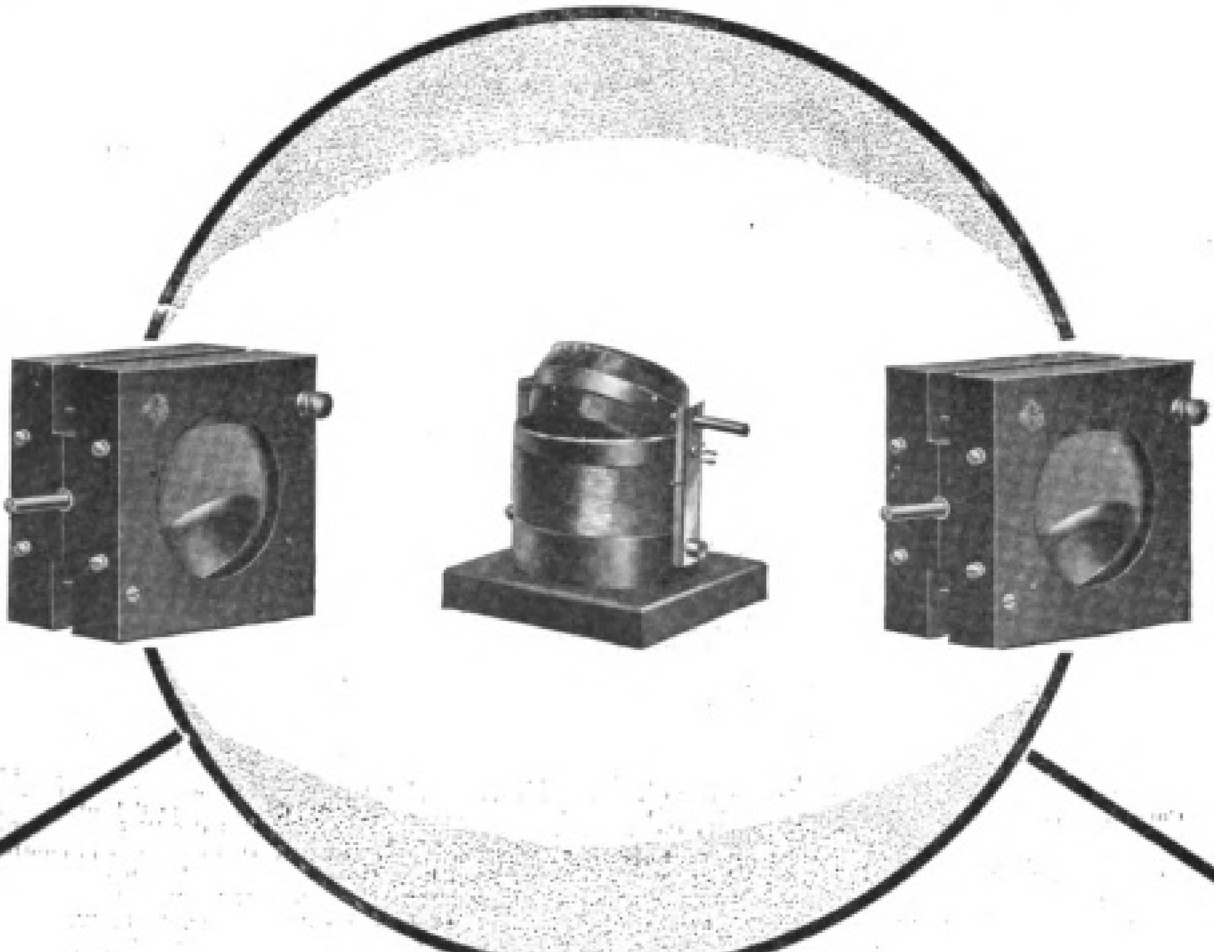
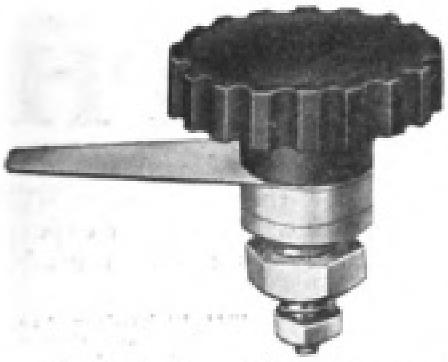


Essential Regenerative Units

The music received nightly in the homes of people over the entire country is made clearer to the listener by using the Marshall-Gerken Variometers and Vario-Coupler.

These new moulded Variometers are correct in every detail. To take one in your hand and examine it will prove almost a shock—the flimsiness so apparent in the ordinary type is gone. You will note the correct weight, the correct construction and the materials and workmanship employed throughout go to make these variometers the sturdiest and most compact ever produced. They are rapidly becoming standard equipment for discriminating users.

The Marshall-Gerken Vario-Coupler is a fit companion for the Variometers, which have sold like wildfire over the whole country. They have the same inherent quality and sturdiness in every detail of construction.



Switch Arm Type S. A. 3

Price - - - - $ .60 each

Knob—1¼" Knurled Bakelite
Lever—1½" Phosphor Bronze Nickeled
Bushing—to fit up to ⅜" panel

Type S. A. 1 Price $ .50 each
Same as above with 1" knob

ASK YOUR DEALER

to see our new style Binding Posts, which entirely eliminate engraving of panel boards. Their neat appearance with your equipment will go far to satisfy your taste for *Quality* instruments.

Prices

Type M. V. G. Variometer for Grid	$6.50
Type M. V. P. Variometer for Plate	6.50
Type V. C. O. Coupler	5.00

Switch Arm Type S. A. 4

Price - - - - $ .60 each

Knob—1¼" Fluted Bakelite
Lever—1½" Phosphor Bronze Nickeled
Bushing—to fit up to ⅜" panel

Type S. A. 2 Price $ .50 each
Same as above with 1" knob

THE MARSHALL-GERKEN COMPANY

MANUFACTURERS

Jobbers for Radio Corporation of America

132 Radio Building **Toledo, Ohio, U. S. A.**

Contents *of* THE WIRELESS AGE *for* Dec., 1921

VOLUME 9 — *Edited by* J. ANDREW WHITE — No. 3

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VOL. 9. NO. 3 DECEMBER, 1921

THE WIRELESS AGE

WORLD WIDE WIRELESS

The Paris Technical Conference on Radio Regulation

DURING the past summer, delegates representing the leading nations met in Paris to consider certain technical questions with radio communication and to make a report to the next International Communications Conference.

Radio communication is now regulated in accordance with the London Convention of 1912, and the revolutionary developments in radio since that time have made new regulations imperative.

The Inter-Allied Technical Committee, which sat from June 21 to August 22, considered primarily a set of 14 questions prepared by the Preliminary Communications Conference of the five principal powers which met in Washington in 1920.

Two delegates of the Department of Commerce were present. One of the fundamental questions was the classification of waves. The final conclusion really adopts two wave classifications, one by types and one by classes.

The Paris conference did not attempt to allocate particular ranges of long waves to particular countries but formulated the technical principles on which such an allocation should be considered by the next International Communications Conference. The technical principles adopted were in brief; (a) the lower frequency waves should be used for the longer distances and the higher frequency waves for the shorter distances; (b) stations situated in the same general locality and working at similar distances should in principle use adjacent frequencies; (c) each nation should use only the smallest possible number of wave lengths necessary to carry on its radio communication, and (d) use should be made of the directional properties of radio whereby the number of communications carried on in a given region may be increased by employing the same frequency a plurality of times. (This last principle was stated in an appendix to the main conclusions on question 10, but is one of the technical principles laid down).

The conclusions adopted at the Paris Conference are not binding on any of the governments; they are recommendations made by the conference to each of the five governments represented. It is assumed that they will be the basis of discussion and action at the next World Communication Conference.

By arrangement with Mary Garden radiophone transmission of music by the Chicago Opera Company has been made possible

A brief typewritten summary of the results of the Paris Conference has been prepared, and interested persons may secure a copy by addressing the Bureau of Standards, Washington, D. C.

+ + +

Trans-Atlantic Amateur Wireless Test

PAUL F. Godley of Montclair, N. J., is in London directing the receiving end of the A. R. R. L. trans-Atlantic amateur wireless tests to be made on December 7 and for a period of ten days thereafter. Mr. Godley sailed for Europe on November 15. On the previous night a bon voyage dinner was given him by Hiram Percy Maxim at the Engineers Club, New York, at which fourteen of Mr. Godley's associates in the amateur field were present. The American representative took with him two types of receiving instruments for the purpose of co-operating with wireless amateurs in England, France and Holland in the tests that are to be made.

It is expected that between 10,000 and 15,000 amateur wireless operators in the United States and Canada will participate in the tests that are to be made for six hours each evening for ten days. Many American amateurs have installed new sets of the latest type in the hope of making the test a success, and thus establishing trans-Atlantic amateur wireless communication.

+ + +

Pittsburgh Fire Department to Use Radiophones

WIRELESS telephone stations will be installed in all volunteer engine company houses in Allegheny county and in the Pittsburgh Fire Department, it was announced by the Fire Marshal, Thomas L. Pfarr, after a station had been set up in his office and its usefulness was demonstrated.

Immediate communication throughout the Pittsburgh district and the county can be had with the wireless 'phones in case of serious fires, the marshall said. His automobile will have wireless apparatus so he can be informed of fires in any part of his district while making inspection tours.

+ + +

Premier Briand Runs Government by Radio

PREMIER BRIAND of France, who attended the Washington conference was constantly kept informed by wireless of French domestis affairs and important world news. Messages that had been decoded were laid before him, among them being some from Tokio, London, Washington and Peking, retransmitted by the French foreign office.

British Air Fleet Equipped With Radiophones

AMERICAN aviation authorities have been advised that the entire British fleet of air expresses is now equipped with wireless telephones and during their aerial journeys the machines are in constant communication with the ground stations.

British airmen, in a communication to American aeronautical authorities, assert that it is no uncommon thing to hear while "listening in" at a ground station the pilot of an incoming aerial express speaking to the pilot of an outgoing machine and advising him of the peculiarities of the weather along the route.

+ + +

Heising Wins Liebman Radio Prize

THE Morris Liebman award made each year by the Institute of Radio Engineers to that member of the institute who makes the most important contribution to radio art, has just been awarded to R. H. Heising of the Engineering Laboratory of the Western Electric Company, "for his analysis of vacuum tube action and his research work on modulation systems."

In commenting upon the award Dr. F. B. Jewett, vice-president and chief engineer of the Western Electric Company, said:

"There is no one in our engineering department who has individually contributed more to the success of our various undertakings in the radio field since 1914 than Mr. Heising, and the action of the Institute of Radio Engineers is a just tribute to him."

+ + +

Nashville, Chattanooga and St. Louis Railway Installs Radio

INSTALLATION of wireless telegraph stations at Tullahoma, Tenn., and Guntersville, Ala., by the Nashville, Chattanooga & St. Louis Railway, was announced recently by local officials of the road.

The two wireless stations are being used with perfect satisfaction in the sending and receiving of day and night messages.

The two points, Tullahoma and Guntersville, were selected by the railroad as its first installation on account of the difficulty in getting land communications between these towns, telephone and telegraph communications between these points are made difficult, officials say, by waterways.

The stations are of the regenerative, short-wave type, two-step amplification receivers, synchronous rotary gap sending. Before being put into service, they were tested out with Chicago, St. Louis, Detroit and Cleveland, working perfectly under all weather conditions.

Since installation of the wireless stations, operators at Tullahoma and Guntersville have reported hearing conservations from New York and Pittsburgh and have read messages from ship stations both on the Atlantic and Pacific, it was said. A number of Nashville amateurs have reported hearing the two stations working.

Local officials say they intend installing the wireless stations in practically every town located on their lines. A station will be put into operation at Nashville at an early date, it was announced.

With the placing of the wireless stations at various points on the railroad officials claim that they will save thousands of dollars annually in telephone and telegraph tolls. To build pole lines between Tullahoma and Guntersville, where it is claimed land communications are almost impossible at times, officials say would cost the railroad approximately $25,000 while the radio has been installed at an expense of about $2,000.

+ + +

Naval Orders By Radiophone

A RADIOPHONE has been installed in the office of the chief of the shore patrol in the small building at the head of the Custom House dock, Charleston, S. C. This telephone is used strictly for official purposes, and chiefly in promulgating orders to and from the various ships of the destroyer force in the harbor, to the landing at the Custom House.

A similar telephone was in use last winter when the destroyers were in port and greatly aided in the rapid issuance of orders to the officer in charge of the patrol.

Prior to the installation of the radio outfit orders were sent back and forth by messengers using motor boats, and as this was considered a rather primitive method for a modern navy it was decided to have the telephone set up.

+ + +

Thieves Aboard Ship Arrested By Radio

CAPT. HOLME of the American Steamship Collamer has been ordered by wireless to place under arrest four Americans who boarded the vessel surreptitiously before her departure from New York, October 19, for Havre.

It is asserted that the men are charged with thefts and acts of violence.

Los Angeles Department Store Installs Radiophone

WITH the installation of a $12,000 wireless sending and receiving station on the roof of Hamburger's department store, in Los Angeles, Cal., 10,000 radio stations within a radius of 1,000 miles will be served with news reports and concerts. The station is the first to be installed in a department store on the Pacific Coast.

The station will afford lessons to boys and girls interested in wireless operation.

Instruction will be only a part of the work to be accomplished. Morning news reports will be sent out daily from 7.30 a. m. to 8 a. m. to all nearby radio stations. These reports will include financial news, crop reports and news features and bulletins. This phase of the service will be handled through the Evening Express, which will provide the station with all reports.

Daily afternoon concerts and nightly ones three times a week will feature operatic celebrities visiting Los Angeles.

+ + +

Added Marine News By Radio

SHIPS at sea will be supplied by radio after November 10 not only with information about the weather, given heretofore, but practically with everything else to assist the navigator, through an arrangement between the Hydrographic Office and the Naval Communication Service.

Each branch hydrographic office has been assigned to cover a certain area with a naval station to distribute the information. The order of the subjects, which will be sent out twice daily, at 10.30 a. m. and 5 p. m., will be: Derelicts and sunken wrecks, mines, ice, aids to navigation, floating rafts, logs and wreckage, misplaced buoys in harbor fairways, and approaches and other items of sufficient importance to send broadcast.

+ + +

Mary Garden Gives Operatic Music By Radio

OPERATIC music by the Chicago Opera Company during the ten weeks season will be transmitted by wireless telephony to all wireless stations within a radius of 1,000 miles that care to "listen in," Mary Garden, general director of the company, announced.

Radio Industry Figures

ALTHOUGH a few years ago the General Electric Company had no wireless work, it has now taken a commanding position as a manufacturer of radio apparatus and makes most of the apparatus used by its affiliated company—the Radio Corporation of America.

Today a total of about 3,000 persons are manufacturing, assembling, erecting and operating the General Electric line of radio apparatus. The Radio Corporation itself has close to 2,000 employees, and in addition there are about 700 G. E. employees at work on radio apparatus. These figures indicate that radio communication is a developing industry.

General Electric constructed at Schenectady the 21 big 200-kw. high frequency alternators which now send all of America's wireless messages abroad, and are used in Wales and in the Sandwich Islands and are to be used in the new high power station contracted for in Poland. The Fort Wayne factory is making 5,000 pieces of radio apparatus, Pittsfield is making 6,500 and Lynn 2,000.

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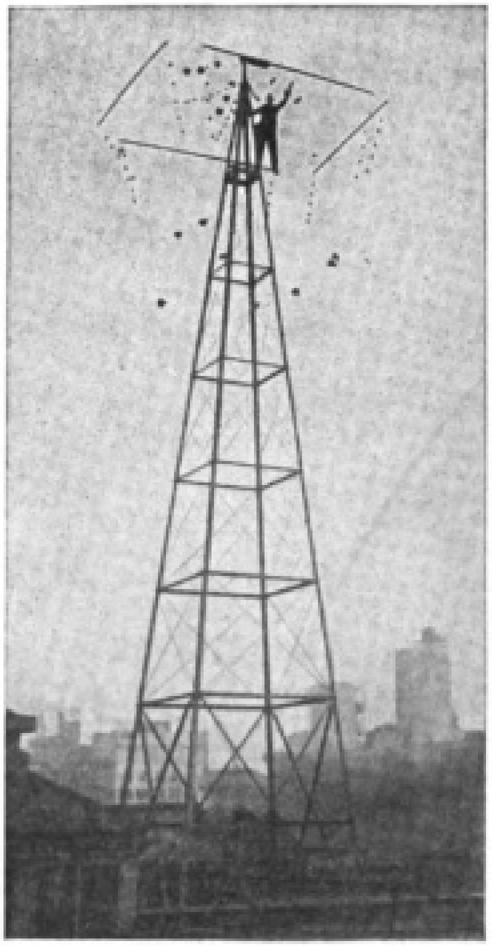


Wireless tower of the Chicago Police Department's wireless station

Radio Effects Novel Rescue of Aviator

WIRELESS and aeronautic science were recently employed in a very timely combination which saved the life of an air service cadet, flying from Mather Field, Cal., over Crater National Forest in Oregon. While in the neighborhood of Crater Lake, the spark plugs ceased working in the engine of his plane, and landing was necessary. Choice in landing places was confined to either the rugged mountain peaks below or a small island of black lava in the middle of the lake. After some deliberation he chose the latter and made a landing in the huge cliff-rimmed cup. The plucky pilot then set his radio outfit in operation and after many hours of waiting, rescue planes arrived carrying the necessary spark plugs. Adverse air currents within the great "moon hole" prohibited the descent of the rescuers, and so the plugs were attached to parachutes and dropped. The lost pilot placed the plugs, started his engine, and made a perilous take-off over the lake surface.

✦ ✦ ✦

French to Build Czech Radio Station

THE Czech Government has just entrusted to the French Wireless Company Societe Francaise Radioelectrique the contracts for the new wireless station to be built just outside of Prague, according to the Journee Industrielle. This is to be a very powerful station which will link the Czech capital with the whole world.

Through an agreement with the Compagnie Generale de T. S. F., the Czech republic will be connected with the great network which the above company controls, of which the station at Ste. Assise is the center and the core.

An English Amateur Station

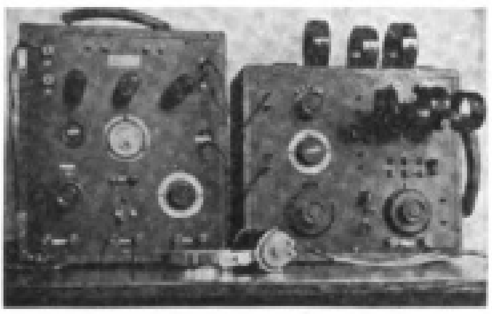
By Alfred Cooper

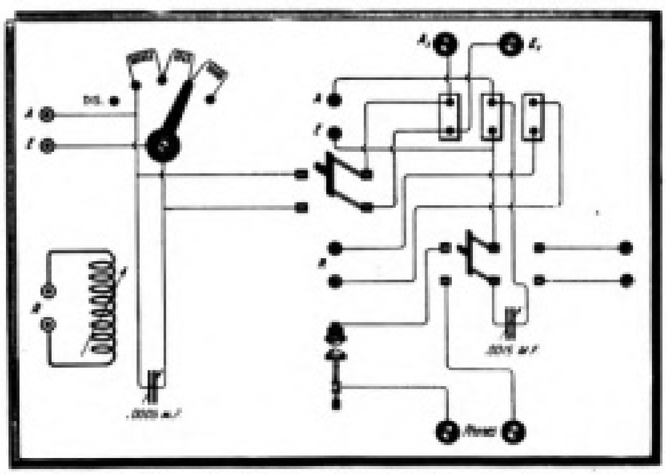
ENGLISH amateurs, working under restricted conditions as regards aerial length and height, have been led to construct highly efficient apparatus. The following is a description of an amateur-built, three valve, low frequency amplification receiver intended to cover all wavelengths from 100-25,000 meters. Valve panel and tuner are separately mounted in cases fitted with lids and handles for portability. Valves used are ES4 type, with filament voltage of 3.5, and plate voltage of 45. Voltmeter reading across detector valve is obtained by pressing knob immediately below dial. A selector switch is fitted enabling 1, 2 or 3 valves to be used as desired; valves not in use may be taken out. A and E terminals on left are connected internally to A and E plug sockets on right. Below the latter are reactance sockets for plugging to tuner.

The tuner is composed of two parts with a novel crystal stand-by circuit. On the left is a five point switch for short wave aerial tuning inductance. A rotary magnetic reaction coil is used and a condenser of .0005 mfd. is shunted across the aerial tuning inductance. This tunes 100-700 meters. On the right is a triple De Forrest coil holder which can be used for either a single circuit tuner with reaction, or a double circuit with reaction. When primary and secondary circuits are used the central switch is thrown over to left which places .0005 mfd. condenser across primary and .0015 mfd. condenser across secondary coil.

For crystal standy-by the 'phones are connected to the right hand bottom terminals, and the double-pole switch above the condenser dial is thrown to the left. This connects a "Perikon" detector in series with the 4,000 ohm 'phones, across the aerial tuning inductance for "plain-aerial" reception.

United States, European and Dutch telephony stations are clearly read on indoor aerials at a height of fifty feet on some of these amateur sets.





Circuit diagram and photographic view of an English amateur receiving set

The Opening of Radio Central

World Wide Wireless Range of the Most Powerful Station on Earth Demonstrated by Globe Girdling Message of Peace and Comity Sent by President Harding as the Initial Message

THE familiar phrase, world wide wireless, took on a new significance on November 5th, when a message of greeting from President Harding was broadcasted from Radio Central station to signalize the opening of the most powerful radio station on earth.

Within thirty seconds the first acknowledgment came back. It was from Carnarvon station in Wales. Others followed, until seventeen countries outside of the United States had responded. Norway, Germany, France, Italy and Belgium reported receipt of the message; also Sweden, Japan, New Zealand, Colombia, Costa Rica, Nicaragua, Honduras, Panama, Cuba, Hawaii, Canada and Australia.

The dream of communication engineers thus became a fact. Then Radio Central, seventy miles out of New York, at Rocky Point, L. I., with a range that reaches everywhere, immediately settled down to the business of sending paid messages to a foreign shore.

The formal opening was an occasion not soon to be forgotten. Promptly at three o'clock the purr of the alternator was drowned in the squawk of a loud speaker signaling: CQ, CQ, CQ, and there followed this impressive message:

The White House,
Washington,
United States of America.

To be able to transmit a message by radio in expectation that it may reach every radio station in the world is so marvelous a scientific and technical achievement as to justify special recognition. It affords peculiar gratification that such a message, from the Chief Executive of the United States of America, may be received in every land, from every sky, by peoples with whom our nation is at peace and amity. That this happy situation may ever continue, and that the peace which blesses our own land may presently become the fortune of all lands and peoples, is the earnest hope of the American nation.

—Warren G. Harding.

Pencils were busy among the three hundred guests gathered in the power house and on scratch pads and backs of envelopes distinguished scientists and representatives of the nations of the world jotted down America's greeting to the world. Among those in the assemblage of guests who had been brought to Rocky Point in a special train of nine cars were E. W. Rice, Jr., president of the General Electric Company; Ralph Peters, president of the Long Island Railroad; Major General George O. Squier, chief signal officer of the Army; Owen D. Young, chairman of the Board, Radio Corporation of America; David Sarnoff, general manager of the Radio Corporation; Gano Dunn, president of the J. G. White Engineering Corporation; Dr. F. B. Jewett, research engineer of the American Telephone and Telegraph Company; Prince Lubormirski of Poland; the ambassadors of Chile, Venezuela, Argentina and Brazil, and a number of experts familiar to all in radio, including Dr. Michael I. Pupin, Roy A. Weagant, C. H. Taylor, Dr. Alfred N. Goldsmith, Edwin Armstrong, F. B. Guthrie of the U. S. Shipping Board and Arthur Batcheller, chief radio inspector of the Department of Commerce. The gathering was a veritable who's who of radio.

Prince Lubormirski, Major General George O. Squier and Owen D. Young inspecting the Radio Central plant during the opening ceremonies

The ceremonies began with a warning call for attention two minutes before 3 o'clock, when, on the stroke of the hour, an American flag suspended above the 200 kw. alternator dropped, revealing a portrait of President Harding illuminated by a frame of incandescent lights. As the message began an aerial salute of bombs thrown from hand mortars outside crashed out and re-echoed over the barren flats of the Long Island countryside.

The control of Radio Central was effected for the occasion from a desk in the White House, the President closing a switch which set in operation an automatic transmitter through which perforated tape was run.

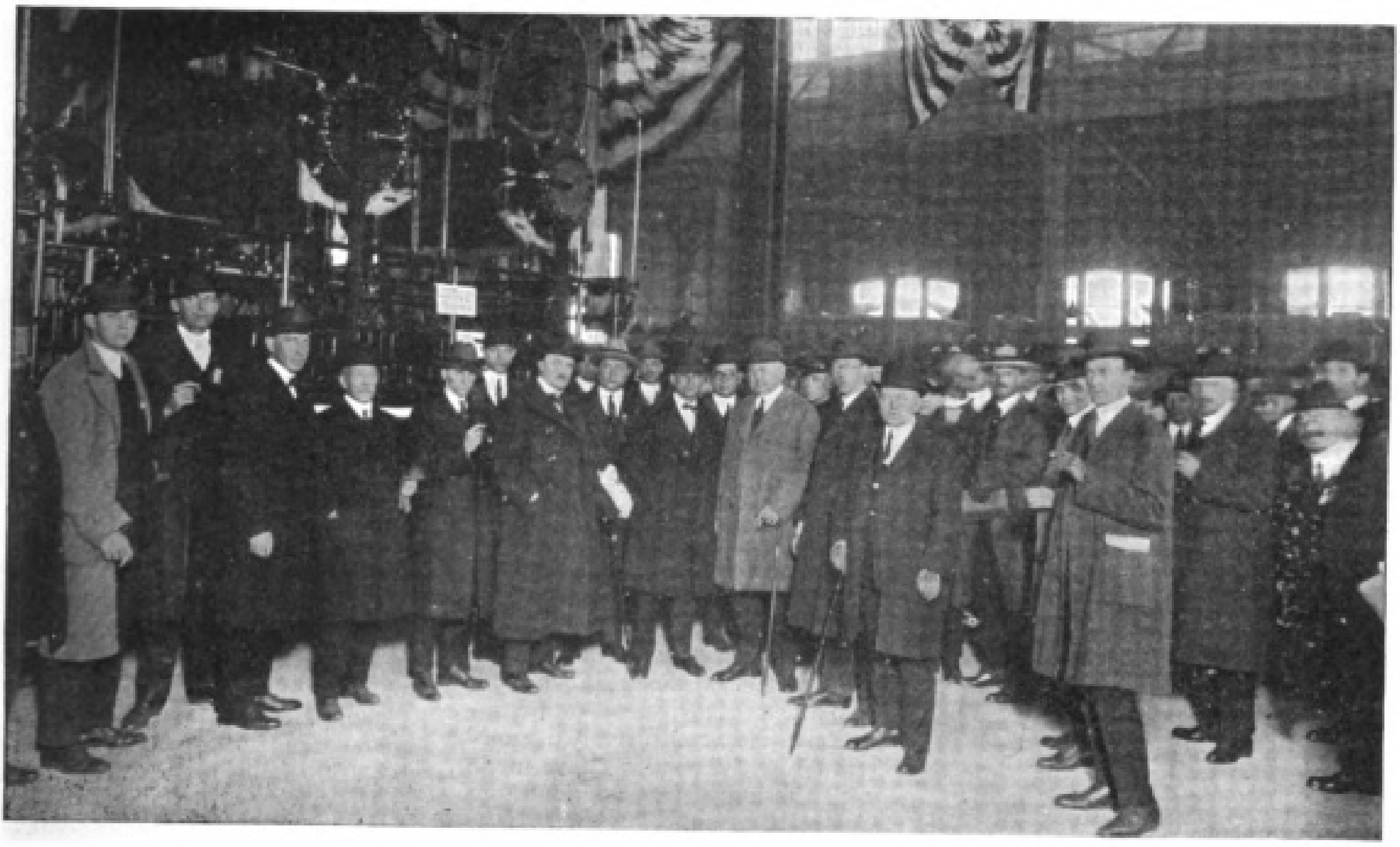
At the conclusion of the message the guests were taken to the Community House, where live the bachelors of the staff of Radio Central, separate houses being provided for the married personnel. The ceremonies here were brief, being of an interpretative nature.

David Sarnoff, general manager of the Radio Corporation, expressed, on behalf of all assembled, the regret felt that Edward J. Nally, the company's president, was unable to be present on the memorial day. He explained that Mr. Nally had sailed that very day from European shores, having been detained by important negotiations abroad, but that he was aboard the Aquitania and in touch with the assemblage by radio. He read the following message received from Mr. Nally:

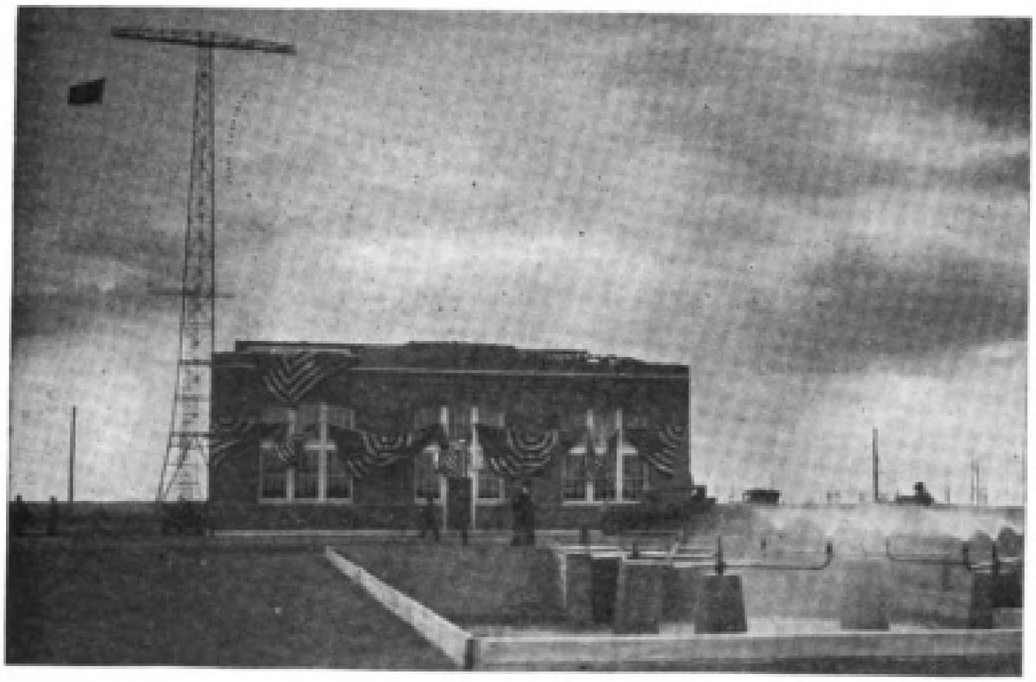
"Regretting that important matters relating to traffic for our world wide wireless system have detained me in Europe preventing me from being present at the historical moment of the opening of our great Radio Central Station, I send my best wishes for the success of the undertaking. Although the new station is not yet in regular service, its voice has reached every section of Europe and I believe penetrated the furthermost world distances. It is the clearest signal ever radiated and it will be the potent agency to bring the nations of the world to closer communication and better understanding. I take this opportunity to extend my sincere thanks to all of those associated with me whose skill and energy have carried to such successful conclusion the orders and plans of our Board of Directors."

Another message read was from the distinguished inventor of wireless; it said:

"My heartiest congratulations to the Radio Corporation of America and to all those concerned in the rapid completion of

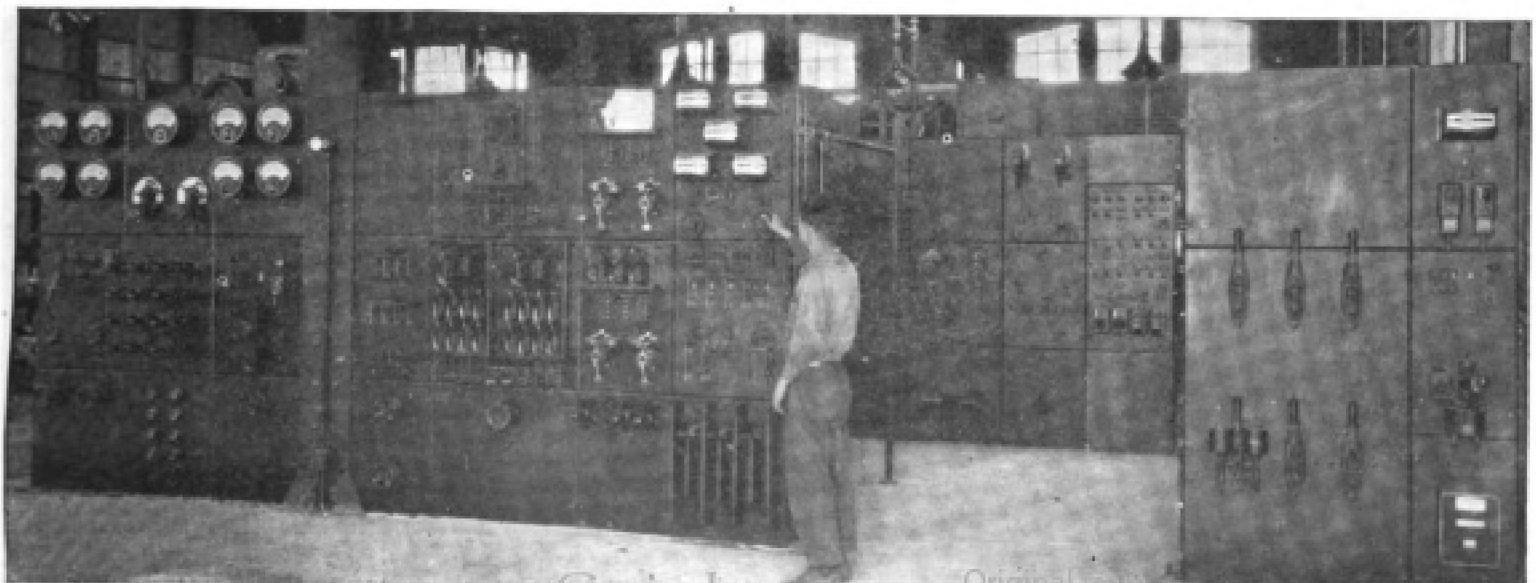


Top — The large illuminated picture of President Harding, who officially opened the station, can be seen above the huge transformer on the right. Among the assembled guests were distinguished scientists, Government officials, prominent corporation executives, Ambassadors from foreign countries and the leading radio experts.



Center—The power house and cooling pond which is part of the circulating cooling system for the Alexanderson alternators

Bottom — Control boards at Radio Central comprising voltage regulators, compensating control, magnetic amplifier control, telegraph control and main power supply panels



The Community House at Radio Central which accommodates the bachelors of the operating staff. Separate cottages are provided for the married personnel

the new long distance Radio Central Station on Long Island. I sincerely believe that this station will prove its great usefulness in facilitating rapid communication between America and distant parts of the Globe and add one still more efficient link to those already uniting the old and the new worlds."—Guglielmo Marconi.

Godfrey Isaacs, managing director of Marconi's Wireless Telegraph Company, from London, sent the following greeting:

"I send you my warmest congratulations upon the opening of your new station. Its efficiency has already been demonstrated and I look forward with confidence to the great work which it is destined to achieve in the new era of intercontinental communication."

A message from the Telefunken and Transradio Companies was then read, as follows:

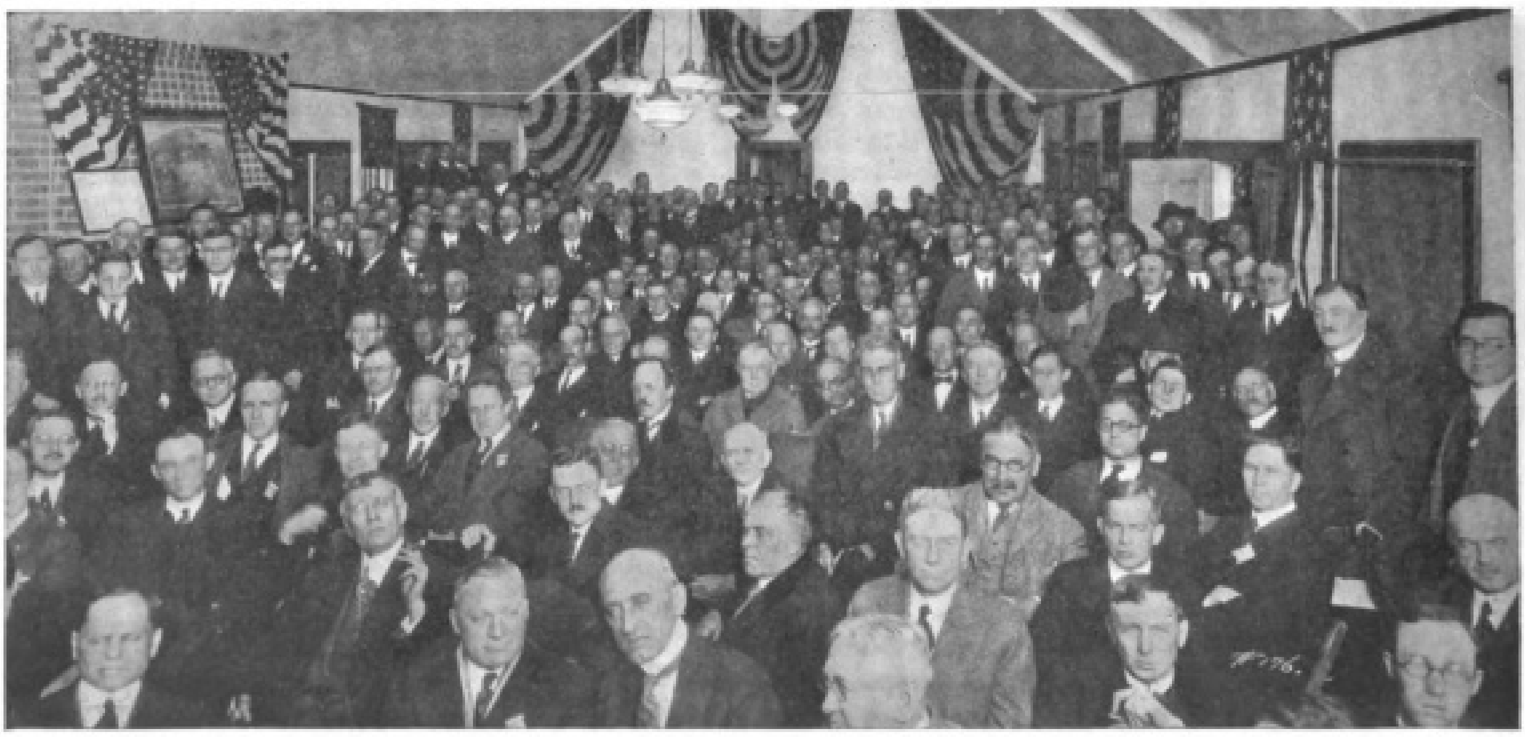
"The directors and members of the Telefunken Company of Germany and its Associated Company Transradio takes this opportunity to congratulate the Radio Corporation of America upon the achievement attained in the development of wireless communication as is so conclusively demonstrated by the tests we have made with the new Long Island Radio Central Station. The success of this new station should spur on all scientists and engineers to further research and scientific development always endeavoring to give as a result of their efforts a quick and reliable wireless communication service to all the peoples of the world. We wish you all success in your present and future work in the field of international communications."

Other congratulations of like character were read in the form of messages received from French, Japanese and Italian radio officials.

Mr. Sarnoff then introduced Owen D. Young, chairman of the Board of the Radio Corporation, who made a stirring address, in part as follows:

"If there be any thrill, and there is a very great thrill in this occasion to me, it is not because of the great technical achievements which have made this station possible; it is not because of the work done, great as it is, by these constructors of the station; but it is that today America is able to lay down in her name, in twenty-eight countries of the world, this message from the President of the United States.

"Just a word about the Radio Corporation of America: Some two years ago when it became evident that this new art of communication might become influential in the world's communications, an attempt was made to mobilize the resources, especially the technical resources, of America. This attempt has been successful to the extent that the American Telephone and Telegraph Company, the Western Electric Company, the Westinghouse



Listening to the address of Owen D. Young, Chairman of the Board of Directors of the Radio Corporation of America, in the Community House on the occasion of the opening of Radio Central

One section of the receiving station. Each shelf contains the apparatus necessary to receive from one European station. Three such sections afford nine receiving circuits

Electric and Manufacturing Company, the United Fruit Company, and the General Electric Company, joined not only all the inventions which they then had, but undertook for twenty years to come, in the radio field, to turn their inventions in to the Radio Corporation of America, in order that America might quickly develop the best radio communication in the world.

"Our new art heretofore has been suspended in its development by patent litigation by energetic claims of engineers, by the great clash of large concerns. America could not wait for the duplication of the history of the Telephone Company, or the duplication of the electrical industry. She could not wait ten years while her people were fighting, because the communications of the world were at stake, and America's position in those communications was at stake.

"Now, as to the position of America:

"England, because of her geographical position, was the natural landing place of the cables of the world. Realizing the importance of communications of the world, she took advantage, as she properly should, of that geographical location, until if you look at the maps of the communication systems of the world, you will see the great lines running to and radiating from London.

"In this new art of radio communication, America is the center of the world.

"Why? Because every country in the world desires to get direct communications with America and not to relay through a country on the coast where a cable may be landed.

"It is hardly worth while to develop radio merely for communication within Europe, alone. The distances are relatively short, the means of communication — land communication — already developed. Radio is designed to reach out afar.

"Norway has already come, and we are in communication with her. England has already come, and we are in communication with her. France has already come, and we are in communication with her. Germany, with her cables cut, is yet in direct communication with America. Poland, whose Minister is here today, has already come in, and contracted for a high power station to reach out directly to America.

"Every country in Europe, seeking to build a radio station, makes one inquiry. 'Will this station communicate with the United States?' And the answer must be yes, or the station is not built.

"Now the question is: Has America the courage, the far-sightedness, the skill, to take advantage of her geo-

The operating station located in New York City where by means of special remote control Radiograms are transmitted through Radio Central and other R. C. A. transatlantic stations graphical position in this great new art, as England took advantage of her position with reference to the cables?

"Is America ready to take advantage of this, not because she is grasping for something she is not entitled to, but because nature has given her a position on which she ought to realize?

"Is she ready in this great art to take her place in the communication of the world? That means two things:

Multiplex receiving station located at Riverhead, L. I., sixteen miles east of Radio Central

It means that we must mobilize our technical resources in America in a single unit. It means that we must mobilize back of that unit our financial resources, and back of that, we must have at least the moral support of the Government of the United States.

"Will America do it?

"Already there has been a charge that the Radio Corporation of America is a monopoly. It is not a monopoly; but if it were, it would be a fighting unit of America against the world in the development of communications.

"I have just returned from Europe and I have come to an agreement with the Germans, the English and the French regarding a co-operative development of wireless in South America; because Germany was starting to build a station in the Argentines, the French were starting to build a station, the English were, and the Americans were — four stations to do the work of one. It was a great waste of capital; and that is not all. We know that the wavelengths in the world are limited and must therefore be conserved.

"And, even if these private companies could afford to waste capital for four stations where only one could adequately do the job, we certainly could not afford to waste wavelengths on stations which would be operating at only twenty-five per cent. of their capacity.

"Therefore it became necessary (and I am glad our friends abroad recognized it) for us to co-operate, and instead of having four stations in the Argentine, we will have one, an International Station, carrying messages from the Argentine to all parts of the world.

"We expect there will be a similar station in Brazil, and such other countries of South America as may show need of these communications.

"The reason for Mr. Alexanderson's absence, is that he is in London now in consultation with the technical people of the other nations, laying out plans for these great new stations.

"I am very keen about this communication business. We have in Washington, just about to convene, a Disarmament Conference. When you can no longer appeal to the Armies of the world, you must appeal to the public opinion of the world, and there can be no public opinion of the world unless there be cheap and adequate communication in the world. I venture this assertion; that underlying the success of any program of diarmament is inevitably the development of adequate communications, and this new art promises to be effective in making these communications available everywhere."

Mr. Young stated his pleasure that the President of the United States had favored the station by sending the opening message, and added, in conclusion: "The Radio Corporation of America has had heretofore, by nomination of the President, a member of the Government sitting with its Board of Directors. I sincerely hope that policy may be continued in order that America may still go forward in developing these communications with the united support of the technicians, of the capitalists, and of the Government."

The deep significance of Mr. Young's remarks will be realized by readers of The Wireless Age through familiarity with the development of Radio Central as described in past issues. In actual operation, the station follows closely the lines along which it was originally designed and as it has been previously described.

Radio Central comprises three separate but closely connected units; these are:

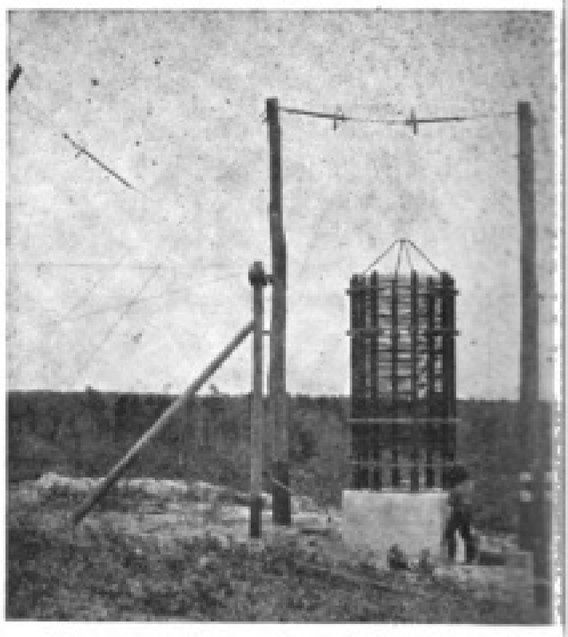
A high power multiplex transmitting station located at Rocky Point on Long Island seventy miles from New York City having several separate antennae systems each designed to communicate with a given country.

A multiplex receiving station located at Riverhead, L. I., sixteen miles distant from the transmitter and so planned and arranged as to simultaneously receive all radiograms destined to the United States from as many foreign countries as take part in the world wide wireless system.

A Central Traffic Office in New York City, where all actual radio telegraph operating takes place. Here radiograms are gathered from various sources and directly radioed to foreign points not only through Radio Central, but other high power stations. This direct transmission is accomplished through the use of a special remote control system whereby operators at 64 Broad Street, in the heart of New York's financial district, do all necessary transmitting work.

In a like manner, reception is accomplished with similar direct advantages where the incoming signals are made audible at Riverhead, L. I., and automatically transferred over landlines to this Central Traffic Office. These signals are recorded on typewriters by skilled telegraph operators or are automatically received at high speed by ink-recorders. Final delivery is then effected through a special messenger service, or dispatched by telegraph when the point of destination is other than New York City.

The construction of Radio Central began July, 1920, and the first test signals were sent in October, 1921—a little more than a year from the time construction started—a record in itself when one considers the great amount of work accomplished.



Monster tuning coil at Radio Central Station

The station site occupied by Radio Central covers 6,400 acres or 10 square miles. 1,800 tons of structural steel were used to erect the first twelve towers, each tower employing approximately 150 tons. Each tower is 410 feet in overall height and the cross arm or bridge supporting the antenna wires at the top is 150 feet long. 8,200 tons of concrete were employed for the foundations of twelve towers, the base of each tower leg be-

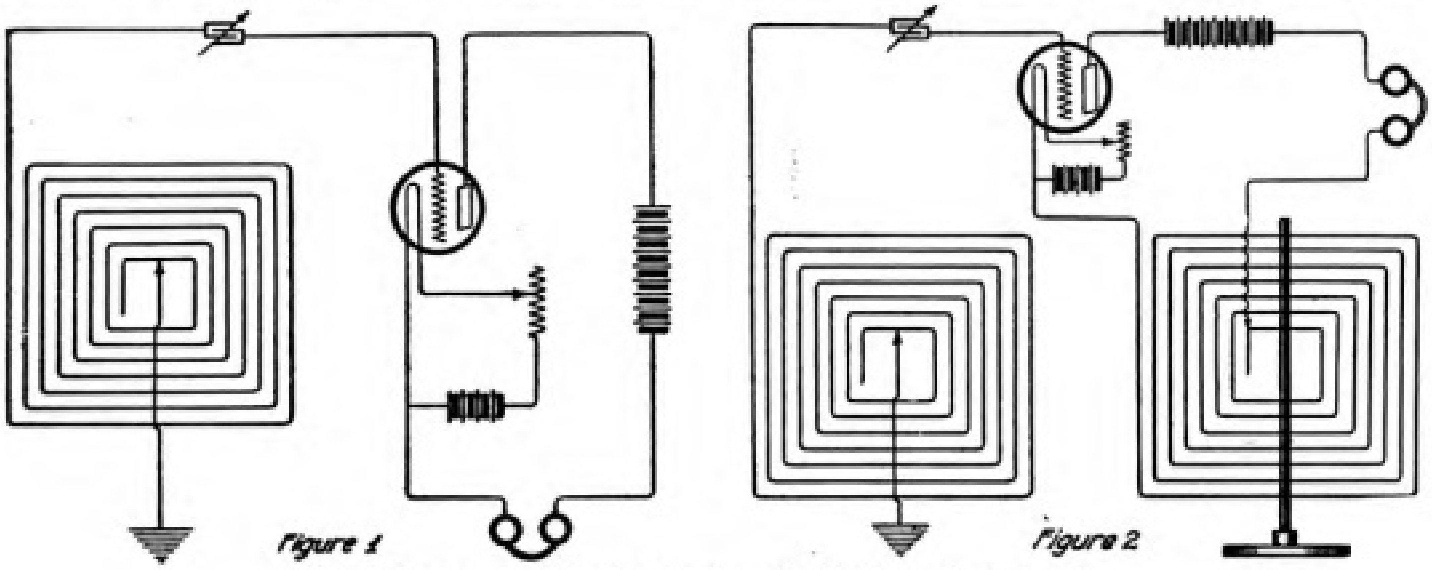
(Continued on page 45)

Regenerative Coupling by Loop Antennae

H. K. SANDELL describes a novel method of employing loops for damped and undamped wave reception.

Referring to the drawings, figure 1 shows an antenna of the loop or spiral type which is grounded, and has a variable point of connection with the spirals or loops of the antenna, so that the antenna may be used for the reception of different wave lengths. The antenna is connected with the grid of a vacuum tube, the filament of which is heated by a storage battery. A variable condenser is used in series with the grid. The plate circuit may include the receivers or may be provided with connections for regenerative or cascade coupling or for further amplification, as desired.

To receive signals transmitted by undamped waves, a second antenna of loop or spiral type may be interposed in the plate circuit; this antenna being brought in quite close proximity to the antenna connected with the grid and mounted rotatably so that its angular position with relation to the antenna connected with the grid may be varied at will. Using this arrangement for the reception of signals transmitted by undamped waves, the angular position of the plate loop relative to the grid loop is varied slowly until the signals become audible in the receiver.



Circuit diagrams employing loops for damped and undamped wave reception

It is apparent that this circuit may be utilized for the reception of damped waves, in which instance the two loops or antennae together act as a regenerative coupling when properly positioned relative to each other. This position is readily determined by rotating one loop while listening at the receiver.

Single Loop Receiver With Directional Properties

THE directive receiving properties of a loop antenna have long been known. Such an antenna, however, has the disadvantage of receiving signals equally well from either one of two opposite directions. Bellini and Tosi have proposed a way in which this disadvantage may be overcome by providing a second antenna in which the currents produced by incoming signals coming from a desired direction, may be in phase with those produced in the first antenna while currents produced by signals coming from the opposite direction will be opposite in phase in the two antennae. By applying the currents produced in the two antennae to a receiving circuit the currents produced by the desired signals will add in the receiving circuit while the currents produced by signals coming from the opposite direction will be neutralized in the receiving circuit.

In the Bellini-Tosi system one antenna is of the magnetic loop form and the other antenna is an electrostatic antenna. E. F. W. Alexanderson claims that similar results may be obtained by the use of a single loop antenna which is arranged so that two separate currents may be derived therefrom, one due to the magnetic exposure, and one due to the electrostatic exposure. These two currents will differ in phase and the phase relation of the two currents produced by signals coming from one direction will differ from the phase relations of the two currents produced by signals coming from the opposite direction. The currents produced by the two exposures may be applied to the receiving circuit by means of variable intensity couplers and suitable phase shifting means in such a way that the currents produced by the desired signal will add in the receiving circuit while the currents produced by the undesired signals will be neutralized.

The drawing, figure 1, indicates an antenna of the magnetic loop form, one end of which is grounded at 3. Currents due to the electromagnetic exposure of this antenna will be produced in the coupling coil 4, which is inserted in series with the loop. Currents due to the electrostatic exposure will be produced in the coupling coil 4 (which is inserted in series with the loop) and the coupling coil 5 which is inserted in the ground connection. The currents produced in the coils 4 and 5 are impressed upon the receiving circuit 6 by means of two intermediate circuits A and B, which contain phase modifying devices.

The currents produced in coils 4 and 5 are impressed upon intermediate circuits A and B by means of variable intensity coupling transformers and the secondaries 11 and 12, which are included in the intermediate circuits A and B. Each of these circuits preferably comprises two portions having different phase angle characteristics. As illustrated each circuit comprises two branches, one branch which includes resistance 13, capacity 14 and inductance

15, and a second parallel branch which includes resistance 16 and inductance 17. The two branches are preferably so designed that the resultant impedance of the first branch is capacitive and the resultant impedance of the second branch is inductive. Coupling coils 18 and 19, which are included in the resonant receiving circuit 6, are so arranged that the coupling between these coils and the inductances 15 and 17, may be varied at will in order to vary the phase of the resultant currents impressed upon the receiving circuit 6. By suitable variation of the coupling of coils 18 and 19 it is possible to adjust the system so that the two currents produced by the desired signals will add in the receiving circuit 6 while currents produced by signals coming from other directions will oppose each other and will be neutralized. The desired neutralizing effect may be obtained both by adjustment of the coupling coils 18 and 19, and by adjustment of the intensity couplers 9 and 10. The receiving circuit 6 includes an inductance 20 and a tuning condenser 21. The currents set up in the receiving circuit are impressed upon the grid circuit of a detector of the pliotron type.

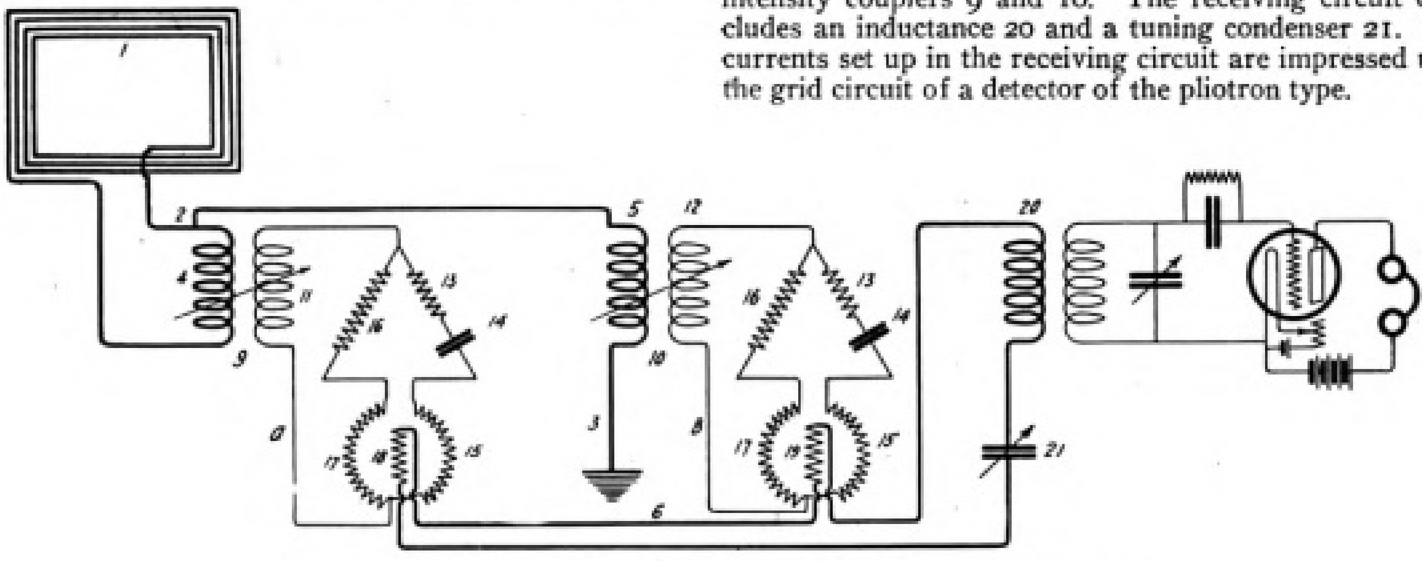


Figure 1—Circuit diagram of a directional receiver using one loop antenna

It is preferable that the receiving antenna should be aperiodic and that the intermediate circuits, which contain phase shifting devices, should also be aperiodic. By arranging the apparatus in this way so that the phase differences are obtained in untuned circuits the adjustment of the apparatus is rendered much more nearly independent of frequency variations than would be the case if tuned circuits were employed before the current is impressed upon the receiving circuit.

Circuit for the Elimination of Static

STATIC interference constitutes a very serious menace to the satisfactory reception of wireless messages and the elimination of the interference is a problem of great difficulty. The difficulty inheres in the fact that the frequency to which the receiving system is tuned—and is therefore most responsive—is very closely the same as the frequency of the natural oscillations set up by the incidence of an atmospheric disturbance on the receiving antenna. The natural oscillations are, therefore, of substantially the frequency to most strongly affect the receiving device, and cannot be eliminated by tuning as can persistent disturbances from a foreign station.

L. Espenschied describes an arrangement by which the receiving device, in addition to being operatively connected to the receiving antenna, is connected to an auxiliary circuit which simulates the receiving antenna as regards natural oscillations, means being provided for exciting natural oscillations in the auxiliary circuit simultaneously with the excitation of natural oscillations in the receiving antenna by transient disturbances.

Referring to figure 1, 1 is a receiving antenna, tuned by means of condenser 2 and inductance 3 to resonance with the waves it is desired to receive. A receiving system comprising a resonant receiving circuit 4, a detector 5 and a receiving device 6 is connected to the antenna. The detector 5, of the vacuum tube type, has its input side connected to the resonant receiving circuit 4, and its output side connected to the receiver 6. Receiving circuit 4 is resonant to the receiving frequency; 7 is an auxiliary antenna preferably aperiodic. Across an impedance element 8, which may be a non-inductive resistance element, and which is in series with antenna 7, is connected to the input side of an amplifier 9, of the vacuum tube type. To the output side of amplifier 9 is coupled, very loosely, an oscillation circuit 10 which is also con-

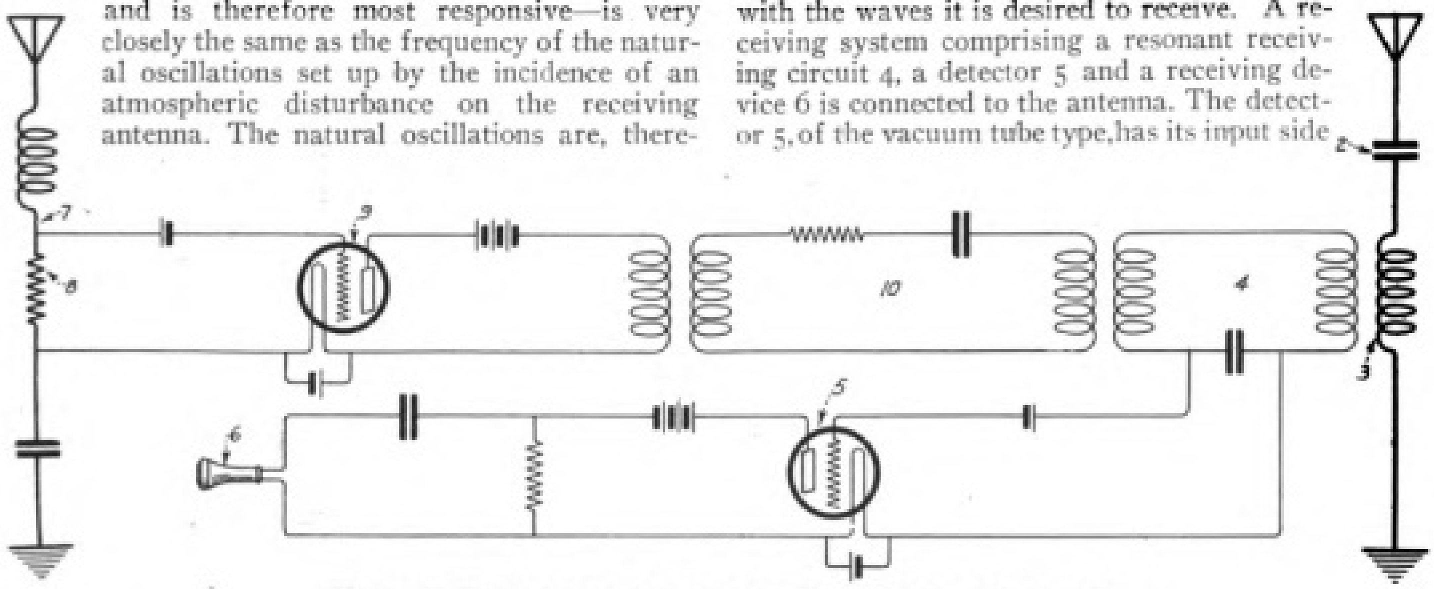


Figure 1—Circuit having two antennae for the elimination of static

nected to the resonant receiving circuit, 4. Circuit 10 contains resistance, capacity, and inductance elements which are to be given such value that the oscillation circuit 10 has the same natural periodicity as antenna 1, and also the same characteristic damping factor. When this condition is satisfied the natural oscillation is executed by oscillation circuit 10 when excited by an impulsive disturbance are similar to those executed under like conditions by antenna 1. The connections of antenna 1 and oscillation circuit 10 to circuit 4 are differential and, therefore, simultaneous oscillations in antenna 1 and oscillation circuit 10 oppose and tend to neutralize with respect to receiving circuit 4.

to practically zero value by adjustment of the relative connections between the receiving circuit 4 and antenna 1, and between receiving circuit 4 and oscillation circuit 10 respectively.

Figure 2 is an arrangement incorporating the same fundamental principle in a circuit employing a single antenna. This arrangement is particularly adapted to a system for the reception of undamped waves of a definite frequency. Referring to figure 2, 1 is a receiving antenna tuned to the frequency of the signals to be received. The antenna circuit includes an inductance coil, 2, and a condenser, 3, adjusted so that their joint serial impedance at the frequency of reception is zero. A non-

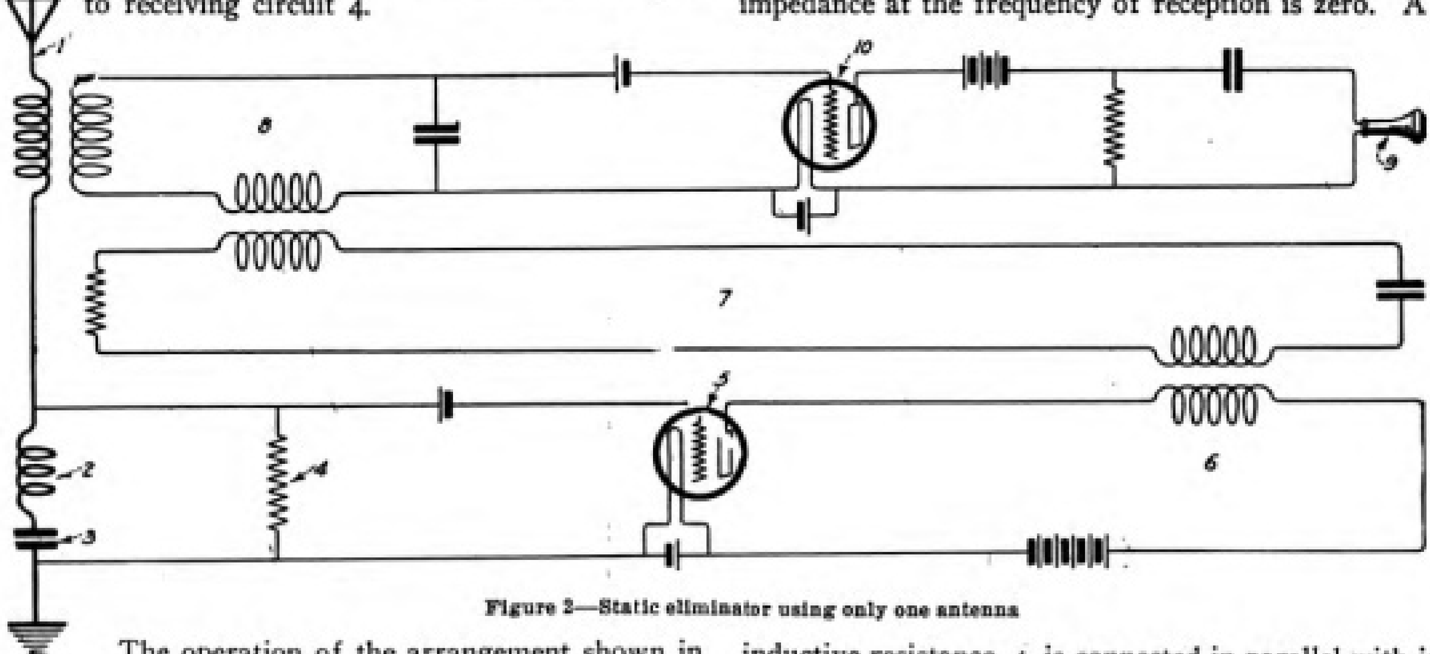


Figure 2—Static eliminator using only one antenna

The operation of the arrangement shown in figure 1 in protecting receiver 6 from interference will now be readily understood. When the system is receiving relatively sustained oscillations of the frequency to which antenna 1 and receiving circuit 4 are attuned, antenna 7 is unresponsive and consequently oscillation circuit 10 is not energized. The reception of signals is, therefore, unaffected by the auxiliary arrangement whose function is exclusively to reduce interference. When, however, an atmospheric or arbitrary disturbance strikes antenna 1 it simultaneously strikes antenna 7 and both antennae are excited. Antenna 1 executes characteristic damped oscillations, while antenna 7 impresses an impulsive potential difference across the input circuit of the amplifier 9. As a consequence oscillation circuit 10 is impulsively excited and executes characteristic damped oscillations of the same periodicity and damping as those simultaneously executed by antenna 1. Due to the non-linear characteristic of the vacuum tube amplifier the waves of the static impulses received from the antenna 7 are distorted so as to present steeper wave fronts, which increases the transient or impulsive excitation of the oscillation circuit 10. Receiving circuit 4 is, therefore, excited by oscillations of the same form in antenna 1 and oscillation circuit 10 respectively and in consequence of differential connection said oscillations oppose and tend to neutralize. Since the magnitude of the oscillations executed by oscillation circuit 10 is controllable by the amplifying power of amplifier 9, proper adjustment of the amplifying power will make the resultant induction in receiving circuit 4 substantially zero. This resultant induction may also be varied and reduced

inductive resistance, 4, is connected in parallel with inductance, 2, and condenser 3, and across the terminals of this resistance is connected the input side of an amplifier, 5, of the vacuum tube type. The function of the non-inductive resistance 4, is merely to provide a conductive path between filament and grid of the amplifier. Connected to output circuit 6, of the amplifier 5, is the oscillation circuit 7, containing resistance, inductance and capacity elements so adjusted that the natural oscillations characteristic of this circuit are of the same frequency and damping as those characteristic of the antenna 1. The resonant receiving circuit 8 is differentially connected to the antenna 1, and oscillation circuit 7. A telephone receiver is connected to the receiving circuit 8, through a vacuum tube detector 10.

The operation of the apparatus in figure 2 will be readily understood in the light of the explanation of the operation of that of figure 1. When continuous waves of the contemplated frequency are being received the potential difference across the terminals of resistance 4 is zero in consequence of the fact that inductance 2 and condenser 3 are serially resonant at this frequency. Oscillation circuit 7 is therefore not excited through amplifier 5. When a transient or arbitrary disturbance strikes the antenna, amplifier 5 and, therefore, oscillation circuit 7 are impulsively excited, oscillation circuit 7 oscillating in the same manner as antenna 1. The natural oscillations in the antenna 1 and the oscillation circuit 7 oppose with respect to the receiving circuit and by a proper adjustment of connections and amplifying power they may be approximately made to neutralize completely.

Condenser Effects on Receiver Primaries

By Ralph R. Batcher

A LARGE number of the receiving sets in use are so designed that a variable condenser is connected, either permanently or temporarily, across the primary of the receiving transformer to permit finer tuning or to increase the wavelength of the circuit. Most operators using such a circuit soon discover that it responds to two wavelengths.

When the circuit is analyzed carefully this is what is to be expected, and the exact relation of the two resulting waves, and the factors which cause them to vary with circuit adjustments can be worked out theoretically. The process is laborious, however, and the formula which is derived is too unwieldy to use with ease.

There are six factors to be considered: the natural wavelength of the antenna—λ_0, the capacity of the antenna C_0, the effective or equivalent lumped inductance of the antenna L_0, the lumped inductance at the base (the tuning coils) L_1, the capacity of the parallel condenser C_1, and the resulting wavelength or wavelengths λ_1.

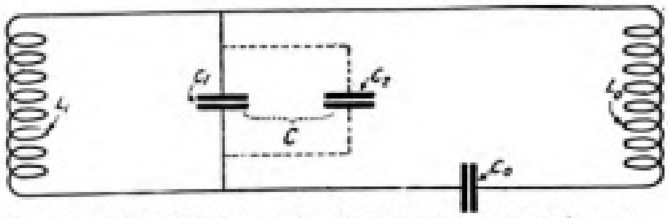


Figure 1—Simplified circuit of a receiving transformer

Referring to figure 1, which is a simplified diagram of the circuit under consideration, it will be seen that the condenser C is really a part of two oscillatory circuits L_1 C and L_0C_0C. The capacity in this case in effect divides, part being effective in each circuit. The mathematical solution, a fourth degree equation, is as follows:

(1) Let $\lambda_0 = K\sqrt{L_0 C_0}$

(2) $\lambda_1 = K\sqrt{L_1 C_1}$ Where $\begin{cases}\lambda_1 \text{ is resulting wavelength or wavelengths.} \\ C_1 = \text{a fictitious portion of capacitance C.}\end{cases}$

(3) $L_1 C_1 = \dfrac{L_0 C_0 C_2}{C_0 + C_2}$ (4) $\lambda_1^2 = \dfrac{L_0 C_0 C_2}{C_0 + C_2} K^2$

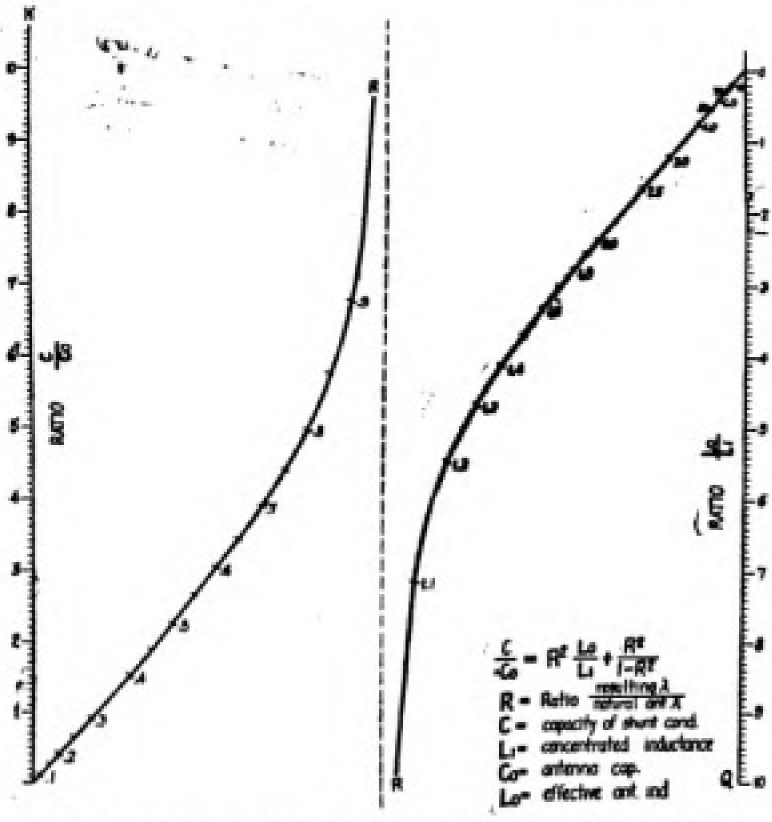


Chart 1—Nomographic chart to determine wavelength of short-wave sets

(5) $\lambda_0^2 = L_0 C_0 K^2$

(6) $\lambda_1^2 = \dfrac{\lambda_0^2 C_2}{C_0 + C_2}$ Substituting (5) in (4)

(7) $\dfrac{C_0}{C_2}\lambda_1^2 = \lambda_0^2 - \lambda_1^2$

(8) $\dfrac{C_2}{C_0} = \dfrac{\lambda_1^2}{\lambda_0^2 + \lambda_1^2}$ Solving for $\dfrac{C_2}{C_0}$

(9) $\dfrac{C_1}{C_0} = \dfrac{L_0}{L_1}\,\dfrac{C_2}{C_0 + C_2} = \dfrac{L_0}{L_1}\,\dfrac{\lambda_1^2}{\lambda_0^2}$ — from (3)

(10) $\dfrac{C}{C_0} = \dfrac{C_1}{C_0} + \dfrac{C_2}{C_0} = \dfrac{\lambda_1^2}{\lambda_0^2}\,\dfrac{L_0}{L_1} + \dfrac{\lambda_1^2}{\lambda_0^2 - \lambda_1^2}$

This (10) is a quadratic equation which when solved for λ_1 gives.

(11) $\lambda_1 = \lambda_0\sqrt{\dfrac{CL_1 + C_0L_0 + C_0L_1 \pm \sqrt{(C^2 + 2CC_0 + C_0^2)L_1^2 + (L_0^2 + 2L_0L_1)C_0^2 + 2CC_0L_0L_1}}{2C_0^2L_0L_1}}$

For convenience it is desirable to let $\dfrac{\lambda_1}{\lambda_0} = R$.

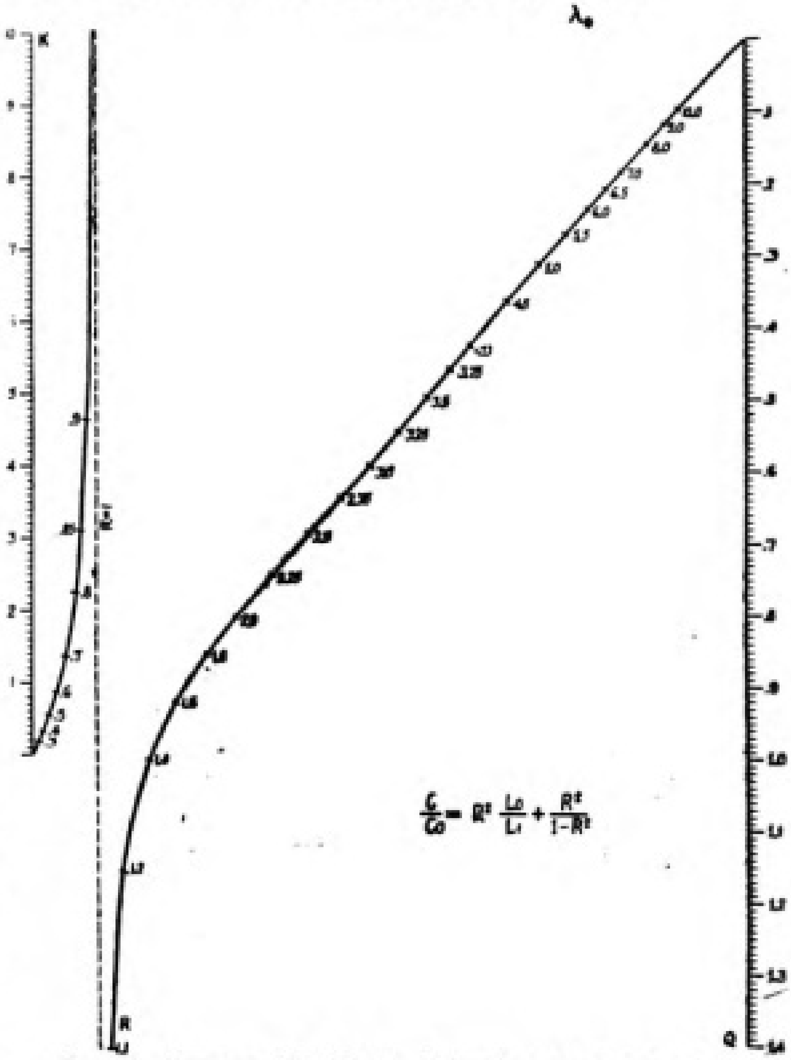


Chart 2—Nomographic chart to determine wavelength of long-wave sets

There are several methods of obtaining solutions for various sets of conditions, but the easiest method is by the use of curves. The values of λ_0, L_0 and C_0 are fixed for any one antenna and their values can be measured and substituted in the formula and the resulting solution can be plotted on cross section paper, with λ_1 values as ordinates, C as abscissa and a separate curve for each major step of the loading inductance.

However an alignment or "Nomographic" chart is simpler to use. Standard charts can be drawn to represent the formula, which with slight alteration of the scale values can be used to fit any desired conditions and can be used with any antenna.

Two charts are shown which will probably cover the majority of conditions. It is first necessary to determine the values of λ_0, L_0, and C_0. On the charts will be noticed two parallel scales at either side. These represent the ratios of C/C_0 and L_0/L_1 respectively, and vary from zero to ten. Substitute the values of C_0 and L_0 and mark

(Continued on page 44)

EXPERIMENTERS' WORLD

Views of readers on subjects and specific problems they would like to have discussed in this department will be appreciated by the Editor

A New Wavemeter Model for Amateurs

By Joseph Pearlman

FIRST PRIZE $10.00

AS an instrument for tuning and measuring purposes the wavemeter is becoming more and more indispensable, and every well-equipped amateur station should have one. The particular design which the amateur will adopt depends largely on his experience and ingenuity. The writer presents the details of the design and construction of his own wavemeter, which he believes to be new and original. While the experimenter is apt to change his receiving and transmitting sets as frequently as the progress of the art and his pocket-book dictate, a wavemeter requires no alteration and for this reason the wavemeter described here was built carefully for long service.

The main elements of a wavemeter are the inductance and condenser. Now in order that the wavemeter calibration be very accurate, it is highly important that the inductance of the coil and the capacity of the condenser be the sole determining factors in the wavelength. If the inductance coil has a high distributed capacity and the connecting leads are long, the capacity and inductance thus introduced will affect the accuracy of the wavemeter reading. This wavemeter was so designed that the connecting leads are of negligible length. The plan and front views show the disposition of the inductance, condenser, and ammeter, and it will be seen that the leads are so small that their inductance is entirely negligible. To secure minimum distributed capacity a honeycomb coil was used.

The wavemeter was particularly designed to tune my C-W transmitter and it was necessary to employ a milliammeter as an indicator to detect the oscillations. The ammeter employed here is a Roller-Smith hot wire meter. This type of meter is very rugged, and will carry fairly heavy overloads without damage to itself. In using a wavemeter for tuning it often happens that too close coupling, or due to just hitting the resonance point, there will be a large current flow in the wavemeter circuit, and unless the indicating ammeter is properly designed it will probably burn out. The Roller-Smith is designed with a short-circuiting device which cuts the ammeter out of circuit, when the ammeter pointer swings over the end of the scale.

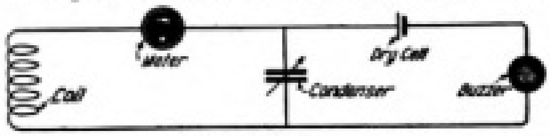


Figure 2

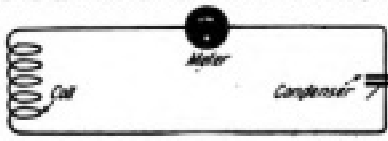


Figure 1

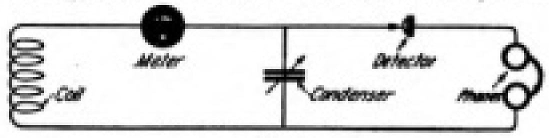


Figure 3

Various connections and uses of the wavemeter

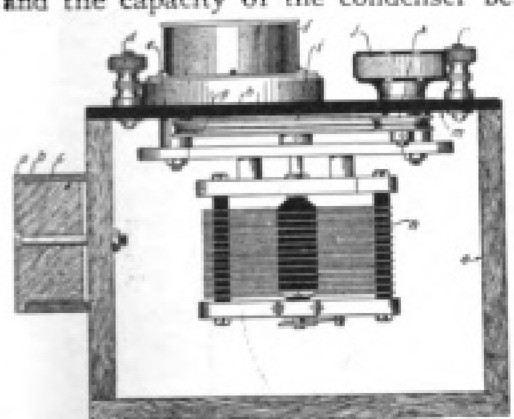


Figure 4—Front view with side of box removed

From the plan and front views it will be seen that the condenser and movable parts of the wavemeter are mounted inside a box, and the stationary parts are mounted outside it. The box is made of oak wood, early English finish. The outside dimensions are 6¾ inches wide, 7½ inches long and 5 inches deep, the stock being ⅜ inch thick. The panel on which the meter, binding posts, scale, etc., are mounted, is a 3/16 inch dilecto panel, dimensions being 6¾x7½ inches. The panel is fastened to the box by means of four No. 8 oval head nickel-plated brass wood screws, ¾ inch long.

The inductance coil is an L-35 honey comb coil having an inductance of 75 microhenries, and is mounted on the left side of the wavemeter box. The method of mounting will be clear from a consideration of the front view. A wooden form is made to fit into the coil as shown, and the entire unit is fastened to the side of the box by means of a screw and nut, the screw being a No. 8/32x1¾ inches long flat head screw. The terminals of the coil are brought out to two quad binding posts on the left side of the wavemeter box (top). In the front view A is the wood form for the coil, B the honeycomb coil, C the fastening screw, and D the coil binding posts.

The condenser employed is a 0.001 microfarad condenser which, with the above coil, will cover the range from 150 to 450 meters very nicely. The mounting of the condenser is the standard mounting and is supported from the main dilecto panel by three supports, ½ inch in diameter and ½ inch long, in which fit No. 8/32x1 inch oval head screws and hexagon nuts.

Variation of the condenser capacity is accomplished by a device which is new and original. A four-inch grooved pulley I is attached to the condenser shaft by means of a brass bushing which is forced into the pulley, the brass bushing being held in place by means of a pin, seen in the front view of the set. A small one-inch grooved pulley is coupled to this larger pulley by means of silk fishing cord (so-called silk worm gut) which circles the smaller pulley one turn, and likewise around the larger pulley. The entire coupling arrangement is twisted into a figure 8 as seen from the plan view, both ends of the cord being tied to the larger pulley. To the smaller wheel, which acts as a vernier pulley, is attached in a conventional way, a vernier knob, which controls the motion of the smaller pulley, and therefore also of the larger pulley and the condenser plates attached to it. Since the larger pulley is four times as large as the smaller pulley, the ratio of transformation is four to one and thus a suf-

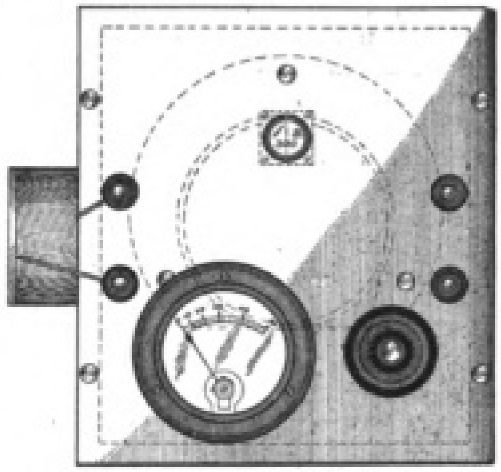


Figure 5—Plan view of the wavemeter

ficiently fine motion of the condenser plates is secured. The silk fishing cord can be procured at any dealers handling fishing supplies and should be about 1/32 inch thick. To the larger grooved pulley, whose motion is identical with the motion of the condenser plates, is attached a paper scale, which may be pasted on to the pulley before calibrating the condenser.

On the plan view will be seen a hole with a fine reading or indicating the wavelength on the paper scale. This hole has an upper diameter of ¾ inch and tapers down to 9/16 inch. On the bottom is fastened by means of four No. 2/56x⅛ inch round head screws (seen on the indicator) a square piece of transparent celluloid, ⅞ inch by ⅞ inch, which has a fine line scratched across the center, this fine line acting as the pointer on the wavemeter scale.

On the right hand side of the wavemeter box at the top will be seen two quad binding posts. Although this meter was designed for tuning the transmitter its use is considerably extended by incorporating binding posts to take care of either a buzzer or a pair of 'phones and detector. Figure 1 shows the connections when using the wavemeter as a C.W. tuning device. If two binding posts are connected across the condenser terminals, we can use these binding posts for connecting an external battery and buzzer to it, thus transforming the wavemeter into a buzzer driven device for generating oscillations which would enable tuning or calibrating a receiver on the low waves. On the other hand, we could also connect across these two binding posts a pair of 'phones and receive as in figure 3, and the wavemeter could now be used to tune a spark transmitter or be used for reception purposes. Thus without any extra expense or trouble, the uses of the wavemeter are multiplied threefold.

The wavemeter here described has given excellent results, particularly the special form of mechanism employed for the movable condenser plates. It will be seen that it is not essentially different from employing a set of gears to transform the motion, but the writer has found an imitation "belt drive" as outlined above to be far superior and to give better results.

Portable Wavemeter for Amateur C.W. Transmitters

By Louis Frank

SECOND PRIZE $5.00

HOW many amateurs operating a transmitter really know what their wavelength is? It is safe to say that very few do, and they have some kind of wavemeter. Most amateurs guess at the wavelength on which they are transmitting. I found that I did not know on what wave my transmitter was radiating until I had constructed and calibrated the following small and inexpensive wavemeter.

The assembled wavemeter is shown in figures 1 and 2. Figure 1 shows a plan view, figure 2 a side view. The entire wavemeter occupies a space of but 8 by 10 inches, is very light and therefore portable. It is made up of three elements, a variable condenser, a fixd inductance, and a milliammeter, hot wire type. These elements are connected in series forming a closed radio frequency circuit. They are mounted on a plain wooden base made of ½ inch stock, and the disposition of the parts is as shown in the drawings.

The condenser is a General Radio Condenser Type 182-A, having a maximum capacity of 0.0007 microfarad, the scale of which is divided from 0 to 100.

Using the inductance described below this condenser covers the range of wavelengths from 100 to about 500 meters, but since the first and last waves are at the extremes of the condenser scale we may really consider the wavemeter to cover the range from 150 to 450 meters very satisfactorily. Knowing the capacity of the condenser at each division from its calibration curve, and knowing the inductance of my wavemeter coil I was able to calculate quite accurately the wavelength of the coil-condenser combination at each degree of the condenser scale. The following table shows the wavelength of the combination at the indicated condenser degrees:

Condenser degrees	Wavelength meters
8	100
17	150
25	200
36	250
47	300
58	350
71	400
84	450
100	500

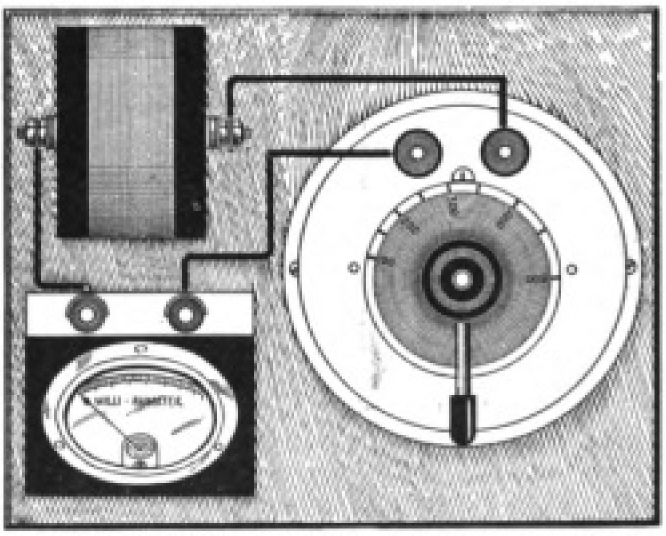


Figure 1—Plan view of the portable wavemeter for amateur C.W. transmitters

In order to make the wavemeter direct reading the following was done. A sheet of three ply Bristol board was cut out into a semi-circle of the same size as the condenser dial. One semicircle on the Bristol board was divided into 100 equal divisions, and calibrated and marked in wavelengths according to the above table. The edges of the condenser dial were marked at the 0 and 100 point and the condenser knob and handle taken off, and the Bristol board scale laid over the condenser scale until they coincided exactly. The sheet of Bristol board was then firmly shellacked to the condenser plate, the condenser handle and knob were replaced and the condenser was ready for use on a direct reading wavemeter.

The wavemeter inductance used is shown in full detail in the sketches. I found that an inductance of 110 microhenries with the General Radio Condenser would do very well. As seen from the coil drawings, it is a single layer solenoid wound on a soft wood core, having two soft wood end pieces. The dimensions and drillings of the core and end pieces are given in the drawings. The coil is wound with 33 turns of No. 21 D.C.C. wire and the terminals brought to two posts through two holes drilled in the end pieces at the top. The coil terminals consist of two No. 8/32x1 inch round head machine screws with two nuts on each. The end pieces are tied to the core by four No. 8/32x1 inch flat head wood screws.

For a resonance indicator I used a 0-100 milliammeter, hot wire type, which I had available. It is quite likely that most amateurs have not such an ammeter available and consequently must use something else. The writer has used a similar wavemeter with a 2-volt glow lamp as resonance indicator. For tuning transmitters this type of indicator is very satisfactory, especially since ammeter readings are not essential, and a resonance setting obtained in any other way is satisfactory.

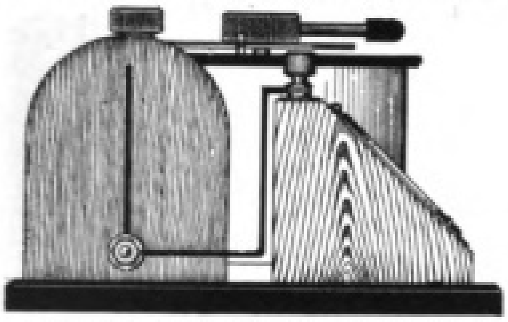


Figure 2—Side view of the wavemeter

The wavemeter as described here has proved entirely satisfactory from every point of view. The cost is negligible, which should recommend it to all amateurs. The coil is easily built at very little cost, the glow lamp is inexpensive. The only item which costs a little is the condenser. The construction work is practically nil.

To those amateurs who can afford it I would strongly suggest the use of a milliammeter. Although the glow lamp is entirely satisfactory for tuning the transmitter, if an ammeter is available in its place the use of the wavemeter will be very largely extended. With the milliammeter a host of measurements easily made becomes available to the amateur. I have not only been able to tune my transmitter by using the milliammeter as resonance indicator, but I have also been able to take resonance curves and so on. In other words there are so many things which can be done with the wavemeter when used with a measuring instrument, that I believe the cost of a milliammeter will soon pay for itself.

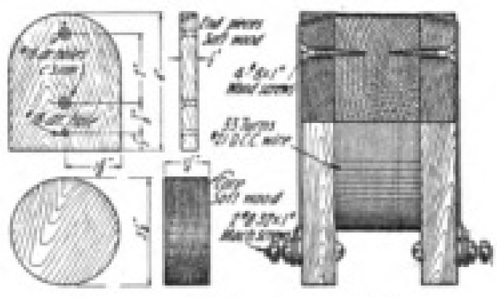


Figure 3—Constructional details

Wavemeter for Tuning C.W. Transmitters

By C. Chandler Pidgeon

THIRD PRIZE $3.00

THE essentials of a good wavemeter for tuning C.W. sets are a coil of known inductance, a condenser of known capacity and a radio frequency ammeter.

To cover the range of 150 to 450 meters satisfactorily, a coil with about 63,000 cms. inductance and a condenser of about .001 mfd. capacity, are necessary. Any good condenser of about this capacity is suitable, but there are certain characteristics which render some better than others. The plates should be rugged and evenly spaced and the rotating plates should be accurately located with respect to the stationary ones, and should be at all times parallel to them.

The radio frequency ammeter may be either a good hot-wire ammeter or a themo galvanometer. The latter is preferable, however, on account of its low inductance.

Since it is comparatively easy to select a good condenser and a suitable ammeter, we will pass on to the consideration of the coil. I give below the data for two coils having the correct inductance for use with a condenser of .001 mfd. maximum capacity. The first coil appears to me to be the better, but requires an engine lathe in its construction. The second can be made on a suitable shell turned in a wood turning lathe. Maple, birch, dogwood and mahogany are the most suitable woods for use as tubes. The walls of the tube should be about ½ inch thick and the tube shellacked, dried and sand-papered before winding.

For the first coil, turn a cylinder 4-⅛ inches outside diameter and 3-⅛ inches inside. The outside dimension should be very accurate. The length of this tube is 2½ inches. After preparing the tube begin 9/16 inch from the left end and, with the lathe set to cut 16 threads per inch, cut a spiral groove, 1/64 inch deep, making 22 complete turns. The point of the chaser used in cutting this groove should be rounded slightly and sharpened back to produce a wood cutting edge. At the beginning and end of this groove drill a hole with a No. 53 drill. One-quarter inch from each of these holes, near the ends of the tube, and in line with its axis, drill a hole with a No. 27 drill. Next coat the heads of two ¾x6/32 inch screws with solder. Put one of these screws through each of the No. 27 holes from the inside and put a hexagon nut on the outside. Tin one end of a piece of No. 18 bare copper wire 24 feet long and put through one of the No. 53 holes. Solder this end to the head of the adjacent screw. Tightly wind the 22 turns of wire and tin the end and solder to the terminal screw as at the start.

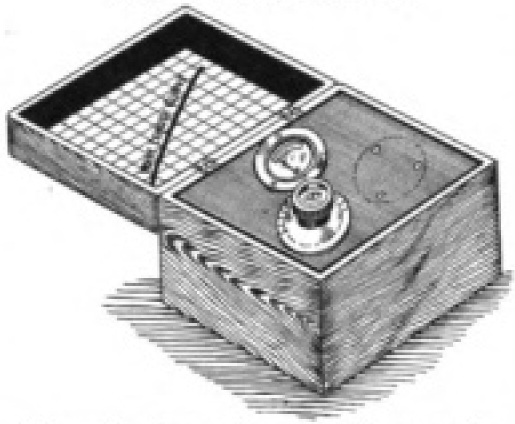


Figure 3—Perspective view of wavemeter

A panel about 8x9 inches of bakelite or formica should be provided, and the coil may be mounted on the panel by three wood screws inserted through suitable holes in the panel and penetrating the end of the tube. The instruments should be so mounted as to make the leads very short, and the arrangement in figure 1 is suggested as being satisfactory.

The panel should be mounted in a box with inside dimensions of about 8x9x5 inches, which is provided with a hinged top deep enough to accommodate the condenser knob. The calibration curve can be placed in the top of the lid.

The connections under the panel are indicated in the diagram, figure 2. Figure 3 is a perspective showing the appearance of the completed instrument.

The second coil referred to above is made by winding closely 25 turns of No. 20 s.c.c. wire on a form exactly 3-1/16 inches in diameter. This winding will be about 1 inch long. A hard wood tube 2 inches long and 3-1/16 inches in diameter may be turned to have ½ inch wall, shellacked and sandpapered smooth. The terminals may be made similar to the coil described above.

The inductance of the first coil is 63,400 cms. and that of the second is 62,900 cms. The range of 150 to 450 meters is easily covered without approaching too close to the ends of the scale with either coil.

The wavelength graph shown in figure 4 is computed on the basis of a condenser of .001 mfd. maximum capacity, and 63,000 cms. inductance.

The curve based on this value will have a maximum error of about 1 per cent. A better curve can be made using the correct value of inductance for the coil used and substituting in the following formula:

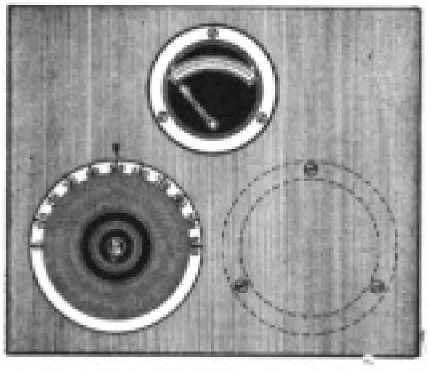


Figure 1—Showing arrangement of the instruments

$$\lambda = 59.57 \sqrt{LC}$$

where L=inductance in cms. and C=capacity in microfarads. The exact location of the curve will depend on the capacity of the condenser. A capacity curve may be made by considering that 18 degrees (on a scale of 180 degrees for full capacity) is 1/10 maximum capacity, and 172 degrees is 9/10 maximum capacity. The capacity graph will be straight between these two points and will curve slightly beyond them.

A wavemeter made as described above will have an accuracy depending largely on the rating of the condenser used. The error will be proportional to the square root of the product, the error in the condenser capacity and the error in the inductance. As an inductance carefully made in accordance with the directions given above should be quite accurate,

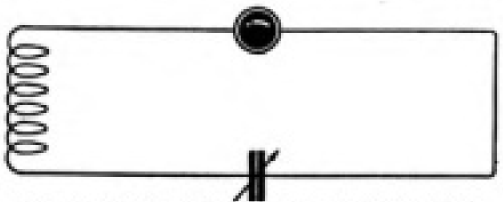


Figure 2—Circuit diagram of connections

the principal source of error will be in the use of an uncalibrated condenser. One should therefore endeavor to get a condenser which has been compared with a calibrated condenser at least at two points on the scale.

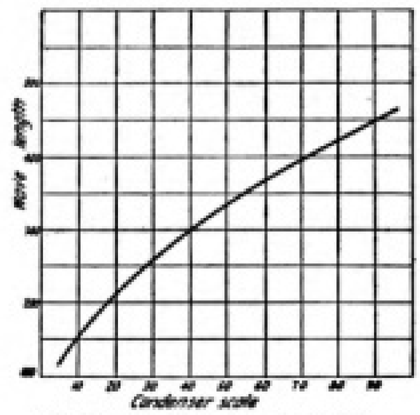


Figure 4—Wavelength graph

Or one should, if possible, use a condenser with which the manufacturer gives the rating accurate to about 1 per cent.

Probably the most satisfactory way to have an accurate wavemeter is to build the instrument described above and send it to the Bureau of Standards for calibration.

Eliminating the "Howl"

By F. J. Shollenberger

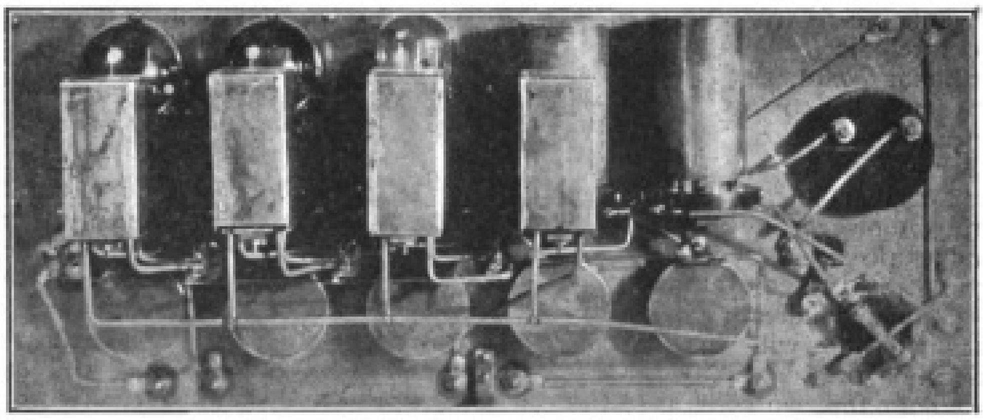
Mount Union College, Alliance, O.

NOT many years ago we were astounded with the results obtained with the first detector tubes, which surpassed the older forms of mineral detection. Following this the single-stage audio-frequency amplifier was developed and a short time later the two-step made its appearance with still more surprising results. However, audio-frequency amplification has seemed content to rest at the second stage.

The majority of manufacturers say that it is not practical to build audio-frequency amplifiers beyond the second stage of amplification, because of self excitation causing the "howl" which is characteristic of high audio-frequency amplification. Radio-frequency amplification, which as a rule is free from "howls," can be used, but it is not the purpose of this article to argue the pros and cons of these two systems. The writer believes that any one having used both systems will be greatly in favor of the former method both from the standpoint of efficiency and adaptability to the lower wave lengths.

Experiments have been conducted during the past year in the physics department of Mount Union College on audio-frequency amplification. Little difficulty was encountered in the building of a three-step amplifier. The only precautions necessary were the grounding of the negative pole of the filament lighting circuit and the placing of the amplifying transformers at right angles to each other to avoid the mutual inductance which would otherwise take place. This instrument has given remarkable results on spark, continuous wave and phone work, being free from noise and the distortion of signals and speech.

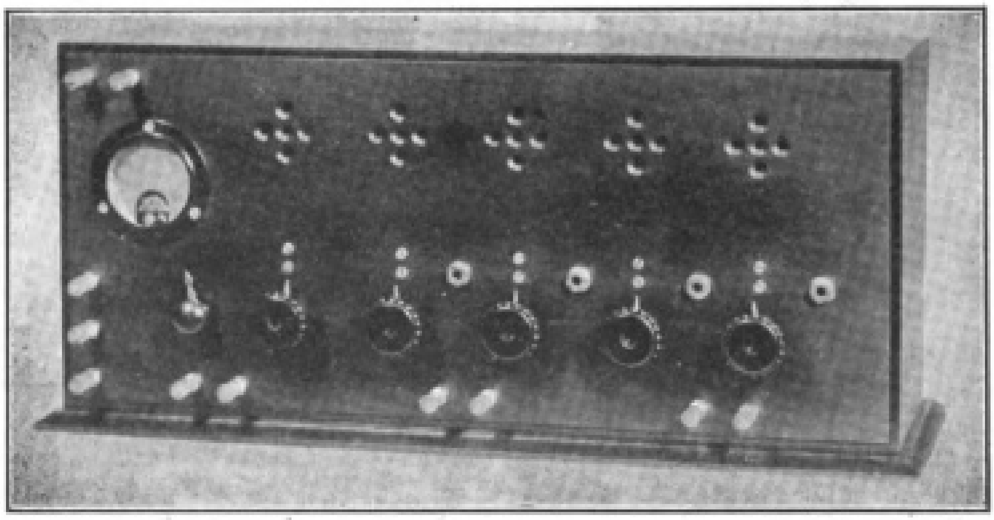
The next experiment was the building of a four-step audio-frequency amplifier, which I shall describe in some detail. A panel 9 in. x 21 in. x ¼ in. was secured, "laid off," and drilled. The sockets and transformers were mounted in vertical position on the back of the panel. In the writer's experience he has found that tubes mounted vertically are less affected by jars than those placed in a horizontal positon, and also tend to keep the filament from sagging. The instrument was assembled—with no shielding—and hooked-up to the antenna and ground. Remarkable amplification was evident from the very first, but there was also a decided "howl." A search to locate the "howl" developed that it originated at various places. The one thing that did most to eliminate it was the connecting of the cores of the amplifying transformers together. It was found later that the grounding of the cores still decreased the noise. It is evident that in amplifiers under four stages, radio frequency oscillations are present, but cause little difficulty. However, by the time they have passed through four transformers their frequency has been reduced enough to be within the audio-frequency range. I believe this to be largely responsible for the increased "howl" of the fourth stage of audio-frequency amplification.



Rear view of the four-step audio-frequency amplifier

The next step was the shielding of the panel and grounding to the negative pole of the filament battery. At this point a plan was devised to locate the "howls" by the aid of an additional three-stage amplifier. A small coil of No. 40 enamel wire was wound and connected to the three stage. It was found upon inserting the small coil of wire between the amplifying transformers of the "four step" that a howl was present in the phones of the "three step." The amplifying transformers were then encased in brass and the cases grounded. The tube sockets and bases were also grounded, which reduced the noise to some extent. Following this the rheostats were encased in brass and grounded as was the shell of the filament ammeter. By this time most of the "howl" had disappeared. The instrument was working perfectly on the third stage of amplification and this led the writer to believe that the difficulty was between the third and fourth stages. It was found that by inserting the small coil of the "three-step" between the fourth and fifth bulbs of the "four step," that a howl was present there. These jackets were placed on the other bulbs and it was found that by encasing the detector and first stage amplification tubes that the "howl" was entirely eliminated. These tubes may be coated with aluminum-bronze, which will give the same result.

The adjustment of the grid leak is very important. Noises resulting from improper resistances of the grid leak are usually of a lower pitch than those resulting from self excitation. A good adjustment of the grid leak may be obtained when the instrument is disconnected from the aerial and ground and the grid leak resistance varied until the amplifier is entirely free from noise.



Front view of the four-step amplifier

The instrument just described is free from any "howl" and works equally well on long and short waves. There is no distortion of speech or change of pitch of signals, both of which "come in" with tremendous volume. The amplifier is used in conjunction with a Magnavox Radio Telemegafone. The music which is sent out by NSF—Anacostia, D. C., distance about 500 miles—is reproduced with such a volume that on several occasions it has been heard at places a half mile distant from our operating room.

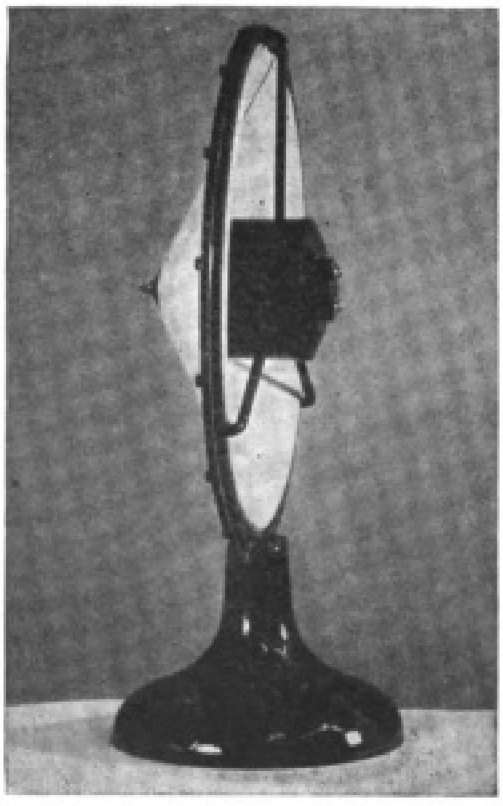
Another experiment illustrating the sensitiveness of the amplifier was the placing of a music modulator, used in radio telephony, in another antenna system a short distance away. The modulator was connected directly between the antenna and ground with no battery or source of current flowing in it except that which was being discharged from the earth. The music and speech which was received from this antenna system was as loud as that from an ordinary gramaphone.

It is evident that amplification of this order is practical beyond the second stage, and it is the hope of the writer that this article may be of some benefit to those who have been troubled with the "howl" of audio-frequency amplification.

An Electrical Sound Converter

By Arthur H. Lynch

THE production of speech and music, received over wireless telephone circuits, has become quite a popular sport. We find nearly every radio club and many homes supplied with one form or another of the so-called "loud-speakers." Their application to radio has been a fact for some little while and instances without number have been mentioned where these machines have acted as the mediums for conveying sounds to large gatherings, which would otherwise have been unable to hear them. A new principle, recently put into commercial use by the Pathe Phonograph Co., has been adapted to the radio art. The new type of phonograph is made without a horn and the vibrations from the needle are taken up by a large conical diaphragm, which produces sound waves that are at least equal in intensity and generally conceded to be of even greater volume than that produced by phonographs with horns.



To the center of the conical diaphragm there is attached a metal plunger which may be influenced by magnetism, and part of the plunger is included within the normal magnetic field produced by two windings over a single iron core, as shown in the diagram. Variations in the current flowing through the windings produce a varying magnetic force in the magnets and their field, so that these variations are reproduced by a vibration of the plunger attached to the diaphragm. Vibration of the plunger results in a vibration of the diaphragm and a production of sound waves. The tone of the sound waves depends upon the number of vibrations of the diaphragm within a given time period, while the volume of the sounds depends upon the distance the diaphragm is caused to move from its normal position. By using this solenoidal action, there is no need for any mechanical connection between the plunger, which actuates the diaphragm, and the source of power which drives the plunger. This eliminates many objectionable effects that frequently occur in musical repro-

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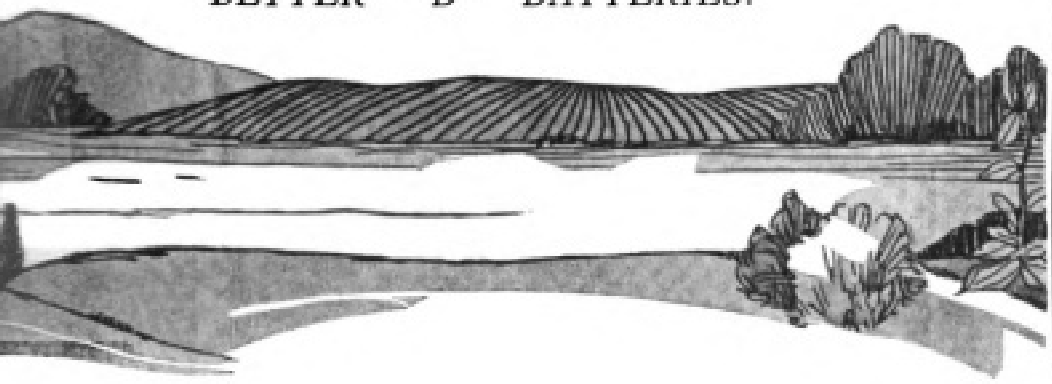

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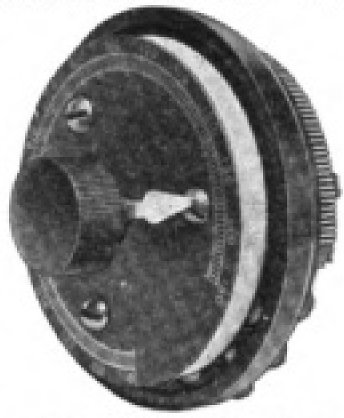

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duction. Reference to the accompanying diagram will indicate the manner in which this machine may be used in conjunction with a receiving station for the production of pure speech, or for transmitting music by radiophone.

The Phonetron is not intended to be used for filling large places with the received sound, such as theatres and large halls, but for smaller places.

In addition to its use, in conjunction with receiving circuits, the Phonetron may be used in connection with a radiophone transmitter, for the production of clearer speech than is possible with the ordinary microphone. The circuit which has been used for this purpose is given with the requisite constants, so that anyone desiring to, mav employ it. In this application there is a complete reversal of the action of the device. Instead of producing sound waves by the action of a changing magnetic field, the diaphragm is caused to vibrate by the voice or the sound waves of the phonograph and these vibrations cause the metal plunger to vibrate within the magnetic field. This vibration of the plunger results in a change of the magnetic field, which affects the current flowing through the windings of the magnetic circuit and those to which they are connected so that there is produced a series of electrical waves which correspond to, or are a function of the sound waves which are made to actuate the diaphragm. Where it is desired to have the music of an orchestra sent over the wireless telephone, it will not be necessary to have the musicians gather closely around a horn connected to the phonetron, as is the case when the ordinary microphone is used for transmission.

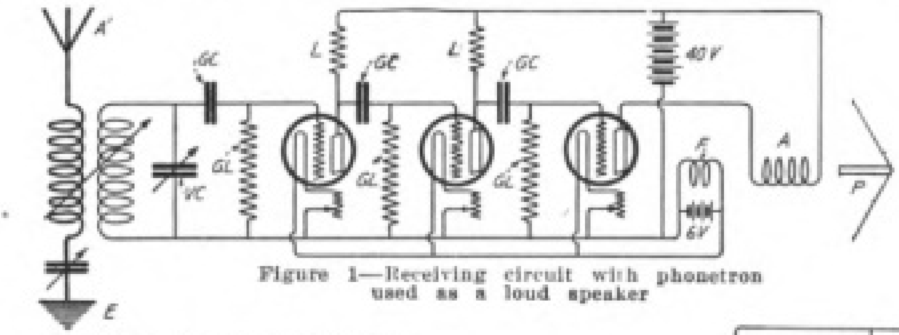

Figure 1—Receiving circuit with phonetron used as a loud speaker

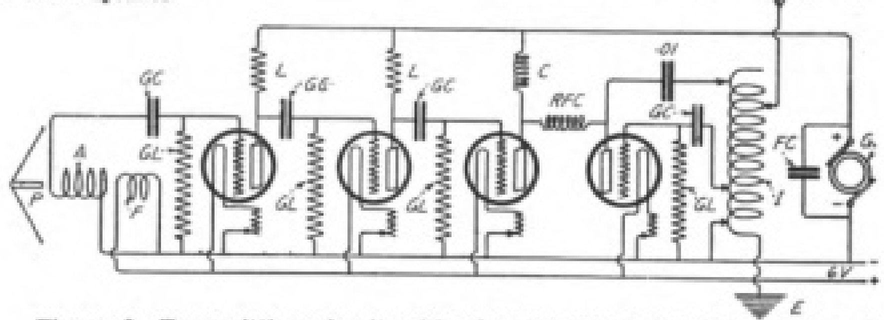

Figure 2—Transmitting circuit with phonetron used in place of the ordinary microphone

Why the "Cage" Antenna?

By E. D. Forbes

AMONG amateur radio experimenters the "cage" type of antenna seems to be considered a new type of antenna which is more efficient than other forms of antenna. As a matter of fact, reference to standard text-books on radio engineering proves that this type of antenna was really one of the first employed in the art. It remains, therefore, to determine whether the cage type has any particular advantages as compared to the flat-top antenna or to other forms and whether such advantages are of especial interest to the amateur. In discussing these questions it will be best to confine the discussion to a comparison of the cage type with the most common form of antenna used by the amateur, that is, a multiple wire flat-top arrangement in which the wires, whether in flat-top or in down lead, all lie in one plane.

The most interesting property of the cage antenna is due to the fact that its form enables corona losses to be reduced. This property may be illustrated by an experiment which can be performed by anyone having about ½ KW. of A.C. power available. It is only necessary to construct small models of the antennae to be studied and to overload them until the corona distribution is clearly evident. The electrostatic capacity of the two antennae being compared should be as nearly the same value in each as possible. Use of a small scale model enables very strong corona discharges to be obtained with a small amount of power.

Figure 1 represents schematically an arrangement for comparing a small cage antenna with a small flat-top antenna. In this figure, AB is a four wire flat-top antenna to be compared with a four-wire cage antenna, CD. T may be a Tesla coil secondary (or other well insulated coil) for which P is the primary circuit. In order to produce the maximum corona discharge for a small power input, the adjustments of circuits T and P must permit very close tuning.

The given dimensions are such that the spreader of antenna AB will make the hoop spreader of antenna CD when bent into a circle. Consequently the wire spacing is equal in the two antennae. This condition of equal wire spacing is necessary in a portion of the following discussion. The capacity of the cage antenna with these dimensions will be about 85 to 90 per cent of the flat-top antenna capacity, a condition which, while it favors the flat-top antenna, does not interfere with the success of the experiment.

Now, when power is applied to antenna AB, it will be noted that the corona discharge is very pronounced on the two outer wires, but is comparatively small on the two inner wires. The discharge, when viewed in a dark

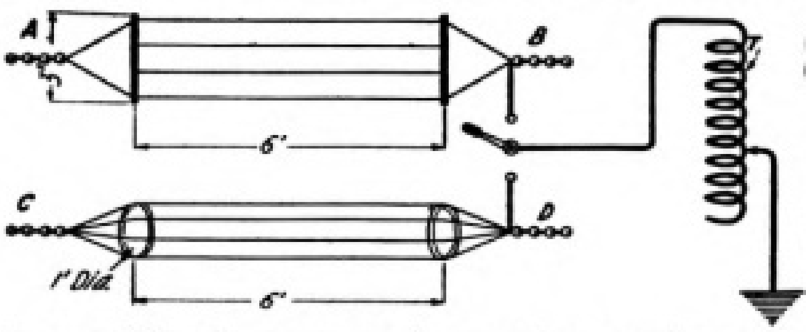

Figure 1—Schematic arrangement for comparing a small cage antenna with a flat-top one

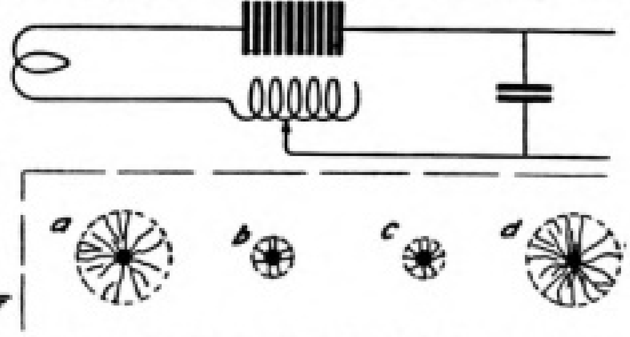

Figure 2—Corona discharge of a flat-top antenna

room, appears to have such a distribution as is shown in figure 2. On the two outer wires the apparent diameter of the discharge appears considerably greater than on the two inner wires. The significance of this phenomenon is discussed in another paragraph.

When, however, the cage antenna is connected in place of the flat-top (power being kept constant and the circuits carefully retuned) no corona or very little corona will be visible on the wires. If present, an equal amount will appear on each wire.

It is to be concluded, therefore, that for approximately identical conditions, the cage antenna is very efficient in preventing corona losses.

The distribution of the corona in an antenna system depends upon the way in which the current is divided between the antenna wires. Since the currents repel each other, any unbalanced arrangement of wires, such as exists in the flat-top, causes the two outer wires to carry more current than the two inner wires while the balanced arrangement given by the cage, causes the current to be equally divided between the wires. Increasing the separation of the wires in a flat-top will also cause a more uniform distribution of the current, but the resulting increase in electrical efficiency may be more than offset by the mechanical disadvantages due to the necessary wide spacing of the conductors.

Unequal current distribution may also increase the I^2R losses in the antenna system. For example and referring to figure 2, assume that the currents in wires a and d are four times greater than those in b and c. The total I^2R, assuming unit resistance, is

for a and d, $2 \times 4^2 = 32$
for b and c, $2 \times 1 = 2$
giving a total of $\overline{34}$

If, however, the total current of 10 units is divided equally between the four wires, each wire carries 2.5 units and the total I^2R loss is equal to 25.

From the above discussion, it appears that the cage antenna will be preferable to the flat-top antenna for use at high voltages and because the more uniform current distribution will decrease the losses. Reduction of I^2R losses is desirable in any case but it remains to determine whether voltages on antennae used by amateurs are high enough in general to make the cage antenna more desirable than the flat-top.

ANTENNA VOLTAGES

Although many amateurs are using continuous or undamped wave transmitters, there are still many who have damped wave sets. Consequently consideration of the antenna voltage conditions that may be experienced with either type of transmitter will be of interest.

In a damped wave transmitter corona discharges are frequently observed on account of the large maximum value (as compared to the average value) which may be reached by the antenna voltage during a wave train. In case the voltage reached by several of the oscillations during the wave train exceeds the critical voltage at which corona discharges start, the losses in the antenna system will be increased and the radiation output decreased to correspond. The possible magnitude of such voltages may best be illustrated by numerical examples using constants that are typical of amateur stations.

Assume
Antenna capacity, .0005 microfarad.
Working wavelength, 200 meters.
Radio frequency, 1,500,00 cycles.
Antenna circuit inductance, 200 meters, 22.5 microhenries.
Spark frequencies, 1,000 and 250 per sec.
Decrement, 15 per complete oscillation.
Antenna current, 5 amperes.

The maximum voltage per wave train is found by first calculating the corresponding maximum value of the current in the antenna circuit from the formula

$$I\ max. = \sqrt{\frac{8\,n\,\delta\,J^2}{N}} \ldots\ldots\ldots \text{(A)}$$

where
I max. = maximum current in amperes.
J = current in amperes as measured by thermal ammeter.
n = radio frequency.
N = spark frequency.
δ = decrement per ½ oscillation.

Then the corresponding maximum value of the voltage is calculated from the equation

$$V\ max. = I\ max. \sqrt{\frac{L}{C}} \ldots\ldots \text{(B)}$$

where
V max. = maximum voltage on antenna (volts).
I max. = maximum amperes in antenna circuit (amperes).
L = antenna circuit inductance (henries)
C = antenna capacity (farads).

Using formulae (A) and (B) with the given data and at 1,000 sparks per second

$$I\ max. = \sqrt{\frac{8 \times 1{,}500{,}000 \times .075 \times 5^2}{1000}}$$

$$= \sqrt{2\ 25\ 00} = 150 \text{ amperes.}$$

$$\text{and } V\ max. = 150 \sqrt{\frac{.000\ 022\ 500}{.000\ 000\ 000\ 5}}$$

$$= 150 \sqrt{4\ 50\ 00}$$

$$= 150 \times 212 = 31\ 800 \text{ volts.}$$

At 250 sparks per second
I max. = 300 amperes.
and
V max. = 63 600 volts.

It may be assumed that corona effects will not be very appreciable for the size of antenna wire ordinarily used and for damped oscillations until the antenna voltage exceeds 50,000 volts. Therefore, in the above example the voltage is well below the critical value for 1,000 sparks per second, but is about 50 per cent. too great at 250 sparks per second. At 125 sparks per second the voltage will be 89,100 volts. These results are based on the assumption that the current in the antenna circuit remains constant, which in turn requires that the power input be kept constant when the spark frequency is changed.

Reference to equation (A) brings out the following facts, of which one, i.e., that relating to the effect of spark frequency variation, has been illustrated by numerical example:

For constant power input
(a) decreasing spark frequency increases antenna voltage.
(b) decreasing decrement decreases antenna voltage.
(c) decreasing radio frequency decreases antenna voltage.
(d) increasing antenna current increases antenna voltage and for (b), (c) and (d) the changes are directly proportional to the square root of the quantities as stated in the equation while for (a) the change is inversely proportional to the square root of the quantity.

A high value of radio frequency is imposed upon the amateur by the law and any consequent undesirable conditions cannot be avoided. Low decrements can be obtained by use of counterpoise and low resistance conductors in the antenna system. Spark frequency effects are also subject to individual preference.

The maximum voltage for an undamped or continuous wave transmitter is very simply expressed by the equation

$$E\ max. = \frac{I\ max.}{\omega C} \ldots\ldots\ldots\ldots \text{(C)}$$

where
E max. = antenna voltage (volts).
I max. = current in antenna circuit (amperes).
= 1.4 times thermal ammeter reading.
C = antenna capacity (farads).
$\omega = 2\pi n$ where n is the radio frequency.

Corona is determined by the peak or maximum value of the oscillations which is obtained by multiplying the effective value (thermal ammeter reading) by 1.4.

For an example, assume the following values which are suitable for a low power, short wave, C.W. transmitter.

Antenna current I = 5.0 amperes.
Corresponding I max. = 1.4 times 5.0 = 7.0 amperes.

Antenna capacity C=.0005 microfarad.

For 200 meter set $\omega = 2\pi \times 1{,}500{,}000$. Whence

$$E\ max. = \frac{7.0}{5\times10^{-10}\times2\pi\times1.5\times10^{6}}$$
$$= 1480 \text{ volts.}$$

The great advantage of undamped over damped oscillations is at once obvious, as far as corona is concerned, since, for a given antenna current, the antenna voltage is reduced approximately 2.5 per cent. to 5 per cent. of the voltage produced by the same antenna current for spark frequencies of 250 and 1,000 per second, respectively Also since the voltage in the case used for illustration is so low (1,480 volts) it is not necessary to make use of a special form of antenna to reduce or to prevent corona losses.

In concluding this discussion, another example is necessary in order to fix the maximum current that can be safely carried by this antenna without exceeding the critical voltage. Since this voltage as previously assumed is about 50,000 volts, the current required to produce this voltage may be calculated by re-writing equation (C) in the form (D) and substitution of the given numerical values.

$$I\ max. = E\ max.\ \omega\ C \quad \ldots\ldots\ldots (D)$$
$$= 50{,}000\times2\pi\times1.5\times10^{6}\times5\times10^{-10}$$
$$= 237 \text{ amperes.}$$

This result shows that it is impossible for the amateur to overload an antenna of the given capacity with any amount of power that he is permitted to use at the present time by the Department of Commerce.

The value of 50,000 volts assumed as the critical voltage at which corona starts for damped oscillations is rather too high when considering undamped oscillations. Fatigue of the dielectric (air) surrounding the conductor causes corona discharges to start at lower voltages. Probably the critical voltage for undamped oscillations will not exceed 20,000 to 30,000 volts and in such case the maximum current calculated from (D) will be correspondingly reduced.

Conclusions

The conclusions to be drawn from this discussion are (a) that the amateur using undamped oscillations need not be greatly concerned about the form of his antenna in reduction of corona losses, but that he may obtain more uniform current distribution by use of the cage type with resultant improved circuit efficiency, and (b) that the amateur using damped oscillations needs the cage form of antenna for even small power input in order to reduce corona losses as well as to obtain uniform current distribution.

Coupling Duo-Lateral Inductances

By Howard S. Pyle

COUPLING devices for honeycomb duo-lateral and other similarly wound coils, have been constructed in many styles. The following data describes two that have been found satisfactory in operation.

The first figure suggests a hinge method of coupling, the chief merit of which lies in the method of controlling such coupling variation and permitting the control knobs and dials to be separated at any convenient distance on the panel.

The secondary coil is mounted in a stationary position, as is customary, on the rear of the panel in the center. All three coils are fitted with wooden centers. The other coils are mounted one on each side of the secondary, one for tickler and the other serving as the primary inductance. These two coils are secured to the panel by small brass hinges and on the centers are mounted another pair of small brass hinges, one to each coil. This completes the coil mounting.

The knobs and dials controlling the coupling must be on the same longitudinal center as the coils, but may be separated at any convenient distance. A dial is shown, which takes a 3-16 inch smooth brass shaft about three inches long. This passes through a 3-16 inch hole in the panel and over the shaft on the inner side of the panel a turned wooden shaft and disc are slipped, which resembles a thread spool cut in half. These may be turned in one piece, or may be a wooden turned shaft with a wooden disc secured to the end by small screws. A set screw through the center of the shaft section of the wooden piece secures it to the brass shaft in a manner similar to that in which the knob and dial are secured to the same shaft.

Two brass rods are made up of stock about 3/16-inch wide by 1/16-inch thick and of a length sufficient to connect the hinge on one of the coil centers to a pivot placed about ¼-inch in from the inside edge of the wooden disc. A small hole is drilled in each end, and the brass strip connected by a small machine screw pivot to one of the hinge holes at the coil end and by a wood screw pivot driven into the face of the wooden disc.

It will readily be seen that when the knob and dial are rotated the wooden disc is also turned which, by means of the connecting rod to the coil, pulls the hinged coil away or pushes it toward the secondary coil, which varies the coupling as may be required. It is also seen that but a quarter turn of the knob and dial is required to bring the coupling from minimum to maximum, which permits the employment of a 90-degree scale on the dial. The degree of coupling obtainable will vary with the size of the wooden disc and will, of course, be varied to suit the builder. It is understood that the disc diameters and other dimensions given

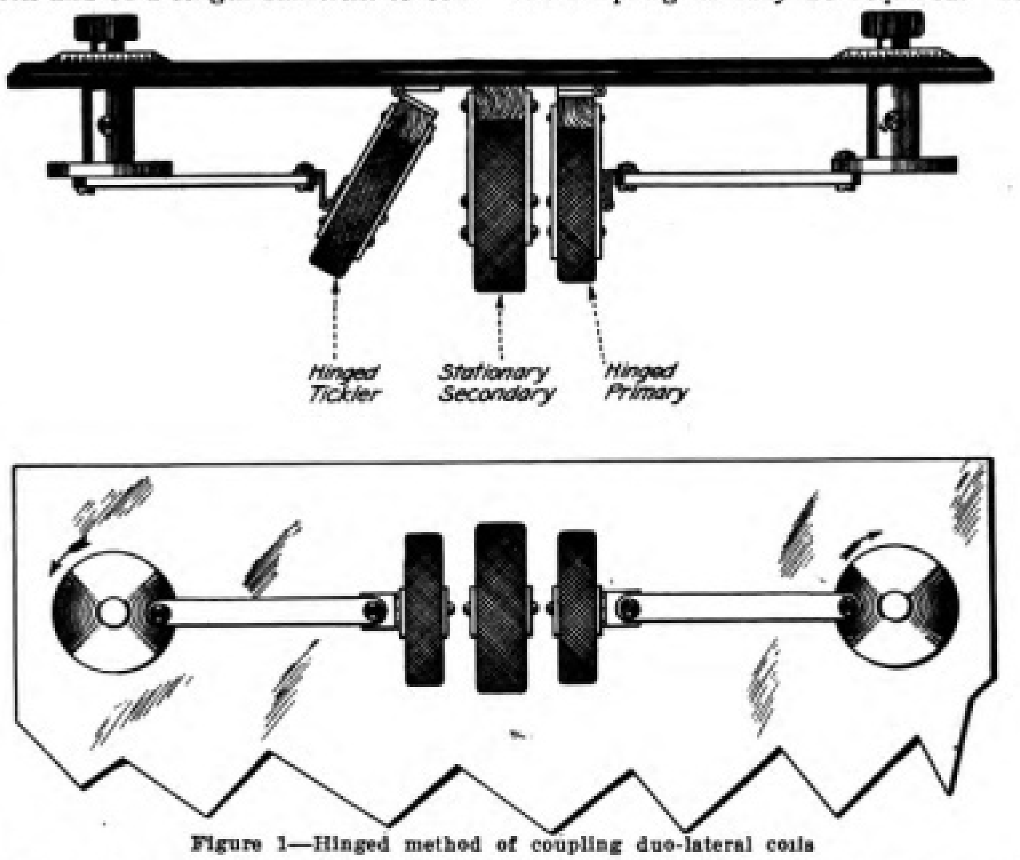

Figure 1—Hinged method of coupling duo-lateral coils

in the drawings are only suggestions and do not necessarily have to be adhered to.

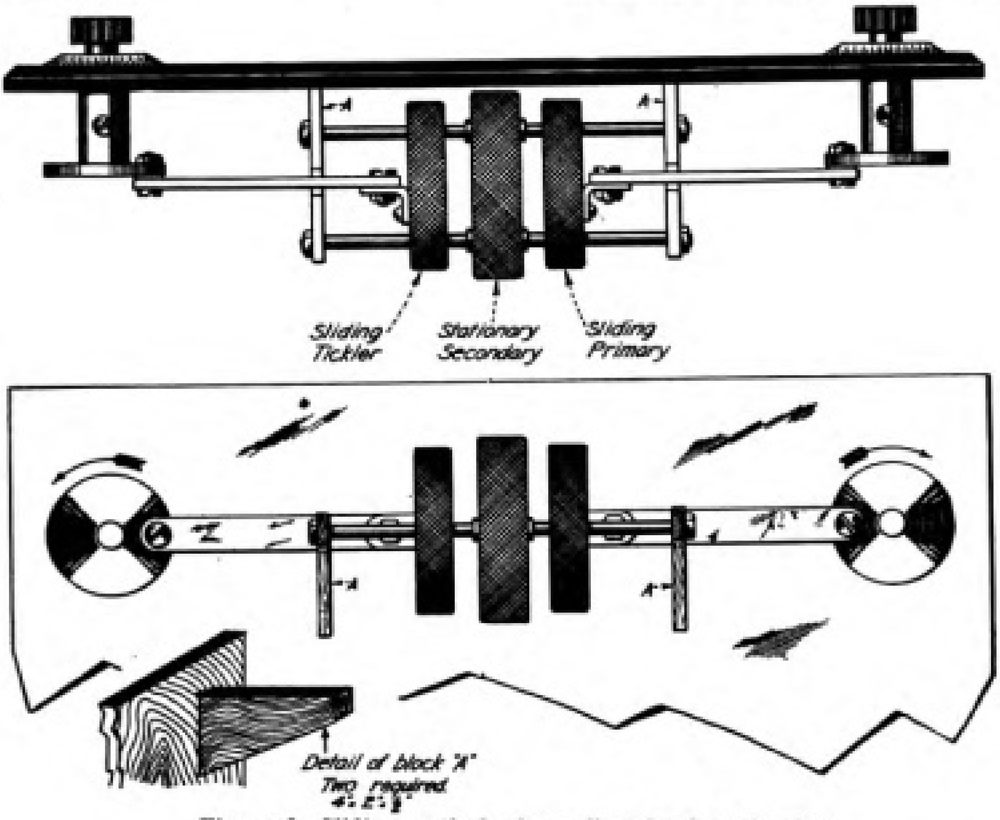

Figure 2—Sliding method of coupling duo-lateral coils

The second coupling scheme involves the same form of knob, dial and bobbin control, but the mounting of the coils follows out another standardized scheme.

Rather than hinging the coils to the panel, two blocks are made as at A in figure 2, and mounted as shown on the rear of the panel. These serve as supports for two brass slider rods, which in turn support all three coils. The coils have wooden centers, as in the first method, but are drilled with two holes to slide along the brass rods. The secondary coil is slipped on the rods and secured in the middle. The primary slides toward center from one side and the tickler from the opposite side. The sliding is accomplished by means of the disc and connecting rod method as in figure 1. Small brass angles are used on the primary and tickler cores rather than hinges, and the connecting rods are pivoted to the angles by small machine screws.

There is little choice as to preference between the two methods, but No. 2 scheme involves less mechanical construction, although it is not as smooth working as the first method.

It is understood, of course, that these designs involve the use of a fixed set of coils, not arranged for rapid change of coil units. They are therefore more adapted to the tapped coils, which give a wider wave length range on one set of coils. The first method, elaborated to use the plug system of coil changing, could, of course, be worked out to take the various coil changes involved in reaching all waves in use.

General Notes on Matters Radio

By S. Solomon

VACUUM tubes are expensive, also they are perishable. Apart from possible breakage of the tube the main danger to the life of the tube is the burning out of the filament. The best advice which can be given in this connection is to take care. Foolproof devices have as yet not been made for the prevention of burning out filaments, so recourse must be had to simple devices, using filament fuses, and resistance in series with the filament.

The low life of tubes is also due to the fact that as the filament is used its diameter decreases and its burning temperature rises. The decrease in diameter of the filament is due to evaporation of the tungsten at the high burning temperatures, evidenced by the dark deposit on the inner wall of the glass bulb. As the diameter of the filament wire decreases, with the current in the filament constant, it follows that its temperature after a hundred hours of use will be much higher than when the tube was first used. A small increase in temperature raises the rate of tungsten evaporation enormously and hence its life decreases. The problem is how to prolong the life of the tube.

Investigations and analyses of the problem show the following. There are three possible constants which can be varied in the operation of the tube, namely the current in the filament, the voltage across the filament, and the power input in the filament. It has been proved that if the current in the filament is kept constant through its life there will be a very great rise in the temperature of the filament for the given current due to the decrease in filament diameter. It has also been shown that if the power input to the filament is kept constant the temperature rise of the filament will not be very great, only about 3 per cent. It has finally been shown that if the voltage across the filament is kept constant throughout its life there will not be a rise, but a drop of about 2 per cent. in the temperature of the filament. Thus we see that constant current in the filament decreases the life enormously, constant power decreases the life considerably less than constant current, and constant voltage—causing a drop of the filament temperature—results in the longest life to the filament. Thus it is preferable to use a voltmeter across the filament than an ammeter. To prolong the life of the tube to a maximum make adjustments of the rheostat so that the filament voltage is always the same. It is for this reason that many of the commercial tube sets are appearing not with filament ammeters but with filament voltmeters.

A great many amateurs very often work their tubes much harder than they should be worked. They think that if they push their filament currents "just a little bit higher" they will receive louder signals or put more juice into their antenna. If they thoroughly understood the relationship between filament current and life they would certainly not do this. Every tube filament, receiving or transmitting, is designed so that it should be worked at what is called its "safe temperature"—that is, a temperature which will give it the most economical life, which is usually considered to be about 2000 hours. Now the value of this safe temperature varies with the size of the filament. Thus the safe temperature of a three mil filament is 2415 degrees Kelvin, that of a seven mil transmitter filament is 2460 degrees Kelvin, etc. Each of these temperatures is developed when a definite current, depending upon the size of the filament wire, flows through the filament. At each of these safe temperatures the evaporation of the filament wire is such that its life is about 2000 hours. This evaporation, which determines the life of the filament, increases enormously with small rises in filament temperature. Consider a transmitter tube with a seven mil filament whose safe temperature is 2460 degrees. It is found that its evaporation may be expressed in relative units by the figure 2.3 grams per sq. cm. per second. If now this temperature is raised only one per cent. to 2485 degrees its evaporation will increase from 2.3 to 3.6, or about 55 per cent. In other words a rise in filament temperature of one per cent. raises the filament evaporation by more than 50 per cent. and so decreases the life of the tube by one-half! Now this rise of one per cent. in the filament temperature can be effected by a small rise in filament current, say about 2 per cent. It is thus evident that filament currents should not be pushed because the decrease in the life efficiency of the filament more than counterbalances any possible increase in output of the tube.

In connection with this question of the life of tube filaments a word of caution may be given with regard to the manner of connecting the plate battery to the filament. It is well known that the plate current combines in the filament with the filament current. If the negative of the plate battery is connected to the negative of the filament battery the plate current will add to the filament current in the negative leg of the filament (see figure 3-a), and this increase in many cases is high enough to be harmful to the tube. If it is connected to the positive of the filament battery there will be a decrease in the filament current and this is far more preferable, as it is safer for the filament. Another advantage in connecting the negative of the plate battery to the positive of the filament battery is that in this way the voltage of the filament battery adds on to the plate battery and is thus effective on the tube plate.

Effect of Metal Bodies on Radio Frequency Circuits

Every amateur knows that if there are steel buildings in the neighborhood of his antenna his radiation is thereby affected. This fact holds whether the metal body is a steel building or tower or small magnetic bodies. The magnetic bodies alter the magnetic field and absorb considerable radio frequency energy thus decreasing the radiation. This fact furthermore holds whether the radio circuit so affected is an antenna or coil and condenser, transmitter or receiver, and also whether the metal body is magnetic or not. Thus aluminum or copper bodies in the neighborhood of radio circuits will alter the output because eddy currents are induced in these metallic bodies and the eddy currents react upon the circuit exactly as the secondary of a transformer reacts upon the primary. In other words the metal body behaves like a short circuited secondary, the primary being the inducing circuit. Consequently care must be taken that near the various radio circuits in the transmitter or receiver there are no heavy metallic bodies. The incidental small metal pieces in the set are necessary, but at least they should not be made of magnetic material.

Figure 1

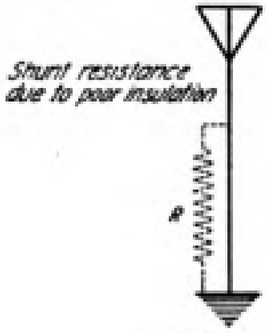

Figure 2-a

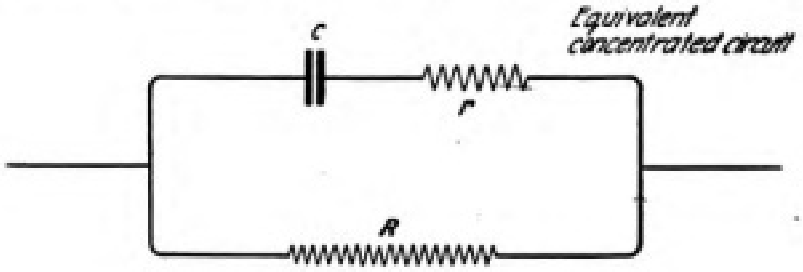

Figure 2-b

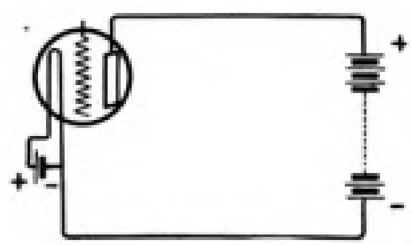

Figure 3-a

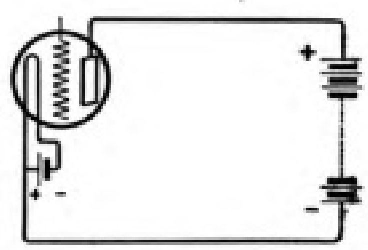

Figure 3-b

Diagrammatic details of correct connections, shunt resistance and proper insulation

Insulation

The problem of insulation in radio work presents entirely different aspects from insulation in D. C. or low frequency A. C. work. The amateur is apt to consider that if he uses a nonconductor having a very high resistance his insulation problem is solved. The question is not quite so simple. In radio it is possible to have megohms of resistance in the circuit and still show no signs of insulation. For example, a thin sheet of mica between two conductors interposes an enormous resistance and for D. C. would be an absolute barrier to the flow of any current. For radio currents of high frequency no insulation at all may be presented, the condenser effect thus produced would result in by-passing any radio frequency current. Another practical example of this effect is the common experience of winding together two insulated wires. No effect would be observed on D. C., but in radio work these two insulated wires might present enough capacity effect to be useful in receiving radio signals. Again two wires lying side by side, separated in air, are apparently well insulated from each other. But leakage currents at radio frequencies will easily evidence themselves and thus prove the apparent insulation to be quite inefficient.

Thus effective insulation against radio frequency involves two factors:

(1) A high ohmic resistance must be available.

(2) The capacity effect produced by the insulation must be negligible. This condition requires the thickness of the insulation to be large compared to the area of insulation.

In high voltage work, for example, on transmitting antennas and high voltage transformers, the only way in which to prevent leakage, sparking from one conductor to another is to make the path along the insulator from one conductor to the other as long as possible. That is, breaking down of insulation does not necessarily imply piercing the insulator. The more frequent manner in which insulation breaks down is by slow surface leak-

(*Continued on page 42*)

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Guglielmo Marconi, *President* — J. Andrew White, *Acting President* — H. L. Welker, *Secretary*

Founded to promote the best interest of radio communication among wireless amateurs in America

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HEADQUARTERS: 326 BROADWAY, NEW YORK

ALL distance records for two-way work by amateur radio stations were broken on the night of November 12th, at midnight, when Amateur Stations 5ZA at Roswell, New Mexico, and 2ZL ,at Valley Stream, Long Island, were in easy communication for twenty minutes, no trouble being experienced in reception at either end of the circuit, with both stations using only one step of audio frequency amplification. The airline distance between the two points is 1,800 miles.

Earlier in the evening 2ZL and 8ZG, at Salem, Ohio, had exchanged traffic and it was then noted that conditions for long distance work were good. About 11.30 P. M. 8ZG heard signals from 5ZA and called, and 5ZA answered. Traffic was then exchanged between 5ZA and 8ZG, an airline distance of 1400 miles, and among the traffic sent from 5ZA was a note to 2ZL, saying that 5ZA was hearing 2ZL well. All of the traffic sent to 8ZG had been heard at 2ZL including the note addressed to 2ZL. As soon as 8ZG had finished with 5ZA, the former station called 2ZL and passed along the note. 2ZL immediately called 5ZA and the latter answered reporting the signals of 2ZL as of good audibility there. Once communication had been established, several messages were exchanged without difficulty.

All the stations concerned in this exceptional work used tube transmitters, but of different types. At 8ZG, the station of A. J. Manning, a 100 watt Kenotron set is used. The set used by Louis Falconi, at Roswell, is of 100 watt output capacity, employing two Radiotrons U V 203, with D. C. plate voltage supply. The set at 2ZL is of 250 watts output capacity, employing two Radiotrons U V 204, in a self-rectification circuit, A. C. being used on both filaments and plates.

Reports have been received that the signals of 2ZL were clearly heard at Tucson, Ariz., Station 6AMT, Nogales, Ariz., WJK, Taft, Calif., and 6GZ, Los Angeles, Calif., during the time 2ZL and 5ZA were in communication, a maximum overland airline distance of 2,500 miles.

▽ ▽

F. CLIFFORD ESTEY, President and Secretary of the Essex County Radio Association of Radio Clubs in Essex County, has become associated with the Clapp-Eastham Company, Cambridge, Mass., as sales manager. Mr. Estey will direct all sales and advertising work for the well-know C-E line of Radio Equipment and Electrical Laboratory Apparatus. New England radio men among whom Mr. Estey has so long been a prominent and popular figure join in congratulating him on his new connection and extend heartiest wishes for success.

△ △

THE First Surinam Radio Association of Paramaribo, Surinam, Dutch Guiana, South America, is a young body, established under legal charter, with the object of furnishing its members, who must be either radio amateurs or students, with the latest information on the most recent inventions, reading and study in wireless.

It is part of the policy of the association to establish friendly relations with associations and clubs of a similar nature in other parts of the world. The association, therefore, requests that other clubs and associations correspond with it.

▽ ▽

AMONG the guests at the opening of Radio Central at Rocky Point, L. I., was the original old timer, John Grinan, 2PM, of pre-war days. Although not operating an amateur station at present, and having business interests in other fields, Mr. Grinan could not resist the call of radio. He was at Kingston, Jamaica, in the West Indies, when his invitation reached him, and took the first steamer for New York, landing there just in time to miss the special train for Rocky Point. He continued the trip by automobile with George Burghard, however, and was present when WQK made its first dot. "Wouldn't have missed it for anything," he said. And from the trouble he took to get there he evidently meant it.

▽ ▽

WHAT is the matter with the air? Seems as though somebody had taken all the life out of it and also that Old Man Static doesn't know that summer is over. O. M. S. would know summer was over if, like some of us, he'd just paid a bill for a cellar full of coal to keep the house warm during these long winter nights, so we can sit up and pound a key all night.

▽ ▽

IT is a frequent occurrence nowadays to hear good C. W. signals from a station 1,000 miles or more away and upon feverishly postcarding the owner, to find out how many ¼ K. W tubes he is using, to have him laconically reply "One 5-watter."

▽ ▽

HOOK up your long wave sets, and tune up to 16,465 meters and listen for WQK, Radio Central, the most powerful transmitter in the world, bar none. But insulate your ears first. There are 600 amperes and 100,000 volts behind that signal.

▽ ▽

THE first annual get-together of the Northern New Jersey Radio Association was held on the evening of November 4, at Krueger's Auditorium, Newark, N. J., and was attended by 150 enthusiastic radio amateurs.

The chairman of the get-together committee, F. B. Ostman, opened the proceedings with a few words and requested the hearty co-operation of all the amateurs in this section in observing the Traffic Rules and Regulations which have just been adopted by the Second District Executive Council for our mutual benefit. Mr. Ostman then introduced the officiating chairman of the evening, Mr. Lester Spangenberg, 2ZM: Mr. Spangenberg spoke on the advantage of a get-together of this kind by meeting "your radio friends personally." Next was introduced Mr. Dewitt Paxton, a professional entertainer, who immediately put the crowd in an uproar with his incessant live wit and humor.

Next in turn came Mr. Paul Godley, who was right at home here surrounded by his many New Jersey friends. Mr. Godley held the undivided attention of all while he outlined the real efforts of the Executive Council to improve operating conditions in the Second District by the adoption of the operating rules and regulations. He requested at least a fair trial for these regulations; also that every radio organization not now a member of the council to join at once. Dreams for better DX by using radio frequency amplification were shattered when Mr. Godley explained that the present regenerative receivers were giving amplification on DX signals equal to that obtained with three and four stages of radio frequency. Needless to say this came like a "bombshell" to many who have been looking for tubes, data, etc., for the construction of radio frequency amplifiers.

Mr. Godley spoke of his trip abroad to copy our signals in the transatlantic test and the co-operation extended by large manufacturers, officials of large radio corporations and the British Government to make this undertaking a success.

Mr. C. W. Stotesbury gave a masterful exhibition on the piano. The popular airs he played during the evening seemed to inspire everyone with song and dance.

Representatives were present from mostly every radio organization in Northern New Jersey. A goodly number of OW's were also present and did much to enliven and inspire with their fair faces. The call letters of many well known stations were called and the owners arose amid rounds of applause. Some were greeted with shrill whistlings which sounded like QRM. It was after midnight when the affair came to an end with the playing of the "Star Spangled Banner."

▽ ▽

TRAFFIC rules to govern about 650 amateur radio operators in and about St. Louis were adopted at a meeting of committees of the St. Louis Radio Association in the Marquette Hotel, held on October 11. The rules follow:

Between the hours of 6 a. m. and 7 p. m. any station may test, tune or transmit, either locally or long distance, without interruption.

Between the hours of 7 p. m. and 10 p. m. stations may transmit locally only.

Between the hours of 10 p. m. and 11.30 p. m. transmission will be restricted to long-distance work only.

From 11.30 p. m. to 6 a. m. is also assigned to long-distance work, and those stations who have worked from 10 p. m. to 11.30 p. m. may not transmit after 11.30 p. m.

All radio telephones and "C. W." sets are considered as radio transmitters and will be governed by the above regulations.

TO an amateur radio operator the formal opening of Radio Central was an event of the greatest interest and significance. Contemplating the massive 410-foot towers, with their spreaders 150 feet wide, and knowing that the signals from the attached antenna were being copied half way around the world, caused no end of wonder as to the future possibilities of radio and what it will ultimately accomplish.

▽ ▽

THE fourth meeting of the Radio Club of Hudson County was held at Moose Hall, Foye Place and Bergen avenue, Jersey City, recently. President Smith presided. It was decided to hold all meetings in the future in this hall because of its central location with respect to the rest of the county.

A very interesting talk was given by the vice-president, T. W. Cooper. Mr. Cooper is connected with the New York Edison Company and has had a wide experience in engineering. He served in the Signal Division of the A. E. F. and was able to give some first-hand information on this phase of the radio work. Amateurs desiring to become members may write to the secretary, John A. Erhard, 311 Maple street, West Hoboken, for application blanks.

▽ ▽

AT a regular meeting of the La Crosse, Wis., Radio club on October 12, Mr. Junker of the La Crosse high school gave a talk on the variometer used in radio work. The club voted to send out at 9.30, 2 p. m. and 9 daily weather bureau forecasts for Wisconsin, Minnesota and Iowa. Mr. Pierce gave a talk on radio and scouting.

All members of the Radio club 16 years or older will shortly be organized into a special instructors' service to serve as instructors to the new boy scout troops which will be organized in the near future.

▽ ▽

"HOW would you like one of those in your back yard?" said one amateur to another, indicating one of the 410-foot towers at Radio Central.

"Oh," said the other fellow, "that would fix me up in great shape. But I'm wondering about the Radio Inspector."

Upon repeating the question to a third amateur, he indicated a 75 foot post used for supporting telegraph and telephone lines, adding by way of reply: "That stick over there would satisfy me."

▽ ▽

THE regular meeting of the Detroit Radio Association was held on October 16. President Darr told the members that the hour between 10 and 11 p. m. had been set aside for long distance try-out work and that no local work be done during that time nor any traffic handled with any station.

Mr. Darr made it clear that Radio Inspector Edwards was in favor of the rules and regulations of the D. R. A. and that the inspector would correct any reported violations that were turned in.

In order that more time may be devoted to long distance work, Sunday morning has been set aside for DX work, no local work to be done up to 1 p. m. Sunday.

Mr. E. Boyes was called on to put before the association the final rules and regulations under which the D. R. A. will be divided into chapters. Five or more radio amateurs will be required to make up a single chapter but any one person may belong to another chapter if he so desires. However, he can represent only one chapter. One member will be required to represent the chapter in the executive council.

A special meeting of all chapters is to be held once each month and a special program is to be provided for these meetings.

There are to be two controlling bodies

Prize Contest Announcement

The subject for the new prize contest of our year-round series is:

RECTIFIERS FOR CHARGING STORAGE BATTERIES

CLOSING DATE :: JANUARY 1, 1922

Contestants are requested to submit articles at the earliest practical date.

Prize winning articles will appear in the March, 1922, issue.

All manuscripts should be addressed to the CONTEST EDITOR OF THE WIRELESS AGE.

One of our amateur readers suggests that we run a prize contest to bring out a cheap practical storage battery rectifier. The vacuum tube has made such apparatus an absolute necessity so let us hear from you with some original ideas and photographs of practical devices.

PRIZE CONTEST CONDITIONS—Manuscripts on the subject announced above are judged by the Editors of THE WIRELESS AGE from the viewpoint of the ingeniousness of the idea presented, its practicability and general utility, originality and clearness in description. Literary ability is not needed, but neatness in manuscript and drawing is taken into account. Finished drawings are not required, sketches will do. Contest is open to everybody. The closing date is given in the above announcement. THE WIRELESS AGE will award the following prizes: First Prize $10.00: Second Prize, $5.00; Third Prize, $3.00, *in addition to the regular space rate paid for technical articles.*

namely: the executive council and the board of directors. The executive council is to be an organization of representatives of all chapters who will take care of all requests for changes in regulations and other items of interest to the association. After all disputes are settled, their wishes will be presented to the board of directors for final action. The board of directors is elected by the association and has ten members. The board of directors elects the officers of the association out of the 10 elected by the association.

The 10 members elected are as follows, names appearing in the order of the highest votes received: C. E. Darr, E. G. Boyes, F. A. Lathrop, C. J. Crockett, G. Roustan, C. R. Witte, G. McIntosh, H. Tank, L. Bather and F. E. Lyons. The board of directors will hold a meeting in the near future and will elect officers of the Detroit Radio Association.

The West Detroit Radio Club has been organized and will, no doubt, be the first chapter under the new ruling. C. R. Witte, member of the board of directors, has been elected president of this club and states that a request will be made for a charter as soon as the system is well under way. Several other chapters are expected to be formed in the near future.

▽ ▽

THE annual election of officers was held October 17, by the Y. M. C. A. Radio Club of Pottsville, Pa. Harry Schoenfelder was elected president, Arthur Brown, vice-president, and Frank G. Kear, secretary-treasurer.

The club approved of the installation of a 1 K. W. transmitting set belonging to Charles Potts which will send messages a radius of 1500 miles on a 200 meter wave length.

▽ ▽

THE Radio Club, composed of students interested in wireless telegraphy, held its annual business meeting October 10 in the rooms of the Central Y. M. C. A., Troy, N. Y. The attendance was a testimonial to the increasing popularity of this new organization, and the club roster now contains more than thirty names, including the new members from the freshman class.

The elections resulted in the choice of the following officers: President, H. D. Harris, '23; vice president, H. R. Mimno, '21; secretary, I. C Singleton, '23; publicity manager, R. A. Gibson, '23; chief operator, L. S. Inskip, '22.

▽ ▽

THE Torrington Radio Club of Torrington, Conn., was formed at a meeting held October 10 at the home of Howard F. Anderson, 52 Field street. The following officers were elected: president, Floyd L. Vanderpoel of Litchfield; vice-president, Howard F. Anderson; secretary and treasurer, Joseph E. Mosier. These three officers with Allen G. Knight and Michael A. Gorman comprise the board of directors.

▽ ▽

A MEETING of the Ansonia Radio Association of Ansonia, Conn., was held recently at the high school building. A short talk was given on the fundamentals of radio communication and the construction and operation of a simple and inexpensive receiving set.

Through the courtesy of the board of education, the association will hereafter meet at the high school every Friday evening at 7.30 o'clock.

▽ ▽

THE Norwalk, Conn., Radio League held a weekly meeting October 11 at the home of its treasurer, Earl Lockwood, Westport avenue. The members were to have elected officers, but the election was postponed until a later meeting.

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JOSEPH N. NATHANSON of the Norwalk High School faculty and Ariel Ainsworth of the student body represented Norwalk at a convention held in Bridgeport recently for the purpose of forming a Radio league. A dozen other delegates from high schools in Connecticut were present. It is proposed to interest every high school in the State in the movement.

Mr. Nathanson was elected vice-president of the league. The president is Mr. Ham of Bridgeport, and the secretary and treasurer Mr. Moore of Danbury.

(*Continued on page 43*)

Stations Worked and Heard

Stations worked should be enclosed in brackets. All monthly lists of distant stations worked and heard which are received by the 10th of each month will be published in the next month's issue. For example, lists received by November 10th will be published in the December issue. Spark and C. W. stations should be arranged in separate groups.

2EL, HARRY H. CARMAN, 217 Bedell St., Freeport, L. I. (October).

C. W.—1BEA, 1CAK, 1UN, (3AHK), 3BL, (3BZ), (3CC), (3EM), 3FM, 3FS, (3RF), 3ZO, 4BY, (4FF), (4GL), 8ACF, 8AIO, (8AWP), 8BCI, (8BO), (8DE), 8II, 8KM, 8UK, 8WY, (8ZG), 9AAS, 9AJA.

Spark—1ADL, 1AMD, (1ARY), 1ASF, 1AW, 1AZK, 1BDC, 1BDT, 1BLE, 1DY, 1GM, 1HK, 1OJ, 1SN, 1ZE, 3ACE, 3AHF, 3ATZ, 3BFU, 3BGT, (3CC), 3CN, 3HJ, (3IW), (3OU), 3UQ, 4BC, 4DH, 4EA, 4EL, (4FD), 4GN, (8AFB), (8AFD), (8AGK), (8AHH), 8AMZ, 8AOA, 8APB, 8AQZ, 8AWX, 8AXC, 8AY, 8AYN, 8BA, 8BGT, 8BRL, 8BSV,8BSY,8BVA,8CI, 8CG, 8HG, 8HY, 8IL, 8JG, (8RQ), (8SP), 8TK, (8XE), 8ZN, 9AGR, 9AIR, 9ASJ, 9AV, 9AWZ, 9BDE, 9CM, 9CP, (9UH), 9VL.

2AQP, E. LAUFER, 690 East 137th St., New York. (October) One tube.

Spark—1ABB, 1ADD, 1ADL, 1AGX, 1AHL, 1AMD, 1ARY, 1ASF, 1AW, 1AZK, 1BCF, 1BDC, 1BDT, 1BFZ, 1BGF, 1BIR, 1BJE, 1BJN, 1BO, 1BPF, 1BVB, 1BWY, 1CK, 1DY, 1FV, 1GM, 1HK, 1IA, 1OE, 1OJ, 1QJ, 1RV, 1SN,1ZE,2AAL,2TF, 3ACE, 3ACF, 3ACM, 3AFH, 3AHF, 3AL, 3ALN, 3AQK, 3AQR, 3BDK, 3BE, 3BG, 3CC, 3DW, 3FB 3FF, 3GJ, 3HG, 3HJ, 3IW, 3JH, 3KM, 3LP, 3OU, 3QF, 3RW, 3TH, 3UQ, 3VW, 3XM, 3ZA, 3ZE, 4AC, 4BL, 4CB, 4CX, 4DH, 4DQ, 4EA, 4FD, 4UD, 5FV, 5XK, 8ACF, 8ACY, 8AFB, 8AFD, 8AFH, 8AFS, 8AGK, 8AHH, 8AHY, 8AIB, 8AJW, 8AL, 8AMZ, 8AOT, 8APB, 8AQV, 8ARD, 8AWN, 8AWP, 8AWU, 8AXC, 8AYN, 8BHV, 8BRL, 8BSY, 8DR, 8DY, 8EC, 8EW, 8EZ, 8FI, 8FT, 8HU, 8HY, 8IN, 8NP, 8OI, 8PB, 8RQ, 8RU, 8SP, 8TK, 8TR, 8TT, 8TY, 8UC, 8UK, 8XE, 8YN, 8ZD, 8ZN, 9AAW, 9AGR, 9AIR, 9AIU, 9AMT, 9AMC, 9ASJ, 9BDE, 9CP, 9KO, 9LY, 9MC, 9ME, 9OX, 9TJ, 9TL, 9TR, 9UH, 9UU, 9VL, 9ZJ, 9ZN, Can. 3BP.

C. W.—1AGI, 1AJP, 1AJU, 1AKB, 1AKG, 1AOL, 1ARY, 1AZT, 1AZY, 1BF, 1BKN, 1BYX, 1CAE, 1CAK, 1HK, 1HN, 1ID, 1IV, 1MP, 1OE, 1QN, 1RZ, 1UN, 1XM, 3APQ, 3BIY, 3BZ, 3EM, 3FS, 3GN, 3HG, 3MO, 3PS, 3RF, 3ZY, XF1, 4BY, 4CO, 4EA, 4EN, 4EW, 4FF, 4GL, 4ZL, 5DA, 6AFR, 7ZR, 8AEF, 8AIO, 8AJP, 8ALE, 8AMZ, 8AQF, 8AQG, 8AQZ, 8AWP, 8BKX, 8BO, 8BPL, 8CI, 8DA, 8DE, 8DR, 8FQ, 8GE, 8GV, 8II, 8IQ, 8JQ, 8JS, 8LF, 8LJ, 8NQ, 8RQ, 8RU, 8SE, 8UJ, 8UK, 8UQ, 8VJ, 8VY, 8WY, 8ZG, 9AAV, 9AJA, 9IW, 9RT, 9XM, 9ZY, Can. 3BP.

2OM, F. B. OSTMAN, Ridgewood, N. J. (November)

Spark—1ADC, (1ADL), 1ADM, 1AMB, (1AMD), (1ARY), (1ASF), (1AW), 1AXC, (1AZK), (1BCF), (1BDC), (1BDT), (1BIR), (1BJE), 1BKP, 1BLE, 1BRJ, (1BVB), 1BWY, 1CHX, (1CK), 1DF, (1DY), (1DZ), 1FB, (1FU), 1FV, (1GM), (1HK), (1IA), (1MA), (1OE), (1OJ), 1OT, (1QP), 1RV, (1SN), 1XM, (1ZE), 3AAN, 3AC,(3ACE),3ACM,3ACR, 3AGL, 3AIC, (3AL), (3ALN), (3AQR), 3ARM, (3ARN), (3ATZ), 3BC, (3BFU), (3BGT), 3BX, (3CC), (3CN), (3DM), 3DN, (3EZ), 3FM, 3GM, 3GX, 3HG, (3HJ), (3HS), 3HX, (3IW), (3KM), (3LP), (3OU), 3PB, (3QN), (3RW), (3TH), 3TT, 3UC, (3UQ), 3UX, (3VW), 3WX, 3XF, (3XM), 3ZA, 3ZE, 3ZO, 3ZZ, 4AG, 4AS, (4BE), 4BQ, (4BX), (4BY), (4CX), 4DH, 4DQ, (4EA), (4FD), 4GN, 4XC, 5DA, 5EA, 5ER, (5FV), 5HK, 5XA, 5XK, 5ZK, 5ZL, 7XD, (8ACF), (8ADE), 8AFA, (8AFD), (8AFS), (8AGK), 8AGT, (8AHH), (8AHS), (8AIB), 8AIO, 8AJK, 8AJL, 8AJT, (8AJW), 8ALW, (8AMB), (8AMZ), (8ANO), 8ANY, 8AOT, 8APB, 8AQV, 8ARD, 8AVO, 8AVT, (8AWP), 8AXC, (8AYN), 8AYS, 8BBU, (8BCO), 8BDO, (8BDY), (8BO), (8BRL), (8CG), 8CI, (8CV), 8DR, 8DZ, (8EA), 8EB, 8EQ, 8EZ, 8FI, (8FT), 8FW, 8GO, 8HA, 8HG, 8HP, 8HU, (8HY), 8ID, 8IL, (8IN), 8JQ, 8JS, 8JU, 8KH, 8LH, 8LW,(8MZ), (8NZ), 8OI, 8PX, 8PM, 8PT 8QE, (8RQ), (8RU), (8SP), (8TJ), 8TK, 8TT, 8TY, 8TZ, 8UC, 8UK, 8UP, 8VQ, 8WA, 8WZ, 8XE, 8YN, 8ZAA, (8ZD), 8ZN, 8ZR, 8ZW, (9AAW), 9ABV, 9AFX, (9AGR), (9AIR), (9AIU), (9AJH), 9AMG, 9AMR, 9ANC, 9APK, 9AQE, 9AQN, (9ARG), 9ARI, 9ASJ, 9DMJ, 9ASN, 9AW, (9AWZ), 9AXU, (9BDE), (9CP), 9DWP, 9DZY, 9EA, 9EE, 9ET, (9GC), 9HM, (9HR), 9KH, 9LF, 9LQ, 9MC, (9ME), (9OX), 9PC, 9PS, 9TL, 9TO, (9UH),(9UU), 9UW, 9VZ, 9WK, (9WT), 9YM, 9ZJ, 9ZN; Canadian (3BP), (3EI), (3JL).

C. W.—1AJS, 1AKG, 1ANQ, 1BAI, 1CAK, (1OE cw and voice), 1PT, (1PE), 1QN, (1RZ cw and voice), 3ABI, 3AHK, (3EM), 3FF, 3FS, 3HG, (3HJ) 3MO, 3ZY, 3ZZ, Canadian (3BP), 4CO, 4FF, 4GL, 8AAZ, 8ALE, 8ARV, (8AWP), 8BPL, 8DE, 8GE, 8HK, 8LF, 8LX, (8UJ), 8UK, 8VJ, 9AA, 9ANE, 9AOJ, 9HY, 9IO.

Distance Records

WHEN signals from a radio station are heard at unusual distances it is proof that the station is an efficient radiator of energy. The location, apparatus, construction and operation of an efficient station is therefore, of great interest to all amateurs, and THE WIRELESS AGE wants this information.

You are therefore requested to send us a monthly list of distant amateur stations heard, which will be published regularly. Report only stations located 200 miles or more distant from your station. Arrange the calls by districts (each district a paragraph), and the calls in alphabetical order.

State whether the stations heard use a spark or C. W. transmitter. THE WIRELESS AGE will follow the records closely and whenever possible will secure and print illustrated articles on the stations consistently heard over long distances, for your benefit and the benefit of amateurs.

If a station is an efficient radiator of energy, it should be given proper credit in the history of amateur progress, and at the same time you will be given credit for efficiency in receiving in having heard it, as your name, address and call letters will be published with all lists submitted by you.—THE EDITOR.

2ZL, J. O. SMITH, Valley Stream, L. I. (October). This station not regularly operated.

C. W.—1TS, 1QN, (1CAK), 1XE, fone, (2HI), 2ADL, (2XA), (3BZ), (3CC), 3PB, (3AAE), 3ANB, 3ZO, (3ZY), (4FF), 4GL, 8BO, 8DE, 8EA, 8GE, 8II voice, 8IQ, 8JQ, (8JS), 8WY, (8AWP), 8BCI, 8BDP, 8XB, 8XM, (8XY), (8ZG), (8ZZ), 9HD, 9LQ, 9AAV, 9ARD, (9XM), Canadian (3BP), 3JL, (9AW), Army (XF-1), (NMW).

Spark—1HK, 1OE, 1BDI, (1ZE), 3CC, 3HX, 3HJ, 3LP, 3MO, 3OB, 3RW, 3AIC, 3ACE, 3AQR, 4EA, 5DA, 5FV, 5ZL, 8BA, 8DR, 8DY, 8GW, 8HP, 8JU, 8MQ, 8RQ, 8RU, 8SP, 8TK, 8TT, 8ACF, 8AFD, 8AGK, 8AHH, 8AHU, 8AQV, 8AQZ, 8AYN, 8BEP, 8XE, (8ZD), 8ZN, Canadian 3JL.

HARRY GEDULD, 237 East 100th Street, New York City.

The following stations were heard on a home made short wave regenerative set, using a single, old style audiotron.

1ADL, 1AJP, 1ARN, 1ARY,1AW,1BDC, 1BDT, 1BWY, 1DY, 1OX, 1ZE, 3BP, 3GM, 3LP, 3VJ, 3VW, 3SX, 3SJ, 3AQR, 3OU, 3VF, 3GX, 4EY, 4FD, 8ACF, 8AFD, 8AFS, 8AGK 8AHH, 8AJT, 8APB, 8AM, 8BFM, 8BNY, 8BR, 8DA, 8DR, 8EA, 8HT, 8MZ, 8RO, 8RU, 8XE, 8XK, 9AGR, 9AIR, 9ME, 9US,

2BAK, OLD POST ROAD GARAGE, Tarrytown, N. Y. (Oct. 10 to Nov. 10).

C. W.—1FN, (1QN), 1UN, 1BDI, 1AFV, 1CAK, 1XNA, (2ADL), 3BA, 3BY, (3BZ), 3CC, 3FS, 3HJ, 3PB, (3RF), 3MO, 3ZY, 3AKU, 3ANO, 3BIY, 3ZO, 4BY, 4CO, 4EL, (4FF), (4GL), 4HW, 8AW, (8BA), 8BF, 8BM, 8BO, 8BY, (8DE), 8DR, 8EA, 8DX, 8FB, 8BI, 8FQ, 8GE,(8HA), 8IA, 8IV, 8JU, (8KM), 8LF, 8LJ, (8LV), 8OW, 8PU, 8UK, 8VQ, (8VY), 8WY, 8XE, 8XK, 8XM, 8ZA, 8ZD, 8ZG, 8ZU, (8ZZ), (8ABO), (8ACF), (8ADY), 8AGG, 8AHH, (8AKE), 8ALY, 8AND, 8APT, 8AQF, (8AQZ), 8ARJ, 8AWF, 8AWP, 8AXC, 8AYE, (8BCI), 8BDU, 8BFC, 8BFQ, 8BFX, 8BHQ, 8BJQ, 8BOX, 8BPL, 8BRC, 9AI, 9AW, (9HD), (9LQ), 9RT, 9VG, 9XM, 9YN, 9ZJ, 9AAS, 9AAV, 9AJA, 9ARK, 9DAB, 9MIY, XF1, NX4, KDKA phone and C. W.

Spark—5FJ, 8FI, 8XE, 8ZA, 8ZR, 8BFX, 9ZR, 9ZN.

S. HARRIS, 905 West End Ave., New York. (October).

1NQ, 3AQR, 3ZO, 3HX, 4EY, 5DA, 8BO, 8FB, 8ADH, 8YN, 9AAW, 9ZJ, 9ZN, Canadian 3BP.

4DL, RAYMOND C. BENDER, West Palm Beach, Fla. (Oct. 12 to Nov. 5).

CW—1UJ, 1UN, 2EL, 2FD, 2MO, 2AKO, 2ALP, 2ZL, 3DH, 3ZY, 3BIY, 4AL, 4BK, 4BY, 4II, 4ZE, 5DA, 8DE, 8XM, 8ZG, 8ACF, 9RT, 9ANQ.

Spark—2EL, 2FP, 2RJ, 2ASK, 2CAL, 3EN, 3HJ, 3RW, 3XF, 4BY, 4DH, 4FD, 4FR, 5AA, 5DA, 5XA, 5ZAB, 8XE, 8AWP, 9BDE.

6ALE, W. W. LINDSAY, Jr., Reedley, Cal., (October).

Spark—6AS, 6BM, 6EA, 6EB, 6ER, 6EX, 6FK, 6FT, 6GF, 6GR, 6IC, 6JD, 6KA, 6KP, 6KY, 6KX, 6LC, 6MH, 6OC, 6SK, 6TV, 6VX, 6ABM, 6ACY, 6AEZ, 6AGF, 6AHU, 6ALV, 6ANP, 6ASK, 6ATV, 6AVB, 6AVV,

6AVY, 6AWH, 6ZB, 6ZX, 7BP, 7ED, 7GA, 7IU, 7KB, 7KG, 7KM, 7LU, 7LY, 7MF, 7MP, 7MY, 7OZ, 7XD, 7ZJ, 7ZM, 7ZT, 7ZU. All the above stations worked.

C. W.—2FP, 5BR, 5ZA, (6GR), 6JE, (6ZN), 6AAT, (6ABY), (6ABX), (6ALA), (6ASJ), (6AWT), (6AWV), (7XF), 9AQ, 9BD Canadian, 9CP, 9RY, 9AMB, 9ZAC, 9ZAF.

8BSH, CLARENCE MATHENY, 5120 Globe Ave., Norwood, O. (Sept. 27 to Oct. 15).

C. W.—2CP, 2FP, 2RW, 2XA, 3BZ, 3HJ, 3MO, 3ZO, 3AAE, 3AVK, 4FF, 8BK, 8DE, 8DR, 8FO, 8JQ, 8LF, 8MK, 8NQ, 8TN, 8TT, 8VJ, 8VY, 8XM, 8ZV, 8ACF, 8AIO, 8ARK, 8AVH, 8AWP, 8BEF, 8BOX, 8BPL, 9ZB, 9ABU, 9AJA, 9AVN, 9AWZ.

Spark—2OM, 2RP, 2AJE, 3BP, 4BQ, 5DA, 5HK, 5ZL, 5FV, 8BC, 8BO, 8CF, 8CI, 8CP, 8FI, 8HU, 8ID, 8IJ, 8IN, 8RQ, 8RU, 8SP, 8TT, 8TZ, 8ZE, 8ZA, 8ZD, 8ZN, 8ZR, 8ACS, 8ADO, 8AEZ, 8AGK, 8AHY, 8AIB, 8AIM, 8AIW, 8ANK, 8ANY, 8AYN, 8AYR, 8AYV, 8BBU, 8BCD, 8AFD, 8BOI, 9AC, 9AW, 9BM, 9CP, 9EE, 9FS, 9GB, 9HM, 9HR, 9LQ, 9MC, 9MK, 9OX, 9UU, 9YN, 9ZB, 9ZJ, 9ZN, 9AAW, 9AAG, 9AOU, 9AMK, 9ARJ, 9ARZ, 9AYW, 9AYY, 9DII, 9DJP.

8AXC, EDWARD MANLEY, 328 Fourth St., Marietta, O. (October).

Spark—1AW, 1IA, 1IN, (1WR), 1BDC, 1BDT, 1BLE, 2BK, (2DN), 2EL, (2FP), 2RB, 2OM, 2TA, 2TS, 2WB, 2XH, 2AHL, 2AJE, 2AQI, 2ARB, 2ASL, 2AWF, (3AC), 3AL, 3CC, 3CG, (3HJ), 3HX, 3IW, (3KM), 3OM, (3OU), 3PU, 3QN, 3QW, 3RW, 3UQ, 3UU, 3VS, 3VW, 3XM, 3ZA, 3ZO, 3ZZ, (3AQR), (3ARN), 3BFU, 4AS, 4CD, 4CX, 4DH, (4DQ), 4EA, 4EY, (4FD), 4FJ, (4GN), 4XK, 5ER, 5FJ, (5FV), 5HK, 5RZ, 5XU, 5YL, 5ZL, 5ZAB, 8AL, 8AY, 8BP, (8CG), 8DJ, 8DR, 8DV, (8DY), (8EF), (8EA), 8EW, 8EZ, 8FE, 8FI, 8FT, 8GW, 8GX, 8HU, (8IN), 8JJ, 8JQ, 8JU, 8MM, 8OI, 8RG, 8RQ, 8RU, (8SP), 8TJ, (8TY), 8UC, 8UP, (8VQ), (8WA), (8WZ), 8XE, 8ZA, 8ZD, 8ZN, 8ZZ, 8AAR, 8ACF, 8ADO, 8ADQ, 8AFD, 8AFS, 8AGK, 8AHH, 8AIB, 8AIO, (8AJT), 8AKV, 8AMB, 8AMF, 8AMU, (8AMZ), 8ANC, 8AOI, 8APB, 8AQV, 8ARD, 8ARS, 8ASZ, 8AXN, (8AYN), (8AYS), (8BCO), 8BDO, 8BFH, 8BHV, (8BKN), 8BOY, 8BRL, (8BUN), 8BVA, 9DY, 9EL, 9FS, 9MC, 9ME, 9OX, 9UH, 9UU, 9VZ, 9XI, 9YA, 9YB, (9ZN), 9AAP, 9AGG, 9AIR, 9ANC, 9ASJ, 9BDS, 9DAB, 9DCX, 9DQY, 9DWZ, 9DYU, Canadians 3BP, 3EI, 3FO, 3JL.

C. W.—1XE, fone icw, (2FP), 2KL, 2ZL fone, cw, icw, 2ZV, 2AHL, 2AWL, 2AYZicw, 2BAD, 2BCN, 2BGM, 2BRG, 3CR, (3HJ), 3MO, 3ZO, 3AAE, 3ABI, 3BIY, 4CQ, 4GL, 8BK, 8BO, 8CI icw, (8DE), 8DR, 8GE, 8GV, 8II, 8iQ, 8KM, 8LV, 8LX, 8NQ, 8PN, 8VJ, 8VY, 8XK, 8XM, 8AJV, 8AOA, 8AQZ, 8AWP, 8BDU, 9ZB, 9AAV, 9ACO, 9AJA, KDKA, NMW.

8ANW, J. PLANTY, 710 Warren Ave., Niles, Ohio.

Spark—1AM, 1AMD, 1AW, 1GM, 1ZE, 2ASL, 2AZL, 2FP, (2OM), 2WB, 3AAN, 3AQR, 3BL, 3IW, 3XF, 4HF, 5DA, 5FJ, 5ZL, 5ZZ, (8AFD), 8AFS, 8AHU, 8AIB, 8AIM, 8AMP, 8ANX, 8AOT, 8APB, 8APP, (8ATZ), 8AVT, (8AWP), (8AWX), 8AWZ, 8AXC, 8AYN, 8BBU, 8BDP, (8BOY), 8BPK, 8AL, 8BK, 8BO, (8CH), 8DF, (8DY), 8EB, (8EZ), 8FI, 8HB, 8HC, 8HP, 8HU, 8JL, 8JP, (8JU), 8OI, (8QC), 8QB, 8SC, 8SP, 8TK, (8TT), 8UC, 8WA, (8WJ), 8XE, 8YN, 8ZR, 8ZZ, 9AAW, 9AEQ, 9AIR, 9AQA, 9ASP, 9AWZ, 9AXU, 9AZA, 9UCB, (9DWM), 9UMT, 9BM, 9BP, 9CP, 9EE, 9FU, (9FS), 9GX, 9HM, 9HR, 9HT, 9ME, 9MC, (9OX), 9PT, 9QH, 9UH, (9UU), 9VK, (9UH), 9XI, 9YB, 9ZB, 9ZJ, 9ZL, 9ZN.

C. W.—1ANQ, 1AZX, (1CAK), (1TS), 2AFP, 2AWL, 2BEL, 2BND, 2FP, 2OE, 2RU, 2WI, 3AAE, 4GL, 5DA, 5FF, 5ZL, 8AAU, (8AWX), 8AWP, 8BCI, 8BK, 8BO, 8BQ, 8DE, 8DR, 8HA, 8HJ, 8II, 8IV, 8JU, 8KM, 8NQ, 8RQ, 8VY, 8XK, 8ZY, 9AJA.

8ZG, A. J. MANNING, Salem, Ohio. (Last 11 days of October)

Spark—1ADL, 2BK, 2BM, (2EL), 2PV, 2RQ, 2TS, 2WB, 2AID, 2AWF, 3HJ, 3HX, 3OU, 3RF, 3QW, 3AQR, 5FV, 5FJ, 5LO, 5ZL, 5ZZ, 5ZAB, 8FA, 8JP, 9CP, 9FA, 9HR, 9HS, 9KO, (9MC), 9PB, 9PN, 9RY, 9UH, 9UU, 9XM, (9YB), 9YM, 9ZC.

C. W.—1QP, 1UN, 1ADL, 1ANQ, 1AZK, 1BDI, 1BFZ, (1CGG), 2DN, (2DA), (2EL), 2EQ, 2FZ, 2KL, 2XQ, (2ZL), 2ZV, 2ABD, 2ABR, (2AFP), 2AJF, 2AWL, 2BAK, 2BRC, 2BGH, 2BYS, 3BZ, 3FM, 3MO, 3RF, 3QV, 3ZO, 3ZV, 3ZY, 3ZZ, (3AAE), 3ACE, 3ADT, 3BIY, 3BEC, Can. 3BP, Can. 3JL, 4EN, (4EL), 4BQ, 4BK, 4FF, 5DA, 9GL, 9LV, 9LQ, 9RT, 9UC, 9XM, 9XI, 9AJA, 9AKD, 9XAH, 9ZAE.

8ZD, B. P. WILLIAMS, 5220 Orleans St., Pittsburgh, Pa. (Oct. 1 to Nov. 10).

Spark—1AMD, 1BRW, 1GM, 1NBA, 1ZE, 2AQV, 2AQI, 2AIM, 2AWL, 2DA, 2FD, 2JU, 2OM, 3IW, 3XF, 4BE, 4BQ, 4EY, 4GL, 5FJ, 8AFG, 8AJK, 8AFD, 8AWP, 8AYN, 8AMD, 8AXC, 8ASZ, 8AHV, 8AJV, 8ABO, 8BA, 8BO, 8BK, 8BP, 8DY, 8EA, 8FI, 8GW, 8IQ, 8IL, 8JJ, 8MM, 8JU, 8NZ, 8OI, 80J, 8SP, 8TK, 8TY, 8TT, 8WA, 8XE, 8XS, 8ZA, 8ZN, 8ZE, 8ZAA, 9AAW, 8AWZ, 9AIP, 9ANC, 9CP, 9FS, 9MC, 9ME, 9PC, 9UU, 9ZN, 9ZJ, 9ZC, Canadian 3BP, 3KG, NZO.

C. W.—(Oct. 29 to Nov. 10th) 1CF, 1QP, 1TS, 2BEA, 2BGM, 2BAK, 2EH, 2ZL, 3BZ, 3ZV, 3ZY, 4BY, 8ABO, 8AWP, 8AFQ, 8APT, 8BCI, 8BUM, 8BRC, 8BDU, 8EA, 8JS, 8KM, 8XY, 8ZG, 9AAS, 9AMT, 9AKD, 8HD, 9VG, 9YAE, 9ZY, XF-1, NSF.

All above stations worked.

General Notes on Matters Radio

(Continued from page 38)

age along the length of the insulator. Making the path from one conductor to the other as long as possible decreases the possibility of this form of breakdown. It is for this reason that all high voltage insulators are designed after the fashion of figure 1. The irregular curvature of the insulator makes the path from one conductor to the other much longer across the surface of the insulator than if it is straight from one conductor to the other.

Sand, salt, water and other similar impurities weaken the insulation considerably. Care should always be taken to keep insulators free from them.

Once your insulation has broken down, unless repair is made, its resistance to break down will be considerably weakened thereafter. For the breaking down inevitably results in carbonizing the insulator. The thing to do is either to substitute a new insulator, or to scrape the carbonized insulator very thoroughly with a knife until the carbonized material is thoroughly removed.

Soldering studs and wires on insulators carrying studs frequently impairs insulating properties of the insulator. This is frequently due to the spreading of soldering flux over the length of the insulator. Confine the soldering flux just to the stud and see that no flux leaks over the insulator.

Air insulation is as good as any other kind and should be used wherever possible. In the first place it is much less expensive and in the second place it is self-healing insulation. Using other dielectrics, once it is punctured, it is necessary either to replace the insulation with new ones, or to repair the old insulation. If air breaks down it immediately recovers its insulating properties.

The Effect of High Resistance Shunt Paths on Radio Circuits

Due to imperfect insulation there is very frequently a high resistance in shunt with some part of the radio circuit, and through this shunt path there flows a very small current. This insulation resistance may be of the order of one million ohms or 100,000 ohms, or if it is very bad, the resistance may be less. Now it may be thought that because this insulation resistance is so very high that it cannot have very much effect on the main circuit. That this is not so will be seen from the following actual experience. The poor insulation in the case being cited resulted in a high shunt resistance from antenna to ground. In figure 2 is shown an antenna shunted by a very high resistance R. This is equivalent to a capacity and resistance in series being shunted by a high resistance R. The capacity is the antenna capacity, the resistance r is the antenna resistance. The following analysis will show the effect of the shunt resistance path on the antenna resistance. Let E be the antenna voltage, which is effective across the shunt high resistance R. Then the watts lost in the shunt R due to the small leakage current is given by

$$\text{Watts Lost} = W = \frac{E^2}{R} \quad (1)$$

But $E = \dfrac{i}{\omega C}$ where i is the antenna current, C antenna capacity and ω the antenna periodicity.

Substituting this value of E in equation (1) we get

$$\text{Watts Lost} = W = \frac{E^2}{R} = \frac{\left(\dfrac{i}{\omega C}\right)^2}{R}$$

$$= \frac{i^2}{R\omega^2C^2}$$

Calling $\frac{1}{R\omega^2C^2} = R^1$ we get that

$$\text{Watts Lost} = W = i^2R^1 \quad (3)$$

(Antenna Watts)

In other words this conclusion shows that the high shunt resistance, due to poor insulation, results in the insertion of an equivalent series resistance in the antenna, thus decreasing the antenna output. The lower this shunt resistance is the higher is the resistance which it inserts in the antenna.

A set on which I was working had a coil mounted on a dilecto framework, one end of which was at the antenna high potential point and the other near ground potential. The radiation with the dilecto badly impregnated with solder flux was in the neighborhood of 2 amperes, which gave a very low efficiency. Investigation pointed to this probable source of trouble, and after the insulation mounting of the tube was improved there was an increase of antenna current of about 25 per cent. to 30 per cent.

Let us take typical constants to show this. From equation 3 we see that the equivalent series resistance due to the shunt leakage path is

$$R^1 = \frac{1}{R\omega^2C^2} \quad (4)$$

Suppose the antenna has a capacity of 0.0003 microfarads, the wavelength is 1000 meters, and the insulation results in a shunt leakage path of 1,000,000 ohms. The periodicity corresponding to 1000 meters is 300,000. Substituting these constants in the equation (4) we have

$$R^1 = \frac{1}{\underset{(R)}{10^6} \times \underset{(\omega)^2}{9 \times 10^{10}} \times \underset{(C)^2}{9 \times 10^{-18}}} = \frac{1}{81 \times 10^{-2}}$$

$$= \frac{100}{81} = 1.2 \text{ ohms.}$$

In other words, in this case, if the insulation were poor enough to present a shunt leakage path of one million ohms it would be equivalent to increasing the antenna resistance by 1.2 ohms. If the insulation were so poor that it had a resistance of say one-quarter million ohms, it would have the effect of introducing a resistance in the antenna of four times 1.2 or 4.8 ohms, and in the case of a 5-ohm antenna it would cut the radiation in half. Thus the very great importance of good insulation becomes apparent. Similarly, not only does poor insulation from antenna to ground result in such disastrous results, but poor insulation from any high potential point to low potential point will produce these very undesirable effects. So the amateur's watchword should be, "Look to your insulation."

National Amateur Wireless Association

(Continued from page 40)

THE Trumbull Radio Club was organized October 20 for the interest of the wireless men of Niles, Warren and Mineral Ridge, Ohio. Officers elected fere Mr. J. Planty, (8ANW Niles, O.) President; Mr. H. Dunigan (8AEJ, Mineral Ridge, O.) Vice President; Mr. E. Baumann, Secretary and Treasurer, Warren Ohio. The club has about 40 members. Meetings are held on the second and last Tuesday of every month, at Niles, at 7.30 P. M. All amateurs in that section are invited to join.

▽ ▽

A NEW radio club has been organized in the Pittsburgh District in the Borough of Sharpsburg. It is called the Tri-Boro Radio Club. Meetings are held every other Saturday night so as not to conflict with the meetings of the Radio Engineering Society. The officers elected at the first meeting are as followes: President, R. G. Devaney; Vice President, V. Wagner; Secretary, Joseph Seifred; Treasurer, H. J. Hohman. The new club has a membership of fifty.

▽ ▽

THE Poultney Executive Radio Council was organized on November 1, 1921 at the station of Mr. Frank Fassett, (1BOX). Eight charter members were present. A constitution was adopted and the following officers elected: president, Frank Fassett; vice-president, Walter Hitt; secretary, George Town; treasurer, Emerson Pray; chief radio instructor, Victor Borst (2BIA). The purpose of the organization is "To promote the art of Radio Communication in Poultney and vicinity and to eliminate QRM." The President spoke briefly on the subject of "Radio Communication Laws." Code practice was held and satisfactory progress made. Hereafter meetings will be held on the first and third Mondays of each month. Membership is not restricted to Poultney residents and any radio enthusiast in the vicinity desiring membership is invited to communicate with the secretary.

▽ ▽

W. W. LINDSAY, Jr., (6ALE), of Reedley, Calif., reports that at 5.14 a. m., Eastern time, on November 23rd his C. W. signals were copied by 1ES of Brookline, Mass. Lindsay was using one 50-Watt Radiotron with A. C. on the plate. Looks like a record for 100 watts input.

▽ ▽

THE United States Army has recently started the operation of an experimental radio station at the Field Artillery School, Camp Knox, Kentucky. Both spark and C.W. transmitters are used. The call of the station is WUBC and is in charge of Lt. E. M. Link and Lt. H. P. Roberts. This station will be pleased to handle amateur traffic and work with any other station within its range.

▽ ▽

F. CLIFFORD ESTEY has joined the Clapp-Eastham Company of Cambridge, Mass., as general sales manager. Mr. Estey has the best wishes of all his friends in his new field of endeavor.

▽ ▽

A RADIOPHONE transmitter has been added to the equipment of the radio station at the Wayne State Normal School, Wayne, Nebraska, the station has a daylight range of approximately 100 miles.

Queries Answered

ANSWERS will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no questions answered by mail.

S. D. B., Wayne, Pa.

Q. 1. What is the wavelength of an aerial containing 3 wires 120 ft. long (2 ft. apart) 10 ft. lead-in, 25 ft. ground lead and 40 ft. high?

Ans. 1. Approximately 175 meters.

▽ ▽

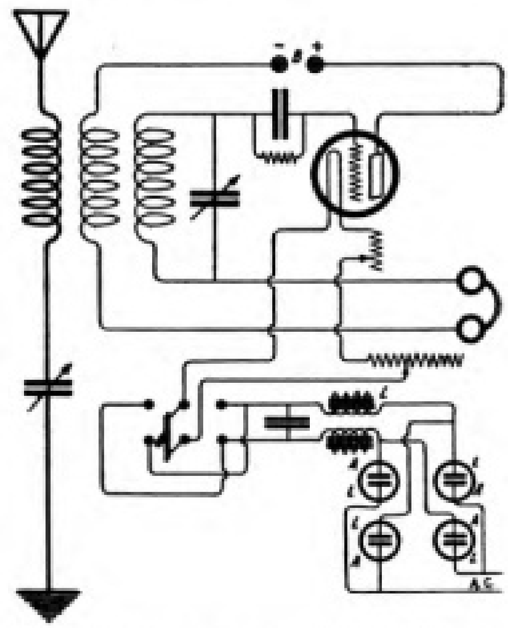
W. H. A., Mount Vernon, N. Y.

Q. 1. Please give me a diagram so I can use A. C. with following apparatus:

Two variable condensers
One triple coil mounting
One radiotron, U. V. 200
One rheostat
One "B" battery

Plus anything else I need so I can light the filament of my radiotron with A. C. I am having a good deal of trouble with a storage battery.

Ans. 1. It will be necessary to have an electrolytic interrupter, a variable resistance and a filter circuit. The connection is as follows:



R must have a safe current carrying capacity of 1.5 amperes.

L—L—primary windings of ¼" spark coils

C—capacity of approximately 4 mfds.

The electrolytic rectifier consists of glass battery jars with lead and aluminum plates. The solution is a 20% solution of sulphuric acid. The size of plates for the rectifier and the values of inductances L and capacity C must be experimented with a slight amount to obtain the best results.

By merely using a resistance wire of a greater current carrying capacity any number of tubes up to seven or eight can be run off the same rectifier.

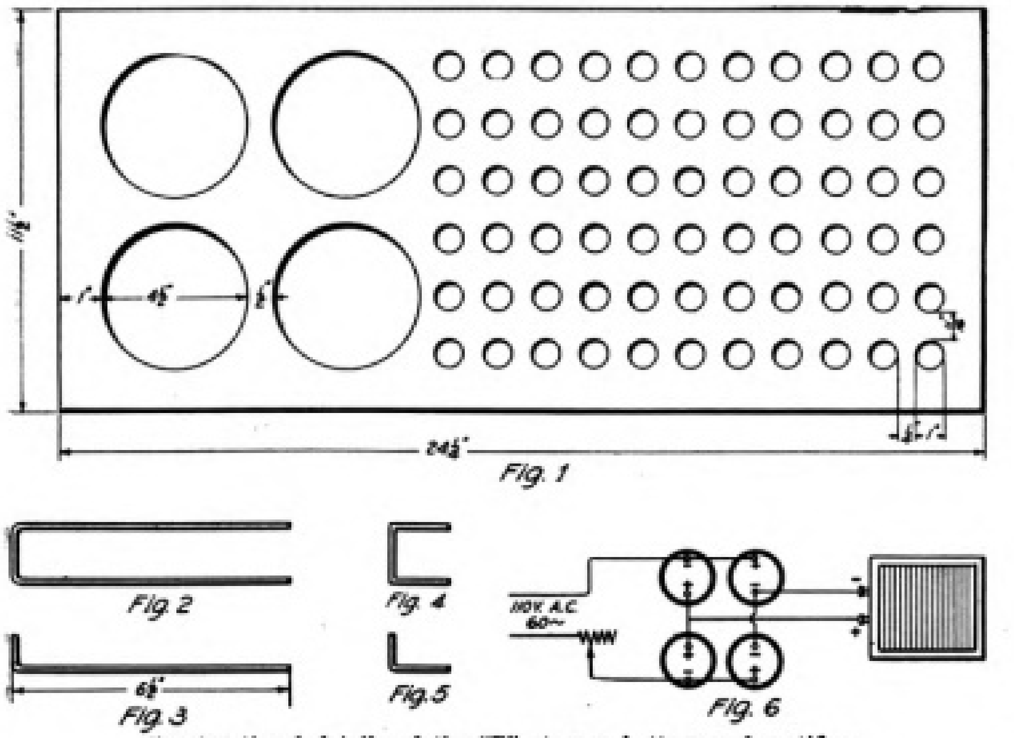
The double pole double throw switch is a polarity changing switch.

A "B" Storage Battery and Rectifier

By A. Greenberg

HOW to construct a real storage battery and rectifier for your vacuum tube detector and amplifier should prove interesting to every amateur. The outfit consists of four rectifying cells and sixty storage cells. Test tubes 1 x 7 inches are used for the storage cells and jars 4½ x 7 inches are used for the rectifier cells. First cut three pieces of wood 11½x24¼x ½ inches; leave one plain for the base and drill the other two as shown in figure 1. Then cut two pieces 11½ x 8 x ½ inches to be used for the ends. Assemble the rack from these pieces.

Next obtain from a storage battery service station 15 negative plates and 15 positive plates. Cut these plates into strips ¾ inch wide and 6 inches long. Then cut and bend 54 strips of lead 2½ inches long and ¾ inch wide as in figure 4. Solder one end to a negative plate and the other to a positives plate. Cut 12 pieces of lead 1½ inches long and ¾ inch wide as in figure 5, to be used for the end cells. Solder to six of these pieces six negative plates and on the other six the positive plates. Take care in cutting plates that none of the paste comes out.



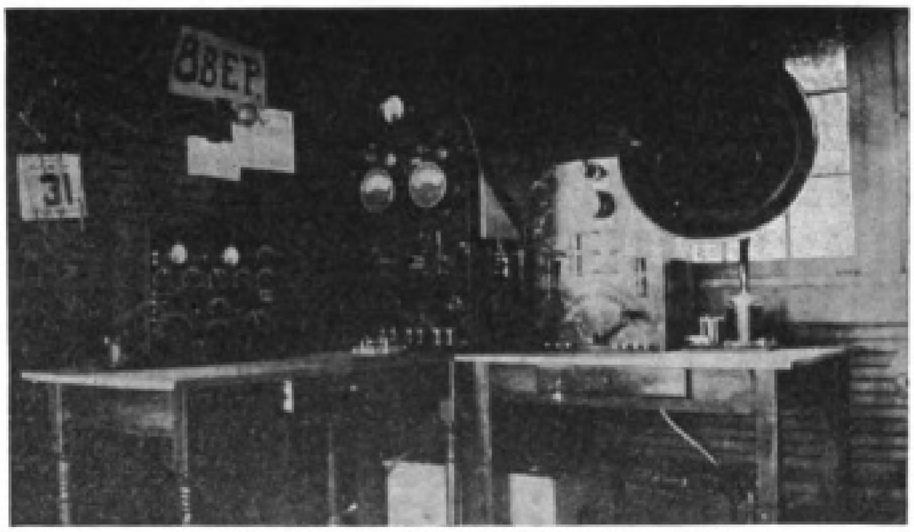
Constructional details of the "B" storage battery and rectifier

Secure 60 test tubes 1 x 7 inches and insert them in the rack. Then assemble the plates in the test tubes, making sure to have one positive and one negative plate in each cell. Connect the cells in series by connecting the end cells, as the others are already connected through the lead strip. Mix pure sulphuric acid with rain water until the hydrometer registers 1.2 specific gravity. In mixing acids always pour the acid into the water.

To make the rectifier plates cut four pieces of lead plate 6½ x 3 x ⅛ inches and four pieces of aluminum 6½ x 4 x ⅛ inches, and bend as illustrated in figure 2. With a piece of emery cloth, brighten the plates, and with a knife cut lines on the aluminum plates to help the formation of gas. Make four round taps to fit on the jar and fasten a lead and aluminum plate in each jar. Separate them two inches.

For the rectifier dissolve sodium phosphate in water and add a teaspoonful of sulphuric acid. The exact amount must be determined by experiment.

Lead plates will not be as good as the pasted plates, but will answer the purpose.



The Allen Radio Station, 8BEP, of Defiance, Ohio

Condenser Effects on Receiver Primaries

(*Continued from page 26*)

down opposite each ratio value given the value of C or L_1 which must be used to give that ratio. It is further desirable to set down the condenser scale reading in degrees or the tap on the coil that must be used to give that respective capacity or inductance.

The values on the two scales marked "R" must also be changed as follows: The value of R represents the ratio of the resulting wavelength to the natural wavelength of the antenna. Thus with a natural of 200 meters, a value of R of 0.9 would mean 180 meters, and a value of 2.5 would mean that the circuit would respond also to 500 meters.

To use the charts lay a ruler across the chart in such a way that the scales K and Q at the sides are cut at the points corresponding to the capacity and inductance of the load in the circuit. The points where the R scales are cut will determine the wavelengths of the circuit.

Both of these charts are the same except that Chart 1 is particularly adapted for circuits designed for short wavelengths, where the lumped inductance in the circuit is small, and Chart 2 where the lumped inductance is large, for use with circuits capable of receiving signals with a wavelength longer than the natural antenna period.

It will be seen that it is impossible to tune exactly on the wavelength that is equal to the natural period of the antenna as at that point the formula is indeterminate. If the distributed capacity of the coil in the primary of the receiver is large its effect will be to reduce the accuracy unless it is considered part of the parallel capacity and its value included in with C.

The Opening of Radio Central

(*Continued from page 22*)

ing sunk nine feet below the ground with a total base area of 360 square feet. The distance between two adjacent towers is 1,250 feet or a total of nearly three miles from the first to the twelfth tower.

Each antenna consists of sixteen silicon bronze cables ⅜ inch in diameter stretched horizontally from tower to tower. In all, fifty miles of this cable has been used for the first two antenna systems which have been erected. The ground system for both antennae consists of 450 miles of copper wire buried in the ground of the entire antenna system in starfish and grid iron fashion.

The first power house section covers a space of 130 feet by 60 feet and accommodates two 200 k.w. high frequency transmitting alternators with auxiliaries and equipment. A sending speed of 100 words per minute is at present possible with the use of each transmitting unit at Radio Central. This means a combined sending capacity of 200 words per minute for the two completed units. The erection of additional antenna units forming the spokes of the huge wheel and further improvements which are being made will correspondingly increase the transmitting capacity of the big station.

The final installation at Radio Central will comprise twelve antenna units supported by 72 towers, forming, so to speak, the spokes of a giant wheel nearly three miles in diameter. Ten high frequency alternators will be employed which in total will give a power output of 2,000 kilowatts or 2,700 horsepower. The electrical force thus brought into play at Radio Central permits the realization of the vision of communication engineers to transmit messages to all points of the world from a single centrally located source.

WIRELESS WHIMS

"I LOVE the cows and chickens, but this is no life," Samuel Curtis, wireless operator at the Government station at Mt. Echo park, said just after he had flashed his resignation to Washington, D. C. Curtis is quitting because the building in which his station is located also houses several families of chickens, a few cows and even a couple of amiable horses. The operator was barely able to tell his troubles because he could not raise his voice above the din of the barnyard surroundings. Every time he opened his mouth a rooster, on mischief bent, crowed "on all six." The hens joined in the chorus. The wireless operator sent a complaint to Washington recently that he would not work under the conditions and demanding a decent station. He never received a reply to his complaint.

"What if they refuse to accept your resignation?" Curtis was asked.

"Stay here with the cows and chickens," Curtis answered.

William Clark, assistant operator, said Wednesday that he, too, would quit his job if the station stays in the stable.

"My nerves are getting terrible," he said.

▽ ▽

IN the case of "Wireless Tappers," the one thing overlooked was the significance of the fact that the messages which "leaked" were always ones sent at night.

With all other methods eliminated, this meant that artificial light must in some way be the secret of communication. But there was no light except the regular light in the room where the telegraph operator and the detective posing as a clerk were stationed.

Then the answer flashed into the criminologist's mind. Draegsell had told him the desk was so far back in the room that, although in a straight line with the window, it could not be seen from another building. But Draegsell had made this observation in the daytime, when it was bright outside and comparatively dark inside. At night, with the interior of the room lit artificially, and darkness outside, it would be easy for anybody in one of the opposite buildings to see every move the telegraph operator made, if he had a good pair of field glasses.

But the only thing the operator did was to smoke and read books. How could a man signal without exciting suspicion while reading a book? By turning the pages of the book. He could send dot-and-dash messages by turning pages quickly and slowly. But the "dot" and the "dash" periods between turning pages could be lengthened to several minutes, and thus not attract attention of any observer not in the secret.

As it turned out afterward, the operator smoked his pipe only as a signal to the watcher that he was delivering a message.

▽ ▽

WHEN the spider has woven his web he carefully puts a tiny drop of gum at intervals along the circling threads which will hold any fly or similar insect which may come in contact with any part of the web. When the spider takes up his position of watchful waiting in the center of the net, he has a foot on each of the radiating threads so that the instant that any creature is entrapped the spider is at once acquainted with the fact by wireless telegraphy.

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

Of the Wireless Age, published monthly at New York, for October 1, 1921.

State of New York }
County of New York } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. Andrew White, who, having been duly sworn according to law, deposes and says that he is the editor of the Wireless Age, 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, Wireless Press, Inc., 326 Broadway, New York, N. Y.

Editor, J. Andrew White, 326 Broadway, New York City.

Managing Editor, none.

Business Manager, J. D. Conmee, 326 Broadway, New York City.

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.)

Wireless Press, Inc., 326 Broadway, New York, N. Y.

E. J. Nally, (850 shares) 233 Broadway, New York, N. Y.

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 bonafide 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.

J. ANDREW WHITE,
Vice-Pres. and Gen'l Manager.

Sworn to and subscribed before me this 16th day of September 1921.

M. H. PAYNE.
(My commission expires March 30, 1922.)