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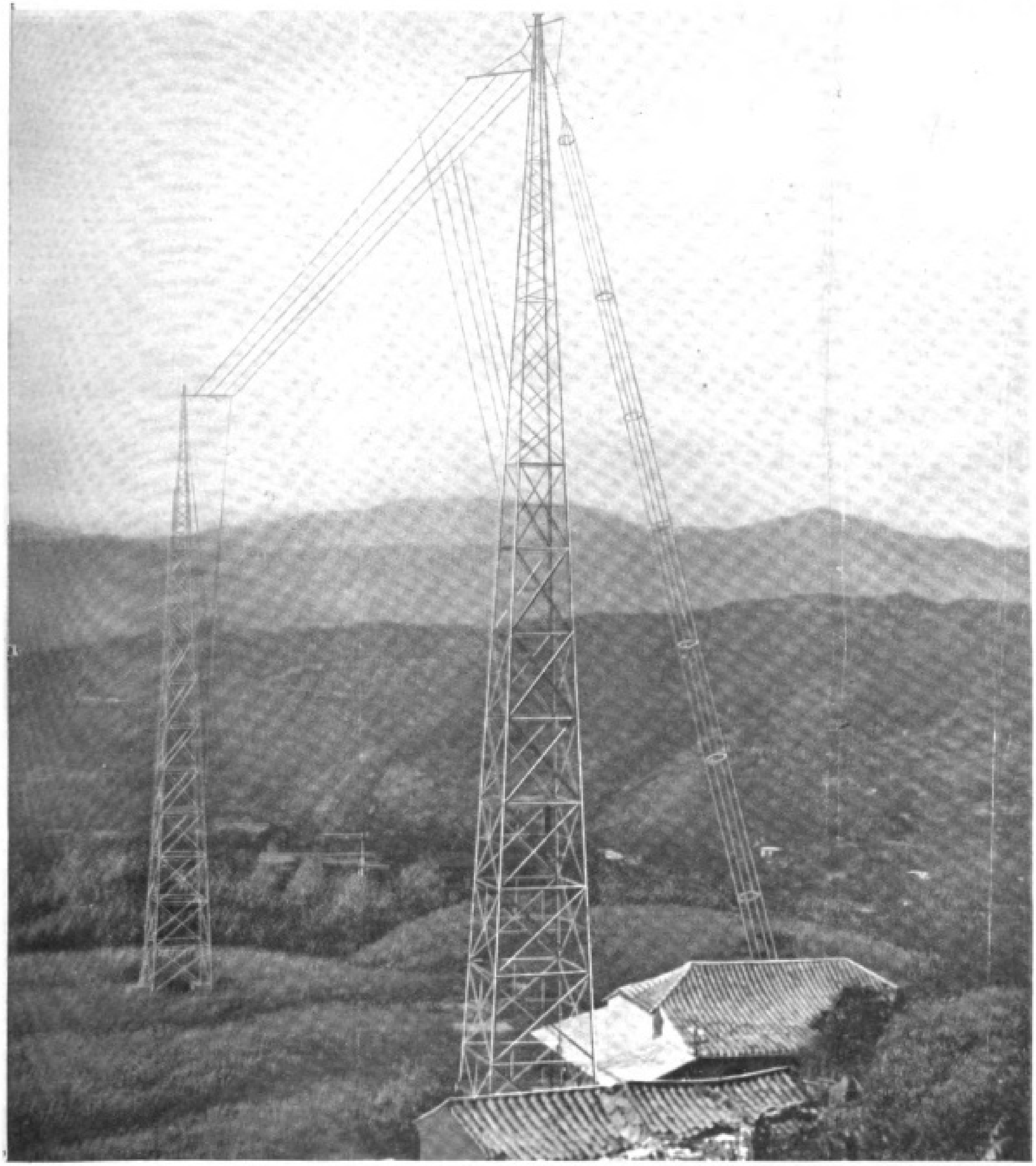
The WIRELESS AGE

Volume 9 Number 4



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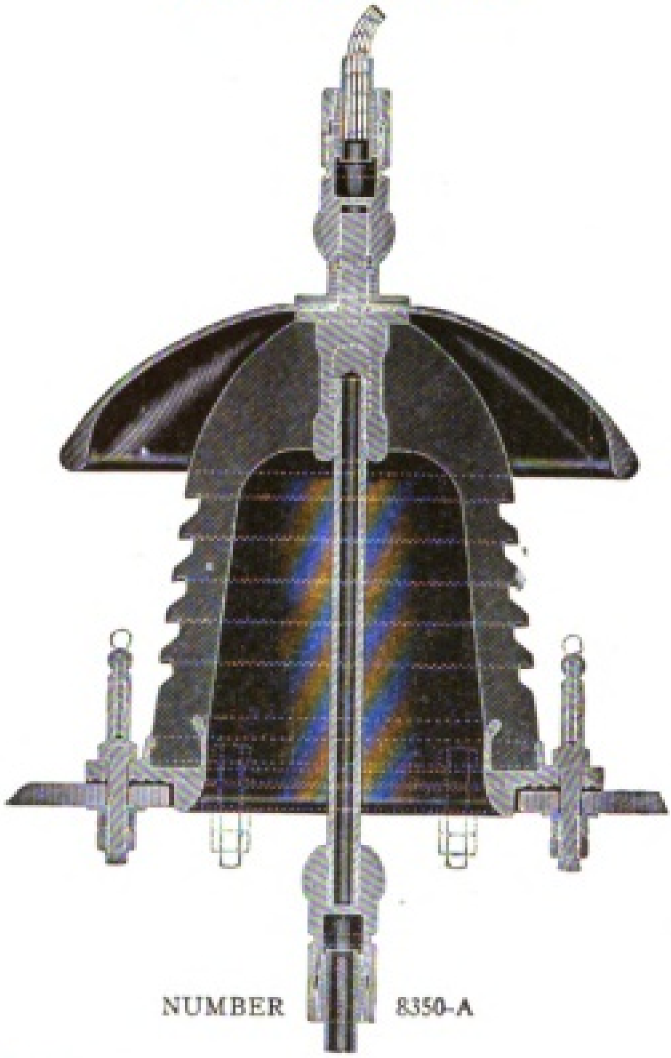

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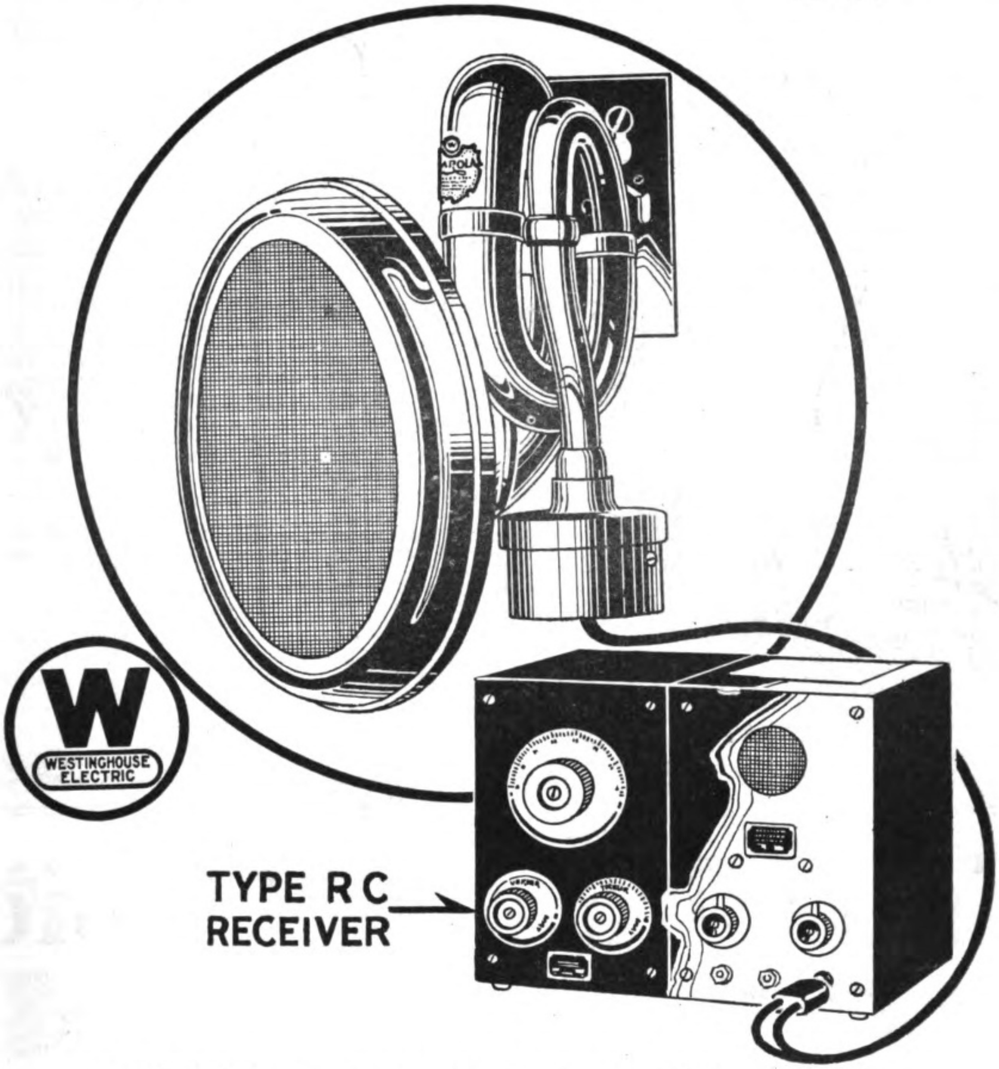

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Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signalling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein. Printed in U. S. A.

VOL. 9. No. 4

JANUARY, 1922

THE WIRELESS AGE

WORLD WIDE WIRELESS

Chinese Radio Regulation

THE Far East Committee of the Washington Armament Conference disposed of the question of use of wireless installations in China by the Powers, by adopting a resolution that the powers recognize China's territorial integrity in respect to the erection of wireless stations in that country. It provided, in effect, that all radio stations maintained in China without authority shall be taken over and operated by the Chinese Government. It is further provided that foreign government radio systems shall be confined in the future to the sending and receiving of only official messages.

Under this plan use of wireless would be restricted to diplomatic and Governmental messages. Those installations which were permitted by Chinese grants, would be used only to the extent authorized by the grants and the Powers would co-operate with Chinese communication authorities through conferences to the end that wavelengths be not interfered with.

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New Radio License Law Needed

DISCUSSING the decision of the Supreme Court of the District of Columbia that the Government had no discretionary power in the granting of licenses for wireless stations, wireless experts assert that a new law ought to be drafted by Congress at once to cover this defect. The present law, under which the decision was made, was framed in 1912, when the number of wireless stations was comparatively few.

The objection to the granting of the radio license to the Intercity Radio Company was that its spark apparatus caused so much interference with other receiving and sending apparatus of more modern construction that for many hours a day stations were unable to operate. Experts contend that one reason for this is that the Intercity Radio set is in the midst of steel skyscrapers, which seize the current and hurl it broadcast into the air, creating a chaos of flashes for other stations. This station is on the top of the World Tower Building at 110 West Fortieth street, New York City.

Lieut. Commander David C. Patterson, Jr., in direction of the naval communications in this port, said that he intended to ask for a reframing of the law, because it was virtually impossible for his stations to work during the hours of the day when the Intercity Company was sending commercial messages to Cleveland, Detroit and other cities where they have stations.

Telephoning from moving trains has been made possible by apparatus constructed by the General Electric Company and shown in the above view

He said that the principal interference affected the radio compass system, whereby the Naval Communication Service guided ships in the harbor and off the New Jersey coast during heavy fogs.

Commander Patterson said that the interference of this station also extended to ships at sea, and that recently he had received a wireless complaint from the coast guard cutter Seneca. The commercial companies in the city, as well as all the government stations, have joined in the protest.

Commander Patterson said that protests had been filed with the city on the stringing of the wires, and other protests have been filed with the Department of Commerce and other official agencies in Washington. It was on the basis of these protests that Secretary Hoover refused to grant a new license to the Intercity Company. Winning the case in the District of Columbia Court, the Intercity Company obtained a writ of mandamus to require the secretary to issue the license.

The recourse now is to new legislation, which is being discussed. It is expected that all the Government agencies that protested against the interference of the Intercity will seek a new law.

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Long Distance Radio Records

A NEW world's record for long distance radio communication was made on November 5, according to the Radio Corporation of America, when President Harding's message addressed to the nations of the world was picked up in New Zealand, 10,000 miles away. The message was sent from the new radio central at Rocky Point on Long Island.

Announcement was made on November 24 from London by the Marconi Company of the successful sending for the first time of a series of test messages by wireless from Carnarvon, Wales, direct to Australia.

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Radiophone Broadcasting From Eiffel Tower

A WIRELESS telephonic news service will soon be distributed from the Eiffel Tower in Paris. The news will consist of important financial and political events in France and throughout the world, the news from foreign countries being picked up by Government wireless.

It will be possible for banks and newspapers with receiving stations to receive this official news service free. Announcement of this has been made by Gen. Ferrie, chief of the French Military Wireless Service. He adds that he hopes soon to arrange for wireless telephone service between Paris and London, so that any Paris subscriber can talk with a person in London by way of the Eiffel Tower.

Radiophones on Coast Guard Boats

COAST guard crews along the New Jersey coast soon are to be equipped with wireless telephone apparatus to assist them in their work of life saving and running down rum smugglers, it was announced by officials of the United States Coast Guard Board.

The Board has been conducting tests along the coast for several days. Guards in a boat five miles at sea, talked with mates in the patrol station at the Inlet near Atlantic City carrying on conversations with the same ease that the ordinary telephone affords.

Installation of the radio phone is to start immediately.

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Branley Refuses Prize

LAST year the Chamber of Deputies, of France, voted to give 20,000 francs to Edouard Branley, inventor of improvements in wireless telegraphy, for the extension of his laboratory and continuation of his researches. Recently it was decided to extend the gift into an annual grant of the same amount.

A letter has been received from M. Branley thanking the Chamber but rejecting the offer. In explanation he says: "I do not consider myself in the same ranks as Pasteur, Lamartine and the great names which we revere and with whom I cannot be compared. My own modest resources will suffice me."

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Churches Use Radio

THE members of the Bushwick Avenue Congregational Church, Brooklyn are displaying unusual interest in the wireless equipment which was recently installed in the church building.

The sermon preached by the Rev. John Lewis Clark, pastor, on Sunday evening was conveyed over the wireless apparatus, which has a sending capacity of 300 miles. Dr. Clark stands in his usual position when delivering the sermon, and there is nothing to indicate that his words are being transmitted and probably listened to by hundreds of persons living as far away as Philadelphia or Troy.

Two hundred and fifty persons gathered in St. Paul's Methodist Episcopal Church, Eighty-sixth street and West End avenue, New York to hear a radio telephone concert.

Several men from their homes in different parts of New Jersey and Long Island made short addresses and an orchestra of string instruments played several numbers. Dr. Raymond Forman, pastor of the church, arranged radio concerts during the Christmas holidays.

The members of the Herron Avenue Presbyterian Church, Pittsburgh, who have been without a regular pastor for some time, enjoyed by the aid of the wireless the service conducted in the Calvary Episcopal church of that city last Sunday.

Members in Herron church, who are wireless enthusiasts, installed a small receiving outfit in the church. A loop antenna, a condenser and amplifier, was put upon the rostrum where the preacher was wont to stand. The horn stood on the pulpit.

The congregation gathered and waited for the transmission of the service from the other church. Very clearly and distinctly the music of the Calvary choir was received, then the voice of the rector was heard preaching the sermon.

The success of the experiment led participants to predict that some time in the future a great preacher will deliver his sermon to thousands gathered in many churches by the aid of the wireless.

There's a collection box in one South Side church, Chicago, Illinois, that is not getting all the money its congregation warrants.

The reason is that the church is equipped with a microphone which enables telephone operators within a radius of many miles to "listen in" on sermons and hymn singing. This fact was revealed yesterday by Professor Phillip Fox of the Northwestern University astronomical department. He has "attended" many services by wireless in his observatory.

"I figure I owe the church about $5. I will gladly remit, if I can find out which one it is."

With the aid of wireless telephony, the first services of the "Radio Church of America" were heard by thousands of persons. The size of the "congregation" was estimated at "anywhere between 25,000 and 50,000 persons," depending, it was said, entirely on the interest that the services created among the potential auditors and not up any mechanical limitations within the carrying radius.

Dr. Richard Jay Ward preached the sermon and was assisted by Dr. M. H. Leventhal.

Persons in Washington, Wilmington and other cities around Baltimore and as far away as New Haven, Conn., "listened" in on a sermon preached by wireless telephone by the Rev. Dr. Francis T. Tagg, former president of the Methodist Protestant General Conference.

Not a dozen persons were in the same room with Dr. Tagg when he delivered his sermon, but it is estimated that more than 2,000 heard him preach, and also heard the hymns which preceded the sermon in this unusual service.

The Rev. Joseph M. Kelley, of the faculty of Loyola College, Baltimore, Md., delivered a radio sermon that was heard distinctly at points far distant from Baltimore. Father Kelley is a wireless telephone enthusiast, working the station at Loyola College. Preceding the sermon, a violin solo was played by Raymond Dugan.

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Fleming Speaks on Vagrant Radio Signals

WHERE do the mysterious "vagrant" signals come from that every day—and particularly at night—are received on wireless aerials? Despite the most diligent research experts are not yet able to answer the question with any degree of certainty.

"From the earliest days of long distance wireless telegraphy the difficulties in reception due to vagrant or natural electric waves and atmospheric electric discharges passing down the receiving aerial have been the bane of the wireless telegraphist," said Prof. J. A. Fleming in a lecture to the Royal Society of Arts.

Prof. Fleming, who invented the thermionic valve receiver which revolutionized wireless telegraphy and telephony, said: "Having regard to the fact that the positive atmospheric electric potential gradient of the earth increases at the rate of about 100 volts per metre of ascent, roughly speaking, it is not surprising that aerials several hundred feet high may be traversed by quite large currents due to this cause alone which may utterly swamp the feeble signal currents."

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Australian Radio Plant Planned

THE Australian Federal Parliament has appointed a committee with authority to investigate and approve a plan for the establishment of direct wireless communication between Great Britain and Australia.

Interest in the undertaking has been stimulated by the facility with which Australian stations caught President Harding's "round the world" wireless message and by the fact that press associations received without relay messages sent from Carnarvon, Wales. Prime Minister Hughes has announced a proposed direct wireless scheme linking Australia, the United Kingdom and America. The Commonwealth and the Amalgamated Wireless Company will jointly finance the scheme, the Government holding the controlling interest in the company.

High power stations will be constructed within two years, to be operated at rates two-thirds of the cable rates.

Brooklyn Institute of Arts and Sciences to Have Radio Station

A PERMANENT radio station is to be established on the roof of the Academy of Music, by the Brooklyn Institute of Arts and Sciences, where members will be able to communicate with distant points and enjoy radio concerts broadcasted from different radio stations. Director Charles D. Atkins of the department of education, made this announcement in his report, at the monthly meeting of the Board of Trustees.

The first exhibition and demonstration of wireless telegraphy and telephony will be conducted by the department of electricity.

Director Atkins said he had secured permission from the Academy Board to install antenna on the roof of the Academy, where a permanent radio station will be established.

Regular radio meetings will be held. Through this station members will be able to communicate with distant points at these meetings and enjoy some of the radio concerts broadcasted from different radio stations.

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San Francisco to Edmonton By Radiophone

A GOOD record for land transmission of wireless telephony was achieved when a concert program being sent out by wireless from San Francisco was picked up and distinctly recorded at Edmonton, Alberta, Canada, despite the fact that the path of the message lies over several mountain ranges. The two points are over 1,400 miles apart. This good receiving work was accomplished by W. W. Grant, wireless engineer for the Dominion Government.

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Small Radio Sets in Paris Get Time Signals

FIFTEEN hundred small wireless outfits have been installed in Paris jewelry, watch and clock stores to enable the jewellers to catch the correct Greenwich Meridian time as it is sent daily at 10 o'clock by the Eiffel Tower. Formerly the exact time had to be obtained from the observatory by telephone.

The installation is simplicity itself. The outfit, about nine inches in diameter, is hung on a nail in the wall. A copper wire run down to the cellar or along a water or gaspipe serves as a "ground wire," while the removal of the bulb from a nearby electric light and the insertion of a contact plug take the place of antennae. It can be done in five minutes.

The outfit can be regulated to hear everthing that is sent out from the Eiffel tower. The correspondent listened in when the press matter was being sent out one day and the signals were clear and easily heard.

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Radio Corporation Adds Three Directors

THREE additional directors have been elected to the board of the Radio Corporation of America, according to a statement issued by E. J. Nally, president. The new members are: Edwin M. Herr, president of the Westinghouse Electric & Mfg. Co.; Gen. Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Mfg. Co., and Arthur E. Braun, president of the Farmers Deposit Nat. Bank of Pittsburgh.

With a receiving set carried in his hat and using a guy wire for antenna and man-hole plate for ground, Frank Chambers listens in on radio traffic

Chinese Wonder at Radio Telephony

THE marvels of the wireless telephone have taken the Orient by storm, according to Prof. C. H. Robertson, a noted American lecturer, who has been demonstrating the latest development of electricity throughout China and Japan during the past six months. On the first day that he puzzled the Celestials of Shanghai by carrying on an intelligible conversation with some mysterious individual in empty space, it was estimated that more than 14,700 natives came to witness the performance. Before he had left the city his lectures on the wireless 'phone had been attended by an aggregate of at least 300,000 people.

Increased Radio Service to Japan Urged

FRIENDLY relations between the United States and Japan are being endangered because of limited radio facilities transmitting news of the arms conference to the Far East, V. S. McClatchy, Sacramento publisher, declared before the Senate Naval Affairs Committee.

News reports of speeches of both President Harding and Secretary Hughes sent to Japan at the opening of the conference, McClatchy declared, were forced to be cut to such an extent because of the limited radio facilities that the full meaning of the addresses were lost.

"The promotion of world peace," he declared, "demands that fuller news reports should be exchanged. News between the Orient and the United States should be free from government control and subsidy, uncensored and at low rates. Affairs of State as well as commerce demand that this be done."

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Radio Companies Pay Dividends

MARCONI'S Wireless Telegraph Company, Ltd., has declared a dividend of 7 per cent on preferred shares interim divided, and 5 per cent on ordinary shares, less income tax, payable on February 1, 1922, to all stockholders registered up to and including December 16, 1921, and to holders of share warrants to bearer.

The Marconi International Marine Communication Company, Ltd., declared an interim dividend on December 19, 1921, of 5 per cent less income tax, upon the issued capital of the company, to shareholders registered on December 1, 1921, and to holders of share warrants to bearer.

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The First Wireless In Albania

FOR the first time in its history, Albania, which is the seat of one of the oldest civilizations in Europe, is in direct communication with the capitals of Europe by means of wireless telegraphy.

Mr. L. M. Heron, of Washington, D. C., was sent to Tirana, Albania, by the Junior American Red Cross to take charge of the first vocational school in the country and carried with him a wireless outfit which he set up. The Prime Minister and members of Parliament watched with interest as Mr. Heron sent the first wireless message from their country to Paris, London, and other cities.

The Progress of Radio Communication in Venezuela

By George H. Clarke

DURING the past year Venezuela has made notable progress in the field of radio-communication, having finished the installation of the first portion of her contemplated chain of radio stations throughout the republic.

The radio service of Venezuela is under the control of the Minister of Promotion (Minister de Fomento), who has general charge of new developments in the country, as wire and wireless communication, mines and oil concessions. The present minister, Dr. Gumersindo Torres, is a man of far vision with great faith in the value to Venezuela of the more modern development in the general field of communication, and it is due to his far-sighted policy that Venezuela has taken her place at the head of South American nations in the development of a national radio-communication system. The administration of the wire and radio service as a whole is under the charge of General Tobias Uribe, Chief of Communications, under whose wise guidance the not inconsiderable problems which always attend the opening up of a new branch of service are rapidly being cleared up. The technical control of the stations, their installation and maintenance is under the charge of H. Eichwald, a radio engineer of Venezuela whose technical training was obtained in the United States of America. Mr. Eichwald is also in charge of the National School for training operators for the wireless service of the country.

The most important and the most fully equipped station of the group developed under Minister Gumersindo, is that installed at Caracas, the capital of the country. This station has administrative control over all the others, and within it are located also the National Radio School, the receiving apparatus for long wave-reception, such as press, and a direction-finder, in addition to the transmitter and receiver of the station proper. The station is located on one of the smaller hills, overlooking the city and although far from water of any kind and entirely surrounded by mountains, it is remarkably efficient in transmission and reception. The station building is officially known as El Polvorin. Years ago it was used for the storage of powder for the army, but its three-foot-thick walls now are chiefly useful for sound-insulation. The view of the city nestling in the valley below is especially beautiful from this site, and it is no wonder that it is one of the show places of Caracas.

The antenna system consists of two steel towers, each fifty meters high, four-wire flat-top antenna running the entire distance of one hundred meters between towers,

Cabello radio station

and a vertical cage antenna of six wires with cross-shaped wooden separators, running from the nearer tower down to the station. The flat-top antenna is used for all long-wave transmitting and receiving, while the cage antenna is provided especially for work with ships on 600 meters.

The ground system consists of twenty-four copper wires, radiating from the station under the antenna and adjacent to it. These wires are buried a short distance in the earth for mechanical protection. This does not provide a sufficiently low resistance ground, however, and the Government is planning to have multiple-tuning attachments to the antenna installed in the near future in order to increase the efficiency of the set.

Power is obtained from the city electrical power supply of three-phase 50-cycle current. This energy is furnished by a hydro-electric plant in the mountains midway between Caracas and the seaport of La Guayra, and gives very reliable and constant service. A motor-generator is used to provide the high-voltage direct current necessary for the transmitter, and another is installed to furnish direct current for charging storage batteries for the station.

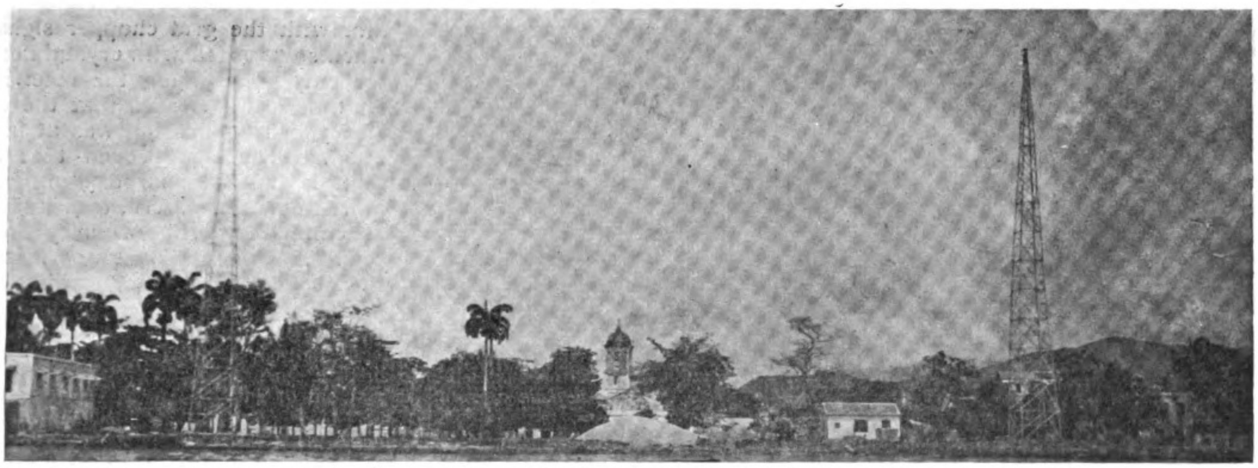
All the wiring in the station is run in trenches cut in the concrete floor, with iron floor-plates over the trenches for mechanical protection. All wiring is done with lead-covered cable, the lead sheathing being grounded at intervals. Single conductor is used throughout.

The radio apparatus proper at this station was supplied to the Venezuela Government by the Radio Corporation of America. The transmitter and its associated apparatus was designed by the General Electric Company, and represents the standard type developed as a result of war-time experience for the United States Army and Navy. The receiver was designed similarly to conform to military requirements, and was developed in the factory of the Wireless Specialty Apparatus Company.

On one side of the station is located the transmitter and its associated receiver, with the motor generators and the protective device against high-frequency kick-back mounted nearby. Here is also mounted a transformer switchboard with two transformers, associated control devices, and transfer switch, for furnishing either twelve volts or twenty-two volts A.C. to the filaments of the pliotrons used in the transmitter, thus permitting the use of either of two types of these devices.

The transmitter is a 3½ k.w. input continuous-wave vacuum tube apparatus. Six power tubes are used in the set, and it is adapted to work with either Radiotrons of the UV 205 type, for which the set was originally designed, or equally well with the long-life power tube recently developed and known as Radiotron UV-204. The former tube uses a filament voltage of 22 volts, and the latter, of 12 volts, hence the filament-transformer switchboard referred to in the preceding paragraph.

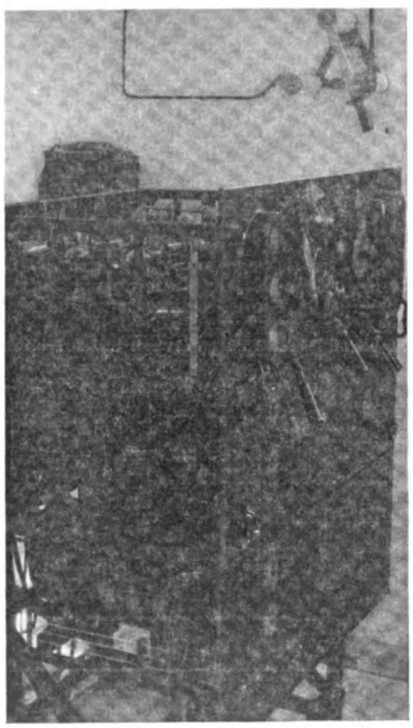
Six wavelengths are provided for in the transmitter, and by means of a wave-changing switch any one of



Off-shore view of Cabello Station showing the towers

six entirely separate coupling coil systems, each for its associated wavelength, may be selected. No adjustment of any kind needs to be made after the wave-changing switch has been thrown, as all the necessary values of plate and grid coupling coils and of antenna variometer have been made in advance during the installation of the set. Using the main antenna wavelengths of 825 meters, 950 meters, 1,150 meters, 1,450 meters, 1,650 meters and 1,950 meters can be obtained, and by shifting to the cage antenna which has smaller capacity than the flat-top and using the 825 meter position of the wave changer, a wavelength of 600 meters is available. By means of the variometer construction of the antenna inductance wavelengths considerably shorter and longer than the mean values above given can be attained. Thus if the antenna that is erected happens to differ from the constants of the specified one, the wavelength can be readjusted to any desired value by antenna inductance variation.

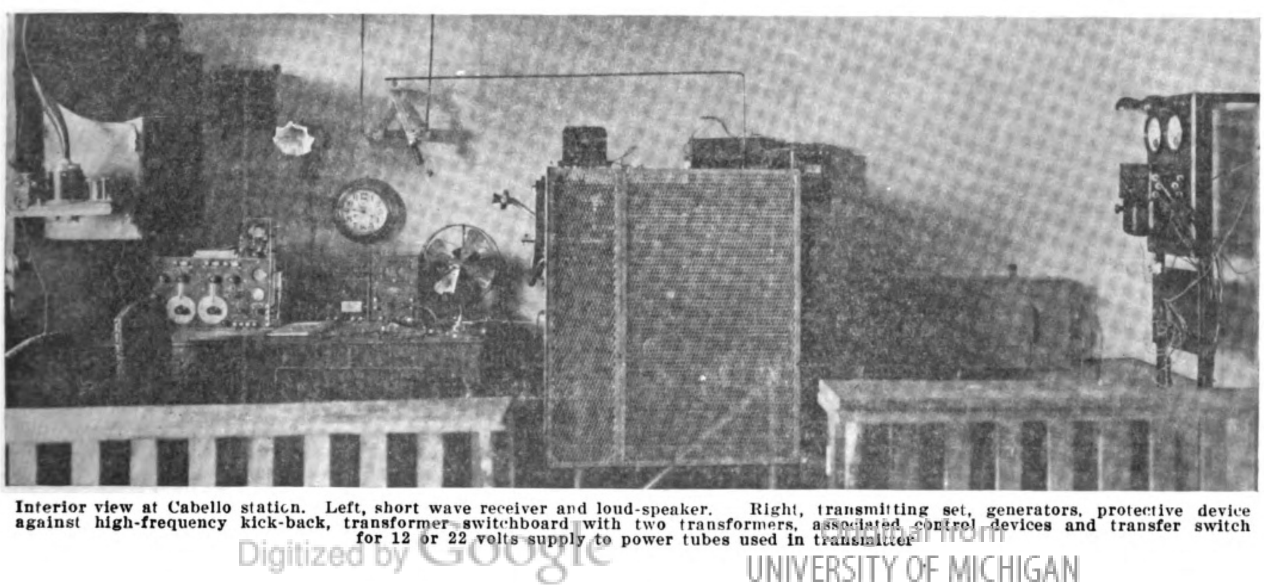
For working on continuous waves for telegraphic communication and on I.C.W. using the grid chopper for damped waves, the six Radiotrons are thrown in parallel. When radio-telephony is desired a single movement of a switch divides the tubes into three oscillators and three modulators, constant - current or plate modulation being used. Speech-varied currents from the microphone supplied with the set are transformed to higher voltage, amplified by a vacuum tube amplifier, and then suitably impressed on the modulator grids.



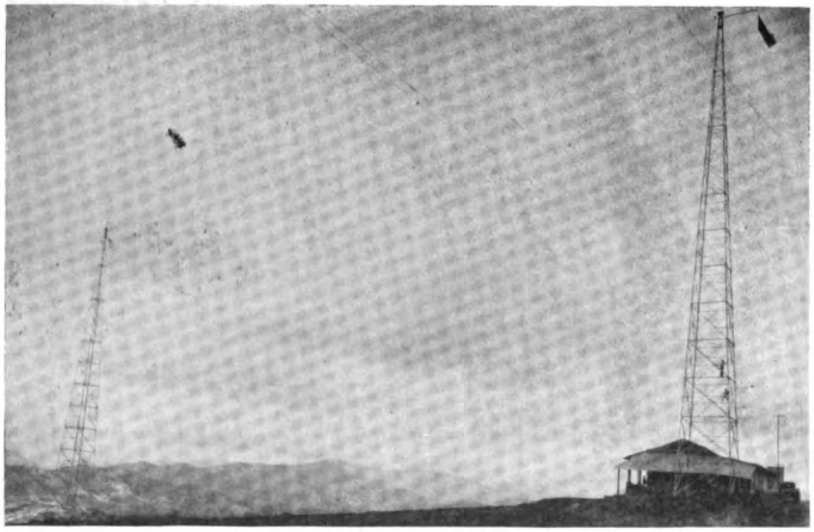
3½ K.W. six tube, continuous wave transmitter

For damped wave working with ships, the grid circuit of the six oscillating valves is periodically interrupted by a motor-driven commutator, and a very pleasing four-hundred cycle note results. The grid chopper is located on the table near the main key of the operator, and by means of two switches, one to start and stop the chopper motor and the other to short-circuit the commutator when C. W. is desired, the operator has easy control of the character of the waves emitted.

The control of the transmitter is very simple. The three main operat-



Interior view at Cabello station. Left, short wave receiver and loud-speaker. Right, transmitting set, generators, protective device against high-frequency kick-back, transformer switchboard with two transformers, associated control devices and transfer switch for 12 or 22 volts supply to power tubes used in transmitter



Caracas radio station showing the modern type of towers installed

ing switches, namely (1) Send, ground, receive; (2) C.W.—Telephone, and (3) wave-changing switch automatically make all necessary connections for their respective functions. The parts are quite rugged and have stood up well in service.

All necessary protection has been provided for the set. Around the 2,000-volt direct-current generator which delivers plate current to the power tubes is a protective device consisting of a number of aluminum cell lightning arresters in series. A protecting spark gap is located across the filament and grid bus-bars in the transmitter proper. Each plate circuit has an individual fuse, and a main fuse is placed in the supply lead from the high voltage generator. Filament fuses are provided for either voltage of supply for the filaments.

By feeding the filaments with alternating current, the life of the power tnbes is considerably increased. The middle point of the low-voltage secondary of the filament transformer is grounded, thus taking away the alternating current hum which otherwise would be impressed on the created oscillations. A further refinement in this set is the use of a filament voltmeter to indicate the voltage on the filament, rather than an ammeter to indicate filament current. The resistance of the filament changes throughout its life, and constant current through it would tend to reduce its life greatly, but by keeping the terminal voltage constant equal usage of the filament during its entire life is guaranteed.

The receiver used with this set is the standard type of the Wireless Snecialtv Apparatus Co., known as UR-1420. Two amplifiers are provided, a two-step tone-frequency amplifier model UR-1000 A, and a six-step radio-frequency detector tone frequency amplifier. A Magnavox is also included as part of the equipment, and with the six-stage amplifier, signals from distant countries, hitherto inaudible, can be heard a mile from the station.

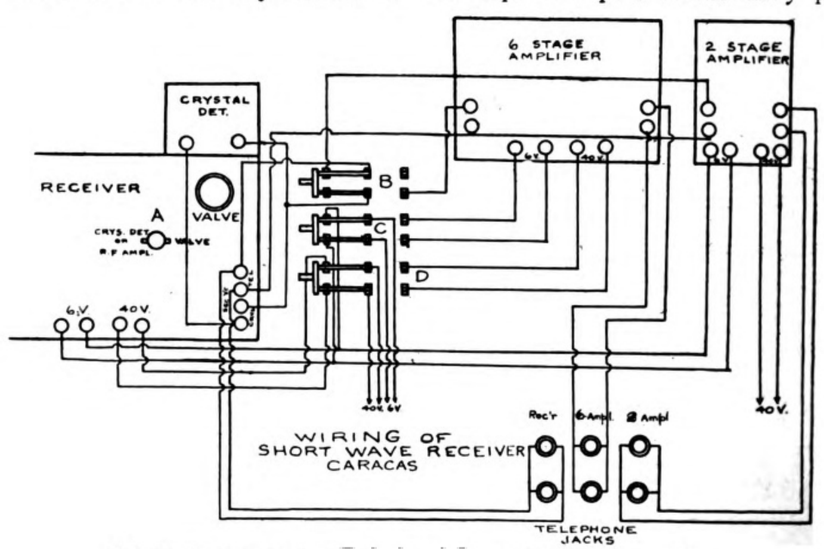
The Radio Corporation C.W. transmitter gives from twelve amperes at the shorter waves to nine amperes at the longer waves, at full power. On the auxiliary antenna, about ten amperes C.W., and eight amperes "chopped" can be obtained. With this radiation, using C.W., day signals at Puerto Cabello are extremely loud without amplifier, and static has to be exceptionally severe to interrupt communication. Distances of about 600 kilometers, over mountains, to the inland stations, are regularly covered by day. With the grid chopper, distances as high as three hundred miles have been attained.

Some trouble was experienced at first with the grid chopper signals, when ships fitted with crystal detector only were doing the receiving. At first it was feared that the efficiency of transmission was at fault, but later it was proven that the fault lay in the sharper tuning required even for I.C.W. transmission as compared with ordinary spark sets. As soon as the ships learned the necessity for exact tuning, satisfactory distances began to be attained.

The telephone range of the set is about one hundred miles over land. A radio-telephone concert to ships at sea is given every day by Mr. Eichwald, usually on 1,100 meters, and on a recent trip of the S.S. Caracas the writer had the privilege of listening in "on the other end" of the music. The modulation was beautifully clear and distinct, comparing favorably with the best hitherto heard.

The "chopper" note is a beautiful one, pitched at about four hundred cycles, and rich in overtones, resembling the note obtained with a well-adjusted non-synchronous gap running on commercial frequencies of supply, a note which practical operators always have considered ideal for carrying qualities.

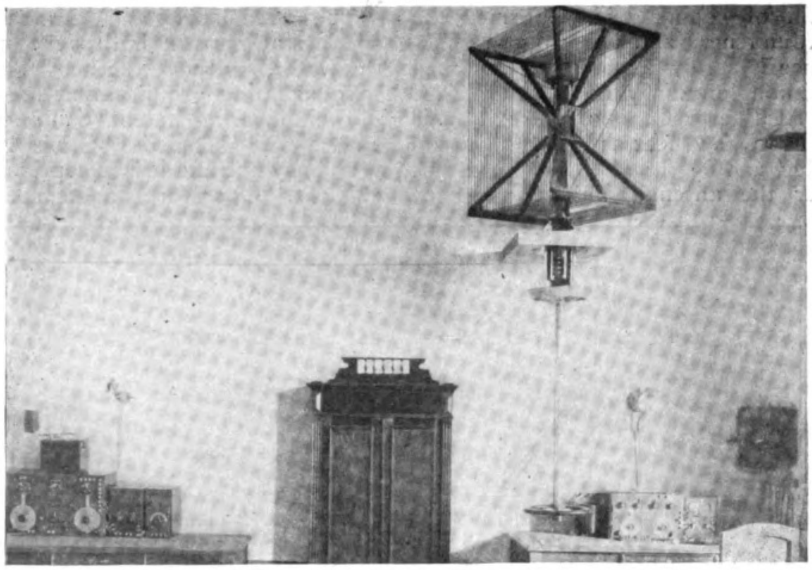
On the other side of the building at the Caracas installation is located the long-wave receiving apparatus, fitted with both two-stage tone-amplifier and six stage combined radio and tone amplifer with detector intermediate. This receiver is especially used for copying press sent out from the Naval stations at San Diego or Balboa. Venezuela is very much interested in the happenings of her northern sister, and the radio news copied before dawn by Mr. Eichwald becomes an important part of the daily pa-



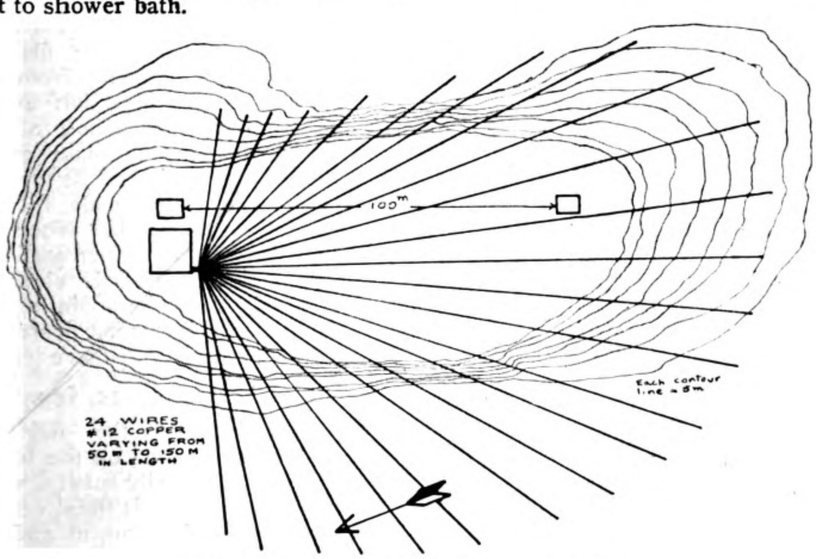
Circuit diagram of the short-wave receiver at the Caracas station per which later risers read with interest. Nearby is one of the latest models of direction finders, a standard shore station type supplied by the Radio Corporation. This is used at present primarily for instruction in the radio school. The Government is considering the problem of installing two radio directional stations on the coast for the benefit of navigation, but before any decision is made on this the operation of the Caracas apparatus will be studied for some time.

The business-like appearance of the interior of the Caracas station and the neat character of the wiring and the arrangement of apparatus, reflects great credit on Mr. Eichwald who installed it, as well as upon the Government for authorizing such a modern and in every way complete outfit. From a battery-charging switchboard in a fume-proof room with lead-covered wires running in trenches to all the receivers and amplifers, to the neat, red-painted copper tubing from the entering insulator to the sets there is no installation in North America which can claim to be better than this one and few that can equal it. Venezuela is to be congratulated on having a station of such a modern type and in taking pains to make an installation which not only delights the eye but also insures the best operation.

The outlying stations of Venezuela, though not so complete as Caracas, show the same painstaking care. The buildings are neat structures of concrete with red-tiled roofs, and are beautiful and well-laid out for their intended use. They are modern in every way, from radio set to shower bath.



Receiving sets at Caracas. At left is shown the lown-wave receiver, at right the radio compass loop antenna and receiver



Ground system at the Caracas radio station

The stations so far installed consist of spark sets at several of the seaports where the main business is communication with ships; arc sets in the interior towns for internal communication, and vacuum tube sets, providing both radio-telegraph and radio-telephone service at the more important cities in the thickly settled portion of the country. A list of these stations is given below, with interesting data concerning each one. It will be noted that new call letters assigned by the Berne International Radio Bureau have very recently gone into effect, superseding the old call letters temporarily assigned by the Venezuelan Government.

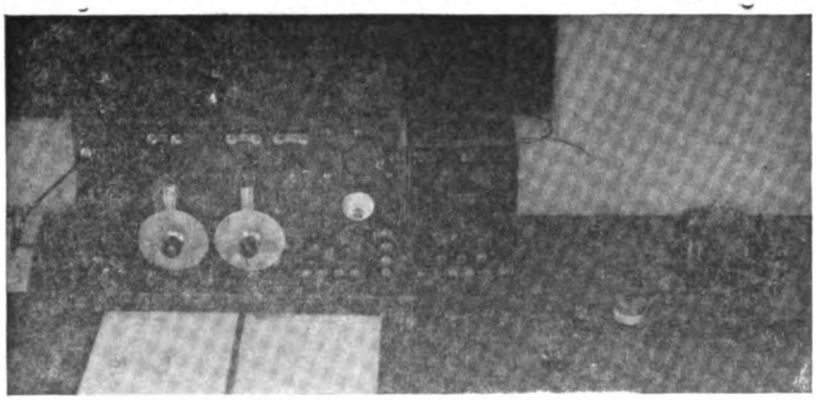
Most of the spark stations operate on wavelengths of 600 meters, although Maquetia and Margarita Island use waves up to 1,200 meters for their interchange service. The continuous wave-stations use a standard calling wave of 1,600 meters, and individual communication waves either side of this value. All stations are fitted with wave-changers so that the use of a calling and a communicating wave is easy from the engineering standpoint.

Location of station	Old call	New call	Type of set	Power of set	Type of communication
Maquetia	HRH	AYG	Spark	5 k.w.	Damped wave
Caracas	HRE	AYA	Vacuum tube	3.5 k.w.	Continuous wave, damped wave, and radiotelephone
Maracay	HRF	AYB	Vacuum tube	3.5 k.w.	Continuous wave, damped wave, and radiotelephone
Puerto Cabello	HRK	AYC	Vacuum tube	3.5 k.w.	Continuous wave, damped wave, and radiotelephone
Maracaibo	HRI	AYF	Spark	5 k.w.	Damped wave
Margarita Is.	HRM	AYE	Spark	2 k.w.	Damped wave
Barquisimeto	HRB	AYH	Arc	5 k.w.	Continuous wave
San Cristobal	HRG	AYD	Arc	5 k.w.	Continuous wave

The Maracay and Puerto Cabello installations are counterparts of Caracas, as to antenna, transmitter and receiver. At both these stations the transmitting as well as the receiving equipment was supplied by the Radio Corporation of America.

Maracay is situated inland surrounded entirely by mountains and is more bothered by afternoon thunderstorms than any of the other stations. Lake Valencia, a large, beautiful body of water is near-by and the soil below the radio station is always moist; in fact, a few feet below the surface one always finds water. A very complete radiating system of copper wires forms the ground here and the ground resistance is as low as could be obtained without auxiliary tuning devices.

At Puerto Cabello, the station is only a few feet from the water's edge, and a grid of copper wires under the antenna and running out into the sea to stone anchorages some fifty feet out insures a rather good ground connection. With the constant sea breeze on one side and the beautiful Floral Park of Cabello on the other the station is situated about as ideally as a station well could be.



Type of receiver in use at the Cabello station

The Maquetia and Maracaibo spark stations are both very near the water, and have the best copper wire radiating grounds that the radio engineering talent could provide. The Maquetia station is a very busy one and it is exceptionally efficient. Operators on steamships plying between New York and Venezuela report that Maquetia (or La Guayra, as it is often incorrectly called), does not fade at all during any time of the day, whereas Curacao, a very efficient and well-installed station in the Dutch West Indies, will at the same time and on the same wavelength, fade to inaudibility. Maquetia is on a narrow ledge of land by the water's edge backed up by a mountain range rising almost straight up to a height of about a mile. Theorists may work on this problem at their leisure.

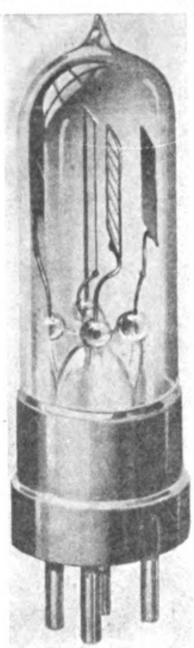
Our southern sister republic is to be congratulated on the rapid progress she has made to date in the establishment of efficient radio communication. This is not surprising for a land which has hundreds of miles of perfect roads through wild mountain regions and that has a modern hanger with a dozen or so modern airplanes flying daily. After a short breathing spell to knit together more closely the system so far established it is to be hoped that she will continue in her development along this line with the same pioneer spirit and the same determination as has already been shown. There is still much need in this vast country for further radio service, and Venezuela knows it well. The history of her success will be shown in the next issue of the Berne call-book for the radio stations of the world.

The Negatron—A New Negative Resistance Vacuum Tube

By John Scott-Taggart

IN THE September number of The Wireless Age, the author described a negative resistance device employing two three-electrode tubes. The present article describes another arrangement in which the effect is obtained by a single tube which has been called a "Negatron" and which operates in an entirely different manner. The subject of negative resistances and their applications is dealt with in the author's new book "Thermionic Tubes in Radio Telegraphy and Telephony," so that it will be unnecessary to preface the following description by any introductory remarks.

The negatron vacuum tube was produced in September, 1919, and the author's patent for it has recently been accepted. The principle on which it works is briefly as follows: A thermionic tube is arranged having two flat anodes, one on each of a filament. Each anode is connected through an anode battery to the filament so that the electrons emitted by the filament, when it is heated to incandescence, are distributed fairly equally between the two anodes. A control electrode, which may be a flat grid, is also arranged within the tube between the filament and one of the anodes. This latter anode will be called the "diversion anode," while the first one will be called the "main anode." If we suitably arrange the relationship between the electron emission and the anode voltage, we may make the total of the anode currents approximately equal to the electron emission. In other words, a saturation effect is obtained. Under these conditions, if we make the grid more positive with respect to the filament we shall divert electrons from the main anode to the diversion anode with a consequent reduction of the current flowing in the main anode circuit. In the negatron, as preferably used, the main anode is connected to the grid so that when the main anode voltage is increased the grid potential is increased, electrons are diverted from the main anode, and the main anode current decreases. Hence the negative resistance effect.



A typical form of Negatron

Theory of Action of the Negatron

Figure 1 illustrates the negatron tube itself. The anode on the left is the main anode (usually small), while the anode on the right is the diversion anode. Between the filament and the diversion anode is a flat openwork grid. A tubular tube with four-pin cap is preferred, the connection to the main anode being taken to the metal portion of the tube cap. A metal spring on the holder presses against and makes electrical contact with this metal portion.

The action of the negatron will be better understood if reference is made to figure 2, which shows a negatron connected up in one way so as to possess negative resistance characteristics. Between the anode A1 and the filament F is a battery H1, and two terminals I, N. Between these terminals a milli-ammeter may, for the time being, be connected. The anode is connected through a battery B to the grid G. This battery is merely connected in this position to keep the grid at a suitable potential which is preferably slightly negative. If G were connected directly to A1, G would have a high positive potential with respect to F. Between F and the diversion anode A2 is a second battery H2. Both H1 and H2 are usually of about 60 volts, but their values are not very important provided that the current supplied to the filament F may be adjusted to produce the saturation effect.

Let us now see what will happen if we increase the voltage of H1. We should normally expect the current to A1 to increase, but as the potential of A1 increases so does that of the grid G. Since G becomes more positive, the current to A2 will increase, and this increase could be measured by connecting a second milli-ammeter in the A2 anode circuit. This method of varying (by altering the space charge) the current to A2 is, of course, well known, as it has been used in ordinary tubes since the introduction of the grid. The important fact to notice, however, is that, if the current to A2 increases, the electrons which go to A2 must come from those which would have gone to the anode A1. There is, therefore, a diversion of electrons. If the A2 anode current increases, the A1 anode current must decrease, and conversely. Similarly a decrease of the A1 anode current would always be accompanied by an increase of the A2 anode current, and conversely. This effect is conditional on the existence of saturation in the tube. Since by decreasing the potential of the main anode A1 we have diverted electron current to the anode A2, the main anode current decreases. There are now two effects which govern the A1 anode current. The increase in the A1 anode potential tends to increase the A1 anode current; the diversion effect, however, tends to decrease the A1 anode current. The diversion effect greatly outweighs the other, and the result is a decrease in the main anode current consequent on an increase of the main anode potential; the converse also applies. A decrease of the main anode potential makes the grid G more negative and decreases the current to A2. The A1 anode current consequently increases. In this way, the negatron acts as a negative resistance.

The negatron as described, works only when the saturation effect is obtained. For this reason, a filament current rheostat is desirable and the current through the filament is adjusted until the negative resistance effect is obtained. If the filament be too bright, there will be no "robbing" action. There will always be a plentiful supply of electrons around the filament and an increase of grid potential would increase the A2 anode current and the additional electrons would come from the source round the filament and not from amongst those which would have gone to the main anode A1. The A1 anode current would, therefore, be unaffected and no negative resistance effect would be obtained.

Characteristic Curves of the Negatron

The above explanation is borne out by characteristic curves obtained with the negatron, three of which curves are shown in figure 3. The thick line shows the main anode current. The top thin curve shows the sum of the two anode currents. The broken line represents the diversion anode current. Since the grid is always kept in the neighborhood of zero volts, the grid current is almost zero. The grid is usually kept slightly negative, so that the grid current is zero. If this were not so, the grid current would add itself to the main anode current and the negative resistance slope would be less steep.

The curves of figure 3 bring out very clearly the "robbing" action which the negatron utilizes. The top curve shows that the negative resistance effect is obtained while the tube is saturated. Since the total current remains constant and the diversion anode current increases (due to the control electrode potential rising), the main anode current must of necessity decrease, and this is shown by the thick curve which slopes downwards. The main anode current decreases to the left of the peak because the saturation effect is non-existent (as proved by the top curve), and the decreasing grid potential produces an increasing space charge between filament anl main anode which decreases the main anode circuit. The curve is, of course, only used along its downward sloping portion and oscillations will only be produced when the main anode and grid potentials are

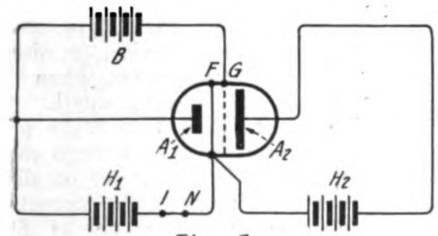


Fig. 2

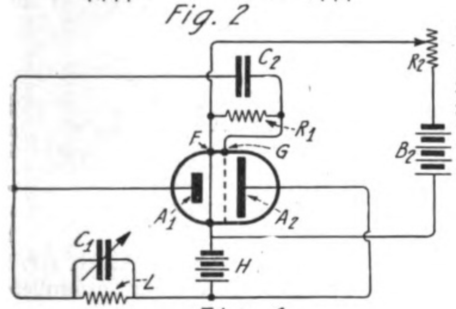


Fig. 4

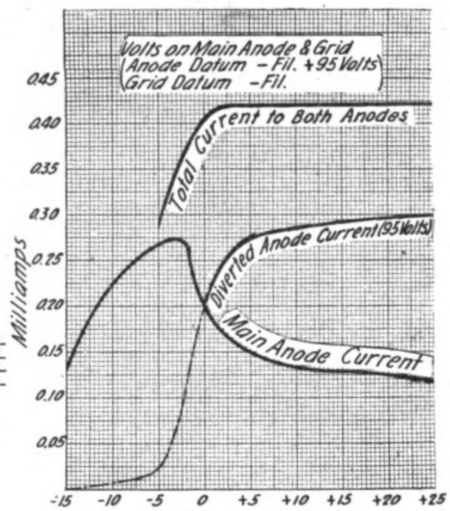


Fig. 3

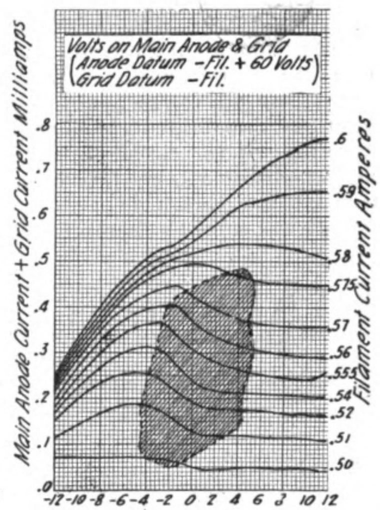


Fig. 5

Circuits and charts pertaining to the Negatron at suitable values. In practice, the grid potential is usually slightly negative and no grid voltage adjustment is necessary.

APPLICATIONS OF THE NEGATRON

To recount the applications of the negatron would take up too much space; they are as numerous and varied as those of the dynatron (which, of course, works on an essentially different principle). The main use of it is as a generator of continuous oscillations for the transmission or reception of continuous waves. It may be used for receiving spark signals by reducing the effect of positive resistance. As a local oscillator it is exceedingly convenient as it will oscillate on all ranges from 600 m. to 20,000 m. (the usual commercial range), without any complicated switching arrangements. The circuit arrangements which have been found most convenient are shown in figure 4. These are the same as those in figure 2, except that the two batteries are replaced by a single one (H) of about 60 volts. The main anode is connected through a leaky grid condenser C2 to the grid G, a resistance R1 being connected across grid and filament. This leaky grid condenser merely replaces the battery B of figure 2 for the purpose of avoiding a high positive grid potential. The filament F is heated by current from the 6-volt accumulator B2 through the rheostat R2, of about 7 ohms resistance. This rheostat is adjusted until continuous oscillations are produced in the oscillatory circuit L, C1. It is to be noted that the diversion anode circuit plays no other part in the circuit than as a path around which electrons are shunted. The A2 anode current produces no effect whatever on the oscillatory circuit L, C1. If this anode were disconnected, the circuit would not, of course, oscillate even if there were plenty of electrons, because the phases of the grid potentials would be exactly opposite to those necessary to produce oscillations. As it is, the grid, over (and beyond) the working range, does not control the main anode current in any way, when the A2 anode is disconnected.

Before concluding it will be of interest, no doubt, to demonstrate by means of curves the fact that the negatron only oscillates over a given range of filament current. Figure 5 shows a series of characteristic curves. Main anode current curves are given for different values of filament current. The negative resistance effect disappears completely when the filament current is above 0.575 amperes. Likewise, it disappears, for another reason, when the filament current is very small. An oscillatory circuit will oscillate provided conditions are such as to come within the shaded area, and no difficulty is experienced in practice through the limited range of filament brightness.

Amateurs Transmit Across Atlantic

Distinction of Sending First Message Across the Ocean Goes to Station 1BCG. Twenty-four Other American Stations Also Heard in Scotland by P. F. Godley

TRANSMISSION of signals and messages across the Atlantic Ocean by an amateur radio station in the United States became an accomplished fact for the first time on the night of December 9 last, when undamped signals from the station of Minton Cronkhite, Greenwich, Conn., call letters 1BCG, were copied by Paul F. Godley, located at Ardrossan, near Glasgow, Scotland.

Mr. Godley made a special trip to Scotland, on behalf of the American Radio Relay League, for the purpose of determining whether or not the signals from amateur radio stations in the United States could be heard across the Atlantic. Definite periods of time for the operation of amateur stations were arranged, qualification trials were held prior to the trans-Atlantic tests, and all amateur stations which covered 1,000 miles or more overland in the preliminary tests were allotted fifteen-minute periods of transmission, and assigned five letters, arbitrarily, which were transmitted repeatedly for fifteen minutes.

The arrangement was, that should Mr. Godley be able to copy any of these transmitted groups he was to refer them to Philip R. Coursey, of London, who alone could determine the identity of the transmitting station by means of the code letters, as the American representative of the amateurs did not have a copy of the code combinations.

John Grinan, prewar 2PM (in the rubber coat) who operated the station

Provision was made for a period of 15 minutes on each night of the tests as a free-for-all transmission period, during which all stations not having a special period of transmission were invited to participate. This included stations which had not qualified in the 1,000 mile preliminary trials, or had not taken part in them. The first station, therefore, to be heard by Mr. Godley, was one which had not been in operation at the time of the preliminary trials, and which took part in the free-for-all period assigned to First District stations.

The trans-Atlantic tests took place between 7 P. M. and 1 A. M. of the following morning, from December 7 to December 16, inclusive.

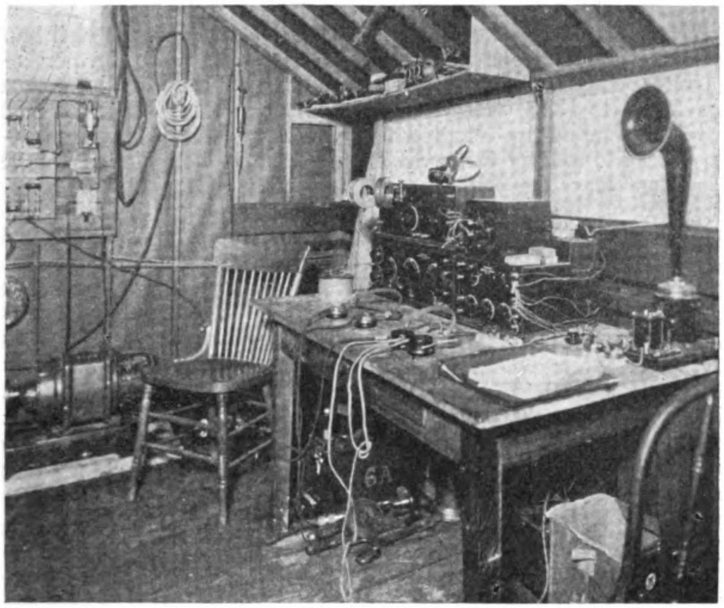
As a result of the first night's transmission, Mr. Godley reported having heard a First District station, Call 1AAY. It has not been possible to verify this, however, as inquiry at the transmitting station failed to show that the owner had transmitted during the time of the tests. No other station was reported on this night.

On the night of the 8th, a heavy rain and windstorm prevailed, with excessive static, and Mr. Godley reported no signals had been heard.

On the night of the 9th, trans-Atlantic transmission of signals on a 200 meter wave became an accomplished fact for the first time in the history of radio, when Mr. Godley reported the reception of signals from station "One Bay Cast George," meaning Station 1BCG. His advices, which came the following night by radio from MUU, stated that the signals of 1BCG were strong and steady. No other stations were reported by Mr. Godley as having been heard on the 9th, so that the distinction of having transmitted the first trans-Atlantic signals from an amateur station, conforming in every way with the Radio Laws and Regulations of the United States, clearly belongs to Mr. Cronkhite and those associated with him in the undertaking.

On the night of the 10th, Mr. Godley reported that eighteen United States amateur stations had been heard and identified.

A cablegram was received by Mr. Cronkhite from Mr. Godley, at this stage of the proceedings, advising him that the signals of 1BCG station were wonderful, and requested that Mr. Cronkhite transmit a complete message. This message was transmitted on the night of the 11th by 1BCG and was received by Mr. Godley, who advised of its receipt by cable. The reception of this complete message entirely verified the earlier reception of signals and established beyond all doubt that the signals of 200 meter amateur radio stations can be reliably copied across the Atlantic Ocean with proper receiving equipment.

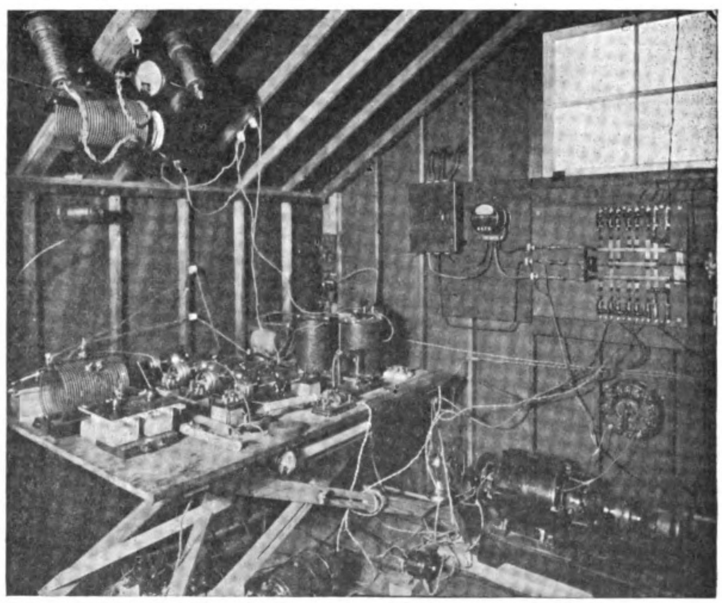


Receiving equipment of 1BCG station

A report has been received from Preston P. Boardman, Tucson, Ariz., Call 6AMT, to the effect that the signals of 1BCG station were heard by him on several nights during the tests, and were particularly good on the nights of the 9th and 10th. It was on these two nights that the signals of 1BCG were reported as being strong and steady in Scotland by Mr. Godley. This report from Tucson, therefore, establishes the remarkable fact that 1BCG not only transmitted across the Atlantic Ocean, but practically effected transcontinental transmission as well and at the same time, and covered one-fifth of the earth's circumference in doing it.

On the night of the 12th, Mr. Godley again reported reception of signals from 1BCG station and stated that the reception of them was practically continuous for most of the night, the station having resumed transmission after the scheduled time of the tests on that particular night.

The successful accomplishment of trans-Atlantic work by 1BCG station is a very gratifying result of unceasing planning and labor on the part of Mr. Cronkhite and his fellow members of the Radio Club of America, E. H. Armstrong, George Burghard, John Grinan, Walter Inman and Ernest Amy, who were associated with him in the undertaking. When the final arrangements for Mr. Godley's trip were completed Mr. Cronkhite and his associates rolled up their sleeves and prepared to prove to the world that the unattained could be attained, and they have been well repaid for their efforts.



Transmitting station of 1BCG. Four Radiotrons, UV204, are used, one as master oscillator and three as power amplifiers, with 2000 volts D. C. on the plates

The transmitting equipment at 1BCG station is rather unusual, as amateur stations go, the set itself employing four Radiotrons UV 204, one as a master oscillator, and three as power amplifiers. A plate potential of 2,000 volts D.C. is supplied by a motor-generator, working on the regular commercial supply lines at 110 volts, 60 cycles. The total input of the set is 989 watts. The set delivers 6 amperes in the antenna, representing 558 watts, based on an antenna resistance of 15.5 ohms. The antenna is of the T type, the horizontal part being 100 feet long. Both the flat top and the leads are eight-wire cages. The effective height of the antenna above the radial counterpoise system of the antenna is 75 feet. The counterpoise is 120 feet in diameter and is supported on poles 8 feet above ground. There is no earth ground connection. All transmitting was done on a wave-length of 200 meters.

In addition to 1BCG, Mr. Godley reported that signals from the following stations had been heard by him during the tests:

1 IRU Hartford, Conn., Robert S. Miner.
1 BDT Atlantic, Mass., S. H. Heap.
1 ARY Burlington, Vt., University of Vermont.
1 BGF Hartford, Conn., Perry Briggs.
1 YK Worcester, Mass., Worcester Polytechnic Institute.
1 EM West Somerville, Mass., Arthur D. Moulton.
1 XM Mass. Inst. Technology, Cambridge, Mass.
1 RZ Brookfield, Conn., John W. Hubbard.
2 FP Brooklyn, N. Y., H. C. Barber.
2 BML Riverhead, L. I., H. H. Beveridge.
2 FD Flushing, L. I., John Di Blasi.

2 EH Riverhead, L. I., Radio Engineers Station.
2 ARY Brooklyn, N. Y., Wm. Warren Redfern.
2 AJW Babylon, L. I., Harry S. Collins.
2 BK Yonkers, N. Y., Carl E. Trube.
2 DN Yonkers, N. Y., Arnold Brilhart.
3 DH Princeton University, Princeton, N. J.
3 FB Atlantic City, N. J., Wm. Jordan, 3rd.
8 ACF Washington, Pa., Thomas F. McNary.
8 EV Vandergrift, Pa., Leroy M. Levinson.
8 XV Cleveland, Ohio, F. S. McCullough.
8 RU Pittsburgh, Pa., Charles C. Rankin.
3 BP (Canadian) Newmarket, Ont., Edward S. Rogers.

Although not reported by Mr. Godley, the signals from 2ZL station were heard in England during the tests and particularly well on the night of the 10th. The signals from 2ZL were heard at several listening stations in England and the code letters verified. On the same night that the signals from 2ZL were heard in England, they were also heard at Stanford University, Monterey, Calif., 6CQ, so that this station, transmitting on 325 meters effected trans-Atlantic and trans-Continental transmission at the same time.

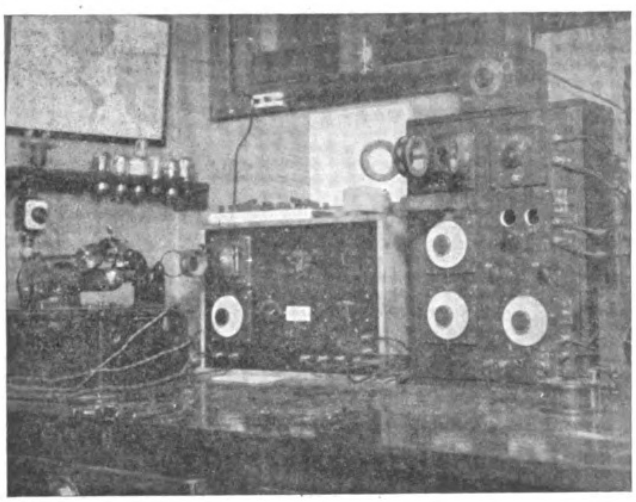
Every possible preparation was made in advance to facilitate the work of the receiving station on the other side of the Atlantic. Wireless men in England have from the first co-operated in every way with great enthusiasm. In Great Britain the laws restricting amateur wireless men are extremely rigid, rendering amateur work almost impossible. As a result there is today about one amateur station in England or Scotland to one thousand in the United States. The British amateurs hope that the success of trans-Atlantic sending by small stations may serve to modify the present British laws and place the British amateur radio man on the same footing as his American cousin.

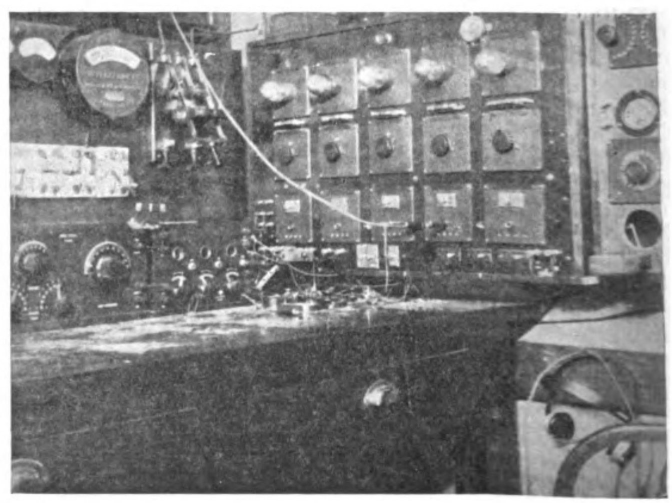
A new era in the history of amateur wireless work will date from this achievement. The horizon of amateurs on both sides of the Atlantic is suddenly lifted. New and fascinating possibilities are opened for them. The immediate result of recent tests will doubtless be to accelerate further trials between the continents on a much larger scale. Wireless men are already predicting that in a few years at most amateur stations throughout the United States and England will work regularly with one another.

That stations as far west as Ohio were able to reach Scotland was due partly to the relation, not always realized, which Britain occupies to America. The general direction from points in this country is northeast. Signals from New England pass over the Maritime Provinces of Canada, and those from Denver pass over Hudson Bay. Mr. Godley expressed the belief that because of better refraction and reflection inland stations had as good a chance of getting over as North Atlantic stations, and this proved to be the case.

Paul F. Godley, the well known radio engineer and former technical editor of THE WIRELESS AGE, is a member of the Institute of Radio Engineers and the Radio Club of America, and is well known to the radio fraternity of the United States. He has had a long experience in telegraphy and radio. His research work in radio has been confined principally to reception and his name is indelibly linked with the adaptation of the Armstrong feed-back circuits to short-wave work. He was the pioneer in this phase of reception and was the logical man to attempt the unprecedented undertaking of the reception of amateur station signals across the Atlantic. In fact, the general sentiment in the radio world during the tests was that if Godley wasn't successful, it couldn't be done. That he was successful, and successful beyond anything anticipated, in making trans-Atlantic transmission by American amateur stations a reality, is a source of great gratification to everybody concerned.

Paul F. Godley's description of Amateur Radio Transmission Across the Atlantic will appear in The Wireless Age





Transmitting (left) and receiving (right) sets at the radio station of Joseph Fairhall, Jr., of Danville, Ill. The Edison dictaphone on the left is used for recording messages

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

Rectified A. C. for Plates and A. C. for Filaments of Vacuum Tubes

By M. Wolf

FIRST PRIZE $10.00

ONE of the reasons why the use of A.C. has not found a more general application among amateurs is probably that it is relatively new as compared with the use of D.C., and like all new methods and inovations it will take some time to come into its own with the amateur fraternity. That it will come more and more into use is shown by the fact that all the radio manufacturing companies are making and selling A.C. rectifiers and transformers for the plate circuit of vacuum tubes.

Once the amateur has tried the use of A.C. on vacuum tubes he will not stop using it. It presents no more difficulties than the use of D.C. on the plate and is certainly more convenient. For it is a fact that most houses are equipped with A.C. power rather than with D.C. Also if he wants to use very high potentials he is limited by his D.C. generator voltage, whereas he can buy or even build a transformer to give him any desired voltage for his plates.

As for the circuits to use these are becoming quite well known. The use of rectified A.C. was originally explained by Dr. Hull of the General Electric Co. and the circuits he advanced are those still in use. If the proper constants are used in these circuits no bugs or difficulties will arise and operation of the tube set will be as steady as with the use of D.C. Then again these circuits permit of the use of A.C. for the filaments of both rectifiers and power tubes, which does away with the annoying inconveniences of run-down batteries, charging them, keeping them in good condition, etc. Also the use of A.C. for the filaments has the effect of giving a longer tube life than the use of D.C., as explained in the Radio Corporation's catalogue of amateur apparatus.

The writer uses A.C. for the filaments and rectified A.C. for the plates of his power tubes. The circuits he uses have been taken from an article on a "Continuous Wave Transmitter," which appeared in the April 1921 issue of THE WIRELESS AGE. In place of the rectifiers the writer used two power tubes, as recommended in the referred article, and connected the grids of these tubes to the filaments, and then used plates and filaments as in the regular rectifier tubes. This arrangement gives excellent results, and saves the cost of extra rectifiers if enough power tubes are available.

The circuit employing the A.C. is shown in figure 1. The power transformer was made up according to the specifications given in the mentioned article as follows: A shell type core was built up as in figure 2, of silicon steel laminations, No. 29 gauge. The size of the laminations and the method of assembly will be clear from the diagram. In order to decrease the losses and thus increase the efficiency of the transformer, one side of each lamination was shellacked. The laminations were then bound together by a layer of linen tape, and an insulating layer of oak tag paper placed over this. Three windings were placed on the core. The primary winding was wound on the center leg of the core and was made up of 110 turns of No. 18 D.C.C. wire, the winding being in two layers of 55 turns each. On the other two legs were wound two low tension secondaries, one on each leg, of 12 turns each of No. 12 D.C.C. One of these supplied the filaments of the power tubes, the other the filaments of the rectifiers with current. Assuming a voltage of 110 in the primary, which the supply power usually is, there would be 12 volts in each of these secondaries, sufficient for my low power tubes. By winding more turns on these low tension secondaries and using a rheostat or reactance in series more voltage could be obtained if necessary and the proper adjustment could be made with rheostat or reactance.

The high tension secondary supplying plate voltage was wound over the primary winding on the center leg. Over the primary were wound two layers of oak tag paper providing sufficient insulation between primary and secondary. On this were wound 880 turns of No. 26 D.C.C., in six layers. This gave a total secondary transformation ratio of eight, thus giving 880 volts. Since only half of this was used for the plates of the power tubes, according to the circuit employed, there was about 400 volts on the plate, allowing for voltage drops, transformer losses, etc.

This transformer was used in the circuits shown in figure 1. In the fil-

(Continued on page 45)

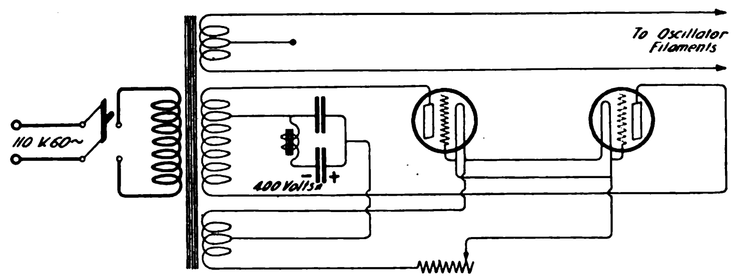


Fig. 1

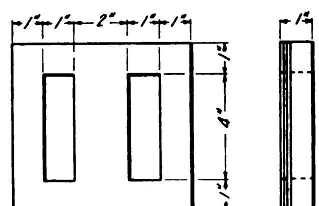


Fig. 2

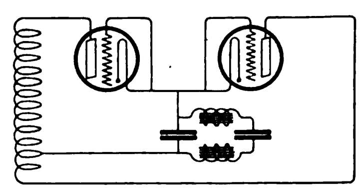


Fig. 3

Figure 1—Circuit employing A. C. for vacuum tubes. Figure 2—Transformer dimensions. Figure 3—Filter circuit connections when two iron choke coils are used

A.C. vs. D.C. for Filament Lighting and Plate Current Supply for Vacuum Tube Transmission

By Edward Thomas Jones

SECOND PRIZE $5.00

IN answering this question one must be set to receive severe criticism from both the pro's and the con's. But the experimenter who has dabbled with A.C. and D.C. for tubes will admit that perfect operation can be had from both sources. It is merely a matter of the expense involved. In this instance I might add that the A.C. supply is rapidly taking the place of the once staunch D.C. source of supply. From my observations with both sources of supply I have the following remarks to present:

1. A.C. source of supply can be smoothed out just as clearly as the D.C. source of supply.
2. The A.C. transformer and rectifying outfit is much cheaper than the D.C. motor generator unit.
3. Automatic I.C.W. is possible with A.C. without the introduction of a chopper device.
4. Self-rectifying circuits work extremely well when four or more 5-watt tubes are connected in parallel, using 10 watts on each half of the cycle.
5. The A.C. apparatus is noiseless.

There are two very workable methods of rectifying the high voltage A.C. source delivered from the secondary of the transformer. First, by the kenotron rectifier tubes; second, by the use of electrolytic rectifiers.

Kenotron Rectification

With a 50-watt transformer and two kenotron UV-216 tubes connected as shown in figure 1 the author was able to obtain 200 milli-amperes at 350 volts. This was on dead shunt to the meter terminals.

Your attention is directed to the polarity obtained when tube rectification is employed. The center tap of the filament lighting source is positive while the center tap of the high voltage source is negative. The polarity switches around with different types of rectifying devices. It will be noted that the center tap of the high voltage source becomes positive in polarity when the electrolytic rectifier is used—see figure 2. On dead short circuit the plates should not heat more than a very dull red. This can be noted when the filament current is suddenly cut off; the plates in a few seconds return to their normal temperature.

I have had good success in using defective receiving tubes, especially those sold for amplifying purposes. By connecting the grid and plates together a very good rectifier is constructed. With two connected in this manner I have obtained 100 milli-amperes.

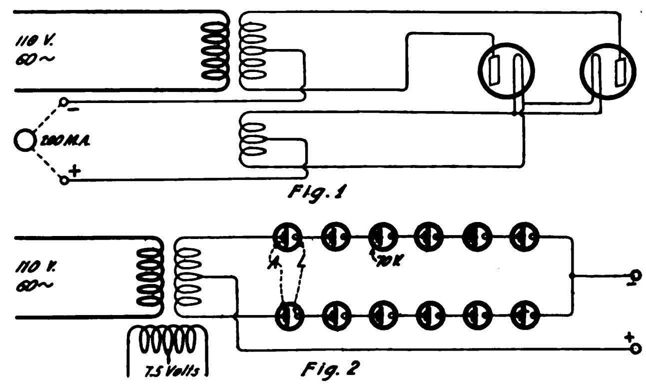


Figure 1—Kenotron rectifying circuit. Figure 2—Electrolytic rectifying circuit

Electrolytic Rectification

There is only one stumbling block in the making of electrolytic rectifiers. In order to form the plates (deposit a white crystal formation on the plates), it is necessary to place them across the secondary of the transformer. Before they are formed, the plates in the solution act as a dead short to the secondary windings. The secondary windings get very hot and the plate forming process must not be continued for over fifteen minutes at a time. Ten minutes would be better. If the transformer was immersed in oil during the process it would permit the forming of the plates in less time.

One pint jars will do. Use pieces of lead and aluminum one inch in width with at least three inches protruding into a solution of borax (20 mull team). Don't be afraid to put borax into the solution; in fact, it should be a thoroughly saturated solution with some borax allowed to settle on the bottom of the jars. Be sure that the strips do not touch the borax. When the aluminum plates spark all over their surfaces—the rectifiers are complete.

For best operating conditions—use one jar for every seventy volts. On a 350-volt transformer I used six jars in each leg—see figure 2. With the arrangement noted the author obtained 180 milli-amperes.

Note, however, that the polarity has changed. The secondary high voltage center tap is now positive, since the current can only flow from the lead to the aluminum plate.

There is absolutely no doubt in my mind that everyone will eventually take to the A.C. source of supply for operation of vacuum tube filaments and plate supply. Circuits have been printed galore and it is felt that a repetition would only act to lengthen the article for no particular good reason.

What Power Supply Should the Amateur Use on Vacuum Tube Sets?

By Bernard Steinmetz

THIRD PRIZE $3.00

THIS problem has no doubt confronted almost every amateur operating vacuum tubes. The solution is not always a simple one, but in certain specific instances is readily at hand. For example, many amateurs have in their houses only D.C. power. They, therefore, cannot use A.C. or rectified A.C. expediently or economically. It would be folly to buy an A.C. motor generator for rectification, when it is cheaper to buy the D.C. motor generator and use D.C. on the plates. These amateurs, therefore, should only use D.C. It is most economical, and will give best results.

But how about the amateur who has A.C. power in his home? In this case the writer fully believes the advantage lies with A.C. power. If the amateur is going to use telephony then rectified A.C. should be used. If just telegraph transmission either rectified

A.C. or straight A.C. for tone transmission can be used.

One of the great advantages in using A.C. for the filaments of vacuum tubes is that the life of the tube is thereby increased. It has been definitely shown that a tube operated with A.C. in the filament lasts considerably longer than a similar tube using D.C. For this reason alone A.C. should be used for the filaments regardless of what power is used for the plates.

Recently numerous circuits have been developed and perfected for the use of A.C. or rectified A.C. on the plates of vacuum tubes. Previously these circuits were not well known, and operating them meant trouble and difficulty, but now there is no reason for not using A.C., as circuits have been designed which give no trouble. A.C. has other advantages. For example, by using A.C. direct on the plates of tubes C.W. tone telegraphy is obtained, the power tubes themselves doing the rectifying. Again the use of A.C. gives a certain flexibility in operation which is extremely desirable. That is, the transformer stepping up the voltage can be made or brought with taps on the primary and secondary, in this way making it possible to secure either very high voltages or very low voltages for the plates. Thus full power, low power, or any intermediate power is readily available for transmission.

In using A.C. the amateur will have no trouble in rigging circuits up as these are designed and recommended by the various manufacturing companies. To show this the writer gives here the details of his set using straight A.C. on the plates for tone transmission. Two vacuum tubes, each 5 watts, are used, the tubes being the Radio Corporations UV-202. The circuits used are those recommended by the above company in their newest catalogue which has recently been issued, and is shown in figure 1.

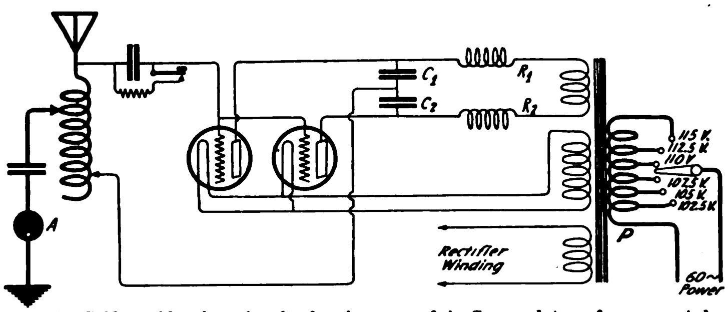


Figure 1—Self-rectification circuit showing use of A. C. on plates of vacuum tubes for tone transmission

The power transformer is the UP-1368 transformer manufactured by the above company designed for 115 volts primary. However, the primary is tapped between 100 volts and 115 volts with 2½ volt taps. The secondary of this transformer is divided into three separate windings, one for lighting the power tube filaments, another for lighting the filaments of rectifier tubes (in this circuit this winding is not used), and the third, the high tension winding, goes to the plates. Two radio frequency choke coils are used in the two plate leads for protective purposes and these chokes R1 and R2 are made as follows: Take a cardboard or wooden form about 2¼ inches in diameter and 2 inches long and wind about 90 turns of No. 30 B. & S. D.C.C. wire on it. This will give a choke of about 0.5 millihenry inductance which is sufficient for this power. C1 and C2 are plate stopping condensers which are about 0.002 microfarad, and can be purchased for about $2.00 each or can be made up. The rest of the circuit is probably well known to most amateurs and needs no description.

This circuit will give excellent results, especially since the values of the different constants has been determined by manufacturing companies.

It might be interesting to mention that amateurs who may still have 500-cycle generators can use this to great advantage. By applying this 500-cycle current to the plate, C.W. tone telegraphy can be accomplished and at the same time the advantages of musical high tone transmission secured, since the 500 cycles on the plates is transmitted.

By following the instructions and circuits of the Radio Corporation of America's new catalogue, which gives these various A.C. and rectified circuits, the amateur will find that the use of A.C. on his vacuum tubes will open up new fields for him.

Modulation Systems in Radio Telephony

By L. R. Felder

THE type of modulation system used in actual practice depends largely on the generator of radio frequency oscillations. Thus it is evident that a modulation system which would be suitable for a vacuum tube generator of radio frequency oscillations might be very unsuitable for an arc generator. The purpose of this article is to give a descriptive resumé of the various modulation methods actually in use, indicating also to what type of radio generators these methods are adapted.

In general modulation methods may be classified as follows:

A 1. Modulation by varying the wave length of the radio frequency oscillator.

2. Modulation by varying the output of the radio frequency oscillator.

Most modulation systems fall into the second class, the first class not having proved itself very practicable. In this first method of varying the radiated wave length according to speech, the radiated wave when speaking is really a band of wave lengths, with the usual resultant disadvantages, namely, the radiated energy is distributed over a wide range of wave lengths, resulting in interference. It is therefore found that the second method of varying the output, or the amplitude of the radiation current, is practically always used.

Another classification which can be made is as follows:

B 1. Non-absorption methods of modulation, where the modulator does not absorb energy from the oscillator.

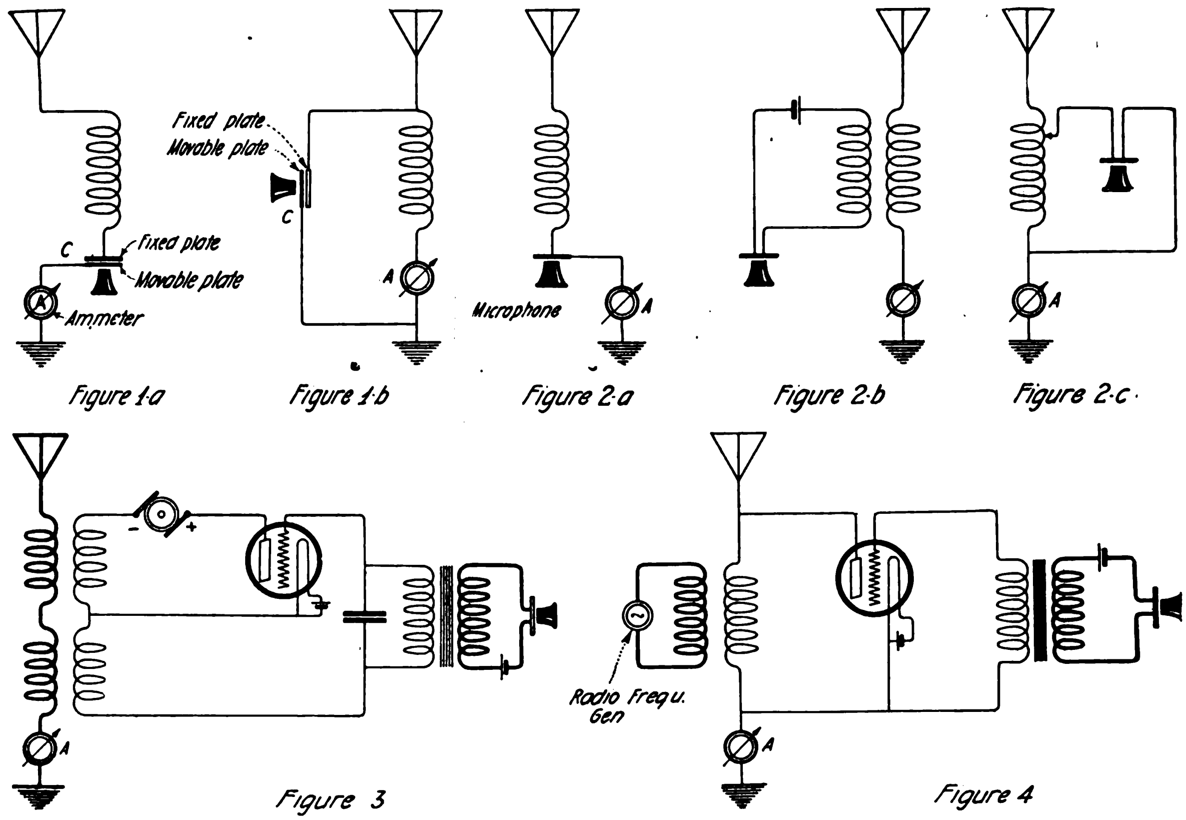
2. Absorption methods of modulation, where the modulator does absorb energy from the oscillator.

Both these classes fall under class A2 above. For our descriptive purposes the classification given under A suffices, but as each method is considered separately it will be pointed out whether it is an absorption or non-absorption system.

We will pass quickly over the first class of wave length modulation by considering briefly one of these methods, namely, the use of the condenser microphone. This microphone consists of the usual mouthpiece and diaphragm, the latter being attached to a series of plates which are movable relative to a fixed series of plates. The microphone may be connected as in figure 1(a) or 1(b). When the microphone is spoken into the voice waves move the diaphragm and the movable plates, thus altering the capacity of C. The motion of the plates is proportional to the amplitude of the speech waves and therefore the capacity and wave length is also proportional to the amplitude of the speech waves. In this way speech modulation is effected. This method has disadvantages, however, and is therefore not much in use. We will pass to the more important methods falling under class A2.

The first and simplest method is the use of the standard carbon microphone in series with the antenna, as shown in figure 2a. Other methods of connec-low power device and the manner in which it is used here requires the passage of the radio frequency current through it or its equivalent, it works best on low power sets. When used with high power difficulties arise, such as packing of the carbon microphone due to overheating, distortion of speech, etc. Consequently it becomes necessary to employ, for higher powers, microphones in parallel or specially cooled microphones. This is a dif-

the speech, altering the output. When the microphone is not spoken into the grid is at its average potential and the oscillator supplies normal output. When the microphone is spoken into the grid voltage swings above and below this mean potential and thus increase and decreases the oscillator output. Thus this system may be considered a non-absorption method if the rises and falls neutralize each other.



Circuits for various modulation systems

tion as shown in figures 2b, c, reduce ultimately to the circuit 2a and have the same effect as the direct microphone-in-antenna system, since the microphone can be transferred into the antenna by the usual transformer relations.

Modulation is accomplished by speaking into the microphone, which alters the resistance and hence the output. This variation of the output is proportional to the speech variations. Since the microphone consumes a certain amount of energy due to its resistance, this system is properly an absorption system. The maximum modulation effect is produced when the maximum microphone resistance (or its equivalent if placed in a coupled circuit) equals the antenna resistance.

This system of modulation can be employed with any type of radio frequency generator, arc, tube, spark or alternator. Since the microphone is a ficult problem, and where powers of any appreciable size are involved this method should be avoided. It is quite satisfactory, however, for low powers, particularly small amateur sets.

Since the use of the microphone, in controlling radio frequency directly, is limited to the low powers, it is necessary to employ other means of control. The vacuum tube possesses properties which make it readily suitable for such control and a series of modulation methods based on these properties have been developed.

The first and simplest method is applicable only to vacuum tube oscillators and is the method of injecting the speech energy into the oscillator grid, as shown in figure 3. The speech voltages in the microphone circuit are stepped up in the secondary of the induction coil and applied to the grid of the oscillator. The average potential of the grid is thus varied and therefore the plate current is controlled by

This method is very satisfactory on low powers as far as percentage of modulation and articulation go. For high powers although complete modulation may be obtained there is considerable distortion of speech and instability of oscillations. This method is admirably suited to amateur sets.

An absorption system of modulation employing vacuum tubes, which may be used with any type of radio frequency generator, is the one shown in figure 4. The principle of this system is the use of a resistance in shunt to a portion of the oscillating circuit, which resistance may be varied by speech. Here the variable resistance is the internal resistance of a vacuum tube, which is connected across the antenna loading coil and ground. The grid is kept normally at a very high negative potential, and thus prevents any flow of plate current and the output in the antenna is the normal oscillator output. When speaking into the microphone the audio voltages vary the mean grid potential and as it becomes more and more positive the valve resistance becomes less and withdraws energy from the antenna circuit. Thus energy from the antenna is absorbed by the valve in proportion to the decrease in negative grid potential produced by the speech voltages, modulation of the radio frequency output being thereby effected. This system is adapted to the higher powers and may be used with any of the systems of undamped oscillation generators.

The most popular and widely used system of modulation employing vacuum tubes is that system called constant current modulation, the circuit of which is shown in figure 5. It is one of the most effective and efficient systems and is capable of being used for any power of the oscillator. It is used solely in conjunction with vacuum tube oscillators.

The manner in which modulation is effected in this system will be readily understood from the following explanation. As will be seen from the diagram in figure 5 there is one oscillating tube and one modulating tube. The modulating tube develops large audio frequency voltages which modulate the radio frequency output in the following manner. When the microphone is spoken into the average grid potential is varied by the speech voltages generated in the secondary of the telephone induction coil. These variations in grid potential affect in a similar manner the plate current with the result that an alternating audio frequency voltage is developed across the iron core inductance L in the modulator plate circuit. This audio frequency voltage is proportional to the speech voltages and, since the modulator is in parallel with the oscillator, adds to the voltage on the plate of the oscillator. Therefore on the positive wave of the audio voltage the oscillator plate voltage increases and the output also. On the negative wave of the audio voltage the oscillator plate voltage decreases and the output likewise. In this way modulation is accomplished. Since the modulator not only effects a decrease in the oscillator output but also supplies a proportionate increase the system is a non-absorption method. This method will be found to be superior to all the modulation systems employing vacuum tubes, giving better control and better articulation. This system is most frequently used in commercial practice.

The above methods employing vacuum tubes in modulation cover the most important and most practicable in that group. We will now consider another group of methods employing a different principle of modulation, namely, magnetic modulation. This group of methods may be used with any type of radio frequency generator and is adapted to any power. It has most frequently been used with radio frequency alternators and has therefore handled powers over 50 and 100 kilowatts.

Figure 6 represents a simple circuit in which magnetic modulation is effected. A represents any radio frequency oscillator coupled to the antenna. MM represent two coils wound around an iron core, the coils being wound in opposite directions so that the resulting radio frequency induction in N is zero. N represents the direct current magnetizing coil, in which circuit the microphone is connected. When the microphone is not spoken into the direct current through N magnetizes the iron to a definite extent, and due to the radio frequency current through MM the iron losses have a definite magnitude. These iron losses are equivalent to the losses in a given resistance in the antenna. In other words the iron core when thus magnetized is equivalent to a certain effective resistance in the antenna. When the microphone is spoken into, the current through the magnetizing coil N varies with the variation in speech intensity, and therefore the magnetization of the iron core varies also. Consequently the losses in the iron vary, which is equivalent to varying the effective resistance of the iron core and thus varying the antenna output as the speech is impressed on the microphone. This system of modulation is an absorption system since the iron core losses are equivalent to an absorption of energy from the oscillator. Various modifications of this method may, of course, be made, but they all reduce to the above principle.

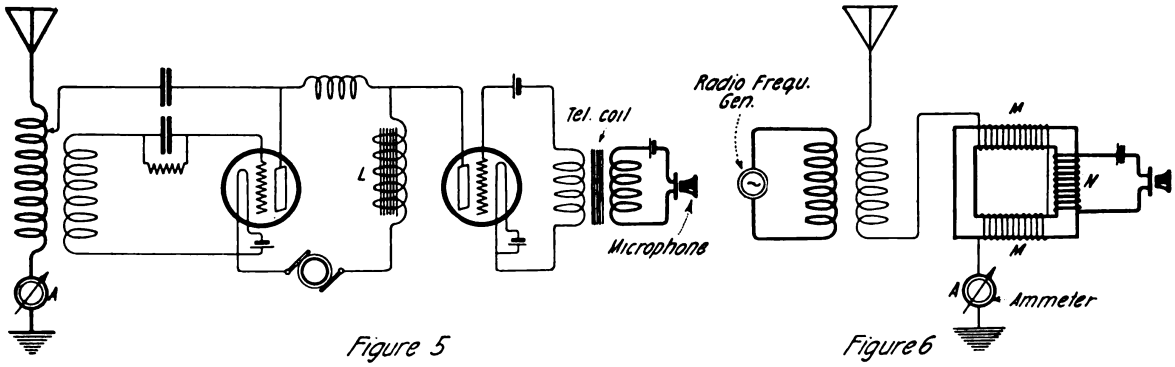


Figure 5—Constant current modulation circuit. Figure 6—Magnetic modulation circuit

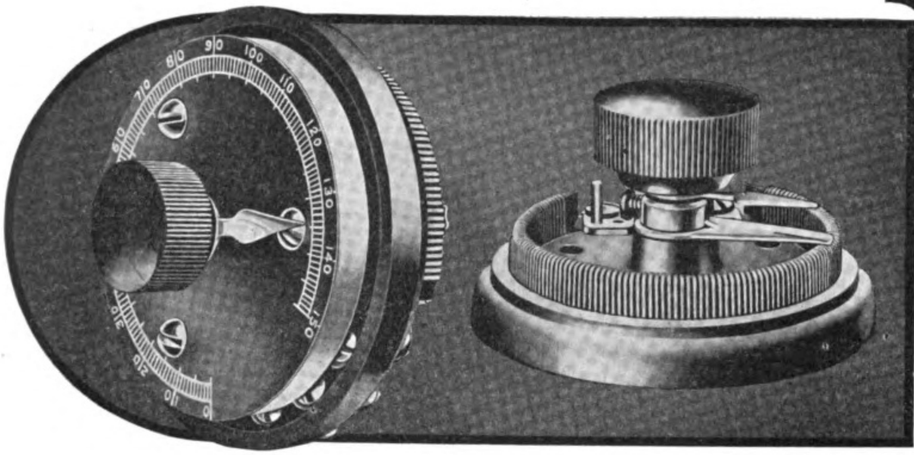
Transformer Iron Loss Data

By Jesse Marsten

THE proper design of power transformers reduces itself to the problem of proportioning the different parts so that the required output is obtained with a minimum total loss at a minimum expense. Reduction of the losses to a minimum is a problem in the proper choice of materials and dimensions of the transformer. The copper loss is determined and definite when the size and amount of copper wire is decided. The iron loss, however, depends on a larger number of factors, namely:

Frequency; flux density; thickness of iron laminations; quality of laminations; insulation between laminations; tightness with which laminations are packed.

The manner in which the iron losses vary with the first four factors is quite well known both qualitatively and quantitatively. This article contains some interesting qualitative information with regard to the last two factors. The data was obtained from measurements on a 5 kw. resonance transformer of standard design, such as is used on standard 5 kw. quenched gap sets. The primary design data



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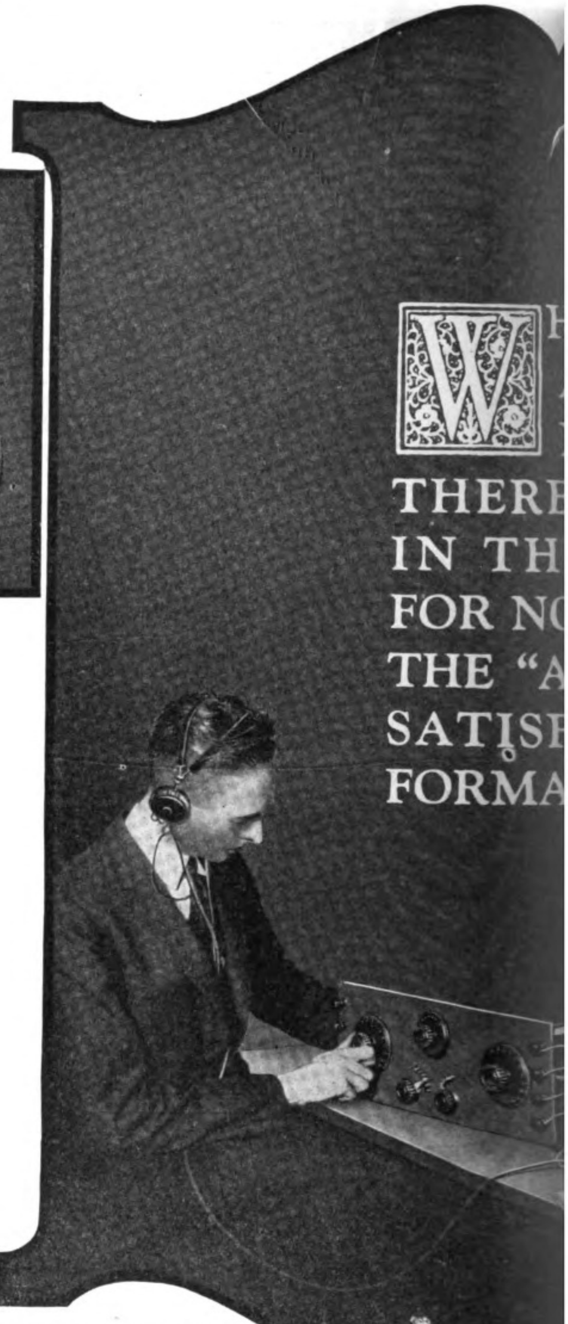

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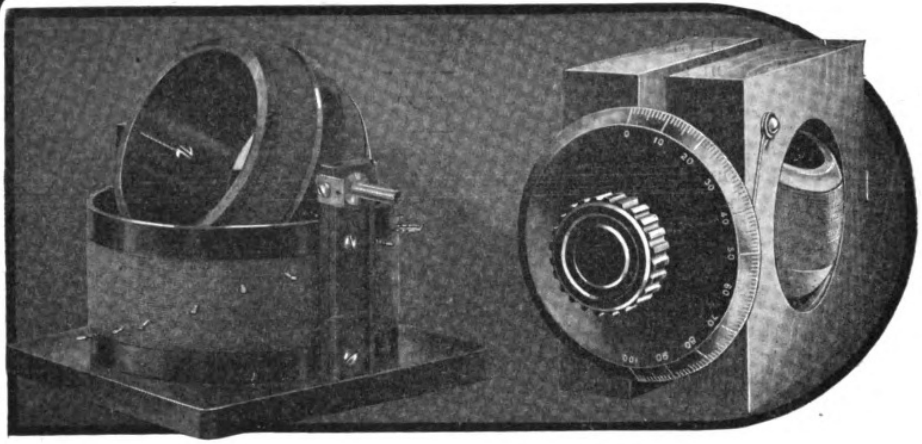

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Canadian

MONTREAL, QUEBEC
J. B. Miller
136 Vendome Ave., N. D. G.

TORONTO, ONTARIO
The Vimy Supply Co.
567 College Street

of this transformer are here noted for reference.

Power, 5 kw.; frequency, 500 cycles; primary voltage, 150; secondary voltage, 12,500; primary current, 50 to 55; secondary current, 1.2; ratio of transformer, 42.

The iron used in this transformer was standard silicon steel, gauge No. 29. These measurements were taken in the course of a more extended investigation, when it was desired to know how the iron loss varied with the tightness with which laminations were packed and with the insulation used. The object was to increase the transformer efficiency. Comparisons were made of the losses with uninsulated laminations, shellacked laminations and paper insulated laminations. In each of these cases the laminations were first loosely and then tightly packed by means of wood clamps along the tops and sides. The losses were measured at various voltages and curves plotted in each case of loss in watts against voltage. The curves thus obtained are shown in the accompanying graphs.

The losses as measured, of course, were only the iron losses. The method of measuring these losses was the standard method, using a wattmeter in the primary circuit, as shown in the figure 1. Voltage and loss were measure simultaneously, and in plotting the curve correction was made for the voltmeter loss error. Also correction was made for the wattmeter loss. In a comparative test such as this, it is important to correct for these small losses, as sometimes this error may be of the same order of magnitude as the difference of loss using two different lamination insulators.

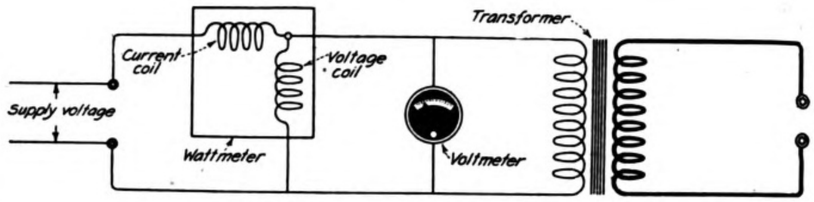


Figure 1—Method of measuring transformer iron losses

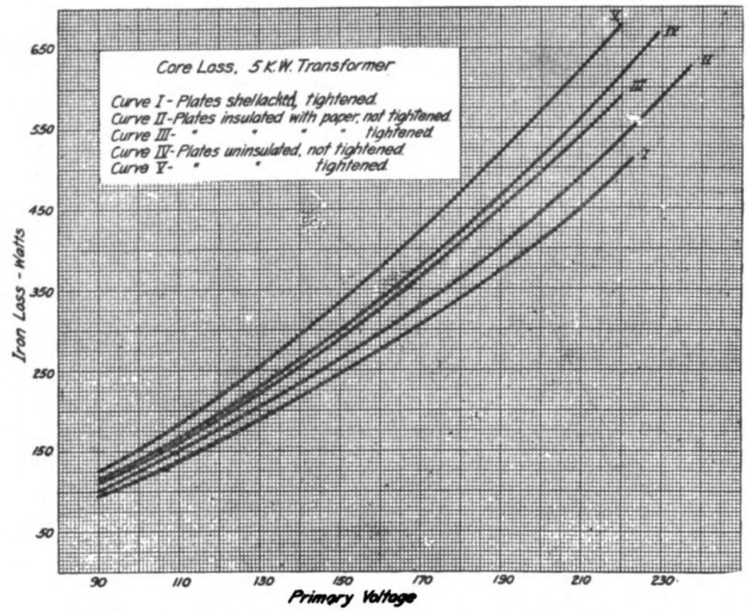
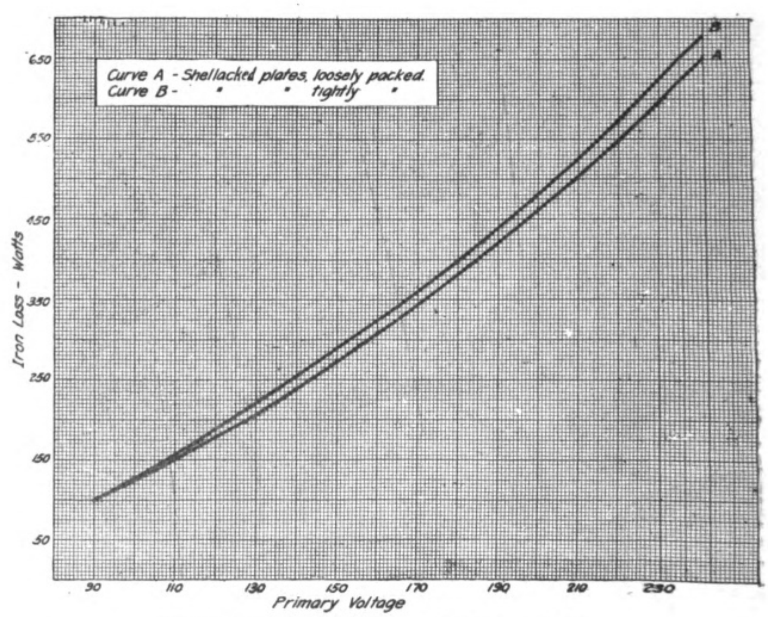


Chart showing comparison of paper and shellacked insulation



Shellacked plates loosely and tightly packed

From an examination of the curves obtained the following conclusions may be drawn:

Shellac insulation is superior to paper insulation in decreasing the losses of the transformer. Even when the shellacked plates are fastened together extremely tight the losses are less than when the plates are insulated with paper 10 mills thick and loosely packed. Whatever the insulation used the losses are increased when the plates are packed tightly together. No measurements were taken on this particular transformer to prove this of the shellac insulated plates. Another transformer was tested for this and the results shown on graph 2 show that the losses are greater when the plates are fastened together tightly.

Thus the results point to the use of shellac insulation with plates loosely packed. The first is practicable, but not the second. The plates may be varnished with shellac, but it is not advisable to pack the plates loosely because of the rattling of the plates. In a 500-cycle transformer the plates will rattle and give the typical 500 cycle note. In a 60-cycle transformer it will give the low 60-cycle hum. It is necessary to clamp the plates tightly to prevent this, even though the losses be slightly increased. This is the usual engineering compromise.

Excellent Work by 6ALE

THE station of W. W. Lindsay, Jr., Reedley, California, call 6 ALE, who recently was heard in Brookline, Mass., by 7 ES, has accomplished excellent results during the past few months. Signals from this station employing a tube transmitter have been reported by 9 AHC, Ellendale, N. D., approximately 1,180 miles, airline; Topeka, Kan., 1,225 miles and Houston, Texas, 1,450 miles. So far 6 ALE has been in communication with other stations in eight States and has been reported from twelve.

A regular schedule for handling traffic has been maintained for some time between 6 ALE and 7 ZU, formerly 7 XD, Billings, Mont. Traffic has also been handled with stations up and down the California coast with regularity. Inland traffic has been handled with several stations located in Utah and Arizona.

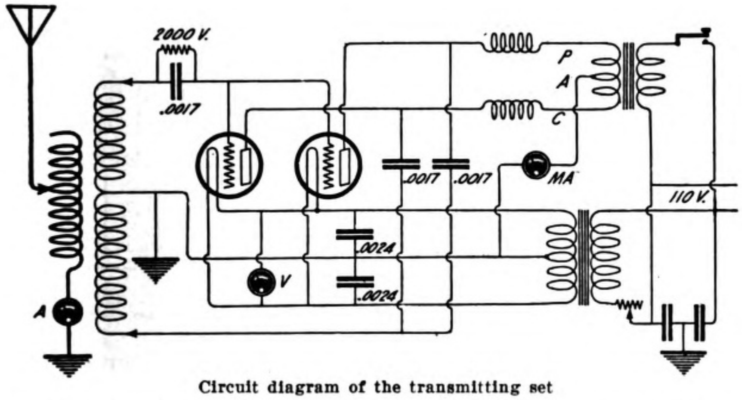
The transmitter used at 6 ALE is one employing two Radiotrons, type UV-203, although only one has been used in working the record distances credited to the station. The normal antenna current with one tube is 2 amperes, and with two tubes, 3 amperes, on a wavelength of 202 meters.

TRANSMITTING EQUIPMENT

The familiar type of self rectifying circuit is used, with 1,500 volts A.C. 60 cycles on the plates of the tubes. The apparatus is mounted on a small table-like stand, and was built this way for the sake of experiment, in order to be able to get at any part of the set easily. The photograph gives a very good idea of the apparatus used. On the lower shelf may be seen the two transformers—plate and filament, with the filament controlling resistance and A.C. voltmeter. A Dubilier protective device is also mounted there. Above this are the racks that hold the three fixed condensers of .0017 mfd. capacity, the grid and two plate condensers,

Mr. Lindsay, operator of 6ALE, and his receiving equipment

respectively. A grid leak of 2,000 ohms is behind the milliammeter. Condensers of .0024 mfd. are also across each low voltage filament winding, these are mounted directly below the tube sockets so as to shorten the radio frequency by-passing circuit. On the top of the table can be seen first the radio frequency chokes, the two tubes and sockets, the radio frequency oscillation transformer and the magnetic antenna transfer switch, with the antenna lead running to the entrance insulator above it. In the ground lead there is a Weston thermo-heating element, which in turn controls the ammeter located above the operating table. The circuit employed is the "Meisner" type, with tuned grid and plate coils, and loosely coupled antenna circuit inductance. This type of circuit has proven most satisfactory, and for the conditions of this station puts more energy into the antenna than any of the many other types of circuits tried. A two 5-watt tube phone and I.C.W. set is also used. This set employs the Colpitts-Heising type of circuit, and works very well. The small generator, with tone wheel mounted on the end of the shaft, is used for this set. All circuits are very easily controlled by the use of magnetic relays and switches.



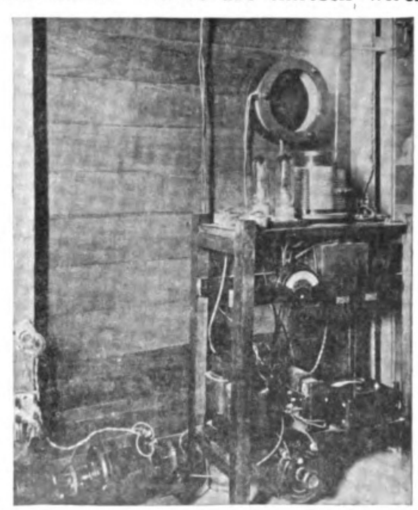
Circuit diagram of the transmitting set

RECEIVING EQUIPMENT

Two receivers are at present in use here. For the amateur waves a Grebe CR3 and tube box are used and have proven very satisfactory. This receiver has been improved a great deal by the addition of a copper shield behind the panel. This shield is grounded, and makes CW tuning a pleasure instead of a worry. The Wireless Specialty Co.'s IP501, which is also shielded, is used for all waves above 300 meters, and with suitable loading coils any range of wavelengths may be obtained with ease. This receiver is very selective and has a wavelength calibrated secondary. A simple change-over switch permits the use of either receiver at will. A sensitive wavemeter, Weston watt-meter and a Magnavox complete the equipment.

ANTENNA AND GROUND SYSTEM

The antenna of 6 ALE station consists of two four-wire cages, 50 feet long, 60 feet high and spaced on 24 feet spreaders. The crosses are 2 feet long on the antenna and 1 foot long on the down leads. The capacity is about .00054 mfd. and the natural period about 180 meters. The ground consists of a buried counterpoise, extending well beyond the ends of the antenna. Inasmuch as the ground is quite sandy here no advantage was seen in raising the counterpoise above the earth. There are thirteen wires in the counterpoise 80 feet long with 3 cross wires and the station in the center. All of the apparatus is housed in a small shack 8x8x8 feet in the back yard. A lightning switch and other safety devices are provided.



Transmitter of 6ALE. Plate and filament transformers, controls and meters on lower shelf. Tubes, tuning inductances, magnetic control switch and radio-frequency chokes on table. Motor generator and tone wheel used with a ten-watt radiophone transmitter shown at lower left corner

An Oscillator For External Heterodyne

By Charles R. Leutz

FOR MEDIUM and long wave undamped reception the heterodyne method with an external oscillator is used almost exclusively by commercial companies. The advantage over the autodyne method with a tickler or conductive regeneration is principally the accurate control of the local source of oscillations.

Figure 1 shows the front view of an experimental oscillator which has a wavelength range of 2,581 to 20,650 meters with a single 180° control. Figure 2 shows the details of the interior construction. This large wavelength range with a single 180° movement is obtained by having the variometer and variable condenser mounted on a common shaft so as to be varied simultaneously, each starting at their minimum value. The variometer used for this purpose was of the Telefunken "D" coil type consisting of two flat "D" shaped coils for both the rotor and stator. The coils are wound with nine No. 38 silk-covered Litzendraht.

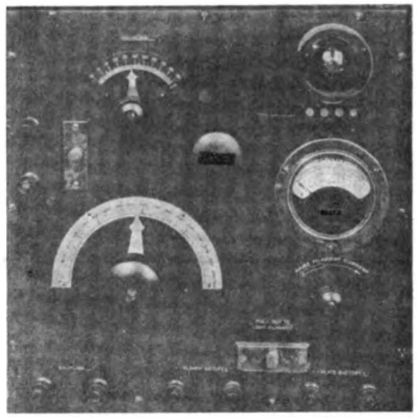


Figure 1—Front panel view of oscillator for external heterodyne

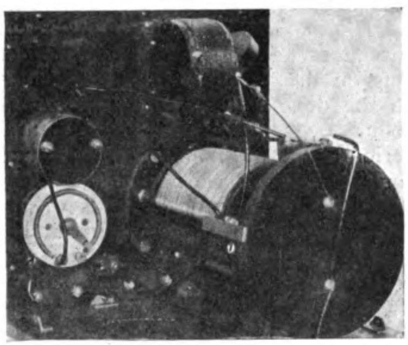


Figure 2—Rear view of oscillator for external heterodyne

The oscillating circuit used is shown in figure 3 which is the common split inductance type. In this case, the filament return is taken from the common lead between the variometer rotor and stator. The usual grid condenser and grid leak is shown but it is not absolutely necessary. A coupling coil is provided so that the supply of oscillations can be inductively coupled to the receiver or other apparatus under test. In this manner the strength of oscillations can be gradually reduced to an exact minimum without varying the filament or plate current, and the scale allows notations to be made for future reference. The filament ammeter is provided so that the filament can be set to exactly the same value each time, which is necessary if the coupling scale readings are to have any comparative value. The coupling coil is also wound with nine No. 38 silk-covered Litzendraht and the coils treated with Sterling varnish after all moisture has been excluded from the coils by baking, and vacuum treatment.

A buzzer is provided in case it is desired to have a source of damped oscillations, the buzzer contacts breaking the oscillations into groups, the resultant note of which can be varied with the buzzer adjustments. The contacts are ordinarily shorted with a switch.

The insulating material throughout is XX black dilecto grained. The construction is of the standard form, all items being fastened to either the panel or base. The balance of the case is removed as a unit to permit inspection.

A typical circuit employing an oscillator for a separate source of oscillation in heterodyning is shown in figure 4. The oscillator is shown coupled to the secondary circuit, although it is entirely possible to couple to the antenna with equal results.

In regard to the operation of this circuit, assume that the incoming wavelength has a frequency of 150,000 cycles to which the antenna circuit is tuned and transferred to the secondary circuit. Now if in addition a second series of oscillations are induced into the secondary circuit, having a frequency of say 150,500 cycles (a wavelength slightly lower than the received wave), there will be a third series of oscillations set up in the circuit, commonly called beats. If the two oscillations, incoming and local are plotted graphically it will be noted that there are periods when these two oscillations are in phase and a like number of periods when they are 180° apart. The amplitude of the combined oscillation rises and falls, reaching its maximum value when the component oscillations are in phase and a minimum when

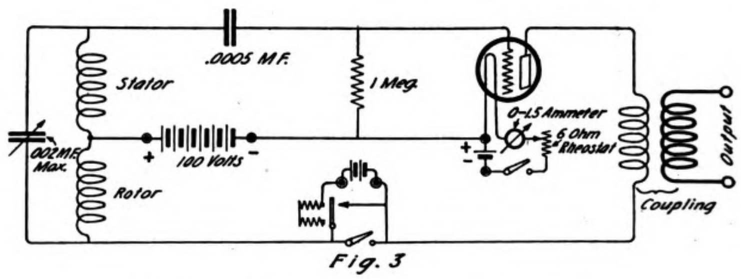


Figure 3—Split inductance type oscillating circuit

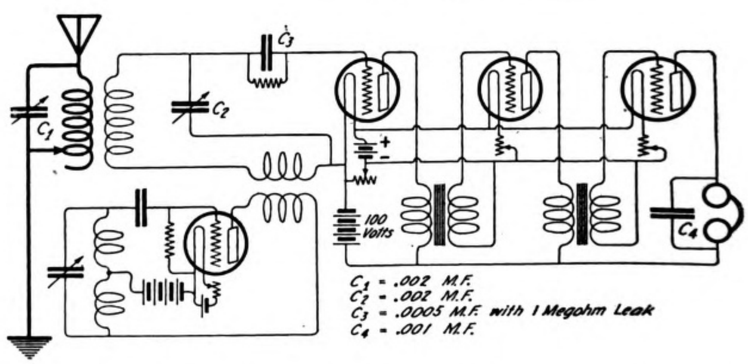


Figure 4—Circuit employing an oscillator for a separate source of oscillation in heterodyning

180° out of phase. The beat frequency is determined by the periodic rise and fall of amplitude and is equal to the difference in frequency of the two oscillations.

The difference in this case is 500 cycles and when rectified by the detector produces a note of 500 cycles in the telephones and as shown in the diagram is then amplified by the audio frequency transformer coupled amplifier through two stages. It is, of course, obvious that radio frequency amplification of the incoming frequency is also possible to bring it up to an order of magnitude suitable for heterodyning and efficient rectification and then if necessary further amplification of the audio frequency current can be carried out.

It will be noted that the desired signal frequency can be adjusted to any pitch without noticeably changing the receiver circuits. This method of reception is especially suited to receiving from stations, the wavelength of which is known in advance. For example suppose that the station desired had a wavelength of 12,500 meters. The oscillator would be set to a corresponding wavelength slightly higher or lower than 12,500 meters and the final tuning of the antenna and secondary circuits could then be accomplished. As soon as these two circuits were brought somewhere near resonance a signal would be picked up having a pitch depending upon the difference in frequencies.

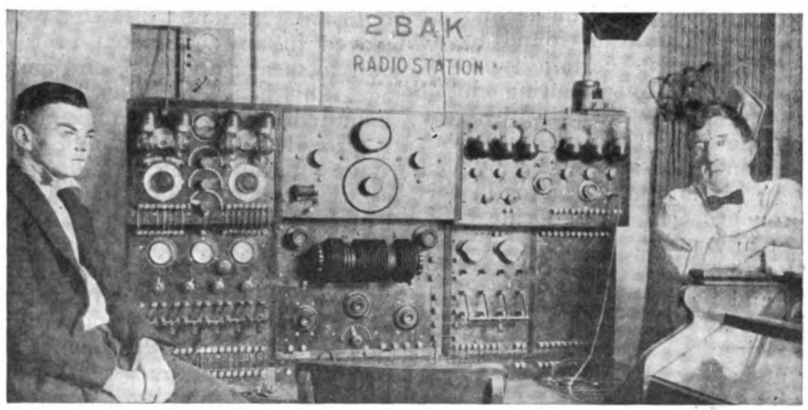
If this system is to be adapted to the amateur wavelengths in the vicinity of 200 meters the frequency will be in the vicinity of 1,500,000 cycles and it is obvious that the oscillator adjustment will be exceedingly critical unless the 180° movement covers a relatively small range of wavelengths. It would be preferable under the circumstances to have the oscillator inductances fixed, and only the condenser variable. The wavelength ratio would then be approximately 2½ to 1, or say 150 to 375 meters. This arrangement in connection with an electrical or mechanical vernier, preferably the former in the shape of a single plate condenser would be entirely suitable for reception on amateur wavelengths. In addition if an oscillator is to be built for low wavelength it would be well to shield the inside of the panel and inside of the case with sheet copper approximately .020 inches thick, and connect to the negative side of the filament battery, to eliminate body capacity effects. It is also possible to eliminate the body capacity effects by properly connecting the low potential leads to controls and having the high potential leads running to the rear of the case. The potential last referred to is the radio frequency potentials —not direct current potentials.

Station 2 BAK, Located at Tarrytown, N.Y.

THIS station was built by Frederick Koenig, who is associated with Joseph B. Slavin in his experimenting at the Old Post Garage, Tarrytown, N. Y. Mr. Slavin holds a commercial operator's license and was an operator on an Eagle boat during the war.

A receiver is being installed on one of the service cars of the Old Post Garage so that it may keep in touch with the station when out on the road.

The transmitting sets and receiver of the station, as well as all controls are mounted in one cabinet on panels which are all removable. The panels are connected with bus bar wiring binding posts on back apron under table and are interconnected in a 2¼ inch space between top of table and bottom of cabinet. There are no exposed parts except the telegraph keys, microphone and head phone. The connections for high voltage A. C. for heating transmitter filaments, A and B batteries—are made to binding posts under table on back apron. All these connections are marked so that at any time the set may be moved. There are handles on each end of the cabinet so that it may be lifted from the table. The left top panel contains the C.W. transmitter and the left lower the C.W. controls. The Heising-Colpitts system, with buzzer or voice modulator C.W. is used. By throwing several switches the four tubes are used as oscillators for straight C.W. or I.C.W. using a chopper wheel. The inductance has variable taps for wave length, plate and grid coupling, also variable condensers in the feed-back and grid.



Operators and apparatus at 2BAK

The center panel of the set contains what is known as a ½ K.W. low power motor boat radio set built by the Sperry Gyroscope Co. It is of the D.C. arc type, with a modifying circuit to break up the sustained waves into audible frequency groups. Power is supplied by a 600-volt 500-watt D. C. Crocker-Wheeler motor generator.

The lower panel to the right of the arc transmitter contains the volt meters and a double-throw, four-pole switch, for throwing the D.C. either to the arc or C.W. transmitter. In the center panel below the spark gap is mounted a short wave receiver. The right top panel contains a special amplifying panel, using a detector and two steps for 'phone, or a detector and three steps, using power tubes, for the loud speaker. All the panels are removable.

Ten-Tube Receiving and Transmitting Set

By Thomas W. Hood, 8AOQ

WHEN the radio bug bit the owner of this station he sure did bite hard. The first real inspiration came one night about 1 A. M. when 1HK was heard calling KQG. The voice was exceedingly well modulated and came in very loud even on one tube.

The following apparatus was built in May, 1921. All the wiring, drilling and finishing was done by hand, but the writer does not advise anyone to try the same kind of a job unless he has lots of patience and a sweet temper. After blowing the works about sixteen times while trying out various forms of circuits which were described as being "very efficient," a set of circuits was decided upon and then came the real work, that of designing a suitable cabinet to hold them. At the time, various panels were being tested out and the writer was using a generator giving 800 volts D.C. and one evening got his fingers across a couple of these front mounted style binding posts. The result was that the slight tickling sensation resulting from the 800 volts made the writer resolve never to mount a single binding post on the face of any apparatus where it could be either seen or felt.

Many amateurs say that four steps of audio-frequency amplification are not practical on account of howling. This was found to be true when using certain types of transformers. By mounting closed core types, as shown in the rear view photograph, this trouble can be eliminated. It will be noticed that absolutely no apparatus in this set touches the wood of the cabinet at any point.

The tuner uses six standard circuits and by the use of small knob switches allows any combination of these circuits. The two triple coil mounts allow any other circuit to be plugged in at various points. It will be found that the judicious use

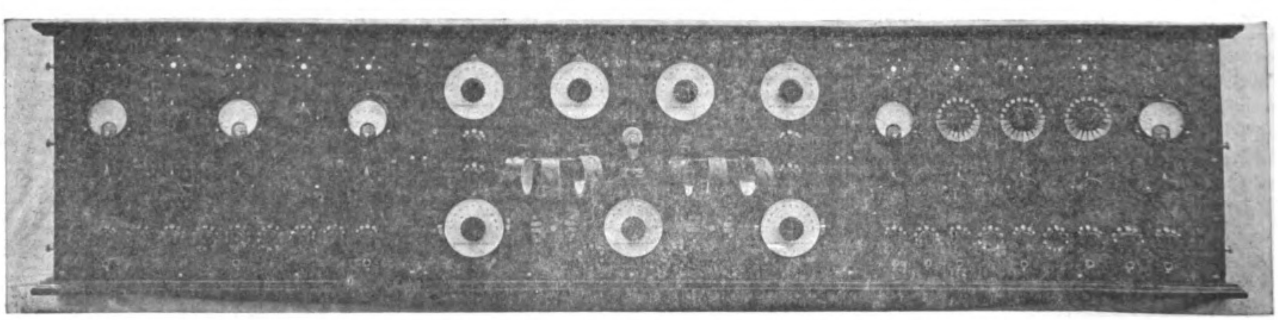
Thomas W. Hood, owner of station 8AOQ

of variable condensers in variometer circuits gives great amplification. Much sharper tuning and the elimination of QRM and QRN can be accomplished by this method.

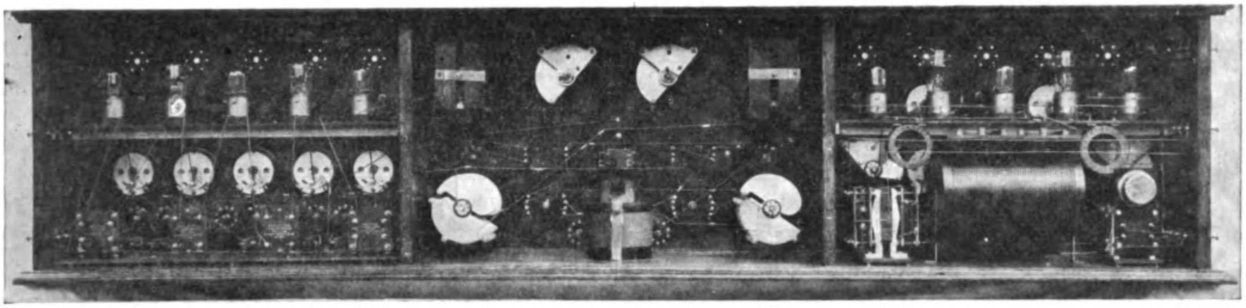
All tubes in the set are under individual filament rheostat control. In the vacuum tube control panel both ammeter and voltmeter can be placed in any individual tube circuit to measure voltage and amperage. This is accomplished by panel-mounted switches. An extra jack is provided on the first and fourth stage for the use of a Magnavox or an extra set of phones. In the "B" battery circuit, each jack is provided with a separate outside binding post which allows any desired voltage to be applied to any tube and also allows the grounding of one side of the amplification transformer. The voltmeter is graduated to fifty volts and gives very accurate measurement of "B" battery voltage. The voltmeter has a two-step multiplier allowing its use on voltages up to 400 volts. All binding posts are mounted on the ends of the cabinet on strips of bakelite one and one-half inches wide by eight inches long.

There are two improvements which have been tried out. One is the capacity screening on variometers by the use of aluminum shields. The use of condensers in this cabinet takes the place of such screening and also allows a sharper tuning. Another is the automatic filament control. This is O.K. until the points on the jack get gummed up and then comes one peach of a job of getting things clean, especially if the jacks are located among a bunch of other apparatus. Just a word here as to the phone. The set was in operation from May 27th until June 4th, and the antenna current, using three oscillators and two modulators, was 1.7 amperes on 219 meters. In the phone panel, jacks are provided for a key with attached plug. The first jack is for C.W., the second for buzzer and the third is in series with the modulation transformer for the microphone transmitter.

This winter the writer intends to build another cabinet which is to be nine feet long by fourteen inches deep by three feet high. The present panels are being incorporated and in addition a complete 1 K.W. spark set, two 1,500 volt C.W. transformers, a rectifier outfit and the substitution of five fifty-watt tubes for the present five watt. The present cabinet weighs 137 pounds complete and is six feet long by sixteen inches high by eleven inches deep. The following is a list of the apparatus used: Switches, .0005 mfd. and .0015 mfd. condensers, rheostats, triple coil mounts, tube sockets, amplification transformers and jacks are of the DeForest Radio Tel. and Tel. Co. The meters are of the Weston



Front view of complete transmitter and receiver



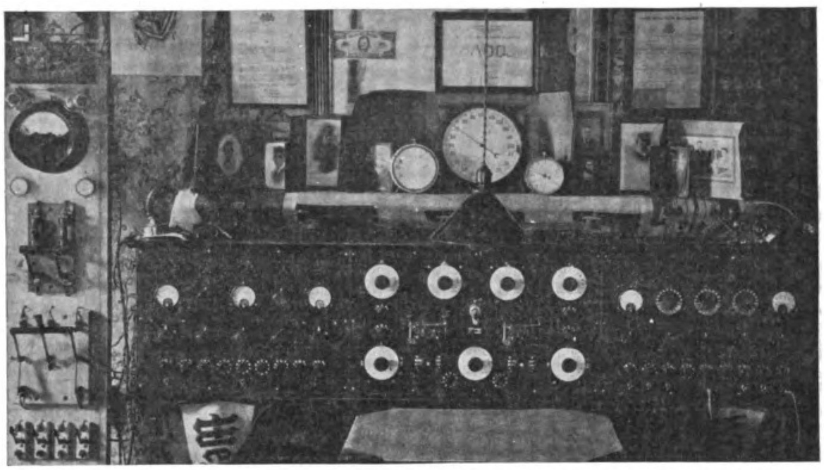
Rear view of cabinet. All the tubes are mounted on Formica racks and the wiring does not touch the cabinet at any point

Electrical Instrument Co. Modulation transformer and chokes of the Acme Apparatus Co. Variometers and vario-coupler of the Pennsylvania Wireless Mfg. Co. at New Castle, Penn. Microphone transmitter and receivers of the Stromberg Carlson Telephone Co. Cabinet of seven-eighths inch oak. Panels are of Formica.

DESCRIPTION OF THE WIRING IN THE CABINET

Phone panel: The inductance is coupled to the three center rotary switches. A tap is taken from each third turn. All the meters on this panel have a switch across them for short circuit. The antenna ammeter is of the thermo-couple type with a maximum capacity of two amperes. Normally three tubes are used as oscillators and two as modulators, but a switch is provided to connect all tubes in parallel as oscillators. The tubes and grid leaks are mounted on the horizontal rack. The milliammeter in the grid circuit has a capacity of 500 M.A. The filament ammeter is so connected as to permit its use on each individual tube in order to determine operating characteristics. Each tube has its individual rheostat. The double coil choke has two microfarad condensers mounted on its frame. Buzzer and modulation transformer are mounted together. Phone, C.W. and buzzer are all operated through jacks. The circuit is the well-known Colpitt's oscillator and the Heising modulator.

Tuning panel: This panel is wired for the tube, ultraudion, standard variometer regenerative, tickler feed back, double coil primary and Weagant's "X" long wave regenerative circuit. A vario-coupler is installed and taps are lead from the secondary to the rotary switches, located at bottom center of the panel. Two primary condenser switches are used. The three-point switches permit the coupling of various parts of the different circuits. Two grid condensers are used, one of them leading to the plate on the fifth tube in the amplifier. Hand capacity when tuning with variometers is entirely eliminated, due to the way in which the secondary condenser is connected. A galena crystal detector is also mounted on the panel and if the detector tube suddenly burns out it may be connected in the circuit by moving the tube switch over one point thus giving quick adjustment. A switch shorts the crystal when not in use.

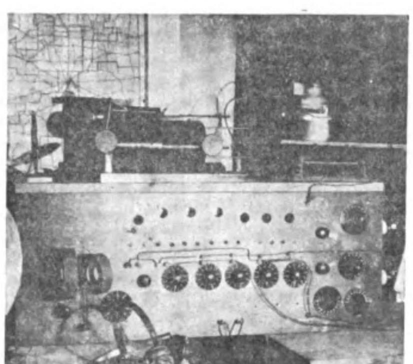


Station 8AOQ when located at Westminster College. A small spark set is shown on the panel at the left

Paper Dials for Your Instruments

HERE is that inexpensive dial you have been looking for. It is cheap, easy to make, and serves the purpose well.

Get a piece of medium weight card board and with dividers draw circles on it, the size of the dials desired. Now with a safety razor blade or other sharp instrument, cut them out. Give them a good coat of white shellac on both sides and edge to make them hard. Paint one side with stove enamel and when dry, divide the circumference into suitable divisions with a protractor and a sharp pointed instrument. The divisions can now be filled with white ink and the dials are ready to fit to any shaft or knob.



They look practically as well as any other dial and can be made for almost nothing. All but one or two of the dials on the home-made set shown in the photo, are of this type.

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

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

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HEADQUARTERS: 326 BROADWAY, NEW YORK

THE Second Annual Convention and Radio Show of the Executive Radio Council, Second District, will be held at the Pennsylvania Hotel, New York, March 7 to 11, 1922, inclusive.

Last year's convention and show was the biggest affair of the kind ever put over in the history of radio. Next month's issue of THE WIRELESS AGE will describe all the wonderful things to be shown, talked about and done this year and you will immediately realize that this year's affair is going to be another smashing big success.

Δ Δ

THE Pompton Valley, N. J., Radio Club held its first meeting on November 17 at the home of Charles Vreeland, and the organization was formed with a membership of seven amateurs. Officers were elected as follows: Charles Vreeland, president and chief operator; Walter Hughes, secretary and treasurer. A committee to draft constitution and by-laws was appointed consisting of Walter Cooper, Dudley Kinsey, Paul Adler and Edward Gaynor. This committee will also act as an entertainment committee and have charge of the club library.

Any person over twelve years of age may join this club. Application blanks can be had by applying to Walter Cooper.

Δ Δ

AN organization of amateur wireless operators has been organized in Westerly, R. I., with the object of increasing interest in wireless telegraphy. A committee consisting of Donald Fancher, Edward Barber and James McKenzie has been appointed to make nominations for officers.

Δ Δ

WIRELESS enthusiasts from Providence, Pawtucket, Central Falls, Valley Falls, Taunton, Fall River, New Bedford, Brockton, Westerly, Woonsocket and Bristol, who have been listening to each other with their wireless telephone apparatus for the past two years, met, many of them for the first time, at a dinner of the Executive Radio Council of Southern New England at the Hotel Dreyfus, Providence, R. I., on November 16.

Seventy-one, many of them women, ranging from amateurs at the game to professional radio men, attended. Charles O. Cressey presided and the principal speech was by Radio Organizer Thomas Giblin of Pawtucket. Plans were made for a series of meetings during the winter, at which prominent radio engineers will be invited to speak.

The association covers all of New England south of Boston.

The object of the council is to stimulate the study of the radio system from both the technical and social standpoint. Its notices have been transmitted to the members through a powerful sending apparatus in Pawtucket.

Fellow N.A.W.A. Members:

By the time you see this, it is probable that 7IP, Craig, Alaska, will have his set working. It is to be a 20-watt C.W. We all know that many 10-watt and 15-watt sets have made some pretty good records, but that's partly due to receiving, so that's where you come in; listen for A. A. McCue, 7IP, Craig, Alaska, on 200 meters, C.W. Hear him break records, and best of all, hear the first real Alaskan "Ham," to break through.

Mr. McCue has installed a Paragon R A Ten and he hopes to make some records,—we hope he does. So far he's only heard coast "hams," but winter's here, so there's no telling what he'll do now.

7IP has an excellent location on the western shore of Prince of Wales Island, right up on the Pacific Ocean.

According to the mail service one would think Craig a million miles from nowhere, as it is, though, it's only about 80 miles from Ketchikan, as the crow flies, so it's possible that Ketchikan will be linked with the States via amateur radio before many moons.

Fraternally,

ROY A. ANDERSON.

Δ Δ

REAR-ADMIRAL M. JOHNSTON, who became Director of Naval Communications when Rear-Admiral Bullard went on sea duty, has accepted an invitation to become an honorary vice-president of the National Amateur Wireless Association. In his acceptance of the invitation, Rear-Admiral Johnston says: "I shall be very glad to do anything I can for the advancement and interests of amateur wireless operators."

Δ Δ

ON the night of December 5 C.W. signals from the station of Colin B. Kennedy, San Francisco, Calif., Call 6XAB, was heard by Herbert A. Wadsworth, 70 V street, N.W., Washington, D.C., an overland airline distance of 2,300 miles. The output of the transmitter at 6XAB was 60 watts.

Δ Δ

ON Sunday, November 13, the Maryland Radio Association, Baltimore, Md., inaugurated a series of Sunday services by wireless, the sermon and music being sent out from local stations and received by all of the more than 2000 stations in the State. On November 20 Rabbi Louis Bernstein of Har Sinai Temple conducted the services. He talked from the station operated by C. Zamoiski at 2527 Madison avenue on "What Constitutes a Great People." The music was sent from the station operated by W. H. Davis at 627 North Mount street. Mrs. E. T. Paul, soprano soloist at Har Sinai Temple, sang Hamil's "Holy Art Thou." The services started at 10 A.M.

THE regular meeting of the Torrington Radio Club was held November 16 at the home of Howard Anderson, 52 Field street. The meeting was largely attended and several new members were enrolled. Many persons have become interested in the club and its work since its organization in January, 1920, and indications are that radio work will prove highly popular in this and surrounding towns. Among the club's members are enthusiasts from Litchfield, Thomaston, Morris, East Litchfield, and Goshen.

At the meeting on November 16, a demonstration of the wireless telephone was given. Victrola selections, played at the home of Floyd L. Vanderpoel in Litchfield by Mrs. Vanderpoel, were transmitted by means of this device to the Anderson home on Field street, a distance of six or seven miles. The music was heard very plainly by all present. The receiving apparatus was one short wave set, with three stage amplifier and loud speaker for receiving music.

Δ Δ

IN co-operation with the city officials of St. Paul, Minn., Boy Scouts are establishing what is to be known as the Boy Scout Municipal Radio Station. The station will be able to communicate by telegraph signals with other stations within a radius of 1,000 miles, and by radio telephone 500 miles. It is planned to make the station of use to farmers by the broadcasting of crop and weather reports, and to cooperate with the State Department of Forestry by reporting forest fires. Inter-troop communication will also be maintained throughout the State, and concerts, lectures, etc., given at the Municipal Auditorium, will be transmitted. Sixteen Scouts are now in charge of this enterprise under the leadership of a Scoutmaster, who has been Chief Radio Inspector of the Pacific Coast Fleet.

Δ Δ

THE Radio Club of Paterson held its regular weekly business meeting on Tuesday, November 1, at its headquarters, the Workmen's Institute, 980 Madison avenue. Twenty members were present. The new officers, P. J. Faulkner, president; J. Saurbock, vice-president; J. Rigby, secretary-treasurer, took office.

Δ Δ

THE Binghamton, N. Y., Y. M. C. A. wireless club elected the following officers at a meeting held on November 16: President Walter Truex; Vice-President, Edward Sharp; Secretary and Treasurer, Charles Winters; Sergeant-at-Arms, James McTigat. Code practice and audion tube construction were discussed and some receiving practiced.

Δ Δ

MEMBERS of the Tri-County Radio Club of Richmond, Va., met in Room 207, John Marshall High School, on November 14.

WILLIAM DODSON was elected president of the Riverside, Calif., Radio Club at an enthusiastic meeting held recently at the home of William Minkler, on Locust street.

The purpose of the organization is to promote interest in wireless telegraphy and radio telephony. Sessions will be held on alternating Wednesday nights.

Other officers of the new club include Don H. West, vice-president, and Robert Kennedy, secretary-treasurer.

Δ Δ

A MAGNAVOX has been added to the equipment of the 55th Infantry Brigade Radio Club, Harrisburg, Pa. A 2-KW transformer in addition to a duplex receiver will also be added within the next few days. The club is making extensive plans for this winter and are preparing to send and receive messages from the various National Guard outfits throughout the State in conjunction with National Guard work.

Δ Δ

A NEW schedule for the operations of wireless amateurs in Bexar County, Texas, was announced recently by L. D. Wall. It is to be put into effect immediately with the aim of relieving congestion due to interference and giving each amateur opportunity to clear his message pad.

From 8 o'clock in the morning until 7.15 o'clock in the evening, operations will be confined to local traffic, relay traffic and tuning of transmitting apparatus. From 7.15 to 8.55, local traffic will be carried on on low power only, the local zone being confined to stations in Bexar County.

At 8.55 o'clock each night, until 9.10 o'clock, all stations will "stand by" for time and weather reports. From that time until 10.15 o'clock at night, the time will be reserved for relay work only. No local work and no tuning or testing of transmitting apparatus will be permitted during this period.

The new schedule applies only to Bexar County wireless operators.

Δ Δ

LINCOLNVILLE, Kans., has established a wireless station to take advantage of the Government market reports made available direct from market centers to the farmer by radio.

The operator of the receiving station has rigged up a telephone and amplifying set, whereby the music of the Westinghouse broadcasting station at Pittsburgh, Pa., can be heard by everyone in Lincolnville.

The service is made possible through the action of the Linconville State Bank, which has erected a wireless station for the benefit of its patrons. Any farmer in the vicinity of Lincolnville who wishes to get the latest market news may have it by simply calling the bank where it is received by radio.

Blanks are supplied by the Government to the stations and are filled in daily with the detailed reports. Out in front of the bank a large bulletin board has been erected, similar to those commonly seen in large board of trade centers, and upon this the results are printed. When the farmers come into town, the first place they head for is the bank's bulletin board. Maybe the market is showing higher prices than obtained for several days past. If so, they hurry home, get their produce or cattle or whatever they wish to sell, and rush back to the town for sale at the prevailing prices. Perhaps the market shows a sudden slump. Now the farmer who was intending to sell his wheat gets dubious, and holds off. When the price comes back to where he believes it should, then he sells—and sells quickly. The small amount of time lost between the setting of the prices in the country's centers and the obtaining of that information at the very source of the land's supplies is of considerable advantage to the farmer.

Many farmers in central Kansas now are receiving their market reports by the air route, and the indications are that the number will be greatly increased before long. Larned, St. John, Great Bend, Herington and Marion all are planning the establishing of the service for farmers in the vicinity.

As a factor in "keeping 'em down on the farm" it appears that the entrance of wireless market reports and incidentally other radio service is one of the best influences yet devised. And the strange part of it is that it was not primarily conceived as such an agent. The purpose behind the establishment of the service was the more efficient results to be obtained in the business of farming.

It is not likely the young folks will be so anxious to leave the farm if they can have up-to-the minute market reports from the business centers or operatic music from the big cities right in their own home community.

Here's a typical incident taken from the every-day experiences of a large number of Kansas and Oklahoma farms. "Son, it's goin' on eleven—better git out to the barn and git the market; I'm figurin' on sellin' the last lot of pigs if the market's stiddy." And the farmer's son goes out to the barn where he has erected his amateur radio outfit, tunes up his set and awaits the sending of the report from the Government station. Within a few minutes the farmer has the necessary information.

The idea itself was inaugurated by the Bureau of Markets at Washington. Stations subsequently were established in four or five cities in the east and middle west, such as Washington, Bellefonte, Pa., St. Louis and Omaha. Every day at stated periods complete reports of the more important markets throughout the country are put on the air, while at 5 o'clock in the afternoon, a complete market letter, called a radio marketgram, a summary of the closing condition in the principal market centers of the United States is dispatched from the Washington offices and relayed into the various parts of America.

The schedule for sending reports is as follows: From Omaha, a finished report on the livestock market is sent at 11:15 o'clock each day (central standard time); and at 11:45 o'clock a complete report on the Kansas City livestock. At 2:15 o'clock, a grain and potato report, giving prices and conditions on the Kansas City, Chicago, Minneapolis and Winnipeg grain market is furnished; and later in the day similar reports. At 5 o'clock a daily radio marketgram is dispatched, covering movements on a national scale in the grain, livestock, fruit, vegetable, hay, feed and seed markets. From St. Louis the reports include a livestock market report at 11 o'clock in the morning, and at Chicago at 11:30; a grain and potato report at 2 o'clock and the radio marketgram at 7. From the Washington and Bellefonte stations is sent marketgrams containing general summaries on eastern prices of livestock, meats, fruits and vegetables, hay, grain, feed and seed at 5 and 7 P. M. (eastern time). The weather report from the offices of the Weather Bureau is appended to the forenoon report.

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G. A. EDWARDS (1AW) of North Sydney, N. S., Canada, an old time amateur and a charter member of the N. A. W. A., entertained a number of friends with a radiophone concert by singers of the Metropolitan Opera, on the night of November 27th. The voices were clear and distinct and of sufficient strength to allow the use of a loud speaking telephone, and could easily be heard 20 feet away. Among the musical numbers heard was "Adeste Fideles," "Onward Christian Soldiers" by choir, "The Holy City," "Rock of Ages," "Sun of My Soul" soprano solo, and "The Palms" the rendition of which was particularly fine. The receiving set consisted of duo-lateral coils with detector and two stage amplifier, and the distance over which the concert was received is close upon 1000 miles. Mr. Edwards is trying to raise sufficient interest in radio to form a local club during the winter.

Prize Contest Announcement

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

What have you done to replace the storage battery for heating the filament of your detector-amplifier tubes?

CLOSING DATE :: : FEBRUARY 1, 1922

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

Prize winning articles will appear in the April 1922 issue.

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

Storage batteries are a nuisance. A device that will permit the amateur to heat the filaments of his receiving tubes from the house current supply (A.C. or D.C.) will be welcomed by every amateur. Not alone for convenience, but for economy as well. Answers should contain diagrams and complete descriptive matter.

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.

Antenna Resistance

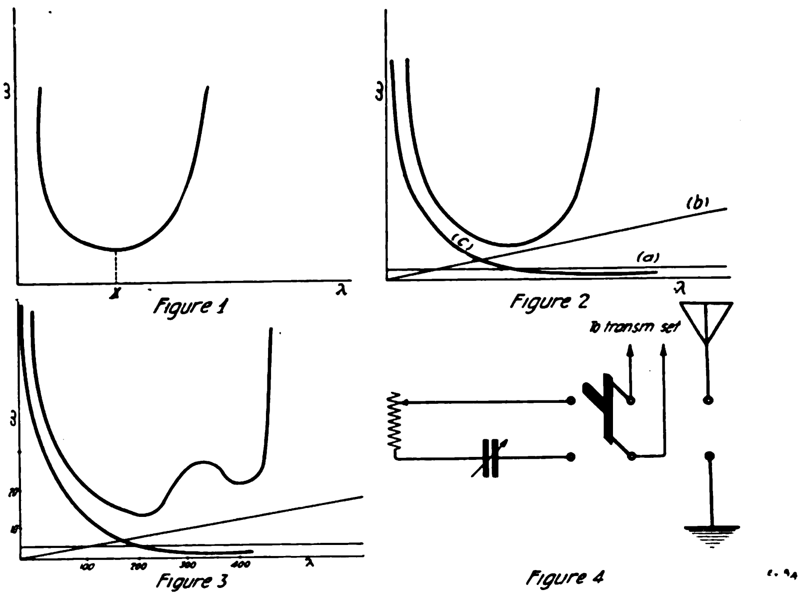
THE consideration of antenna resistance is a very important factor in the determination of the efficiency and range of any transmitting set, either spark or C.W. It is well to obtain a resistance curve of the aerial to be used, and to redesign and reconstruct, if necessary, an antenna which will give a curve showing minimum resistance at the wavelength on which transmission is desired. This article gives an explanation of the subject of antenna resistance, and also a method of determining, to within a few per cent., the values of any aerial, so that a fairly accurate curve may be drawn showing the wavelength at which transmission should be carried on for maximum results.

The design of an antenna to give greatest efficiency differs in every case because of the varying topography at different stations. Trees, buildings, and fences, etc., cause very great losses by absorption of the radiated energy, but this loss is much more pronounced at certain wavelengths than at others. By determining the antenna resistance curve, the points at which these losses are abnormal are shown directly, so that by tuning the transmitter to a different wavelength, better results will be obtained. Without such a curve, it is of course possible that transmission may be attempted at one of these wavelengths at which the resistance is very high, thus giving apparently large radiation in the hot wire ammeter, yet in reality the range is small and the efficiency correspondingly low, since most of the radiated energy is being absorbed by neighboring objects.

The antenna curve is one which shows the resistance of the aerial at different wavelengths. If it were possible to design and construct an aerial in some locality in which there was absolutely no loss by absorption, the antenna resistance of a given aerial would appear as in figure 1. This wave is the resultant of several factors, or a combination of several curves; *i. e.*, the actual ohmic loss in the wire is as shown by curve a, figure 2; the resistance offered by absorption by neighboring objects or the hysteresis curve b—shown arbitrarily as a straight line because its true shape cannot be determined—and radiation resistance curve shown by curve c. The snape and position of this curve is of importance in obtaining maximum efficiency in transmission, although unfortunately it is one which is impossible to determine. It is the ratio between the resistances at corresponding wavelengths on this curve and the antenna resistance curve which determines the efficiency of the transmission. This ratio is greatest at or near the point showing lowest antenna resistance. For the aerial under consideration in figure 1 the best wavelength for transmission is at X meters or at the point where resistance is the lowest.

A curve showing antenna resistance of a four-wire aerial, 50 feet high and 50 feet long, under conditions not quite as Utopian as those considered in figure 1, is shown in figure 3. The hump shown in the antenna resistance curve is the point where surrounding objects are absorbing most of the radiated wave at a wavelength of 320 meters. At this point maximum radiation will be apparent in the hot wire ammeter, yet it is the poorest wavelength at which transmission could be carried on. One should remember that this curve holds only for the aerial under consideration because of varying surroundings. Maximum efficiency will occur at the point of lowest resistance, or at 215 meters in this case.

The method of determining the values for my aerial consists of a "phantom antenna" which can be substituted for the aerial and ground system under consideration. This consists of a variable capacity in series with a variable resistance of five to twenty-five ohms, and calibrated preferably in tenths of ohms for the entire length. Connections should be made as in figure 4 so that the transmitter can be thrown either on to the regular aerial and ground or on the phantom aerial. For the average amateur antenna, which has a natural period of 170 meters, the transmitter should be tuned to about 180 meters on the aerial and ground system.



Curves and connections pertaining to antenna resistance

When the hot-wire ammeter reading is noted, the switch should be thrown to the phantom. The resistance and capacity are now varied until the radiation is the same as with the aerial and ground connected. When this point is reached, the resistance in the circuit is the antenna resistance at that wavelength. This process is repeated for increased wavelengths in steps of about 5 meters until a sufficient number of readings have been obtained to give a good curve. The readings will have a slight error, due, to the fact, that the inductance of the aerial is not introduced in the phantom, yet the curve will be accurate enough for practical purposes.

It is evident that a good ground is essential to keep the antenna resistance low because the greater amount of the antenna resistance lies in the ground connections.

Every precaution should be taken to make perfect connections to and at the ground. Moist soil around the ground plates, rods, or wires, lowers the resistance, but at best, a conductive ground can hardly compare with a counterpoise in efficiency, so wherever possible, a counterpoise should be erected. It has been found that the antenna resistance has dropped about one-third by substituting a counterpoise, even when a fairly good ground had been used.

The subject of antenna resistance is one which should be considered by all those after DX work with their transmitters. If careful readings are obtained, and actual transmission followed accordingly, results will prove more than satisfactory.

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.

2BAK, Old Post Road Garage, Joseph B. Slavin, Operator, Tarrytown, New York.

C. W.—1ZE, 1AFV, 1BXX, 3AW, 3BZ, (3CW), 3FS, 3MO, 3RF, 3ZO, 3ZY, 3AAE, 3AHK, 3AKU, (3BIY), 4AW, 4BY, 4CO, 4GL, 4KK, 4LE, 4YA, 4XC, (8BA), 8DX, 8FB, (8IB), 8IV, 8MP, (8UK), 8VY, (8ZD), 8ZG, 8ZP, 8ZU, 8ZZ, 8ABO, 8AGL, 8AHR, 8AIU, 8AKP, 8AQV, 8AQZ, 8ARJ, 8AWB, 8AWP, 8BBF, (8BFX), 8BOX, 8BPL, 8BOW, 8AWF, 8BWJ, (9VG), 9XM, 9ZJ, 9ZN, (9ZV), 9ZY, 9AAV, 9ARK, 9BED, NMW, (XFI), 9DWJ, (9AJA),

Spark.—1YD, 1ARY, 3RW, 8DK, 8DY, 8HU, 8AJA, 9KF, 9OX, 9UH, 9TL, 9AAP.

CALLS HEARD NOVEMBER, ONE TUBE, 2AQP.

"Spark.—1AAZ, 1ABB, 1ACD, 1ADL, 1AGX, 1AHF, 1AMD, 1API, 1APO, 1ARK, 1ARY, 1ASF, 1AW, 1AWR, 1AZK, 1AXN, 1AZR, 1AZT, 1BBC, 1BDC, 1BDT, 1BGF, 1BIA, 1BIS, 1BJE, 1BJN, 1BJW, 1BM, 1BOE, 1BPF, 1BRW, 1BVB, 1BWT, 1BWX, 1BWY, 1BYE, 1CBA, 1CCB, 1CM, 1CNT, 1COU, 1CQR, 1DY, 1EZ, 1FQ, 1GM, 1HK, 1HO, 1IA, 1IUF, 1MA, 1OBP, 1OJ, 1PU, 1RO, 1RV, 1SN, 1VY, 1YD, 1ZE, 2BM, 2AWF, 2PV, 2TF, 3AC, 3ACE, 3AHF, 3AHK, 3AIC, 3ALN, 3AQR Dalite, 3ARM Dalite, 3ARN, 3ATZ, 3AUW, 3BF, 3BFU, 3BG, 3BGT, 3BH, 3BK, 3CC, 3CQ, 3CM, 3CN, 3DM, 3EI, 3GE, 3GX, 3HJ, 3IW, 3KM, 3LP, 3OU, 3QF, 3RT, 3RU, 3RW, 3SB, 3TH, 3UC, 3US, 3VW, 3XM, 3ZA, 4CX, 4EA, 4EY, 4FD, 4GN, 4SC, 5FV, 8ACF, 8AFB, 8AFD, 8AFG, 8AFH, 8AFQ, 8AGB, 8AHU, 8AIG, 8AIH, 8AJE, 8AJO, 8AJT, 8AJV, 8AL, 8AMF, 8AMZ Dalite, 8AOT, 8AP, 8APB, 8APP, 8AQ, 8AQV, 8ARD, 8AST, 8ATU, 8AVD, 8AWP, 8AY, 8AYN, 8AYS, 8BCO, 8BDH, 8BDY, 8BFH, 8BHM, 8BN, 8BRB, 8BRL, 8BSY, 8BUN, 8BUT, 8BVA, 8CG, 8DJ, 8DY, 8EW, 8EZ, 8FI, 8FJ, 8FT, 8GR, 8HG, 8HU, 8HY, 8JQ, 8KM, 8MZ, 8NO, 8OI 8PX, 8QC, 8RQ, 8RU, 8SP, 8TD, 8TJ, 8TK, 8TT, 8TZ, 8UJ, 8UO, 8VL, 8VN, 8VQ, 8VR, 8WA Dalite, 8WD, 8WO, 8XE, 8XN, 8XO, 8YN, 8YT, 8ZAC, 9AAW, 9AHY, 9AIR, 9AME, 9ARG, 9ASJ, 9AU, 9AVK, 9AWX, 9AWZ, 9AXU, 9AYM, 9AZE Dalite, 9BDE, 9CP, 9DXQ, 9ET, 9HB, 9KO, 9LW, 9ME, 9OX, 9PD, 9TO, 9UH, 9UU, 9VG, 9VZ, 9WU, 9ZJ, Canadian 3EI.

C. W.—1ABG, 1AFV, 1AHK, 1AJP, Dalite, 1AJS, 1AKB, 1AN, 1ANQ, 1ANZ, 1AOL, 1ARY, 1AWB, 1AXV, 1AZW, 1BCG, 1BDI, 1BEA, 1BES, 1BII, 1BQE, 1BSD, 1CAE, 1CEC, 1CF, 1IA, 1IV, 1OK, 1PE, 1PT, 1QN, 1QP, 1TS, 1UN, 1XF, 1XM, 2EH, 2HI, 3XQ, 3AAN, 3AAY, 3ABI, 3AFU, 3AHK, 3APQ, 3AYM, 3BAG, 3BHS, 3BIY, 3BR, 3BZ, 3CE, 3CQ, 3DH, 3EN, 3FP, 3GR, 3HG, 3HJ, 3LV, 3PB, 3QV, 3SI, 3VS, 3ZO, 3ZY, XFI, 4BQ, 4BY, 4BZ, 4CO, 4FF, 4GL, 4GX, 4NX, 4XC, 5DA, 8AEX, 8AGZ, 8AIX, 8AJP, 8AKJ, 8AOA, 8AOT, 8AQF, 8AQR, 8ABW, 8AWF, 8AWP, 8AWR, 8BCI, 8BJV, 8BK, 8BNJ, 8BO, 8BOX, 8BRL, 8BUM, 8BZC, 8CI, 8DE, 8DOW, 8DR, 8ER, 8FB, 8GE, 8GV, 8HA, 8HG, 8HW, 8IB, 8II, 8IV, 8IQ, 8JL, 8JQ, 8KM, 8LF, 8LX, 8MS, 8RQ, 8RU, 8SP, 8TB, 8UK, 8UI, 8UZ, 8VJ, 8VO, 8WR, 8WY, 8XH, 8XK, 8XM, 8XV, 8YG, 8ZD, 8ZG, 8ZZ, 9AAV, 9AJA, 9ALP, 9ARK, 9CI, 9DBT, 9DPO, 9DWJ, 9GC, 9HN, 9RT, 9UA, 9XAH, 9XM, 9ZB, 9ZJ, Canadian 3BP, 9AW, WUBA, NMW.

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.

8ZG, A. J. MANNING, 252 McKinley Avenue, Salem, Ohio (November).

Spark.—1AW, 1ARY, 1AZK, 1BGF, 2BK, 2FP, 2OM, 2UE, 2AIN, 2AJE, 2BWY, 3CC, 3CG, 3HJ, 3HX, 3KM, 3JL, 3US, 3XF, 3XM, 3ZO, 3AIC, 3AFU, 3AHF, 3ASP, 3AQR, 3BGK, 3BGT, 3BP, 3GE, 3JP, 3LS, 4AG, 4EA, 4BQ, 4FD, 4DH, 5EK, 5IS, 5FJ, 5XB, 5XU, 5YE, 5ZL, 5ZZ, 5ZAB, 9AU, 9AP, 9CP, 9ET, 9JN, 9JQ, 9KR, (9MC), 9ME, 9QR, 9UH, 9UU, 9VL, 9WU, 9XI, 9XM, (9YB), 9YM, (9YO), 9YAC, 9YAE, 9ZZ, 9ZN, 9ZJ, 9AAP, 9ARD, 9AAW, 9AMA, 9AQE, 9AQM, 9ASJ, 9AWU, 9AWX, 9AWZ, 9DBU, 9DQQ, 9ZAA, Canada.

C. W.—(1TS), 1UN, 1PE, 1RZ, 1ID, 1ZE, (1ADL), 1AZW, 1AFV, 1ARY, 1CAK, 1BIR, 1BYX, 2CC, 2EH, (2EL), 2FD, (2OE), 2QB, 2WB, 2WP, (2ZL), 2ZV, (2AAX), 2AJW, 2AQI, 2AWL, 2AFP, 2BAK, 2BEB, 2BML, 2BGH, 2BUA, (2BYS), 2BZH, 2DEF, 3CA, 3EM, 3DH, 3MO, 3ZO, 3ZZ, (3APA), 3AAE, 3BIY, 3BAG, 4BZ, 4AI, 4BQ, 4BY, 4CD, 4CO, 4EL, 4GL, 4ID, 4HW, 4LE, 4XC, 5DA, (5ZA, 1400 miles), 9NX, 9LQ, 9RZ, 9HD, (9UU), 9ZJ, 9ZB, 9ACO, 9AAS, (9AJA), (9AKR), 9ARK, 9ANR, 9BBF, 9DKX, 9DWJ, 9XAC, 9XAH, 9ZAF, Canada 3BP.

F. A. MOHNEY, 805 E. Franklin Street, Lima, Ohio.

Spark.—1AU, 1AZ, 1JN, 1OJ, 1UN, 1XM, 1AJS, 1BLE, 2BK, 2EF, 2FP, 2LM, 2OM, 2PL, 2ABR, 3AP, 3AQ, 3BH, 3BP, 3BZ, 3CK, 3HJ, 3IW, 3VW, 3AQF, 3AQR, 4AS, 4CG, 4CK, 4CX, 4DH, 4FD, 4GN, 4XA, 4ZJ, 4AWL, 5BM, 5EK, 5ER, 5FD, 5FJ, 5FK, 5FO, 5FV, 5HD, 5HK, 5JD, 5LL, 5OZ, 5UV, 5XA, 5XF, 5XQ, 5ZL, 5ZS, 5ZZ, 5ZAB, 7XD, 8AJ, 8FI, 8IS, 8QZ, 8SP, 8WU, 8ZK, 8AFD, 8AHD, 9AU, 9AW, 9DR, 9FY, 9GN, 9GX, 9HI, 9II, 9MC, 9NF, 9PN, 9QH, 9QR, 9UH, 9WU, 9ZJ, 9ZL, 9ZN, 9AAW, 9AEY, 9AIR, 9AWU.

C. W.—1BWK, 1TS, 2AK, 2LE, 2ZL, 2ZV, 2AAX, 2ABQ, 2AJF, 2AWU, 2AWZ, 2BAK, 3AH, 3BP, 3BZ, 3CA, 3DH, 3HQ, 3MO, 3QV, 3RF, 3VA, 3ZO, 3ZY, 3AEV, 4BC, 4BY, 4BQ, 4CD, 4CO, 4FF, 4GX, 4JH, 4ML, 4XC, 5BY, 5DA, 5YE, 5ZA, 8GV, 8WY, 8VY, 8XB, 8XE, 8ZP, 8ZU, 8ZZ, 8ABO, 8ACF, 8ADR, 8APT, 9AA, 9AS, 9GX, 9LQ, 9LZ, 9NX, 9RT, 9SC, 9VE, 9VG, 9UC, 9WC, 9ZJ, 9ZV, 9ZY, 9AAS, 9AIF, 9AJA, 9ALK, 9ARK, 9DBQ, XFI, WL2.

8AXC, EDWARD MANLEY, 328 Fourth St., Marietta, Ohio (November).

C. W.—1RZ, 1TS, 1AFV, 1ANQ, 2FP, 2KP, 2OE, 2XK, icw, 2XQ, 2ZL, 2AJF, 2AJW, 2AWL, 2BRB, 2BYS, 3EM, 3MO, 3SJ, 3ZO, 3ZY, 4BK, 4BY, 4GL, 4XC, 8DE, 8EA, 8GV, 8II, 8LU, 8LX, 8RU, 8SE, 8UJ, 8ZD, 8ADR, 8AIX, 8APT, 8AUO, 8BEF, 8BET, 8BPL, 8BOX, 9IO, 9XI, 9ZB, XFI, WL2, Canadian 9AW.

Spark.—1ARY, 2FP, 2WM, 2KQ, 2AQI, 3US, 3XF, 3ZO, 3AQR, 4AG, 4BQ, 4DH, 4FD, 5FV, 5XU, 5YL, 8CI, 8IM, 8JQ, 8SP, 8VL, 8XE, 8ZN, 8ACF, 8AFD, 8AMZ, 8AQV, 8AYN, 8AYS, 8BBU, 8BDC, 8BRL, 9CP, 9OX, 9RY, 9WU, 9YB, 9AKD, 9AOJ, 9AWZ, 9BDE, 9DGO, 9DQQ, 9DYU, KDKA, Canadian 3JL.

8BYZ, HARRY SCHOENFELDER, 513 Boone Street, Pottsville, Pa.

1ABB, 1AEH, 1AEV, 1AHA, 1AIC, 1AMD, 1ARB, 1ARY, 1ATF, 1BIR, 1CIR, 1XAB, 1AR, 1BD, 1CK, 1DU, 1FU, 1HO, 1LE, 1NE, 1QW, 1RL, 1RZ, 1TS, 1XE, 1XF, 1ZM, 2AAX, 2AFP, 2AJW, 2AMO, 2ARB, 2ARK, 2AUF, 2AWR, 2BEK, 2BML, 2BM, 2BK, 2BQ, 2CM, 2KP, 2OG, 2QW, 2TE, 2VH, 2XQ, 2ZL, 3AAY, 3AAZ, 3ACE, 3AHK, 3AIC, 3AID, 3AQV, 3ARM, 3ARY, 3ASE, 3AWZ, 3BFU, 3BPU, 3BPW, 3AC, 3AD, 3AI, 3AX, 3BF, 3BP, 3BR, 3BW, 3BY, 3CC, 3CY, 3CZ, 3DH, 3DR, 3DU, 3EA, 3EL, 3FB, 3FV, 3GW, 3GX, 3GY, 3IR, 3GU, 3JU, 3JV, 3LP, 3NA, 3OE, 3OW, 3OU, 3QR, 3RL 3TE, 3TS, 3TT, 3UA, 3WV, 3XM, 3XN, 3UR, 3YR, 3ZO, 3ZQ, 3ZY, 4BQ, 4ZD, 4AHK, 8ACF, 8AHW, 8AIO, 8AMC, 8APB, 8APV, 8ARI, 8BEP, 8BPO, 8BPZ, 8BRE, 8BSY, 8BVA, 8AM, 8BE, 8BF, 8BG, 8CF, 8EF, 8EW, 8HY, 8IQ, 8PX, 8RW, 8SP, 8TU, 8YW, 8XE, 9AAS, 9AAW, 9AJA, 9ARK, 9AWX, 9BEP, 9BHR, 9DWP, 9AO, 9KO, 9MC, 9SH, 9YA, 9YB, 9YM, 9YO, 9ZB, 9JJ.

8BDB, JOE HILL, 1572 Virginia St., Charleston, West Virginia (November 1-15).

Spark.—2AIM, 2BK, 2EL, 2OM, 3AC, (3ACE), 3OU, (3TJ), 4BQ, (4FD), (4DH), (4GN), 4CX, 4KK, 4EA, 5DA, 5EK, 5ZZ, 5BM, 5ZAB, 5XA, 5ER, 5ZL, 8XE, 8EZ, 8TT, 8AFB, 8OI, 8BSY, 8BM, 8GW, (8EW), (8AQV), (8AIZ), (8BDY), (8WZ), (8AVW), (8ASZ), (8BVA), 8ZA, 9AIR, 9ZI, 9ZN, (9DWM), 9CP, 9ET, (9FS), (9OX), 9LQ.

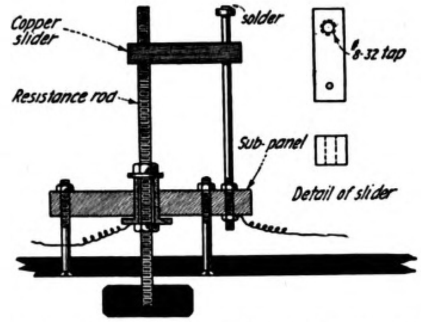
(Continued on page 44)

A Novel Vernier Rheostat

By Walter G. Voss

AT present there is no accurate and simple method by which to vary the current through the filament in vacuum tubes. Rheostats that operate by passing a switch lever over a coil of resistance wire do not give sufficiently fine variation for use with the gaseous type of tube in general use today. A simple way to vary the resistance of a rheostat would be to apply the screw principle which I will describe.

All that is necessary to make such a rheostat is to obtain a piece of German silver or other resistance rod at any dealer in metals. Then put a thread on the rod of say thirty-two or more threads per inch. The rod should be about three inches long and fitted with a knob at one end. It is then passed through a bushing in a sub-panel and fastened at the other side snugly but still sufficiently loose to allow for easy turning. A piece of copper or brass, preferably square, should be cut to sufficient length so that it will, when slotted at one end, slide along easily on the metal rod provided for it. This square piece of metal is drilled and tapped to take the threaded resistance rod. Connections are made to the bushing through which the resistor passes and by means of a flexible lead to the copper slider.



Constructional details of the vernier rheostat

The regular type of rheostat is to be used in connection with this vernier. To operate bring the filament just about to where you want it and then do the fine adjusting by screwing the vernier back or forward so as to respectively increase or decrease the resistance. This is one way of solving this most important problem.

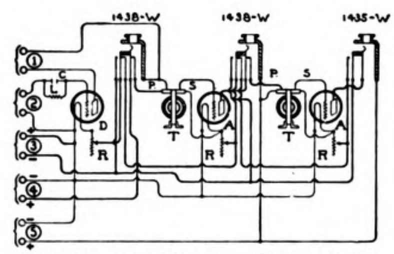
Filament Control Jacks

By Cyril J. Staud, B. Sc.

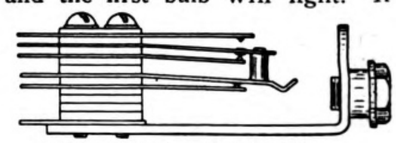
IN accord with the general trend of the times, which is away from the multiplicity of switches which marked the "big set" of former days, the Federal Telephone and Telegraph Company has brought out a line of filament control jacks.

The filament control jack does not differ in construction from other types of standard telephone jacks, but its use in the hook-up given by the accompanying figures is a recent development.

The function of the filament control jack is to obviate the necessity for filament current switches for detector and amplifier tubes. It also eliminates switches between amplifiers and between amplifier and detector and effects a saving in filament current which is wasted under customary operating conditions. With this system, pushing in the phone plug connects the receivers to the circuit at the detector or desired stage of amplification and lights the bulbs, all in one operation.



If, noting figure 1, it is desired to use only the detector it is simply necessary to push the receiver plug in jack M and the first bulb will light. If one stage of amplification is desired, the plug is inserted in jack N and both detector and first step amplifier bulbs will light and the station will operate with one step amplifier. A similar method is followed for added stages of amplification.


The filament control jack

CALLS WORKED AND HEARD

(Continued from page 43)

9AKR, A. C. MERTZ, Mount Carroll, Illinois (November 20 to 30).

C. W.—2FP, 2KL, 2WP, 2AWF, 2AWL, 2BML, 3BZ, 3ZY, 3BIY, 4BK, 4EL, 4XC, (5BY), 5DY, 5RA, 5XU, (5ZA), 5AAY, 8HY, 8II, 8IU, 8IV, (8LV), 8WR, 8RV, 8VJ, 8XO, 8XV, (8ZG), 8ACF, (8AWP), 8BF, 9AP, 9CR, 9DV, (9GL), (9GN), 9GY, 9GX, (9HK), 9KB, 9LG, 9NX, 9UU, (9ZY), (9AAS), 9AGN, (9AJA), (9AMB), (9AMR), 9ANE, 9ARK, (9AVE), 9BAP, (9BBF), (9BHD), 9DBH, 9ZAF, XF1.

Spark.—3XM, 5BM, 5FO, 5HG, 5HK, 5IF, 5IR, 5IS, 5JD, 5LA, 5LP, 5OF, 5OI, 5UI, 5XA, 5XJ, 5XT, 5XV, 5ZS, 8FI, (8ZP), 8ADR, 8BDY, 9AE, 9AO, 9AQ, 9GP, 9CS, 9GC, 9GH, 9GM, (9HK), 9HV, 9IN, 9KY, 9LU, 9MC, 9MS, 9MR, 9PI, 9TI, 9UG, 9VA, 9XA, (9XM), 9ZA, 9ZI, 9ZN, 9AAW, 9ACL, 9ACN, 9ACU, 9AEG, 9AEY, 9AMA, 9AOU, 9APE, 9APO, 9AOE, 9APZ, (9AUH), 9AVP, 9AWX, 9AWY.

THE Hudson Radio Club, one of the largest and most successful radio study groups in Manhattan, now established in the new home at the Columbia Preparatory School, started with a small group of eight charter members organized in March, 1920, and has grown to the large number of forty members at the present time. The members of the club consist of amateurs, graduate engineers, university undergraduates and professional men who are interested in radio work either from a commercial, scientific or experimental standpoint, and the majority of the members have their own radio sets.

Dr. Clawson, principal of the Columbia Preparatory School, 301 West 88th Street, New York, made it possible for the club to have a permanent home by extending the use of one of his classrooms every Saturday evening and permitting the club to erect the aerial on the roof of one of the school buildings and construct the operating room in another of the small class rooms. Club members are permitted to use the operating room every afternoon and evening.

The entertainment committee of the club arranges to have a prominent radio speaker at every Saturday session and four social evenings at prominent hotels are held during the year.

The officers are: Fisk Bingham, president; Gouine Kilbourne, vice-president; Herbert Weil, Secretary; and Robert Morris, treasurer.

Rectified A. C. for Tubes

(Continued from page 27)

tering circuit were two telephone paper condensers of 1 mfd. each, and the iron cored choke was the secondary of an old open core transformer which I had used on a spark set. This choke should be as large as possible, and if two are available much better results will be had if connected as shown in figure 3.

Using this circuit with the constants as outlined excellent results were obtained. There is absolutely no difficulty in operating, for D.C. is automatically produced at the filter condenser terminals. C.W. and telephone can be transmitted, with no indication that A.C. is being employed.

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.

K. P., Detroit, Mich.

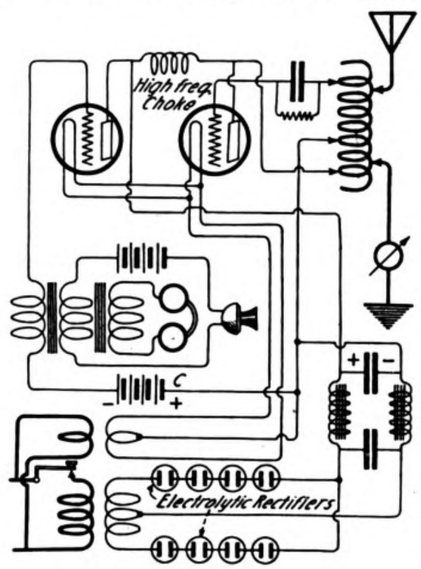
Q. 1. Could you tell me if the wireless station at Great Lakes, Ill., sends out the time signals, also at what hour seventy-fifth meridian time and on what wavelength?

Ans. 1. NAJ sends time on 1512 meters spark at 12 noon, 75th Meridian time.

* * *

J. J. W., Detroit, Mich.

Q. 1. We are radiating 2¼ amperes with 500 volts D.C. on the plate and 2.3 amperes



on the filament on straight C.W. and 2 amperes when we turn on the modulating tube, but although we are radiating two amperes with the modulator tube burning we cannot be heard on the phone. We have tested several weeks trying to get the phone to work and have been unsuccessful. The straight C.W. is very QSA all over.

Ans. 1. It would appear from your diagram that the two tubes oppose each other as their plates are connected to opposite ends of the generator coil and this seems to be borne out from the fact that the addition of the modulator tube lowers your radiated power ¼ of an ampere. We would suggest that you use the following circuit: You would be able to have a valuable amount of information by the purchase of one of the R.C.A. catalogues for 25 cents as it contains several C.W. circuits and valuable data on the proper use of tubes.

* * *

A. S., St. Louis, Mo.

Q. 1. I should like to ask you a few questions concerning the circuit in your September issue on "Efficient Design of Combined Receiver and Radiophone Transmitter" on pages 30 and 31. If I should add more "B" batteries would I have to change anything in the circuit, and by so doing would I get more mileage? Would Radiotrons be about the best tubes to use for this? Shouldn't you have more "A" batteries for transmitting?

Ans. 1. An increase in "B" battery would increase the transmission range and the UV-202 radiotron will use up to about 400-volt "B" battery. No changes in adjustment will be necessary when the "B" battery voltage is increased. The transmitting tube filament should be heated from an eight-volt source.

* * *

L. W., Bicknell, Ind.

Q. 1. I should like to know whether or not it would be possible to construct out of "Radio Corporation" parts a transmission set that could be used equally well for radiotelephony and C. W. telegraphy. This set to use two 5-watt tubes and to be self-rectifying?

Ans. 1. It is not possible to use a self-rectifcation circuit for telephone transmission owing to the fact that the transmitter is producing what may be termed a completely modulated continuous wave and therefore it cannot be used for telephony which is voice modulated C.W.

Q. 2. Would it be possible to modify figure 3 in your C.W. book so as to telephone as well as transmit? What would be the approximate range of such a set with a 60-foot aerial 40-feet high, 4 strand?

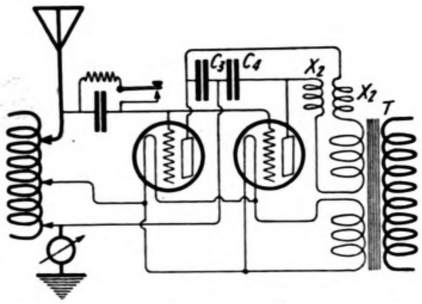
Ans. 2. This would not be possible owing to the fact as stated in answer No. 1.

* * *

H. J. H., Atlantic City, N. J.

Q. 1. I inclose a diagram of a C.W. circuit. Can alternating current be used on the plates of the tubes? If so, please print a diagram of the hook-up, using A.C. on the plates.

Ans. 1. Alternating current cannot efficiently be applied to the circuit you sent us. An efficient circuit for self-rectification of A.C. for the tube transmission is printed here.



C_3 and C_4 are two Radio Corporation condensers UC-1014. T is a R.C.A. power transformer UP-1368. X_1 and X_2 are radio frequency chokes consisting of 90 turns of No. 30 B. & S. wire either cotton or silk insulation on a tube 2¼ inches in diameter. We would suggest that you write to the Radio Corporation of America, 233 Broadway and enclose 25 cents for a catalogue which contains nine excellent C.W. circuits and much valuable data.

* * *

E. K., New York City.

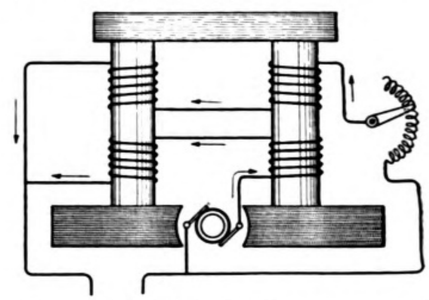
Q. 1. Please let me know how to cure an ionized storage battery (lead plate).

Ans. 2. We understand your question to mean that your battery is badly sulphated. To remedy this give it a long charge at a very low current rate and after it is fully charged discharge it slowly. Repeat this process several times until when the battery is charged and disconnected from the charging source the gravity does not drop after standing for several hours.

* * *

H. F. M., Philadelphia, Pa.

Q. 1. Will you kindly advise me if figure 29, page 30 of Bucher's "Practical Wireless Telegraphy" is correct. My impression is that it should be like this:



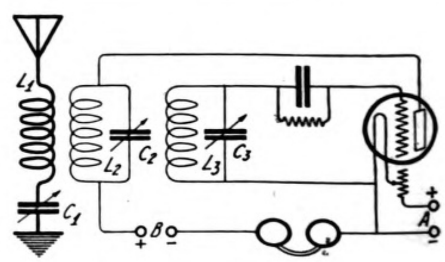
Ans. 1. The drawing is not correct. Your copy, as printed here, is correct.

* * *

J. V. T., Brooklyn, N. Y.

Q. 1. I desire to install a long wave receiver, capable of receiving up to 2,500 meters. Would you be kind enough to inform me through your "Queries Answered" columns in THE "WIRELESS AGE," which type of outfit would be the best to install?

Ans. 1. We would suggest you use a three-coil circuit with duo-lateral wound coils. The circuit is as follows:



L_1 and L_3 are L 1500 coils.
L_2 is an L 1000 coil or 1250 coil.
C_1-C_2-C_3 are of .001 mfd. capacity.

* * *

J. M., and R. S., New York City.

Q. 1. Will you please publish in your "Queries Answered" columns the answer to the following question: Is there any law or restriction in New York City forbidding the erection of a wire across a street or avenue for radio purposes?

Ans. 1. Yes. This is forbidden by City Statute.

G. H. B., St. Louis, Mo.

Q. 1. I am interested in securing an instrument, the name of which I am unable to indicate, but the purpose I want it for is to detect or receive the waves given off in the form of electrons attracted from the polar center of the earth, and refracted or deflected upon a neutral diaphragm, will indicate on the face or dial of a very sensitive galvanometer.

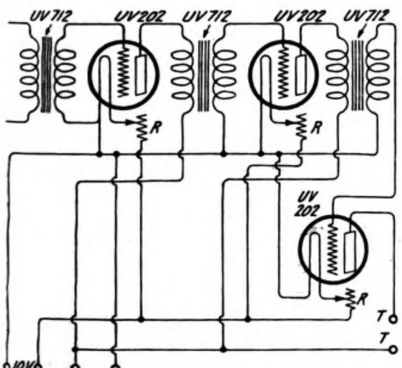
Ans. 1. Suggest you communicate with the Carnegie Bureau of Magnetic Research, Carnegie Institute of Technology, Pittsburgh, Pa.

* * *

H. B. W., Coldwater, Miss.

Q. 1. How can we use your five-watt tube in connection with our receiver as a power amplifier to strengthen our signals to the maximum capacity of the Magnavox which is 150 M.A.'s?

Ans. 1. By the use of the following circuit:



D.C. line through a filter circuit.

R-Filament rheostat P.R. 535 with windings connected in parallel.

This circuit has been used satisfactorily at the Radio Institute of America.

Q. 2. Would you consider a 50-watt tube used as oscillator-modulator using D.C. on the plate and the magnetic modulator as a practical outfit for telephony? If not give us diagram for a good 50-watt set.

Ans. 2. Yes. Refer to figure 2 in R.C.A. catalogue.

Q. 3. What radiophone, if two of them, operates in the daytime on about seven to nine hundred meters? Have heard them several times about 2:30 P.M. very loud, but for some reason we have never been able to tune them properly with the D.L. coils. Is there any special method of tuning voice with these coils?

Ans. 3. Unable to say as there are so many phones in daily operation on those wavelengths, probably a Navy or Army outfit.

* * *

R. F. W., Owensboro, Ky.

Q. 1. I have experimented until I have finally increased my radiation to two amperes using one 50-watt tube, but this seems to be the limit. In the instruction book you say the radiation should be from two and one-half to three amperes. It seems peculiar, but I can get as much radiation with eight and one-half volts on the filament as I can with ten. Am using a transformer giving about twelve hundred volts, rectified by an electrolytic rectifier, which cuts the voltage down to about eleven hundred. Would it decrease the life of this tube to put more voltage on the plates? Have the key in the plate lead, hence voltage is on but about half the time. Have tried both counterpoise and ground, but find the counterpoise best.

Ans. 1. This tube is designed to be used with 1000 volts D.C. and it will work well on 1500 volts A.C. and 150 milliamperes on the plate. We would suggest the use of a plate milliammeter.

If an increase in plate potential does not increase the amperage considerably, which it should do, we would suggest you see if it is possible to lower your antenna resistance by shortening your lead-ins, etc. If you could give us data in regard to the exact wavelength upon which you are transmitting and also the fundamental wavelength of your antenna we would be able to advise you further.

* * *

A. C. H., Newport, Ky.

Q. 1. Using one 50-watt UV-203 tube in the Hartley circuit, with 1000 volts rectified A.C. on plate, the plate gets red hot when the current as shown by a reliable milliammeter is only 75 milliamperes, and filament voltage slightly less than 10. I have been unable to find out why the plate becomes so hot with so small a current.

In the same circuit, but using straight A.C. on plate, tube heats up worse than with rectified A.C. Also the output is nearly as great with 500 volts as with 1000. With 500 volts, 75 milliamperes on plate tube heats more than it should.

Would appreciate an explanation of this tube heating, and a few hints as to overcoming same.

Ans. 1. To assist in preventing overheating use a fan blower. Tube should take 200 milliamperes without overheating. This may be a faulty tube. The UV-203 should stand 1500 volts on the plate and 150 milliamperes.

There is a possibility that the antenna circuit is not in resonance with the oscillator circuit so that the energy instead of being dissipated by the antenna is not being drawn from the tube as it properly should be. If you can give us the resistance of the antenna and the current in the antenna we can tell you if this is the trouble.

* * *

C. A. T., Jersey City, N. J.

Q. 1. Could I trouble you to tell me if there is any form or rule that one can follow in finding the wavelength of an aerial, whether type T, L or cage, when the number of wires are given, length and height of aerial, length of ground and distance the wires are apart, without a wavemeter. I have noticed it is sometimes possible to give the approximate wavelength.

Ans. 1. An approximate method of the determination of the wavelength is to multiply the length of the antenna in feet by 1.44. This will be only a very rough estimate, however. A set of very excellent charts showing the wavelengths of various antennae are given in the "Wireless Experimenter's Manual," by E. E. Bucher, published by the Wireless Press.

* * *

The Peoria Radio Club

THE Peoria Radio Club has been very active during the past year. The spring term closed with a banquet of Illinois radio men at Peoria. The Club now owns its own receiving outfit with three step amplifier. It will soon have a transmitter in operation.

The Peoria Radio Sales Company has completed a 150-Watt radiophone transmitter which will soon be transmitting daily reports and occurances in and around Peoria. Two theaters will send their daily concerts and shows through this station. The Bradley Institute will use it to transmit college news, daily lectures of various kinds, and also will connect it up with the Conservatory of Music.