do it? There is no excuse for the existing conditions to continue for another week.

I sincerely trust that you will use the power and authority vested in you to remedy this situation without delay

THE WILLIAM B. DUCK CO.
Per William B. Duck.

With the Radio Trade

Business Situation

Conditions forecast revival of public interest in radio and a consequent boom in the industry was the consensus of radio broadcasters of the country, who met at the Hotel Sherman, Chicago, October 16, to organize the National Broadcasters' League for the protection of their interests.

The gathering of radio men was somewhat startled by the straight-from-the-shoulder announcement of George S. Walker, President of the Western Radio Corporation, of Denver, who also operates broadcasting station WFAF, that 5,000 radio dealers are on the verge of bankruptcy and that something must be done to readjust conditions in the industry to save this small army of business men from the loss of their investment.

This statement aroused the conferees to a realization of the situation in the industry and brought out an expression of belief that the first of the year would see a renewed interest in radio by the public and the movement of radio supplies from the dealers' shelves. Mr. Walker made it clear that he did not wish to be mistaken for a pessimist. He is convinced that the radio industry is destined to become one of the greatest commercial enterprises in the world, but he insisted that the proper type of men should steer the radio ship, and the industry as a whole should be foremost in their minds and not permit the selfish interests of a few to guide an infant industry, with the risk of running the bark on commercial shoals that might spell its destruction when it has such a bright future.

The majority of the delegates to the meeting were optimistic of the future of radio and expressed themselves as confident that in January there would be a fresh spurt in all lines of the industry. One of those who emphasized this point was Thomas Findley, of Minneapolis, of the Findley Electric Company, who operates Broadcasting station WLAG.

This feeling of optimism confirmed the decision of Milo E. Westbrooke, who attended the conference, made after the First National Radio Exposition last June, that January was the proper time to hold the Second National Radio show, which will be in the First Regiment Armory, Chicago, January 13 to 20. By that time the school boys will have got well into their radio work in the school shops, the radio fans will be spending more time home at nights, the reception will be at its best and the dealers will have completed their inventories and know where they stand and what they want to buy.

Plans are complete for the First Annual South Eastern Radio Exposition to be held in Atlanta, December 4 to 9, inclusive.

This exposition is sponsored by leading radio jobbers and dealers of Atlanta and the southeast, and undoubtedly will create a marked increase in radio activity.

New Klosner Devices

The Klosner Improved Apparatus Company has recently announced to the radio world the introduction of its two new pieces of apparatus, Klosner Vernier Rheostat Model 200 and the Klosner Amplitrol.

The new rheostat is claimed to be far ahead of all other instruments for controlling detector tubes. It has a vernier micrometer adjustment, which makes it several times more sensitive than any ordinary rheostat. It permits getting exactly on the correct spot for loudest reception of speech and code.

It is made of genuine condensite, with phosphor bronze contacts. It is equipped with a dial on which graduations are shown in white. Both course and fine adjustments are operated by one single knob.

The Klosner Amplitrol fills that long-felt radio want—of controlling the vacuum tube circuit without the use of jacks, plugs or additional switches. With the amplitrol in use, it is no longer necessary to plug in from one stage to the next. The phones or loudspeaker are simply attached to binding posts and any stage is turned on at will.

The amplitrol not only adjusts the filament to its maximum efficiency, but it also automatically switches on and off the plate circuit. Unlike automatic filament control, the amplitrol does not put a sudden strain on the filament. It provides a gradual current increase for the filament, prolonging the life of the vacuum tube at least one-third.

It is made of moulded condensite with phosphor bronze contacts. Its exposed metal parts are highly nickel plated. It has a new style knob and dial with graduations in white lettering.

New York Show Dec. 21

Announcement has just been made that with the backing of the more important interests in the radio industry, the American Radio Exposition will be held in Grand Central Palace, December 21 to 30, next. It is planned to make this the first really comprehensive radio exposition ever staged and all manner of inventions, equipment and accessories connected with wireless transmission will be exhibited. The exposition has been officially indorsed by the Associated Manufacturers of Electrical Supplies, and the National Radio Chamber of Commerce, both organizations promising their utmost cooperation in order to insure the event being a credit to the industry.

It is the intention of the sponsors of the exposition, the American Radio Exposition Company, to make the event a display that will cover the entire radio field. The reason the exposition company chose the holiday season for holding the show is that the schools and colleges will be closed, thus offering an excellent opportunity for students, parents and teachers to learn the real value of and the progress made in wireless during the past few years.

Another New York Show

All the latest wonders of the Radio industry will be shown, when radio manufacturers from all over the world will assemble during the week of November 20 to 25, at Madison Square Garden, New York, to stage the greatest exhibition of radio ever held. The scope of the show will be international as exhibitors will bring products of both foreign and American ingenuity before the public, showing the tremendous strides that have been made in the art since broadcasting became popular.

Some of the stellar features announced for the show include the transmission of photographs by radio, the drilling of an entire army by the same method, whispered conversations to be carried on between the Madison Square Tower and Eiffel Tower in Paris, moving pictures showing how radio can be used in place of an anaesthetic during an operation and radio talking pictures.

Pick-Up Records By Our Readers

REMARKABLE success with a Reinartz circuit as described in RADIO AGE is reported by George J. Besnah, 620 Elk St., Stevens Point, Wis. Mr. Besnah, who is associated with the St. Paul Railroad, made a Reinartz set with two steps of amplification with which he has been able to hear such distant stations as KUO, San Francisco; CJNC, Winnipeg, Manitoba, Canada; KZN, Salt Lake City, Utah; WBZ, Medford Hillside, Mass.; the station at Galveston, Texas, and WSB at Atlanta.

Mr. Besnah writes to Mr. Pearne, technical editor of RADIO AGE, as follows:

"Last June I constructed a Reinartz set as per your diagram and have had excellent results with it. I don't think you will find many records that will beat mine. I have two stages of amplification, but seldom use more than one. I heard WAAJ, Boston, Mass., very clearly on the night of July 26. This was in extremely hot weather and static very bad, but I got them in very well on one stage.

"I note your article in September issue of RADIO AGE, saying this set should have a radius of 1,500 miles in winter. In September I heard KUO, San Francisco, Calif., fine, using one stage. This is about 1,900 miles. I live in the geographical center of Wisconsin. Have reached Boston on the East Coast, San Francisco on the West; Galveston on the Gulf and Winnipeg, Manitoba, on the North. Please advise where else you want me to go and I think I can make it. I have an aerial 150 feet long; two wires about 45 feet high. This set was hurriedly constructed to try out this circuit. It is mounted on a wood panel; inside wiring No. 18 bell wire. Not a soldered connection in the outfit. Am sending you a list of some of the places heard, of which I have kept a record. I want to thank you for your very instructive articles and information sent me and your advice to the amateur to build a Reinartz set is a tip they will not regret they followed. Knowing what my outfit will do and has done I wouldn't trade the old pine box for the finest set the radio shops exhibit.

Again thanking you, I am

Very truly yours,

GEO. J. BESNAH.

620 Elk St., Stevens Point, Wis.

Following is a list of stations heard by Mr. Besnah:

KDKA, Pittsburgh, Pa.; KSD, St. Louis, Mo.; KUO, San Francisco, Calif.; KYW, Chicago, Ill.; WDAP, Chicago, Ill.; WGAS, Chicago, Ill.; KZN, Salt Lake City, Utah; WAAJ, Boston, Mass.; WAAK, Milwaukee, Wis.; WCAY, Milwaukee, Wis.; WAAL, Minneapolis, Minn.; WBAD, Minneapolis, Minn.; WLB, Minneapolis, Minn.; WAAP, Wichita, Kans.; WWJ, Detroit, Mich.; WCX, Detroit, Mich.; WDAF, Kansas City, Mo.; WOQ, Kansas City, Mo.; WHB, Kansas City, Mo.; WFAA, Dallas, Texas; WFAS, Fort Wayne, Ind.; WGAB, Houston, Texas; WGAQ,Shreveport, La.; WGAY, Madison, Wis.; WHA, Madison, Wis.; WGF, Des Moines, Iowa; WGR, Buffalo, N. Y.; WGY, Schenectady, N. Y.; WHAA, Iowa City, Iowa; WHAB, Galveston, Texas; WHAJ, Bluefield, W. Va.; WHAS, Louisville, Ky.; WLW, Cincinnati, Ohio; WOC, Davenport, Iowa; WOH, Indianapolis, Ind.; WOI, Ames, Iowa, WOS, Jefferson, Mo.; WPA, Fort Worth, Texas; WSB, Atlanta, Ga.; WLAD, Hastings, Nebr.; DN4, Denver, Colo.; DO5, Denver, Colo.; KFAF, Denver, Colo.; CJNC, Winnipeg, Man.; WBL, Anthony, Kans.; WMAK, Lockport, N. Y.; WLAM, Springfield, Ohio.

6,000 Miles With Crystal Set

"Fort Stockton, Texas,
October 5, 1922.

"Western Radio Corporation,
"Denver, Colorado.

"Gentlemen:

"Last evening, (Oct. 4,)about 10 o'clock p. m. (Central time), using a small, home made loos coupler, with ordinary crystal hook-up, no accessories whatever, in the way of amplification, I very plainly and distinctly heard you giving the list of persons that heard you broadcasting, and your invitation for all to write, in order that you might judge how it was going out.

"Now, as I have contended for some time, this dope you see in some radio journals, that the range of an ordinary crystal receiving set is not over 100 miles or so, is all bunk.

"If a person has a properly designed set, and has a first class ground, with all soldered connections, a good head set, and last but by no means least, a first class crystal, and knows how to tune them in, there is no telling what the range is.

"I have often heard Honolulu at this place air line distance 3,300 miles, in fact used to hear him every night in the winter of 1920, when he was using 9,000 meter spark, with an ordinary crystal hook-up, but of course using a larger tuner.

"Last night I not only heard you plainly, but also heard San Antonio, Texas, Fort Worth, Texas, and the St. Louis Post Dispatch, and all came in very distinctly and plain.

"If you give this out in your broadcast, be sure to state that the reception was with an ordinary crystal hook-up, and that the crystal used was the M. P. M. (Million Point Mineral), which, by the way, is away ahead of any crystal I have ever tried.

"Yours truly,

"GEO. C. HASELTINE.

"Address: Geo. C. Haseltine, Fort Stockton, Texas.

Crystal Scores Again

St. Louis, October 2, 1922.

Radio Age,
Garrick Building, Chicago, Ill.

Gentlemen:

In May I received a thirteen contact point crystal set from you as a subscription premium. My set is doing such good work that I have decided to send you the records I have received.

On Friday, September 29, I tuned in with WGY and the Kansas City Star; on September 30, Rochester, N. Y., and on October, WOC, Davenport, Iowa.

I have just used the crystal set alone without batteries or 2-stage amplifier. My aerial is about 100 feet long and lead-in is about twenty-five feet.

I receive Stations KSD and WCK so distinctly that I can hear it in all parts of the room, in which I have my set installed.

Yours truly,

EDW. J. REBRICK,
1406 N. 12th St.

Back Home Concert

Down in Johnson City, Tenn., arrangements were made last week for a radio concert. This was to be "staged" in the store of the Bishop Electric Company, radio dealers, of that city. It was suggested that it would be interesting to have "home town" girls take part in the concert to be received, and in order to satisfy the desires of the many persons who had been invited to attend the concert, the Crosley Manufacturing Company, Cincinnati, Ohio, broadcast a special concert in which Miss Edith Miller, violinist, Miss Marjory Hunt, pianist, and Miss Lowell Jones, all of Johnson City, took part. The three young ladies are studying music at the Cincinnati Conservatory of Music, and by special permission of the faculty of that institution came to the broadcasting station, the call letters of which are WLW, and played for the folks "back home." And when this special concert was being broadcast the following telegram was received from the Bishop Electric Company: "Big crowd in store enjoying work of Johnson City girls."

Long Distance Record

Summer static didn't bother the radio operator on the tug Oneonta, which was anchored at Columbia river harbor, Astoria, Ore., when he heard Atlanta recently. This is a distance of about 2,400 miles. It is considered a record in radio telephony and is the more interesting in that it was made during warm weather.

Forty-six States in Line

There are at present only two states in the union, Delaware and Wyoming, which do not have broadcasting stations. Kentucky and Mississippi went on the broadcasting map of the department of commerce last week, when stations in Louisville and Corinth were licensed.

Questions and Answers

P. S., Brookline, Mass.

Question: I read your article on the Reinartz tuner and then saw in another magazine, another type of coil. This was wound on a 5-inch tube, with the same number of turns and the taps were taken off at the same places. Could you tell me the difference in inductance? In the October issue of Radio Age, you recommended a "T" type antenna for transmitting. I am using a cage type at present. Is there any difference in efficiency?

Answer: The tube winding is quite often used, although Mr. Reinartz only recommends it for 600 meters and over. In the spider-web type a closer coupling is obtained and the distributed capacitance is reduced to a minimum. If your lead-in is taken off from the center of your antenna, you will probably get better results with the cage type.

M. I., Stoughton, Wis.

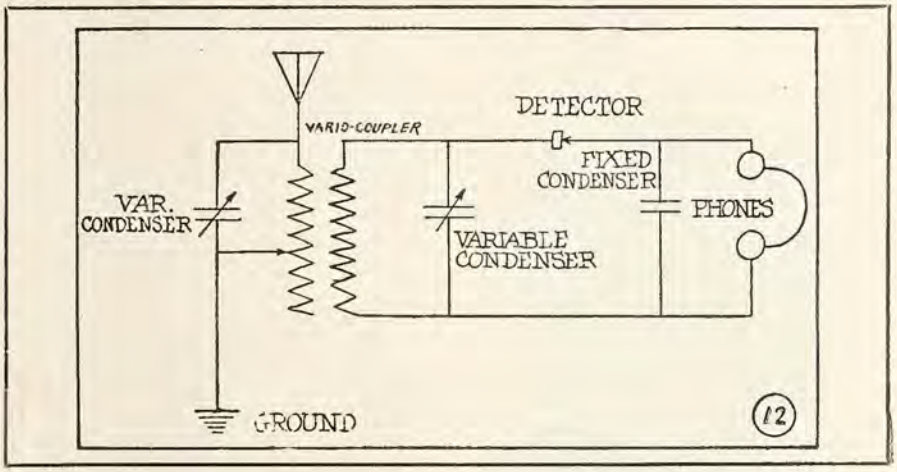
Question: How could I arrange an amplifier or loud speaker so that instead of putting my phones to the ear, it could be put under an amplifier and speak loudly out into the room, so that all present could hear what goes through the connecting phone? Please give me the name and address of a good radio book, from which to read up on radio.

Answer: I do not exactly understand what you mean. If you want a horn to which your phones can be attached, you can procure this at any radio supply house. There are many types on the market. The Wireless Experimenter's Manual, by Elmer E. Bucher, is a good book for you and any book store can get it. It is published by the Wireless Press Inc., 326 Broadway, N. Y.

G. B., Indianapolis, Ind.

Question: I am interested in the Reinartz receiving set. Can such a tuner be used on a crystal set? What is the wave length of the set described? Could this wave length be increased by using honey-comb coils? When you speak of "signals" do you mean music or just C. W. telegraph.

Answer: No. it would not work. Wave length is 130 to 370 meters. Honeycomb coils added to this will increase the wave length. The term signals as used in this case means music, voice or C. W.



L. R. S., Toledo, Ohio.

Question: Will you please give me a good circuit using a vario-coupler, two variometers, detector tube and batteries. I have tried several circuits, but have had poor success, so please send me a good one, or print it in your question and answer column.

Answer: Circuit below.

H. T. W., Middletown, Ohio.

Question: Will you kindly send me details showing how to hook-up vacuum tube to the crystal set circuit enclosed? I would like to have the crystal taken off if possible.

Answer: I am sending this circuit by mail.

E. A. T., South Haven, Mich.

Question: I am a subscriber to Radio Age and would like to receive the following information. Will you please send me a drawing for a good radiophone hook-up, using four C.302 tubes, with voice amplifier? I will use motor generator for plate supply. If possible would like to have all choke coils, etc., described, giving length, number of turns with size of wire used.

Answer: I am enclosing circuit in the mail, but as I have never had any personal experience with this circuit, I cannot give an intelligent description of the coils, but you can soon determine this by experiment.

G. E. McG., Cedar Rapids, Iowa.

Question: Please inform me as to the best method of connecting up a crystal receiving set using a vario-coupler and a variable condenser. I have a good aerial, I think. It is 150 feet long, consists of 3 wires well insulated, and is 40 feet high. Would this be considered a good aerial?

Answer: Hook-up above. Your aerial ought to get splendid results.

W. A. R., Chicago, Ill.

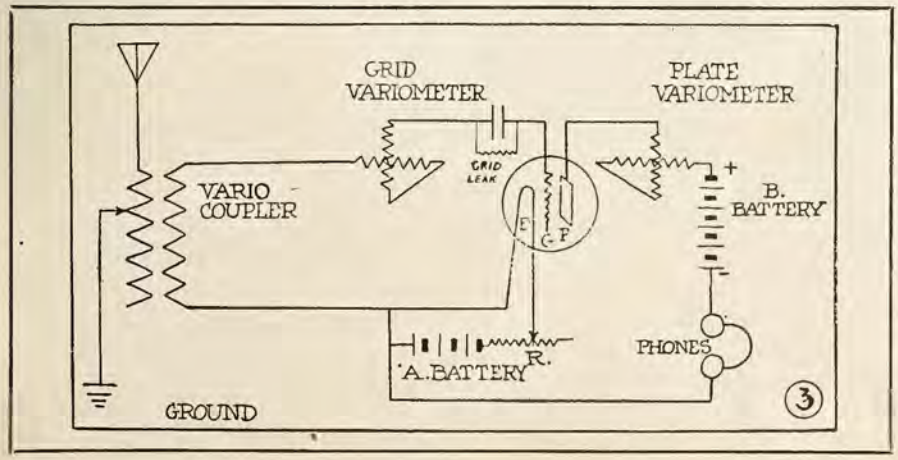
Question: Although an amateur, I read with great interest in the September issue of the Radio Age, your article on, and hook-up of the Reinartz tuner. I mean to get busy immediately on one of these and surely would appreciate it if you would please send me a diagram showing how instruments, switches, control, etc., are placed in box and on panel 8" by 18". Also the kind of bulb used. Will you also please give me a circuit for a sharp, long distance crystal set?

Answer: I am sending you a rough sketch by mail, showing how the panel is arranged, etc. Also I am sending the crystal circuit. Use either Cunningham, Radiotron, or Western Electric tubes. Be sure that you get a detector tube for the detector and amplifying tubes for amplifiers.

E. K., Chicago, Ill.

Question: I have read with interest your article on how to make an audio frequency transformer and would like to know if it is possible to make this transformer and have it work, without a great amount of leakage. Is it possible to calculate the transformer, or is it just experiment? I expect to construct one of them. If silicon steel can not be purchased, what other electrical sheet iron can be used, and where can I purchase that, or silicon steel?

Answer: If the transformer is well made, there will be no leakage to speak of. All joints where the iron comes together should be nice and square, so that they will make good contact. Yes, all transformers are calculated. This particular one has been made and tried out and is not an experiment. You can purchase the iron or steel from Jos. T. Ryerson and Sons, Chicago, Steel Sales Co., Chicago, or Chas. G. Stevens, Chicago. Use either silicon steel, or electrical sheet iron.



U. S. Sells by Radio

Tipping off American business men by radio as to foreign sales openings in order to get the jump on America's competitors for the world markets is the commerce department's latest trade-promoting stunt.

Inquiries for American goods coming into the bureau of foreign and domestic commerce from consuls, commercial attaches and other government representatives in foreign countries are now distributed to New England manufacturers and merchants through the air by the bureau's Boston office in collaboration with the WGI broadcasting station at Medford.

The service was tried out one night last week for the first time as an experiment. By first mail the next morning several letters were received from nearby firms. One of the leading New England manufacturers of artificial leather who happened to be "listening in" that night learned of two openings for his goods; one in Mexico and the other in Colombia. He was much pleased, commending the department of commerce for taking advantage of "this most valuable time-saving device." In the opinion of another New England merchant, the new "sell-it-by-air service" should appeal particularly to the out-of-town manufacturers and merchants who are not in daily contact with the offices maintained by the commerce department in Boston, New York, San Francisco, Chicago, New Orleans and other leading cities. "For example," says this executive, "there are many manufacturers interested in radio who wish to sell abroad but who are prevented from keeping in constant touch by frequent visits and telephone calls with the trade openings reported to the government agents. As the radio stations reach many outlying cities it would seem that this service would be of especial value to more distantly situated business men within a wide radius."

Selling American goods in foreign markets through the help of ether waves can be readily extended to other parts of the United States, in the opinion of Dr. Julius Klein, director of the bureau of foreign and domestic commerce. Director Klein pointed out that his bureau maintains thirty-four district and cooperative offices in this country in addition to the Eastern branch. The sending out of the information in each case is a problem for the local manager to arrange with some nearby broadcasting station, as all of them have been authorized to undertake the work, he said.

Radio to Near East

By CARL H. BUTMAN

Special to Radio Age:

Washington, D. C.—Back of the commercial systems of world communication, known and used by both the Government and private interests, lie existing lines of communication little known to the public, although not strictly "secret." Only recently, when the "Terrible Turks" threatened the Dardanelles and southeastern Europe, the State Department asked the Navy if aid could be given in the transmission of dispatches to the Near East in the event that communication service to that quarter of the globe was broken. To this question, which caused the State Department some concern, the Naval Communications Service made reply as follows: "Our lines of communication to the Embassy at Constantinople and all our naval craft in Turkish waters are established and in official use today. We can communicate with Admiral Bristol within a few minutes."

It has justly been stated that naval communication circles the world. So it does, with the exception of very few corners, and three-fourths of the communication is handled by radio.

How the Service Operates

Today, when a dispatch for Admiral Bristol is filed in the Navy Department, it goes out at once via the Annapolis radio station to a French radio station, thence by land line to the office of the American Communication Service operated by naval personnel in Paris, where it is checked and forwarded by wire to Coblenz. The message is relayed electrically at Coblenz from the office of the chief signal officer of the American Forces in Germany, where Army operators handle the wires to Vienna. The Vienna station is in the Austrian Telegraph building, but the station is operated by the United States Navy. From Vienna the message goes forward by Naval radio service from the station at Laareburg direct to the receiving station at the American Embassy at Constantinople, where naval personnel again handle the dispatch and forward it to the naval ship on station there, which relays it to its destination.

Admiral Bristol is in charge of all American naval vessels in Turkish waters, and the presence of his destroyers makes a sort of fan to all points of which messages can be relayed by radio and delivered from the vessels to other points, In the event of a break in the wires from Paris to Vienna, messages for Constantinople would be radioed by French stations to Vienna and to United States naval vessels in the Mediterranean.

The Return Route

The route of messages from points in the Black Sea to the United States is similar, except that the outlying ship transmits by radio to Constantinople, either to the station ship or the Embassy, but only the ship can send messages. From the station ship the message goes by radio to Vienna, thence to Coblenz by wire and through to Paris, where dispatches are turned over to French Radio Service for transmission, either from Lyons or Lafayette to Bar Harbor and delivered by land wire to the Navy Building in Washington.

This system, though seemingly somewhat round-about, is nearly direct and is good except that it is subject to delay on account of schedules, as the Allies all use the same route in and out of Constantinople and keep it busy twenty-four hours of the day.

Radio Cheers Convict

When George Rollins, convicted of murder, was "listening-in" on his little radio set several weeks ago, he heard information which may bring about his pardon. Rollins in his cell was listening to the regular late news broadcast from the Amrad Station WGI at Medford Hillside. Announcement was made that Governor Sproul of Pennsylvania was to release Frank Smith, alias Jesse Murphy, who confessed some months ago to one of the two murders of which Rollins was convicted. The two killings occurred in February, 1917, for which no one has yet paid the penalty. Rollins and his brother, Charles, were both implicated and convicted. While George was awaiting sentence, Murphy, down in Pennsylvania, confessed to one of the murders. While he did not confess to the killing with which George Rollins is convicted, he has positively stated that Rollins did not do it, and that he, Murphy, knows who did.

Naturally, George Rollins secured a new lease on life when he heard the news by radio that Murphy was about to be released from the Philadelphia Penitentiary and would be brought to justice in Boston. Boston officials have gone to Philadelphia to apprehend Murphy and bring him to Massachusetts.

This is probably the first instance of its kind on record when a convicted life prisoner heard information by radio that will probably bring his freedom.

New Crystal Holder

Michael Maltz, of the Radiall Electric Co., Passaic, N. J., has developed a new method of mounting crystals. The crystal is fastened into the cup with a conducting cement. The cement has the virtue of being less expensive and the crystal is not subject to heat.

Photo-Electric Detector Tubes

(Continued from page 7)

to the fact that these photo-electric or alkali vapor tubes operate best at a lower filament temperature than do the gas content tubes should make them more economical and easier to operate for the average user. The writers were also surprised to find that these tubes function admirably as amplifiers with 10 volts on the plate giving distortionless amplification of speech and having very high amplification factors.

The writers feel sure that the cost of manufacturing will not be materially greater than for the vacuum tubes now in use. The alkali is distilled over into the tube during the evacuation process until a thin silver deposit appears on the tube walls. Space does not permit an explanation of the manner in which this is accomplished.

Design of Portable Wavemeter

(Continued from page 9)

construction of a wavemeter suitable for the measurement of frequencies from about 3,000 kilocycles per second to 530 kilocycles per second (Wave length from 100 to 570 meters).

The parts of a wavemeter are usually: a variable condenser, a fixed inductance coil, and a device to indicate current flow. The condenser will first be considered.

It will be well at the start to eliminate certain large classes of condensers whose construction make them unfit for use in wavemeter circuits. Variable condensers employing other dielectrics than air, and condensers whose capacities are varied by a screw to change the distance between plates, however serviceable they may be for furnishing a variable capacity, will not in general retain their calibration and are therefore untrustworthy for use in a wavemeter. This elimination leaves only air condensers whose capacity is varied by changing the overlapping area of parallel plates, the usual type of variable condenser. All condensers of this type can by no means be used in wavemeters.

A condenser to be used in a wavemeter should have fairly heavy plates rigidly held together with ample tie rods and nuts, spacing washers of large diameter and sufficient thickness, adequate conical bearings, and, preferably, unimpeded rotation through 360 degrees of arc. Particulars in which variable condensers commonly fail to meet these and other requirements are: Too thin plates, spring-supported bearings, extremely close spacing of plates, vertical or lateral play of the shaft in its bearings, contacts made by brushes wiping on movable parts, stops which in arresting the rotating plates shift them out of line, shifting scales or indices, and faulty workmanship which allows short-circuiting of the condenser at some settings. In general, anything that allows a capacity change without a change in scale reading or a change in reading without a capacity change destroys the usefulness of a condenser for wavemeter purposes. Some method of shielding is desirable to eliminate any change of condenser capacity owing to movements of surrounding bodies. The shield usually is a grounded metal

(Continued on next page)

case placed around the condenser.

The inductance coils will next be discussed. The requirements of a wavemeter coil are: (1) That its inductance be such that with the condenser used the desired range of wave frequency can be covered; (2) that its effective resistance and effective capacity be low; (3) that its inductance, resistance, and capacity all be constant.

The first requirement, which has to do with the range of wave frequencies, will first be considered. It is well to restrict the part of the condenser scale used for frequency measurements to the sector between 15° and 170° on a scale graduated in degrees, or between the eighth division and ninety-fifth division on a scale graduated in hundredths. Since the capacity at 170° or 95 hundredths will almost always be more than six times the capacity at 15° or 8 hundredths, the frequency obtained with any one coil at the lower end of this region will be not less than about two and one-half times the frequency obtained with the same coil at the upper end. This will make it possible with one coil to cover the range from 3,000 to 1,200 kilocycles per second (100 to 250 meters) and with a second coil to cover the range from 1,330 to 530 kilocycles per second (from 225 to 570 meters).

The following table gives the number of turns required for two single-layer inductance coils which will cover approximately the stated ranges with each of the maximum capacities indicated in the table. It will be noted that the size of the wire and the spacing between turns are not specified. The inductance is nearly independent of the size of wire used, and the spacing is controlled by the number of turns and the length of the inductance coil, both of which are given. The length of the coil, as indicated, is the length of the actual winding, not the length of the supporting core.

Single-Layer Inductance Coils for Short-Wave Portable Wavemeter.

Coil 1, Range 3000-1200 kilocycles per second (100-250 meters) Diameter, 10 cm. (4 inches); length of winding, 2.5 cm. (1 inch).

Maximum capacity of condenser	Number of turns
0.0005 microfarad	16
0.0007 microfarad	13
0.0010 microfarad	11

Coil 2, Range 1330-530 kilocycles per second (225-570 meters) Diameter, 10 cm. (4 inches); length of winding, 5 cm. (2 inches).

Maximum capacity of condenser	Number of turns
0.0005 microfarad	42
0.0007 microfarad	35
0.0010 microfarad	30

The second requirement stated for the coil was that the effective resistance and the effective capacity be low. Low resistance is desirable in order to secure sharper indication of resonance. There are several reasons for keeping the effective capacity low. This capacity serves to increase the total capacity of the circuit. This increase will be only a small part of the total capacity at the high-capacity end of the condenser scale and hence will not appreciably help in extending the frequency range downward, but it may be a considerable part of the capacity at the low-capacity end of the condenser scale and may seriously limit the upward extension of the frequency range. Another and more serious objection to a large effective capacity is that this capacity is always to a greater or less extent subject to variation as a result of change in the surroundings of the coil. Since this capacity can not be controlled, it should be, as far as possible, reduced.

The practice of surrounding an inductance coil with quantities of miscellaneous insulating material is undesirable in any radio circuit and is especially to be avoided in the case of wavemeter coils. Imperfect insulating materials so used increase not only the effective capacity but also the effective resistance of the coil. This does not mean that all types of manufactured insulating materials are unsuitable for use in frames for wavemeter coils. Probably, however, the best form on which to wind the coil of a wavemeter like that here described is a hollow spool of thoroughly dry wood lightly varnished with an extra grade of insulating varnish. The use of shellac is not considered advisable under any circumstances. The use of wood having even a comparatively small moisture content may seriously affect the accuracy of the wavemeter. Properly selected wood is chosen in preference to manufactured insulating materials, glass, or paste-board. Many available manufactured insulating materials largely increase both the resistance and the capacity of the coil. While the electrical properties of glass make it well suited for a form, it presents too great mechanical difficulties. Paste-board is not rigid enough and should not be used under any circumstances.

The wire used may be solid copper double cotton covered, No. 24 B & S or larger. The wire should be lightly varnished with a single coat of an extra grade of insulating varnish. Further insulation merely increases the effective resistance and capacity of the coil without compensating advantages. The resistance can often be considerably reduced by the use of braided high-frequency cable. Care must be taken, however, in using the high-frequency conductor to see that all the strands are continuous and well insulated from each other and that every strand is joined at the terminals of the coil. If imperfect insulation exists between adjacent strands, these high-resistance contacts may cause a considerable increase in the power losses. Broken strands seriously increase both the effective capacity and the resistance of the coil. The strands may be tested for continuity by dipping one end of the cable in mercury and joining the separate strands at the other end successively to a buzzer or voltmeter joined to a battery, the circuit being closed through the mercury contact. The enamel may be removed from the ends of the separate strands by carefully heating the end of the wire cable to a red heat and dipping it in alcohol. This procedure makes the strands more fragile and consequently particular care must be exercised to avoid breaking them.

A single-layer coil has generally a lower effective capacity than a multi-layer coil of the same inductance and radius. This, together with the greater precision with which specifications can be furnished for winding single-layer coils, was the reason for choosing this type of coil in the table already given. Since appreciable effective capacities exist when there are parts of the circuit near each other which have comparatively large areas and which are at different potentials, it follows that the leads from the coil to the condenser should not be long or close together. An additional reason for having the leads short is found in the third requirement previously stated for a wavemeter coil, namely, that the inductance, capacity, and resistance of the coil, including its leads, be kept constant. Long leads are apt to be flexible; and flexible leads, long or short, introduce possibilities of change in inductance, capacity and resistance which can not be compensated for by any slight advantage they may give in convenience of handling. The best leads are rigid metal terminals soldered to the ends of the wire and screwed to the wooden core. The position of the coil should be such that the plane of the turns of the coil is perpendicular to the condenser plates if the condenser is unshielded. This is to prevent the induced current in the coil from itself inducing eddy currents in the condenser plates. Since it is almost always desired for convenience in coupling to have the plane of the coil vertical and the condenser plates horizontal, this matter will usually take care of itself. A very important precaution in giving the coil permanent characteristics is to draw all the turns tight and so fasten them that with ordinary care in handling they will not shift.

The coils may be attached to binding posts on the wavemeter, so that they may be conveniently connected or removed. Various other methods of attaching may also be used.

The third part of the wavemeter is the device which shows current flow and thus indicates resonance. If a crystal detector and telephone receivers are used, only the one-point (unilateral) connection should be employed; that is, the detector and telephone receivers are joined in a closed circuit, and one point of this circuit is joined to one terminal of the coil. This arrangement is sufficiently sensitive and makes the calibration of the wavemeter fairly independent of the position of the telephone leads, at least so long as they are not closely drawn across some part of the wavemeter or wrapped around it. A more precise indicating device is a

thermogalvanometer or a radio-frequency milliammeter. Available types of thermo couple instruments are usually found more satisfactory than the ordinary expansion type of hot-wire instrument, because they respond more quickly to changes of current. The instrument should give full scale deflection with a current of about 0.1 ampere. It should be able to stand a considerable overload. It is generally inserted directly in the wavemeter circuit, sometimes with a shunt to keep low the resistance of the circuit. It is important to note that the presence of the instrument will probably modify the capacity, inductance and resistance of the circuit, so that the wavemeter should be calibrated with the same instrument in the circuit as will be used in measuring frequencies. An inexpensive indicating device and one which is satisfactory when the power output of the generating circuit is large enough, is a miniature lamp, such as a flashlight lamp, inserted directly in the wavemeter circuit. To avoid any possibility of changing the calibration of the wavemeter, the lamp should not be changed if it can be avoided. If it must be changed it should be replaced by one of identically the same kind. The sensitiveness of this device can be greatly increased by having a dry cell and a rheostat in parallel with the lamp in the wavemeter circuit. By adjusting the rheostat until the temperature of the lamp filament is raised almost to the point of illumination, it is possible to have the lamp lighted by induced currents much smaller than would otherwise be required. However, changes in the battery and rheostat will be likely to change the characteristics of the circuit and hence the calibration of the wavemeter. This device should therefore be used with caution.

The wavemeter may be excited by impact, that is by a source of highly damped waves having only a very few waves in a train. (See "The Principles Underlying Radio Communication," Signal Corps Radio Communication Pamphlet No. 40, p. 278, and Bureau of Standards Circular No. 74.) The wavemeter can then be used as a source of damped waves to determine the frequency to which a receiving set is tuned. The buzzer, in series with the battery, is connected across the condenser terminals, completing its circuit, when the contact is closed, through the inductance coil of the wavemeter. Not more than four volts should be used to operate the buzzer. The buzzer will add to the capacity of the circuit, thereby decreasing its frequency. This decrease will be especially noticeable at the lower part of the condenser scale, where it may amount to several per cent of the frequency. It can be reduced by having short, widely spaced leads to battery and buzzer. If the wavemeter is equipped with both a buzzer and an ammeter or current-square meter, the ammeter must be so connected in the circuit that the current from the buzzer battery can not pass through the ammeter. If this is not done, the ammeter or current-square meter may be burned out by the current caused to pass through it by the buzzer battery.

The assembling of the parts of the wavemeter must be such that each part is rigidly joined to the rest of the circuit. Mounting in a box is as good a means to this end as any from the standpoint of rigidity and is superior to any in portability and in the protection afforded to the parts. A convenient box mounting is shown in Fig. 1.

The overall dimensions are left to the constructor since the size of the component parts will vary. The box should be substantially constructed so that it will stand considerable handling The component parts are all mounted on a panel of rigid electrical insulating material which will not absorb moisture. This panel is, in turn, secured to the supporting box. It is possible to use a panel of thoroughly dried and seasoned hard wood thoroughly varnished with an extra grade of insulating varnish. Fig. 1 shows one possible distribution of the component parts. Attention should be given to the convenience of operation and advantageous wiring of the circuit to keep distributed capacities at a low value. The most advantageous arrangement of the instruments on the panel will depend in part on the particular instruments used, and the constructor should work out the best arrangement in each case.

Fig. 2 gives a circuit diagram showing the connections as they should appear underneath the panel. These connections should be made of No. 12 solid copper wire soldered into lugs. Where bending is necessary, sharp right angle bends are used. If it is desired to make a short-wave portable receiving set, terminals for antenna and ground connections can be supplied without decreasing the value as a wavemeter in any way, provided suitable care is used in handling the instrument. A wavemeter should be handled much more carefully than an ordinary receiving set. If it is desired to shield the wavemeter, a copper or brass sheet can be permanently fixed on the under side of the panel and spaces cut in it to allow for the terminals and supports of the various units. There should be at least one-eighth of an inch clearance for the terminals. Fig. 3 gives the dimensions and construction of the inductance coils.

The forms are turned in a lathe from thoroughly seasoned wood. Several coats of extra grade insulating varnish applied to this form will be desirable in keeping low the absorption of moisture. The proper number of turns of the correct size of wire is wound in a single layer in the recess provided for this purpose. A light coat of extra grade insulating varnish is applied to the wire to keep it in place and to prevent moisture from changing the distributed capacity of the coil. The terminals of the inductance coil are brought out through the wood form and soldered to the supporting brass terminals. The wood screws holding the coil form to the brass supports should be of brass rather than a magnetic material.

It is desirable that the box be provided with a protecting cover and a carrying handle.

After the wavemeter has been constructed, it must be calibrated. This service has been done in the past by the Bureau of Standards. It has lately been necessary, however, on account of the limited personnel available for this work, to limit the tests of radio materials made by this Bureau to tests of precision instruments which will in turn be used as standards for testing considerable numbers of other instruments, tests for Government institutions and state universities, and a few other tests for which there is a special reason why they should be undertaken by this Bureau. Standardization of instruments of the kind described in this Circular can be obtained from various commercial firms and some college and university laboratories.

Consideration has been given to the transmission of standard wave length signals from laboratories equipped with precision measuring apparatus. This would make it possible to determine accurately several points on the calibration curve of a wavemeter without sending it to a standardizing laboratory. The carrier waves of some radio telephone broadcasting stations may be adjusted to some particular wave, such as 360 meters, and one point on a wave length calibration can thus be determined. A wavemeter transported for standardization should be packed in a wooden box large enough to give room for three inches of excelsior on every side, otherwise the wavemeter may easily receive internal damage which will not appear except in its subsequent behavior. The package should be marked "Scientific Instrument. Handle with Care."

Two cautions are offered as to the use of the finished and standardized wavemeter. The first is, not to subject the instrument to any treatment apt to change its calibration. The second is not to couple it too closely to the source of the radio-frequency current which is being measured. The latter error can be avoided by never having the wavemeter so close to this source that it can not be brought closer without changing the setting for resonance.

It is possible to make a decremeter out of a wavemeter by placing a suitable scale on the variable condenser. For a wavemeter having a condenser with semicircular plates or any condenser such that the graph of its capacity against its setting is a straight line, the capacity being very small at zero setting, it can be shown that the decrement scale to be used is one in which the graduations vary as the logarithm of the angle of rotation.* Such a scale, designed for a semicircular plate condenser, is shown in Fig. 2. This scale may be copied or cut from this circular and trimmed to fit the dimensions of the condenser dial with which it is to be used. It may be made stationary with a moving pointer traveling over it, or it may be mounted on a dial rotating under a fixed pointer. At the setting corresponding to maximum capacity the scale reading should be zero. Since the scales of most condensers read counter-clockwise, this arrangement usually places the decrement scale in the unused space opposite the capacity scale. A measurement of decrement is made by first observing the current squared at resonance, then reading the decrement scale at the settings on either side of resonance where the current squared has one-half its value at resonance. The scale is so constructed that the difference between these two readings is equal to $\delta' + \delta$, that is, the decrement of the transmitting circuit plus the decrement of the wavemeter itself. It is then necessary to subtract the wavemeter decrement from the total just obtained. The decrement of the wavemeter is determined as follows: The wavemeter is coupled and tuned to a source of unmodulated continuous waves. The sum, $\delta' + \delta$ is measured as just described. Since the waves are continuous, δ, the decrement of the waves, is zero and the result obtained is δ', the decrement of the wavemeter alone. From determinations of the decrement of the wavemeter made at different points on the scale, the calibration curve of decrement plotted against condenser setting is obtained. The conditions necessary to permit the use of this scale in the manner described are as follows:

(1) The condenser must have semicircular plates. Condensers with plates of a different pattern will have different decrement scales just as they have different capacity calibrations.

(2) It must be remembered that only when resonance is indicated by a current-square meter is the deflection to be reduced to one-half its maximum value in detuning to either side of resonance. If a milliammeter is used, the reading must be reduced not to one-half its maximum value but to the maximum value divided by the square root of 2 or to 0.71 of the maximum value.

(3) The generator must have an output sufficiently large that the coupling employed may be loose enough to prevent any considerable reaction of the wavemeter on the generator.

(4) Neither the generator nor its coupling with the wavemeter must be changed during the measurement of decrement.

The following precaution is to be observed in measuring the decrement of a transmitting station: The decremeter must be coupled only to the antenna circuit to be measured, not to the primary circuit; consequently it should be kept not less than two meters away from the oscillation transformer, and coupling to the antenna circuit should be obtained by placing the decremeter near the antenna or ground lead, preferably the latter. If the antenna current is small, it will be necessary to make a single turn of small diameter in the lead to which the decremeter is coupled.

*J. H. Dellinger. Measurements of radio-frequency resistance, phase difference and decrement, Proc. I. R. E., vol. 7, pp. 27-61, Feb., 1919. Circular 74 of the Bureau of Standards, Radio Instruments and Measurements, p. 197.

Radio Night School

To meet an ever-growing demand for instruction in radio telegraphy and telephony the night school of the Junior College will offer a course covering these subjects. The work of the class is divided equally between lectures and code practice. Illustrated lectures cover such subjects as electrical units, storage batteries, generators, motors, transformers, inductance, electrical resonance, and other essential phases of the work. Because this course has been given in the day school of Junior College, an adequate equipment for the laboratory has been collected.

Head sets and keys are furnished for code practice. Further receiving practice is found in the use of up-to-date receiving sets. The transmitting sets available consist of both spark and continuous wave apparatus.

Other courses to be given include those in sociology, rhetoric, French, Spanish, psychology, history, economics, drama, general inorganic chemistry, and public speaking.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

of RADIO AGE published monthly at Mount Morris, Ill., for October 1, 1922.

State of Illinois, } ss.
County of Cook }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Frederick Smith, who having been duly sworn according to law, deposes and says that he is the Editor of the Radio Age magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., 64 W. Randolph St., Chicago; Editor, Frederick Smith, 64 W. Randolph St., Chicago; Managing Editor, Frederick Smith, 64 W. Randolph St., Chicago; Business Manager, M. B. Smith, 64 W. Randolph St., Chicago.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Radio Age, Inc., Frederick Smith, 64 W. Randolph St., Chicago; John H. Lohbeck, St. Louis, Mo.; M. B. Smith, 64 W. Randolph St., Chicago.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) NONE.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

Frederick Smith,
Editor.

Sworn to and subscribed before me this 28th day of September, 1922.
[SEAL]

HARRIET DILLON.
(My commission expires June 5, 1923.)

NEW BROADCASTING STATIONS

ABBREVIATIONS

The necessary corrections to the List of Radio Stations of the United States and to the International List of Radiotelegraph Stations, appearing in this Bulletin under the heading "Alterations and corrections," are published after the stations affected in the following order:

Name = Name of station.
Loc. = Geographical location: O = west longitude, N = north latitude, S = south latitude.
Call = Call letters assigned.
System = Radio system used and sparks per second.
Range = Normal range in nautical miles.
W. l. = Wave lengths assigned; Normal wave lengths in italics.
Service = Nature of service maintained:
PG. = General public.
PR = Limited public.
RC = Radio compass station.
P = Private.
O = Government business exclusively.
Hours = Hours of operation.
N = Continuous service.
X = No regular hours.
m = a. m. (12m = midday).
s = p. m. (12s = midnight).
Rates = Ship or coast charges in cents: c = cents. (The rates in the international list are given in francs and centimes.)
I. W. T. Co. = Independent Wireless Telegraph Co.
R. C. A. = Radio Corporation of America.
S. O. R. S. = Ship Owners' Radio Service.
C. w. = Continuous wave.
I. c. w. = Interrupted continuous wave.
V. t. = Vacuum tube.
FX. = Fixed station.

Alphabetically by names of cities.

[Additions to the List of Radio Stations of the United States, Radio Service Bulletin, edition June 30, 1922.]

Commercial land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922, and to the International List of Radiotelegraph Stations published by the Berne bureau.]

Station.	Call signal.	Wave lengths.	Service.	Hours.	Station controlled by—
Ceiba, P. R.[1]	WKK	300, *600*, 1610	PG & PR		Bureau of Insular Telegraph.
Chicago, Ill.[2]	WBU	420	P	X	City of Chicago.
Cleveland, Ohio[3]	WGO	300, 450, *600*	PG		RCA.
Cranston, R. I.	WKAP	300, 475, *600*	P	X	Dutee W. Flint.
Los Angeles, Calif.[4]	KFR	300, 525, *600*	P	X	Airline Transportation Co.
Pearl Creek Dome, Cold Bay oil district, Alaska[5].	KFU	1700	P	X	Standard Oil Co. of Calif.
Princeton, Ind.[6]	WJAV	1625	P	X	Indian Pipe Line Corp.
Raleigh, N. C.[7]	WLAC	500	P	X	North Carolina State College.
San Francisco, Calif.[8]	KUO	300, 525, *600*	P	X	Examiner Printing Co.
Vieques, P. R.[9]	WGW	300, *600*, 1610	PG & PR		Bureau of Insular Telegraph.

[1] Loc. (approximately) 0.65° 39′ 00″, N. 18° 16′ 00″; range, 150 system, De Forest v. t. telephone and telegraph; hours, 8 a m.–12 noon, 1–6 and 7–8 p. m.; rates, ship service, 6 c. per word, Ceiba to Vieques 5 c. per word, minimum 40c, for 10 words.
[2] Loc. 0.87° 37′ 20″, N. 41° 52′ 26″; range, 200; system, De Forest v. t. telegraph and telephone; rates, none.
[3] Range, 100; system, RCA (c. w., i. c. w., and v. t. telephone); hours, 23 hours during every 24; rates, ship service, 3 c. per word.
[4] Range, 100; system, composite v. t. telephone; rates, none.
[5] Loc. (approximately) 156° 04′ 00″, N. 57° 42′ 00″; range, 300; system, RCA, 1,000; rates, none.
[6] Loc. (approximately) 0.87° 29′ 00″, N. 38° 17′ 00″; range, 200; system, De Forest v. t. telegraph and telephone; rates, none.
[7] Loc. 0.78° 39′ 45″, N. 35° 47′ 35″, range, 300; system, composite v. t. telegraph and telephone; rates, none.
[8] Range, 150; system, composite v. t. telephone; rates, none.
[9] Loc. (approximately) 65° 26′ 33″, N. 18° 09′ 00″; range, 150; system, De Forest v. t. telegraph and telephone; hours, 8 a. m.–12 noon, 1–6 and 7–8 p. m.; rates, ship service, 6 c. per word; Vieques to Ceiba, 5 c. per word, minimum, 40c. for 10 words.

Commercial land and ship stations, alphabetically by call signals.

[b = ship station; c = land station.]

Call signal	Name.		Call signal.	Name.
KFAX	Chillicothe	b	WBU	Chicago, Ill.
KFBO	Ara	b	WGO	Cleveland, Ohio
KFBP	Moldegaard	b	WGW	Vieques, P. R.
KFBT	Commercial Scout	b	WJAV	Princeton, Ind.
KFR	Los Angeles, Calif.	c	WKAP	Cranston, R. I.
KFU	Pearl Creek Dome, Cold Bay oil district, Alaska	c	WKK	Ceiba, P. R.
KUO	San Francisco, Calif.	c	WLAC	Raleigh, N. C.

Broadcasters Form National League

(Continued from page 4)

enport Iowa. (WOC).

William J. Clark, Radio Editor, Chicago Evening American.

J. C. Hail, City Hall Station, Chicago (WBU).

T. B. Hatfield, Indianapolis, Ind. (WOH).

T. W. Findley, Minneapolis, Minn. (WLAG).

Arthur H. Ford, State University of Iowa (WHAA).

Milo E. Westbrooke, National Radio Exposition, Chicago.

George Lewis, National Radio Chamber of Commerce.

Harold Power, Medford Hillside, Mass. (WGI).

Ralph C. Watrous, National Radio Chamber of Commerce.

Kenneth P. Gregg, National Radio Chamber of Commerce.

John P. Tansey, Radio Club of Illinois.

W. C. Evans, Westinghouse Electric and Mfg. Co., Chicago (KVW).

E. A. Beane, U. S. Radio Inspector, Ninth District.

W. J. Wecherbee, Westinghouse Electric and Mfg. Co., Chicago (KYW).

C. B. Cooper, Ship Owners' Radio Society, Inc., N. Y. City (WCAP).

Four Minutes From Cavite

The transmission of a routine radio message from the Naval Station at Cavite, Philippine Islands to Washington, D. C., was accomplished recently by the Naval Communications Service within four minutes. The total distance was 11,500 miles.

Ordinarily, with the delay on account of schedules, a message from Cavite to the Navy Department would not be delivered in less than several hours, and sometimes a whole day is required in the transmission, due to relaying, static, etc.

Of course the message was relayed at San Francisco where it was received from Cavite, but as the radio circuit to Washington was "set up" the message was relayed immediately. Within four minutes after the sixteen-words dispatch left Cavite, it was received on the aerials on top of the Navy Building in Washington and read in the receiving room below. Radio communication is said to be instantaneous, and a signal is instantaneous, but a message is slower due to the fact that time is required to transmit record, retransmit and rerecord.

Westward, trans-Pacific Radio messages are relayed to Guam and Cavite through Honolulu. Recently through the operation of the Fanning electrical relay at Honolulu 184 words were automatically relayed to Guam from San Francisco, without being transcribed or retransmitted.

Broadcasting stations, alphabetically by names of cities.

[Additions to the List of Radio Stations of the United States, edition June 30, 1922.]

City.	Call signal.	City.	Call signal.
Astoria, Oreg.	KFBM	Louisville, Ky.	WKAG
Beaumont, Tex.	WMAM	Marshall, Mo.	WJAT
Beloit, Wis.	WKAW	Marshfield, Oreg.	KFBH
Boise, Idaho	KFBJ	Miami, Fla.	WIAZ
Bridgeport, Conn.	WKAX	Montgomery, Ala.	WKAN
California (portable)	KFBN	Okemah, Okla.	WKAK
Carrollton, Mo.	WLAB	Omaha, Nebr.	WNAL
Central Point, Oreg.	KFAY	Orange, Tex.	WKAL
Chicago, Ill.	WJAZ	Peoria, Ill.	WJAN
Cleveland, Ohio	WJAX	Pittsburgh, Pa.	WJAS
Cranston, R. I.	WKAP	Providence, R. I.	WJAR
Duluth, Minn.	WJAP	Raleigh, N. C.	WLAC
East Lansing, Mich.	WKAR	Rock Port, Mo.	WMAD
East Providence, R. I.	WKAD	Sacramento, Calif.	KFBK
Everett, Wash.	KFBL	San Francisco, Calif.	KFDB
Fargo, N. Dak.	WKAJ	San Juan, P. R.	WKAQ
Frankfort, Ind.	WKAT	Springfield, Mo.	WKAS
Gainesville, Ga.	WKAY	Syracuse, N. Y.	WLAH
Hastings, Nebr.	WKAM	Topeka, Kans.	WJAQ
Hastings, Nebr.	WLAD	Waco, Tex.	WLAJ
Laconia, N. H.	WKAV	West Palm Beach, Fla.	WKAH
Lincoln, Nebr.	WLAF	Wilkes-Barre, Pa.	WKAZ
Lincoln, Nebr.	WMAH	Yankton, S. Dak.	WJAU

Lists of stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 meters), alphabetically by call letters.

[Additions to the List of Radio Stations of the United States, edition June 30, 1922.]

Call signal.	Station operated and controlled by—	Location of station.	Wave lengths.
KFAY	W. J. Virgin Milling Co.	Central Point, Oreg.	360
KFBH	Thomas Musical Co.	Marshfield, Oreg.	360
KFBJ	Idaho Radio Supply Co.	Boise, Idaho	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	360
KFBL	Leese Bros.	Everett, Wash.	360
KFBM	Cook & Foster	Astoria, Oreg.	360
KFBN	Borch Radio Corp.	California (portable)	360
KFDB	John D. McKee	San Francisco, Calif., 464 California Street	360
WIAZ	Electric Supply Sales Co.	Miami, Fla.	360
WJAN	Peoria Star-Peoria Radio Sales Co.	Peoria, Ill.	360
WJAP	Kelley-Duluth Co.	Duluth, Minn.	360
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAU	Yankton College	Yankton, S. Dak.	360
WJAX	Union Trust Co.	Cleveland, Ohio	360
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	360
WKAD	Charles Looff (Crescent Park)	East Providence, R. I.	360
WKAG	Edwin T. Bruce, M. D.	Louisville, Ky., 1300 South Third Street	360
WKAH	Planet Radio Co.	West Palm Beach, Fla.	360
WKAJ	Fargo Plumbing & Heating Co.	Fargo, N. Dak.	360
WKAK	Okfuskee County News	Okemah, Okla.	360
WKAL	Gray & Gray	Orange, Tex.	360
WKAM	Hastings Daily Tribune	Hastings, Nebr.	360
WKAN	Alabama Radio Mfg. Co.	Montgomery, Ala.	360
WKAP	Dutee W. Flint	Cranston, R. I., Allens Avenue	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	360
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAT	Frankfort Morning Times	Frankfort, Ind.	360,485
WKAV	Laconia Radio Club	Laconia, N. H.	360
WKAW	Turner Cycle Co.	Beliot, Wis.	360
WKAX	William A. MacFarlane	Bridgeport, Conn.	360
WKAY	Brenau College	Gainesville, Ga.	360
WKAZ	Landau's Music & Jewelry Co.	Wilkes-Barre, Pa.	360
WLAB	George F. Grossman	Carrollton, Mo.	360
WLAC	North Carolina State College	Raleigh, N. C.	360
WLAD	Arvanette Radio Supply Co.	Hastings, Nebr.	360
WLAF	Johnson Radio Co.	Lincoln, Nebr.	360
WLAH	Samuel Woodworth	Syracuse, N. Y., 425 Brownel Street	360
WLAJ	Waco Electrical Supply Co.	Waco, Tex.	360
WMAD	Atchinson County Mail	Rock Port, Mo.	360
WMAH	General Supply Co.	Lincoln, Nebr.	360
WMAM	Beaumont Radio Equipment Co.	Beaumont, Tex.	360
WNAL	R. J. Rockwell	Omaha, Nebr., 5019 Capitol Avenue	360

Special land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922.]

Station.	Call signal.	Wave lengths.	Station controlled by—
Altadena, Calif.	6XR	150,275,375	Altadena Radio Laboratory.
Beeville, Tex.	5ZAI	*200*,375	Rialto Theater.
Chicago, Ill.	9XN	variable	Leroy M. E. Clausing, 4545 North Whipple Street.
Columbus, Ohio	8XC	*200*,375	Eruer & Hopkins Co.
Kalamazoo, Mich.	8XF	*200*,375	Kalamazoo College (physics department)
Los Angeles, Calif.	6XJ	200-550	Dean Farran, 1410 South Van Ness Avenue.
New York, N. Y.	2XU	420	American Radio News Corp., 21 Spruce St.
Oakland, Calif.	6XA	variable	Radio Specialty Shop.
Philadelphia, Pa.	3XAI	250,275	Roberts Bros. Elec. Co., 426 South Fifty-second Street.
Plainview, Tex.	5XAH	*200*,375	James G. McInnish
Rockford, Ill.	9XF	variable	A. V. Tronske.
San Francisco, Calif.	6XB	variable	John D. McKee, 464 California Street.

Special land stations, grouped by districts.

Call signal.	District and station.	Call signal.	District and station.
2XU	Second district: New York, N. Y.		Eighth district:
3XAI	Third district: Philadelphia, Pa.	8XC	Columbus, Ohio.
	Fifth district:	8XF	Kalamazoo, Mich.
5XAH	Plainview, Tex.		Ninth district:
5ZAI	Beeville, Tex.	9XF	Rockford, Ill.
	Sixth district:	9XN	Chicago, Ill.
6XA	Oakland, Calif.		
6XB	San Francisco, Calif.		
6XJ	Los Angeles, Calif.		
6XR	Altadena, Calif.		

Alterations and Corrections

Broadcasting stations, by call signals.

KDYS (Great Falls, Mont.).—W. l., 360, 485.
KDZH (Fresno, Calif.).—W. l., 360, 485.
KLN (Del Monte, Calif.).—Station operated and controlled by Monterey Electric Shop.
KNR (Los Angeles, Calif.).—Strike out all particulars.
KSD (St. Louis, Mo.).—W. l., 360, 485.
KSV (Wenatchee, Wash.).—W. l., 360, 485.
KVQ (Sacramento, Calif.).—Station operated and controlled by James McClatchy
KYI (Bakersfield, Calif.).—Station operated and controlled by Bakersfield Californian (Alfred Harrel).
KZI (Los Angeles, Calif.).—Strike out all particulars.
WCAP (Decatur, Ill.).—W. l., 360, 485.
WCAU (Philadelphia, Pa.).—W. l., 360, 485.
WDAF (Kansas City, Mo.).—W. l., 360, 485.
WDAH (El Paso, Tex.).—W. l., 360, 485.
WDAJ (College Park, Ga.).—W. l., 360, 485.
WEAC (Terre Haute, Ind.).—W. l., 360, 485.
WEAP (Mobile, Ala.).—W. l., 360, 485.
WHU (Toledo, Ohio).—W. l., 360, 485.
WJAM (Cedar Rapids, Iowa).—Address 302 3rd Ave. West.
WOO (Philadelphia, Pa.).—W. l., 360, 485.
WSY (Birmingham, Ala.).—W. l., 360, 485.

New Stations in 9th District

Licenses issued during month ending September 30, 1922

Call signal	Station operated and controlled by—	Location of station.
9CVA	Boyd L. Thorp	Second and Edith Sts., Murphysboro, Ill.
9CVB	Philip A. Wachtell	123 W. Adams St., Munice, Ind.
9CVC	Herbert Wall	1440 Cook St., Denver, Colo.
9CVD	Joseph J. Bremken	217 N. 26th St., Omaha, Nebr.
9CVE	Dale M. Ashby	415 N. Church St., Gibson City, Ill.
9CVF	Leonard M. Schwabe	508 N. William St., Columbia, Mo.
9CVG	Fred C. Heinze	Wilson, Kansas
9CVH	Willis E. Ranney	1646 Beachwood Ave., Louisville Ky.
9CVI	Edward T. Howell	641 Van Buren St., Milwaukee, Wisc.
9CVJ	Paul M. A. Milker	912 N. 8th St., Fargo, N. Dak.
9CVK	Edwin J. DeCosta	Box 153, Lake Villa, Ill.
9CVL	Carl P. Budke	Gore and Glendale Rd., Webster Groves, Mo.
9CVM	William R. Coyne	131 Sheridan Ave., North, Minneapolis, Minn.
9CVN	John F. Palmquist	2908 S. 42d Ave., Minneapolis, Minn.
9CVO	Harold W. Siebens	5772 DeGiverville St., St. Louis, Mo.
9CVP	James P. Burke	3011 Union Ave., St. Louis, Mo.
9CVQ	Noel Bader	4433 Clarence Ave., St. Louis, Mo.
9CVR	Albert B. Marshall	950 S. 5th St., Louisville, Ky.
9CVS	Frederick Mumm	7219 Jackson Blvd., Forest Park, Ill.
9CVT	Bernhard W. Alden	723 N. 9th St., Kansas City, Kans.
9CVU	Norbert W. Knoernschild	644—28th St., Milwaukee, Wisc.
9CVV	Richard D. Leffholm	2616—4th Ave., S., Minneapolis, Minn.
9CVW	Edward Goodberlet	3712 Finney Ave., St. Louis, Mo.
9CVX	Richard H. Fitch	1408 Capitol St., Yankton, S. Dak.
9CVY	Edward D. Lindsay	1017 Admiral Blvd., Kansas City, Mo.
9CVZ	L. M. Turner	412 State St., Beloit, Wisc.
9CWA	Orene G. Cathcart	1404 E. Third St., Winfield, Kans.
9CWB	George Furtney	1302 Wilson Ave., Columbia, Mo.
9CWC	Lincoln J. Simms	850 Faulkner Ave., Wichita, Kans.
9CWD	John R. Greene	Gore and Glendale Rd., Webster Groves, Mo.
9CWE	Leo Conner	Broadway, Greenwood, Ind.
9CWF	John N. Burnside	112 Boone St., Boone, Iowa.
9CWG	Thomas J. Clinton	1206 S. 15th St., Springfield, Ill.
9CWH	Norman J. Atwell	Dexter, Minn.
9CWI	Everett Stone	90 Pewabic St., Houghton, Mich.
9CWJ	Fred. A. Lankton	148 W. Dakota St., Denver, Colo.
9CWK	Vance E. Olson	847 E. 57th St., Chicago, Ill.
9CWL	Edwin S. Van Buskirk	829—14th St., Denver, Colo.
9CWM	Herbert T. Hintgen	224 Dakota Ave., Wahpeton, N. Dak.
9CWN	Harry Samuels	411 N. 7th St., St. Louis, Mo.
9CWO	C. W. Otis	17 E. Washington St., Greencastle, Ind.
9CWP	Thomas E. Lenigan	1247—6th St., Beloit, Wisc.
9CWQ	David C. Maloney	1824 Pine St., Murphysboro, Ill.
9CWR	Edwin L. Benton	222 Main St., LaCrosse, Wisc.
9CWS	Robert F. Edgar	3821 S. 4th Ave., Minneapolis, Minn.
9CWT	John H. Smith	936 E. Maple St., Jeffersonville, Ind.
9CWU	Henry S. Duttweiler	R. F. D. No. 1, Lockridge, Iowa.
9CWV	Verner Hicks	901 S. Mechanic St., Marion, Ill.
9CWW	Robert H. Freeman	Chicago Ranch, Briggsdale, Colo.
9CWX	Clarence A. Brockert	911 W. Main St., Plattsville, Wisc.
9CWY	Frank Bubacek	R. F. D. No. 1, Cedar Rapids, Iowa
9CWZ	Paul Wichman	Belmont, Wisc.
9CXA	Ben Herr	R. F. D. No. 3, Lebanon, Ind.
9CXB	Garvin H. Dyer	1321 Concord St., Springfield, Mo.
9CXC	Albert W. Brown	370—45th St., Milwaukee, Wisc.
9CXD	Robert Van Derwarn	1305 Park Ave., Racine, Wisc.
9CXF	Carroll J. Burnside	322 Quincy St., Rapid City, S. Dak.
9CXF	Clemens E. Spellman	810 Ella St., Beatrice, Nebr.
9CXG	Robert F. Bartl	1515 State St., LaCrosse, Wisc.
9CXH	Leo. L. Drolet	265 Main St., Bourbonaise, Ill.
9CXI	A. G. Schwerling	733 Linden Ave., Newport, Ky.
9CXJ	William L. Cobb	2908 Arsenal St., St. Louis, Mo.
9CXK	William Barrett	3200 Gilham Road, Kansas City, Mo.
9CXL	Theresa E. Finnell	621 E. Water St., Pontiac, Ill.
9CXM	Chester Roney	110 N. Ball St., Webb City, Mo.
9CXN	George E. Marshall	2045 S. Lawrence St., Wichita, Kans.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 19th of month for succeeding month's issue.

HELP WANTED.

Men—WOMEN OVER 17. GET U. S. GOVERNMENT POSITIONS. $90—$195 month. Steady. No strikes. No Layoffs. Pleasant work. Short hours. Paid vacation. Common education sufficient. Experience unnecessary. Many examinations coming. List free. Write immediately. Franklin Institute, Dept. K117, Rochester, N. Y.

PUBLICATIONS.

RADIO MANUAL, everything the beginner should know. How to build and operate an inexpensive receiving set. Sixty-four pages, thirty illustrations. Twenty cents. Postpaid. Raydio Publishing Company, Caxton Building, Cleveland, Ohio.

FOR SALE

I have nine Federal Jr. crystal sets. List $25. Will sell lot for $100. J. M. G. Care RADIO AGE.

CRYSTALS

TESTED GALENA CRYSTALS from our own mines shaped and tested at the mine in best standard hookup—direct to user. A real crystal—not a pinhead. Twenty-five cents postpaid, five for $1.00 to group buyers. Ozark Crystal Co., Box 1, Morrelton, Mo.

Set Clocks by Radio!

By Carl H. Butman

Washington, D. C., Oct. 23.—Through naval radio broadcasts, it is now possible to set your clocks and watches to standard time twice daily, provided you have a radio receiving set. At noon and at 10 every night the naval radio stations at Arlington, Annapolis and Key West transmit signals, indicating the exact time for the 75th Meridian, or standard Eastern time.

The actual time is kept at and sent from the Naval Observatory in Washington, the source of standard time for the territory east of the Rocky Mountains, the Chronometer and Time Office at the Naval station at Mare Island, California, serving the Western territory and ships off the Pacific Coast.

The Clocks Are Wrong, But—

In a deep, even-temperature vault at the Naval Observatory three Riefler clocks keep sidereal, or star time, and although they are not quite correct, it doesn't matter. They are checked by the observation of certain stars as they cross the meridian, and their exact error and rates of error calculated. Having obtained the exact Washington sidereal time, a correction for the difference in longitude of Washington and the 75th meridian, which is eight minutes and about fifteen seconds, is made to secure Eastern standard time. This is kept on two transmitting clocks, one of which sends out the time signal to the three radio transmitting stations by means of a relay.

Previously to sending the time signals, the sending clock is checked with one of the standard Riefler clocks, by comparing their ticks, which are recorded on a chronograph, wavy pen lines indicating the separate ticks. These are measured by a finely divided scale and compared. Determining the error, the sending clock is speeded up or slowed electrically until its ticks correspond exactly with the standard clock.

How to Get the Right Time by Radio

The ticks of the transmitting clock are sent to the three transmitting stations by closing a switch at the observatory, but they are broadcasted by radio from the three stations.

Five minutes is required to send a complete time signal, starting at 11:55 and running to noon, and from 9:55 to 10 p. m. The time signals consist of telegraphic dashes every second except the 29th of each minute; the 55th to 59th seconds of the first four minutes, and the 50th to 59th seconds inclusive of the last minute before the hour. Each of these blanks is caused by a missing tooth on an otherwise incomplete gear-wheel. Following the 59th second of the last minute, there is a long dash commencing at the beginning of the new hour. Listen in for N. A. A. on 2650 meters and set your clocks then.

By means of a radio receiving set at the Observatory the message of ticks may be caught and recorded on a chronograph for comparison with the sending clock's record to determine the loss in transmission. It averages about .09 of a second. The time signals sent from Annapolis on a wave length of 16,900 meters have been heard in Australia, while in the Antipodes time signals have been heard coming around the world both ways. With a receiving set it is now no excuse to say "my clock was wrong."

9CXO	Taylor H. Paisley	3706 Washington St., Kansas City, Mo.
9CXP	Eugene S. Strout, Jr.	303 W. 4th St., Waterloo, Iowa
9CXQ	Harry R. Heuer	5666 Cabanne Ave., St. Louis, Mo.
9CXR	Elmer C. Madson	Wayne Block, Yankton, S. Dak.
9CXS	Cloice Wagner	Main St., West McHenry, Ill.
9CXT	Richard M. Purinton	154—9th St., Lincoln, Ill.
9CXU	Roy E. Gorzney	512 Morris St., W., Morrison, Ill.
9CXV	William W. Eymer	811 Douglas Ave., Yankton, S. Dak.
9CXW	David E. Sparks	3638 Rokeby St., Chicago, Ill.
9CXX	William L. Perdue	104 Brown St., Hopkinsville, Ky.
9CXY	Fred L. Reed	2906 1-2 Arsenal St., St. Louis, Mo.
9CXZ	Hilton Hushower	722 Pennsylvania Ave., South Bend, Ind.
9CYA	Clark Radio Shop	128—38 S. Second St., DeKalb, Ill.
9CYB	Raymond L. Herchert	1619 Union Ave., St. Louis, Mo.

CALLS REISSUED

9AS	Fred L. Demarin	3219 W. Fifth Ave., Chicago, Ill.
9GT	Randall Wright	2114 Morse Ave., Chicago, Ill.
9QB	Sam Burdett	6464 Dorchester Ave., Chicago, Ill.
9UH	Vernon R. Lucas	820 N. 4th St., Fargo, N. Dak.
9API	Raymond Gomersall	2626—4th Ave., S., Minneapolis, Minn.
9AYY	McKinley High School	Missouri and Russell Sts., St. Louis, Mo.
9BSH	Albert B. Jordan	1014 Good Hope St., Cape Girardeau, Mo.
9CCB	General Radio Laboratories, Inc.	1730 Tribune Bldg., Chicago, Ill.
9DIS	John B. Bayard, Jr.	505 N. 6th St., Vincennes, Ind.
9DJL	Leslie M. DeVoe	Zionsville, Ind.

CALLS CANCELLED

9DJL	Harold R. DeTuncq	1696 Ashland Ave., St. Paul, Minn.
9XS	Manhattan Electrical Supply Co., Inc.	1106 Pine St., St. Louis, Mo
9YR	Munice Senior High School	Munice, Ind.
9ZH	Reorganized Church of Jesus Christ of the Latter Day Saints	202 Bowen St., Independence, Mo.
9AYY	Leon L. Drolet	265 Main St., Bourbonnais, Ill.
9BSH	Clarence Stallman	312 B. East St., Hutchinson, Kans.
9DIS	Robert Bartl	1515 State St., LaCrosse, Wisc.
9ZD	Edward C. Stockmann	140 W. Third Ave., Denver, Colo.
9UH	Bert S. Brown	26 Alexandria Pike, Clifton, Ky.
9ZZ	Walter M. Aronson and Albert R. Perkins	3952 Bellview St., Kansas City, Mo.
WAAP	Otto W. Taylor, c-o United Electric Co.	441 N. Roosevelt St., Wichita, Kans.
WFAK	Domestic Electric Company	7908 Eulalie St., Brentwood, Mo.
WBAE	Bradley Polytechnic Institute	Institute Place, Peoria, Ill.
WQX	Walter A. Kuehl	Riverview Park, Western and Belmont, Chicago, Ill.
WAAE	St. Louis Chamber of Commerce	511 Locust St., St. Louis, Mo.
9YAI	Transylvania University	Third and Broadway, Lexington, Ky.
WCAZ	Robert E. Compton and Quincy Whig-Journal	Quincy, Ill.
WKH	The Midland Refining Company	Norfolk Ave., and 4th St., Norfolk, Nebr.

CHANGES IN ADDRESS.

9BCV	Joyce E. Prather	100 Oak St., Mounds, Ill.
9PP	Harry F. Wilson	1105 Franklin Ave., Normal, Ill.
9APK	Harry B. Smith	114 Ridge Ave., Evanston, Ill.
9AKR	Albert C. Mertz	Byron, Ill.
9ATT	Stanley E. Fey	402 Armory St., Champaign, Ill.
9KM	Lawton Biddle	442 Bosart Ave., Indianapolis, Ind.
9DH	James Schulz	9th and Cedar Sts., St. Paul, Minn.
9AZR	Harold C. Armagost	327 W. 4th St., Florence, Kans.
9DXO	Vivian F. Munson	328 Williard St., Kewanee, Ill.
9AMI	J. Emerson Decker	119 Second St., S. E., Mason City, Iowa
9DSH	Earl Sullaway	212 N. Clinton St., Collinsville, Ill.
9LN	Waldo C. Grover	3214 S. Colfax St., Minneapolis, Minn.
9AJY	Walter J. Hammond	616 E. 23rd St., Pittsburg, Kans.
9AJH	John G. Beckley and N. H. Reeve	304 Chestnut St., Western Springs, Ill.
9ANF	Harry C. Harvey	135 N. 13th St., Lincoln, Nebr.
9DPL	Charles J. Bowers	1131 Virginia Ave., Kansas City, Kans.
9DGN	Russell Pelle	2704 Jefferson St., Louisville, Ky.
9BGD	Irving H. Cohen	241 E. 60th St., Chicago, Ill.
WDAP	Midwest Radio Central, Inc.	Drake Hotel, Chicago, Ill.
9CSK	Harry G. Crofts	Carrier Mills, Ill.
9BAX	Burton F. Miller	Box No. 165, Coloma, Wisc.
9BBF	Ernest T. Sperling	21 S. Jefferson St., New Ulm, Minn.
9BAZ	John B. Wathan	R. R. No. 1, Box 97, Mocking Bird Valley, Louisville, Ky.
9BBL	Ralph Schwartz	616 Montgomery St., Shelbyville, Ind.
9BBR	Joseph A. Brence	920 Adams St., Waukegan, Ill.
9AIL	Rudolph W. Martin	Rochester St., Mukwanago, Wisc.
9DSL	James H. Best	Cincinnati, Iowa
9EP	John W. Coleman	211 N. Broadway, Lexington, Ky.
9ALX	Stanley Tollman	3927 Beachwood Ave., Pine Lawn, Mo.
9DPB	Floyd K. Johnston	3319 Larimore Ave., Omaha, Nebr.
9QG	Robert E. Hughes	519 Asbury Ave., Evanston, Ill.

BROADCASTING.

WAAP	United Electric Co.	441 Roosevelt St., Wichita, Kans.
WLAG	Cutting & Washington Radio Corp.	230 Oak Grove, Minneapolis, Minn.
WLAP	W. V. Jordan	306 W. Breckenridge, Louisville, Ky.
WLAR	Mickel Music Co.	128 Main St., Marshalltown, Iowa
WLAS	Hutchinson Grain Radio Co.	Hutchinson, Kans.
WLAT	Bosch Company, Charles G.	317 Main St., Burlington, Iowa.
WLAX	Greencastle Community Broadcasting Station	17 Washington St., E. Greencastle, Ind.
WMAG	Tucker Electric Co.	217 N. Washington St., Liberal, Kans.
WMAJ	Drovers Telegram Co.	1505 Genesee St., Kansas City, Mo.
WNAB	Park City Daily News	413 Tenth St., Bowling Green, Ky.
WOAE	Midland College	Irving St., Fremont, Nebr.

EXPERIMENTAL

9XO	Morkrum Company	1410 Wrightwood Ave., Chicago, Ill.
9XP	Carrington, G. L.	300 S. Main St., El Dorado, Kans.

SPECIAL

9ZI	Anderson, Roy E.	235 Main St., Lexington, Ky.

TECHNICAL AND TRAINED SCHOOL

9VG	North Dakota Agricultural College	Fargo, N. Dak.
9VAQ	Southeast Mo. State Teachers' College	Normal Ave., Cape Girardeau, Mo.

(MISS) M. GUNNISON, Chief Clerk,
U. S. Radio Inspector, 629 Federal Bldg.,
Chicago, Ill.

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