THE MARCONIGRAPH

An Illustrated Monthly Magazine of WIRELESS TELEGRAPHY

EDITED BY J. ANDREW WHITE

Volume 1. DECEMBER, 1912 No. 3

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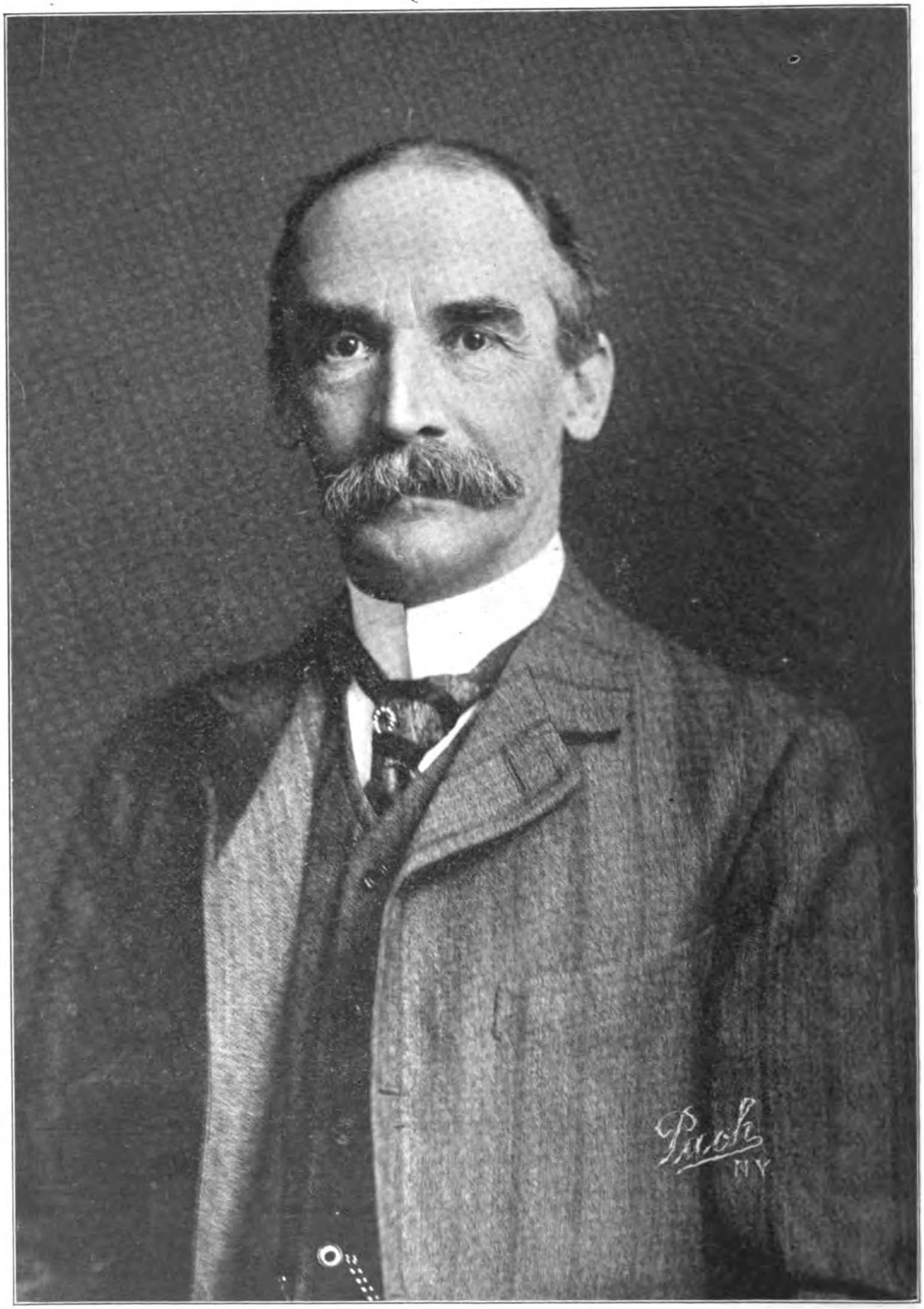

JOHN BOTTOMLEY
Vice-President Marconi Wireless Telegraph Co. of America.

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Vol. I. **December, 1912** **No. 3**

IF Mr. Bottomley, whose portrait appears on the opposite page, had failed to make a mark in the career that he had chosen for himself, it would have caused greater surprise than the fact that he is at the present moment one of the most important business men of New York; for his mother was Hannah Thomson (sister of William Thomson, afterwards Lord Kelvin), and, if heredity counts for anything, John Bottomley must have derived a large share of his intellectual capacity from his famous uncle.

He was born at Belfast, Ireland, in 1848, a fact which is not without its interest for those followers of Buckle who uphold that external circumstances play a great part in moulding a man, for it is remarkable that many of those who have in after years become the world's most notable men have spent their early life in Ireland, and, in the most impressionable stage of their careers, have been influenced by the spirit and cast of thought which is peculiar to that country.

Moreover, the young Bottomley had the even greater advantage of being educated at private schools in Belfast, where his individuality was less likely to be stamped into that dread matter-of-fact uniformity which is so often the price paid for a public school career, and it was only when he was old enough to look after himself and his opinions that he entered Queen's College. But he was still quite young when he went into business in connection with the largest business house in Ireland on a six years' apprenticeship, and here he made very good use of the opportunities which came his way, for when four years of service were expired his firm waived their right to the remaining two years of his apprenticeship, and placed him in charge of all the departments and establishing agencies throughout Ireland. In 1870 Mr. Bottomley took charge of the flax and grain exporting house of Cummings, a firm that did a large business with Russia and England, and had two important depots at Riga and London.

Any young man would have had reason to be proud of such achievement, and most would have been content to rest on their merits, but not so John Bottomley. In 1880 he went to America, took up the study of law, and was admitted to the Bar as soon as he had become a naturalized American citizen. By so doing he achieved one of his most cherished ambitions, and was able for twenty-five years to practice indefatigably the profession which he had adopted. It was in 1898 that he first met Mr. Marconi, and took up the very responsible task of introducing wireless telegraphy to the American world of commerce, and when the immense developments of the system required the reorganization of affairs he became, in 1902, general manager, secretary, and treasurer of the Marconi Wireless Telegraph Company of America. Since then he has been nominated as vice-president of the company, which position he holds, in conjunction with many other important offices.

But Mr. Bottomley's interests are too wide to allow of his being entirely absorbed in any one particular occupation. He takes a keen interest in the social work of his city, and often this enables him to use his expert knowledge for the benefit of the community. He is president of the New York Electrical Society, vice-president of the Harlem Library, which is now incorporated with the Public Library, and is vice-president of the Harlem Dispensary, besides being trustee of the Empire City Savings Bank and a member of the Finance Committee. He is also a well-known figure at the Engineers' and New York Athletic Clubs.

Wireless Penetrates the Upper Amazon Regions

FOREMOST among those features of a wireless system which contribute to its great success might be mentioned: simplicity. For it can be installed in regions which present the greatest difficulties to the overhead and underground telegraphic cable systems; difficulties which have very often proved to be insurmountable; and for this reason not a few remote parts of the world have been compelled to forego the use of telegraphy—to do without that greatest aid to modern life.

Wireless telegraphy is altering all this. Day by day new districts are being brought within its scope; before very long there will be but few large stretches of territory in the world that will not be linked up by means of wireless; few stretches, at any rate, where the application of the system is warranted by commerce and population.

It will come as a surprise to many people, perhaps, to learn that wireless telegraphy has penetrated to the upper Amazon, that river of rivers, and that at the present time it is playing a great part in opening up a vast region to the outer world which, until most recently, was scarcely known by name to most of us. From the time when, nearly 400 years ago, the courageous Orellana descended the Andes on the eastern side, struck the head waters of one of the main tributaries of the Amazon, and sailed therefrom to the coast, until September, 1850, when the Emperor, Dom Pedro II., of Brazil, sanctioned a law authorizing steam navigation on the Amazon, later opening the greater portion of it to all flags, the river was *aqua incognita;* now it is a busy scene of international traffic, ocean-going steamers from all parts of the world and flying all flags, crowd its waters, and on its banks are ports equal to many a well-known port in the United States.

Of these, Para, near the entrance, and Manaos, almost halfway up the main river, and situated in the heart of the country, are the best known, Manaos in particular having become the great depot for the collection of the produce of the upper Amazon. From this point it is shipped down the river to Para, or direct to European and American ports. Manaos alone has been connected by cable with Europe, the regions above it on the various large tributaries of the Amazon being cut off from rapid communication. One of the most important of these territories extends from Porto Velho, on the Madeira, downwards to Manaos. The Madeira begins at the junction of the Guaporé with the Mamoré, and is a river wherein lie great future possibilities as it taps the rich and luxuriant region which lies at the foot of the Andes on the eastern side, along the lower portion of Peru, and the borders of Bolivia. In fact, it may be said to be the great natural highway for the conveyance of the products of a third of the State of Bolivia to the port of Para. But for a distance of 210 miles, from Guajara Mirim to Porto Velho, the river is beset with rapids, which makes navigation extremely hazardous. To overcome this difficulty the Madeira-Mamoré Railway Company, has constructed a line 210 miles in length, along the "rapid" portion of the river, and by this means goods are to be conveyed to Porto Velho and then forwarded by river to Para.

This railway company, being exceedingly enterprising, hit upon the idea of connecting Porto Velho and Manaos by means of wireless telegraphy, thus bringing Porto Velho within the bounds of the most advanced civilization, and accordingly the Marconi Wireless Telegraph Company were instructed to fit up two wireless stations, one at Manaos, the other at Porto Velho. The work was completed some time ago, and at the present time the upper Amazon, from Porto Velho to Manaos, is within the wireless circuit. It may interest our readers to learn how the work of installation was accomplished and the nature of the plant erected. With this in view, we publish the notes of one of the engineers who was engaged upon the work.

He says: "After a long and tiresome voyage across the ocean, due to the intense heat, the prospect of the journey up the Amazon grew very attractive; interesting it could not fail to be, for we were about to ascend the river which has the greatest volume of water of any river in the world, and one which for many years, and even to-day, to a certain extent, has been enveloped in the mantle of mystery, for that which is unknown is ever mysterious, or deemed so. But contrary to our expectations, the journey proved monotonous; at times decidedly uninteresting. After all, all rivers are very much alike, and all have their interesting and their uninteresting portions. Did one exclude all ideas as to latitude and longitude, shut out the vision of mediaeval junks with shining brass cannon and yellow, oval mongol faces peering at you from their decks, several places on the Woosung River, going up to Shanghai, would be found but glimpses of Father Thames.

"From Para, which is growing to be a very great port, and which has enormous possibilities (for with Brazil lies the future), the steamer passes to the main stream of the river through a section termed 'The Narrows.' Here the river craft thread their way between picturesque islands, and in places the waterway is such that the sides of the vessel are almost scraped by the boughs of trees, which overhang the river in luxuriant masses of various and delicate shades of green. Occasionally the channel widens, but at the widest part one could throw a stone to the shore. On many of the islands we passed fine tall trees were to be seen, several with a uniform height of eighty feet or so. To me the timber seemed to be poor in the whole, but here and there a good specimen appeared, its fineness rendering it conspicuous among the poorer of its kind. The river was in flood, and we saw it, therefore, at its busiest. We passed a number of craft of various kinds, and here and there on the river banks stood houses of primitive description, while in places small settlements were to be seen. The houses, if one can

As the Bank Rose to a Height of Sixty Feet All Materials Had to Be Hoisted Up an Inclined Track.

term them such, were of the usual wood and leaf construction, the floor being carried some feet above the level of the ground to avoid flooding. In these small homesteads live the people of the country, generally of Indian or mixed blood, and making a living by collecting wild rubber from the nearby growing trees, cultivating the indispensable manioc and fishing in the waters everywhere at hand. Later we passed farms under water, the cattle wading and swimming in search of food.

"Once through 'The Narrows,' and we steam out into the wide stream, and from this point on to Manaos the journey becomes less interesting. The country is very flat and it is thickly clad with trees; soon the lack of variety begins to tell on one. The 'sameness' of the Amazon, if one may call it so, is like the 'sameness' of many another tropical river—the very wealth of vegetation grows monotonous, bare banks and an inland view are longed for, and one begins to abominate the never ending prospect of trees, trees, nothing but trees. Except when one is passing at the flowering season of most of the trees there is little variation in their coloring. At that season of the year, however, a brilliant scene may be witnessed, for many of the trees flower like plants and you have blossom in all notes of color from the rich red of the flamboyant acacia to the yellows and whites of other arboreal orders.

"Our sense of pleasure was not increased by the presence of mosquitoes. True, there were not many; that is, not so many as we had been led to expect, yet we took the precaution, obviously a wise one, of sleeping in mosquito-proof bunks, for we were told that the mosquitoes present were of a particularly dangerous variety; hence a good deal of the discomfort they caused was of the anticipatory nature. The heat was very trying. During the day it was most severe, though the sun's rays on this part of the Amazon are not so deadly as they are in many other parts of the globe, owing to the humidity which prevails, but with nightfall came relief, for which one was truly thankful. In fact, the nights were often cold and one enjoyed a warm blanket.

"Arriving at the site which had been selected for the Manaos station, we found it was about three miles west of the town and about a mile east of the pumping station. The ground lies about a quarter of a mile back from the river bank and fronts the river. The bank here rises to a height of sixty feet above high-water mark, and for this reason it was necessary to cut an outlined plane down the face of the cliff and lay a track up from the water's edge to the site of the power house. All materials had to be brought by lighter from the town, unloaded at the foot of the track, hoisted up the inclined plane, and sent down to the power house. The greatest difficulty we had to contend with was the variation in the height of the river, the fluctuation from high to low water amounting to from 30 to 35 feet.

Our track was constructed approximately at high water, and it had to be constantly extended as the river became lower, for as the water dropped the bank did not keep to its almost vertical slope but commenced to slide rapidly; and before all the material could be unloaded the track had to be extended on trestles.

"The station we erected at Manaos is equipped with two 70 kw. 2,000-volt A. C. generating sets, driven by belting from steam engines. The transmitting aerial is suspended by four steel masts, each 217 feet high, the receiving wire being carried over them to a short mast 65 feet high at the receiving house. This station is built to connect with a similar one at Port Velho, on the Rio Madeira, with a 5,000 word per day capacity.

"After the Manaos installation had been completed we journeyed by steamer to Porto Velho to undertake the installation there. The journey from Manaos to Porto Velho occupies from eight to thirty days, according to the state of the river; at low water boats can proceed by day only, and even then must make their way very carefully to avoid the many sandbanks and shallows. Occasionally a boat grounds and is compelled to wait, ignominously, where she has struck until another craft comes along and hauls her off; meanwhile the mosquitoes descend upon her and her living freight, to the disgust and discomfort of the latter, whose only recreation consists in attempting to bag some of the many alligators which are basking, like themselves, on the mud-banks.

"At Porto Velho, the site chosen for the wireless station was part of what used to be known as Cascalha Hill, a railway camp; now its name has been changed to Wireless Hill. Thus does the Marconi system make geography!

"Our material was unloaded and brought to the foot of this hill by the Madeira-Mamoré Railway Company, the company

for which we were erecting the two stations, and we were cheerfully informed that we would have to haul it up and on to the site. All difficulties were overcome speedily, however, and the station, similar in all respects to that we had erected at Manaos, was soon completed. Singularly, one of its first performances was to announce the opening of the first section of the Madeira-Mamoré railway to Manaos, and since then it has proved of immense benefit to the railway company in their arduous undertaking of opening up trade communication between eastern Bolivia and the outer world.

"When the River Madeira is full, ocean-going steamers occasionally steam up to Port Velho, and captains of such vessels have found the wireless system of great aid to them in communicating with their agents or owners. Wireless should play no small part in increasing the importance of Porto Velho, and in aiding to make it the great trade headquarters for the territory fed by the Madeira and its tributaries.

"The following details of the power plants at the two stations (each is the same as the other) may prove of interest: The power house is a steel-frame galvanized iron building, extending over an area of 100 feet by 30 feet. It has two 100 H. P. boilers, of the economic return tube marine type, situated so that the doors are, approximately, on the centre line of the building, giving the fireman ample room in front of the furnace for stoking and cleaning; the bunkers run along the end of the building, and alongside the boilers. Two Mumford steam pumps are provided, fitted so that either or both may be used for the supply of water to either or both boilers. At Manaos these pumps take their water from a 60,000-gallon reservoir, which was built beside the power house and is kept full by an electric motor-driven pump, lifting water from a well sunk about a hundred yards from the main building. Water was found in the dry season a few feet below the ground at this point, but it was not considered sufficiently reliable as a permanent source, so the well was sunk some twenty feet deeper; there a second layer of water-containing gravel was struck, immediately above a strata of white clay. A good supply of water from this well is always available. Besides this source of supply, the gutterings of the building are all constructed so that they drain into the reservoir, and the amount of water collected in this manner is more than sufficient to compensate for that used by the boiler during the rainy season. At Porto Velho the railway people have provided a main from their camp water supply, obviating the necessity of constructing a reservoir, well and pump.

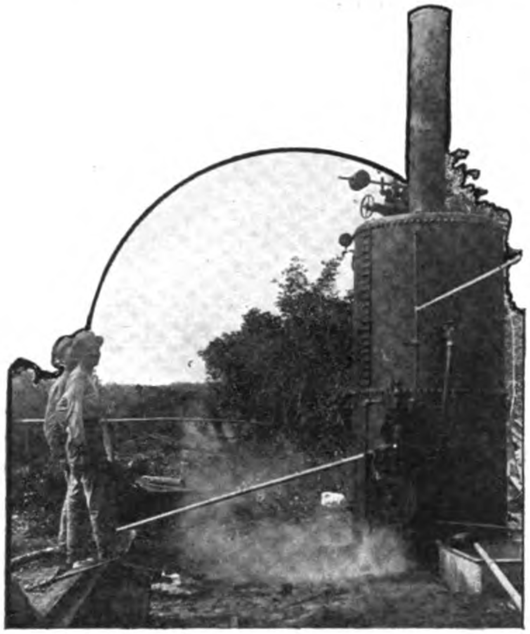
"The boilers are connected with a single steam main, which feeds both engines and pumps. The engines are in the second or main division of the power house. Besides the engines this room contains the alternators and switchboard, and a work bench. The engines are compound, by Davey Paxman & Company (horizontal slow speed compound Colchester type), each capable of delivering 100 b. h. p. at 120 revolutions per minute. Each has a seven-foot flywheel, on which is laid the belting which transmits the power to the alternator. The alternators, built by the E. C. C., are two in number, and each is capable of delivering 70 kw. at 2,000 volts, 50 cycles, when run at 600 r. p. m. The alternator sets are right and left hand, corresponding to the engines, and are mounted on separate beds, with the adjacent faces machined up so that if necessary the two beds and the two alternators, which are provided with shaft extension and half couplings, may be bolted together and the whole plant run as one unit.

"The switchboards are divided into two groups, one for the d. c. and one for the a. c. machines. Each alternator feeds three transformers, each capable of going 25 kw., at 20,000 volts, when supplied with single-phase alternating currents at 2,000 volts. Thus it will be seen that the generating plant is duplicated throughout, the station working on one set and having the other as a standby. As a matter of fact, owing to the damage done to the Porto Velho transformer in transit, only one transformer was able to be worked when the plant was operated first, and communication was maintained for more than a month in this manner.

"The transformers are in the third and last section of the power house. In this room the high tension electro-magnetic relay switches, the various tuning inductances, the motor-driven disc discharger, condenser, jigger and aerial tuning inductances, were installed. The high tension relay switches are worked from the receiving room by the operator on duty there. The condenser stands are built to accommodate the Poldhu type condensers, and are divided into two groups, with the disc discharger between them. This discharger is a 24-inch eight stud standard type disc, directly connected, through an insulating coupling, to a 10 b. p., 220-volt d. c. motor, built to run at 3,000 r. p. m. The side electrodes of this disc are cup pattern, and are revolved by insulated gearing, driven through a worm gear on the end of the disc shaft. The jigger is a modified high-power one. The connection to the aerial is made through a leading in insulator, set on to the end of the building. The transmitting aerial is suspended by insulated wires from steel masts. The outer pair of masts are 220, and the inner pair 200 feet high.

"The earth system is made of a number of metal plates buried in proximity to the power house, and a system of radial wires laid on the surface of the ground under the aerial, extending from a stream beyond the free end of the aerial back to the power house, and thence to the river. The two receiving wires are suspended over the transmitting wires and run from each outer mast, past the main pair of masts and the power house, to a short 60-foot mast erected beside the receiving house. The receiving house is a small galvanized iron building covering an area of 20 by 10 feet, and is divided into two rooms, the instrument room containing the magnetic detector and the valve receiver. From this house the whole of the wireless work is transacted, since the manipulating key in this building controls the relay switch in the wireless room at the power house and regulates the dis-

The Bank Commenced to Slide Rapidly and Before All the Material Could Be Unloaded the Track Had to Be Extended on Trestles.



The Natives Were Pleased Beyond Measure After Effecting Some Temporary Repairs to the Engine.

charge of the transmitting condenser, in accordance with the reorganized groupings of the code."

And As Ye Sow

Mr. Marconi, in an interview in Washington, praised American democracy.

"Over here," he said, "you respect a man for what he is himself—not for what his family is—and thus you remind me of the gardener in Bologna who helped me with my first wireless apparatus.

"As my mother's gardener and I were working on my apparatus together a young Count joined us one day, and while he watched us work the Count boasted of his lineage.

"The gardener, after listening a long while, smiled and said:

" 'If you come from an ancient family, it's so much the worse for you, sir; for, as we gardeners say, the older the seed the worse the crop.' "

The number of steamships required to carry wireless under the new law is estimated at 1,000.

Radio 'Phone—Perhaps

Dr. Riccardo Moretti, of Rome, claims to have solved the problem of wireless telephony owing to a special generator of electric oscillations of his invention, which has been successfully experimented with between Rome and Tripoli. This apparatus consists of two poles fixed vertically a small distance apart and through one of which a thin continuous jet of water flows.

The water is evaporated by an electric spark between the ends of the poles and an alternating current of extraordinary rapidity is consequently generated since the the oscillations thus produced are calculated at several hundred thousands every second. As the oscillations exceed in number and rapidity the vocal vibrations by means of this generator it is possible to transmit the voice over long distances.

Dr. Moretti has experimented with his invention in connection with the naval wireless installations with the addition of ordinary telephone receivers and transmitters, but he is now working on a hydraulic transmitter, particulars of which are still undivulged as it has not yet been patented abroad. Dr. Moretti is the nephew of Prof. Marchiafava, the Pope's physician.

He admits that he owes his invention to Marconi, and insists that it is nothing else but an application of wireless telegraphy to the telephone. Dr. Moretti has granted the prior rights of his invention to the Government, and in fact a wireless telephone station is already being installed between Tripoli and Rome. Meanwhile an Italian syndicate has been formed for the exploitation of the Moretti generator of electric oscillations.

New Head for Navy System

Commander W. H. G. Bullard will head the radio-telegraphy office soon to be established at the Navy Department under the Bureau of Navigation. Lieutenant Commander D. W. Todd, in charge of the radio division of steam engineering, will be his assistant.

The radio office is necessary because of the expansion of radio affairs, due to the ratification of the Berlin convention.

The American Marconi Organization

Some Interesting Details Regarding the System Under Which the American Marconi Company is Enabled to Efficiently Handle the Enormous Volume of Wireless Traffic of This Country

THERE is always a certain amount of conjecture among laymen as to the manner in which the business of large commercial institutions is carried on. Probably because wireless telegraphy is the most recent addition to those more or less public utilities which the business man first hails as an innovation of questionable value and gradually comes to look upon as a necessity, is the reason why so much curiosity has been evinced as to the method of handling radio telegraphic messages.

While a great deal has been written about what are generally understood to be the technical phases of commercial wireless service, little has been said regarding the system controlling the vast amount of radio messages handled each day of the year.

As can readily be understood, a business which derives its revenue from the general public must be conducted in such a manner that present demands are well taken care of and at the same time possess a system

John Bottomley Dictating to His Secretary. As Vice-President and General Manager This Admirable Executive is at All Times Thoroughly Conversant with Each One of the Countless Details in the Conduct of the Company's Business.

George S. De Sousa, Traffic Manager, Who is Responsible for Maintaining a Continuous Message Service.

capable of expansion in conformity to the increasing needs of its patrons.

In the early days of commercial wireless telegraphy the traffic was principally confined to the exchange of greetings between passengers on shipboard and their friends on shore, or to summary messages between the owners and captains of sea-going vessels. This is not the case to-day.

Newspapers now receive a substantial proportion of the daily dispatches from their foreign correspondents by trans-Atlantic wireless, large import and export houses are availing themselves of the lower rates of this service and transact a goodly portion of their formerly cabled business through the newer means of communication, and the regular ship to shore traffic has been immeasurably increased. Add to the foregoing the regular press dispatches which are sent out to scores of passenger steamships to be later printed in the daily newspapers published aboard these vessels, and some idea may be had of the enormous volume of messages handled by the Marconi Company daily.

One View of the Traffic Department.

The fact that the accuracy and rapidity of Marconi service has received almost universal public recognition, which is best indicated by the steadily increasing message traffic, speaks volumes in praise of those who are responsible for the conduct of its business. That the Marconi Wireless Telegraph Company of America stands to-day a model of efficient management is, in a great measure, due to the business acumen of John Bottomley, vice-president and general manager; to his untiring application and unflagging zeal in promoting the welfare of the company. In the executive offices he is a familiar figure to each member of the staff, and his amazing knowledge of every detail in the work of the various departments has become proverbial. Many instances where this comprehensive knowledge has startled some unwary employee might be cited, but the essential point to be made is that Mr. Bottomley is here, there and everywhere about the offices, at all times of the day, his sagacity and inordinate capacity for work setting an invaluable example to every member of the organization. Combining qualities rarely found in association, this admirable executive at once is capable of handling expeditiously the largest affairs without for a moment ceasing his vigilance over the countless details of the company's business.

Closely patterned after him through years of association, George S. De Sousa, upon whose shoulders rests the responsibility of maintaining a continuous message service, adjusting the rates and tariffs and, in fact, directing the entire traffic in wireless messages, has effectively demonstrated his ability as traffic manager. Aside from carrying out the general regulations of the company, the traffic department, through its manager, controls and supervises the telegraph

Where the Message Reports Are Checked and Verified and Charges Apportioned Among the Various Companies. Marconigrams for All Parts of the World Are Received at the Window in the Background.

The Staff to Whom the Five Hundred Marconi Ship Operators Report Immediately After Their Ships Arrive in Port.

staff on ship and at shore stations, deals with reports from operators and with all correspondence relating to the telegraph business; prepares and issues all forms and circulars relating to the conduct of the ship and shore stations, prepares and issues sailing lists and charts, obtains and issues call letters for all ship and shore stations. The sailing lists show the approximate time at which steamers may be expected to be in communication with the coast stations and are supplied to all telegraph offices throughout the country so that radio messages destined for ships at sea can be properly routed. This department also checks the traffic returns from all ship and shore stations and is responsible for the rendering of all accounts relating to telegrams with government telegraph departments, shipping, and the telegraph and cable companies. Here, too, are engaged the operators. They are first trained in the Marconi school and after reaching the required standard of efficiency they are assigned to the various stations. It is also the duty of the Traffic Department to deal with all complaints and inquiries and to settle refunds and all differences relating to messages.

One of the many and constantly recurring problems encountered by this department is the adjustment of tariffs and rates. Not only is the public to be considered when these are made up, the regulations of the Berlin Convention enter into the subject and approval by the United States government is required. In step with the forward progress of wireless transmission of messages, a short time ago the Marconi Company decided to abolish message rates for telegrams exchanged between shore stations and ships at sea and place the business on a word rate basis. At first, the telegraph companies operating the land lines opposed the innovation, even after the Berlin Convention had been ratified by the government, but after some deliberation they finally agreed to establish word rates. These radio messages carry three classes of tolls, "ship tax," "coast tax" and "landline forwarding charges," which must be checked and verified, charges apportioned properly, and an accounting made with the various affiliated Marconi companies and the land telegraph companies. The vast amount of detail this involves is best shown in the fact that the business handled requires a large staff of men thirty days to check up the message reports of the preceding month.

Naturally in the transaction of a message business so vast a certain number of complaints are registered. These occasionally relate to delay in transmission, but more often are based upon errors in the address. Immediately upon receipt complaints are numbered and acknowledged and a copy of the message in question is secured. In cases where the inquiry is based upon delay the wireless service is first thoroughly investigated and if the delay is not disclosed the matter is referred to the connecting land line telegraph company to whose lines it was transferred. As full copies of all messages sent and received are kept in the Traffic Department, together with what might best be termed a diary of incidents of communication it is not a very difficult matter to trace a delay should it have occurred in the wireless service. In cases where an error in transmission is found to have occurred in either the wireless or land line service charges are refunded.

One of the most interesting features of the wireless business, the assignment and regulation of ship operators, also comes under the supervision of the traffic manager. At the present writing there are about 500 men, from 270 ships, who are required to turn in their reports immediately after docking. A number of these report weekly, some every two weeks, and the majority about every twenty-one days. First their traffic returns are dealt with and a full accounting made, after which the apparatus inspection report is scrutinized and any trouble recorded therein immediately investigated. Supplementing this feature, the apparatus of each ship is inspected upon arrival, regardless of the fact that no trouble has been reported, and in cases where defects are manifest the construction department is notified and the apparatus is immediately overhauled. After these matters have been successfully dealt with, the operator turns in his "process verbal," a record of all communication events with the exact time of their occurrence, covering day and night watches during the entire voyage. Largely through these written records are operators judged as to their qualifications for promotion. All of these records are carefully preserved and frequently referred to as occasion demands.

While their ships are in port, operators are required to report daily in case it should be necessary to transfer them to other ships. On the day of sailing they are instructed to be on hand some hours before the time of departure, as various matters require attention before Chief Operator Edwards will permit an operator to sail with his ship. Uniforms, which are cared for at the office during the period on shore, must be secured, and a requisition made for whatever supplies are necessary for the forthcoming voyage; these include message forms, abstract forms, official circulars, the receipt of which must be acknowledged in writing, and maintenance supplies such as detectors, telephone headgear and incidental parts. If any expensive apparatus is requisitioned the inspector must pass upon the matter before the parts can be supplied. Operators are required to report for duty aboard their respective ships three hours prior to sailing and notify the office of the fact by telephone from the dock superintendent's office. Failure to report on time subjects the offender to a fine proportionate to the delay occasioned, and, in some cases, if available, another

A View of the Contract Department Where Are Secured the Contracts for Ship and Shore Installations.

operator is dispatched to replace the offender.

A very high standard of efficiency is required of Marconi operators. After the student at the operator's school has passed the final examination, he is required to pass a manipulation test demonstrating his ability to send and receive messages at a rate of not less than 20 words a minute. From time to time each operator in the service is tested and his ability recorded to ascertain those fully qualified to become first operators. This is an honor greatly sought after and considerable pride of class is noticeable among the men; those who have once attained this position are careful to abide by the regulations, as it is considered almost a calamity to sail as second operator.

Another duty of the Traffic Department is to see that all operators have the licenses required by the Government. During the past few weeks it has been necessary to send the entire force, as each operator reported, to the Navy Yard to obtain the new license in compliance with the recently enacted law effective December 13. Notwithstanding the general demand for operators occasioned by the new legislation, all the ships have been manned.

That all of these, and countless other details are expeditiously dealt with, is principally due to the exceptional capacity of Mr. De Sousa, who somehow finds time to give personal

C. C. Galbraith, Under Whose Direction the Work of the Contract Department is Performed.

Frederick Minturn Sammis, Chief Engineer.

attention to each matter under the supervision of the traffic manager and still ably perform the duties of assistant secretary and treasurer of the company.

In close touch with the Traffic Department, the Contract Department, through which are secured the contracts for both the sale and rental of wireless apparatus along the Atlantic coast and the general supervision of all contracts for wireless installations on ship and shore, is ever a scene of activity. Under the direct supervision of C. C. Galbraith, whose experience as general manager of the United Company has brought him in close touch with shipping affairs, this department is accomplishing effective work as shown by the steadily increasing number of Marconi installations.

Upon the shoulders of Frederick

A Corner of the Engineering Department, Showing Some of the Engineers Who Are Constantly Engaged in Designing New Apparatus for Commercial and Government Stations.

Minturn Sammis, chief engineer, rests the responsibility of designing and constructing the Marconi apparatus which has won such universal recognition of superiority. In the Engineering Department, over which he presides, there are to be found the ten assistant engineers and several draughtsmen constantly busy with the design of new apparatus both for commercial and government work.

To Mr. Sammis are left the intricate problems, the work of the department being generally divided in such a manner that the details pertaining to the installation of ship equipments and their maintenance are handled by his assistant. At the present time the Engineering Department has a very considerable task in refitting and re-tuning some 650 ships and shore stations to comply with the new law. A large force of inspectors and assistants are busily engaged with the necessary tests and adjustments; a formidable task, for after the adjustments have beene made, the testing of these stations requires many hours of close application on the part of each inspector and his two or three helpers. Comprehensive reports from engineers in charge of outside work are required each week. These reports are carefully examined and certified and kept on record.

Prominent among the matters now engaging the attention of the Engineering Department might be mentioned the large number of sets being delivered to the United States Army and Navy Departments, the successful completion of the 100 h.p. station for the United Fruit Company at Santa Marta, Colombia, another of the same type at New Orleans, now about half finished, and the commencement of work on a third at Swan Island. In addition, a special set has just been sent to Manila on trial and a large order is expected after this has been tested.

Partial View of the Auditing and Accounting Department Where Are Recorded the Transactions of the Company's Business Throughout the Country

John P. Curtiss, Manager of Publishing Department.

The general engineering policy as to type, size and power of apparatus to be used throughout the entire system under the control of the American Marconi Company is governed from this department. It hardly seems necessary to add anything in regard to the executive in charge of the Engineering Department, as the well-known efficiency of Marconi apparatus is the best indication of the caliber of the man behind the technical end of the business.

The Auditing and Accounting Department of any concern handling an amount of business as vast as the American Marconi Company must prove of interest to those whose minds incline toward figures. As auditor of the company, John Young has accomplished what many strive for and few succeed—the establishment of a system of accounting that adequately covers present needs and is capable of almost unlimited expansion.

Prior to the acquisition of the United Wireless Telegraph Company the accounting work was competently handled by a few clerks, but under the altered conditions an extension of floor space and increased staff were found imperative. The increase in the volume of operations necessitated new systems of recording transactions and owing also to the fact that the business of the company extends all over the United States it was considered advisable to localize the operations and distinguish them according to divisions.

The Pacific Coast Division may be regarded as the only one possessing a distinct identity. By reason of its geographical position it was found convenient to have many of the records appertaining to its operations kept in San Francisco. The head office—which in accounting parlance may be termed the controlling account—nevertheless requires frequent statements as to the progress of the division; also the various book transactions relative to the fitting or maintaining of equipments on foreign ships and wireless communication with ships controlled by affiliated companies must pass through the

J. Andrew White, Editor of "The Marconigraph" and the Steamship Daily Newspapers.

New York books. In a word, New York is the foreign clearing house for the various divisions.

Proportionate in importance in the order named are the Great Lakes and Southern Divisions. In the case of the former, returns are made direct to New York, and the transactions recorded therefrom and apart from statistical records; no books of any importance are kept at the headquarters in Cleveland as operations there are at a standstill during a portion of the year. In the latter case the transactions are recorded both in Baltimore and New York. The other divisions are of minor importance and reference need not be made to them.

From the foregoing it is apparent that the Auditing Department has an effective grasp on the whole financial situation. It is in close touch with the Traffic Department and receives at stated periods information as to movements of ships, execution of new contracts, traffic returns and all the elements which go to make up the debit and credit of the accounts of a large organization.

That proportion of the traveling public who from time to time are accustomed to make trips on ocean-going vessels are familiar with the daily newspapers published for the benefit of passengers. What is not so well known, however, is the fact that to the Marconi Company is due the credit for this material addition to the modern conveniences of ocean travel. The steadily increasing number of ships using Marconi equipment and the demand on the part of the passengers for news of the day's events on shore, together with the desirability of informing the general public on wireless developments through THE MARCONIGRAPH, necessitated the establishment of a Publishing Department during the past year.

As this department, of necessity, possesses a distinct individuality, its accounts are kept separately and its operations conducted by dual heads, John P. Curtiss supervising the business management, and J. Andrew White directing the editorial staff; the policy and operations of the department, of course, being dictated by the executives of the company.

Our readers are familiar with the

General View of the Publishing Department.

contents of THE MARCONIGRAPH and with its purpose: to set forth in detail the interesting features in the development of radio-communication, to report the progress of the affairs of the company, and to offset the mass of newspaper misinformation. Little, then, need be said in regard to the manner in which it is published other than that under the direction of Mr. Curtiss, qualified for the position by years of experience managing widely known magazines, the details of accounting, distribution and the general business of the department are most capably conducted. The advertising solicitors for THE MARCONIGRAPH and both ship newspapers—the transatlantic and coastwise ships using separate papers—are under his control, and advertisements must be approved before inserted in any of the publications.

The OCEAN WIRELESS NEWS, as the coastwise ship newspaper is styled, appears in magazine form and contains at least two illustrated fiction stories and a number of articles of general interest. The body of the paper is made up in the Publishing Department and distributed to the various ships. A daily summary of the world's news, market quotations and reports, and sporting gossip compiled by the Associated Press is transmitted from the high power wireless stations to the various ships, aboard which the news is set up and printed on the four blank pages allowed for that purpose.

In addition to the periodicals, this department maintains a publicity service, sending out bulletins containing important occurrences in the company's affairs to the newspapers. This is done so that Marconi affairs will not be erroneously reported in the daily press of the country.

When it is considered that thousands of copies of the several publications are printed and distributed each month, it will be seen that the management of this department is no sinecure. If their contents prove interesting to the public it is entirely due to the editor, Mr. White, who directs and passes upon every item that enters each one.

Summing it up, the manner in which the work has been apportioned to each department and carried out by the able executives in charge should warrant the assertion that the organization of the American Marconi Company closely approaches that very desirable pinnacle termed "ideal." This, in combination with a well-established business making rapid strides forward all the time, is about all any one could desire of a corporation serving the general public.

Fixing Boundaries by Wireless

Wireless has invaded the Congo to aid in laying out frontier lines. According to a recent treaty, France ceded a certain amount of territory in Africa to Germany in exchange for concessions in Morocco, so that this led to expeditions on the part of both countries in order to fix the boundary lines. Captain Periquet states that wireless telegraphy will be used for the first time on a large scale so as to determine latitudes exactly. Wireless stations now exist in the French possessions, also in Cameroon and Belgian Congo, and all these are to be utilized by the expeditions.

A Still Stronger Figure of Speech

Daniel Webster delivered a speech in the United States Senate which was once celebrated and which is not yet forgotten, in which he described England as the country whose drum beat never ceased and on whose territory the sun never set. Those were strong figures of speech, used by way of illustration, but what would the "god-like Daniel" say now, with wireless speech around the world by the same nation almost realized, and certain soon to be an accomplished fact?

The extensive system of Government supervision over wireless telegraphy becomes effective December 13.

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The Editor will be pleased to receive original articles of timely interest pertaining to Wireless Telegraphy and Telephony. Articles accompanied by good drawings and clear photographs especially desired. If accepted, such articles will be paid for on publicaton, at regular rates.

No manuscripts will be returned unless return postage is enclosed.

Vol. I. DECEMBER No. 3

Editorial

Our prophecy that a magazine of wireless telegraphy would be heartily welcomed by the quarter of a million Americans interested in this fascinating art seems to have been verified, judging from the many letters of recommendation received from subscribers following the publication of our first issues.

It is gratifying to have such unmistakable evidence of appreciation from our readers and we take this opportunity of thanking each of them for their well wishes.

Some of the letters were of particular interest in that they contained valuable suggestions as to specific subjects in which the writers were interested. We like to receive letters of this nature, as we feel it our first duty to please our readers, and where we know exactly what they want it is a comparatively simple matter to have prepared the requested article.

And we are also greatly indebted to those who have volunteered the details of occurrences upon which we were but superficially informed. A letter of this character, over the signature of one prominently identified with incidents dealt with, we consider worthy to be printed in full:

"I am taking the liberty of bringing to your attention one more of the many instances where wireless has had an important part to play in the saving of life and property. As in the past, the Marconi wireless system was equal to the occasion, for through the medium of its apparatus the Norwegian steamship *Noruega* was successfully brought into Newport News after sustaining an accident that without immediate assistance would have resulted in total loss and the ship would now be lying at the bottom of the Atlantic.

"The Norwegian steasmship *Noruega*, Captain Hansen in command, was bound from Christiania to Vera Cruz, Mexico, via Newport News and Galveston. On October 31 this ship cleared from Newport News and on November 1 was 95 miles south of Hatteras in a heavy sea and high wind. On the same day the schooner *Glenlui* was making heavy going from Pensacola to Montevideo. These two large ships when crossing the other's course came together, the *Glenlui* tearing a hole 30 feet by 25 feet in the starboard side of the *Noruega*, out of which tons of cargo slid into the ocean and the empty space in the ship was filled with water. In the excitement of the moment it looked to all on board as though the *Noruega* would soon settle and go to the bottom. The Marconi operator immediately set to work to summon assistance, and in a short time was in communication with the Allianca of the Panama Railroad Company, bound from Colon to New York, two revenue cutters and one battleship, all of which came to the assistance of the damaged vessel.

"The *Allianca* could do little owing to her large list of passengers and soon proceeded on her way to New York, leaving the *Noruega* and *Glenlui* in care of the revenue cutters. Passengers from both ships were taken off and landed safely at Norfolk, including the entire crew of the *Glenlui,* and the *Noruega* eventually arrived stern end foremost at Newport News shipyard in tow of the revenue cutter *Onandaga.*

"Twenty days and nights and an extra large force of men were required to complete the necessary repairs to the *Noruega.*

"She is now on her homeward voyage after experiencing one of the most troublesome trips of her career. Marconi wireless once more fulfilled its purpose and not only brought assistance to the passengers and ship, but kept her owners and agents supplied with complete information, all of which was accomplished at an extra expense of less than fifty dollars. Had this ship not been equipped with wireless it would, in all probability, have been a total loss. At best the vessel would have been picked up by some passing ship and salvaged to the amount of $50,000 or more, which would have been charged against the Insurance Underwriters.

"I am informed by the owner of the S. S. *Noruega* that he has brought to the attention of the insurance companies of Norway that Marconi wireless saved the Underwriters something like $50,000 through its perfect service, and that he has requested the insurance companies to recognize the value of such service by giving substantial reductions in insurance premiums to ships equipped with Marconi apparatus."

A very interesting letter in many respects, and we extend our personal appreciation to its writer.

While on the subject of correspondence we might mention the fact that scores of readers have written for information in regard to wireless securities which they hold. The majority of these people ask to be enlightened on matters of common knowledge and, presumably, each one expects an individual letter in reply. Owing to the heavy correspondence of this nature it is absolutely impossible to give every letter personal attention, so we have classified these letters, and where a number of inquiries have been received on the same subject will attempt to satisfactorily answer these general questions.

First, to those subscribers who have complained of delay in the delivery of THE MARCONIGRAPH—these letters, incidentally, being received principally from residents of cities far distant from New York—we reply that the fault lies with the post office authorities. Newspaper mail which was formerly transported by passenger trains is now sent by freight, and under the new conditions copies destined for points 1,000 miles or more from New York are subject to a delay of a week or ten days. All periodicals are suffering in like manner, and our subscribers are not the only ones with reason to complain.

As a number of subscribers have inquired the reason for temporary certificates being issued in place of regular American Marconi stock certificates of the par value of five dollars, we will go over the situation once again.

When, earlier in the year, the capitalization of the American Marconi Company was increased and the par value of stock reduced from twenty-five dollars to five dollars per share, newly engraved certificates were necessary; and as these could not be prepared on time, the temporary ones were issued. These are perfectly valid and negotiable and are good delivery all over the world. Nevertheless, those shareholders who so desire may have their temporary certificates exchanged for the new issue by forwarding the former to the Corporation Trust Company, 15 Exchange place, Jersey City, N. J.

As to the original stock, par value one hundred dollars, each share can be exchanged for five shares of the new five dollar stock. A number of inquirers cannot seem to grasp the reason why, if the twenty-five dollar certificates are exchangeable in the same ratio, that those of hundred dollar par value cannot be exchanged for four times that number. To explain this, it must be recalled that at the time when American Marconi stock had a par value of one hundred dollars, the capitalization of the company was $6,650,000, and as the market value of the shares was considerably below par for the reason that the company was not then doing sufficient business to warrant its large capitalization, and further to effect economy in corporation taxation, the capitalization was reduced to one-quarter of its original figure. The hundred dollar shares became twenty-five dollar shares and were exchanged on an even, or one to one, basis. Only the amount of capitalization was reduced —the number of shares remained the same.

This is the explanation in the clearest language we possess, and we hope it will be understood by all.

There have also been a number of inquiries regarding the affairs of both English and Canadian Marconi Companies. Some of the queries, it seems to us, are almost irrelevant. For example, this one in regard to the Canadian company: "Can you give us any light as to the way this company is managed? Has Canada no law making it obligatory that corporations furnish stockholders yearly statements?"

While we are glad to render whatever assistance we can to our readers, we become impatient with this sort of thing. For it is a matter of common knowledge that the Marconi Company of Canada prepares annual statements and balance sheets which are sent to all stockholders of record. Perhaps if the writer had ascertained whether his or her proper address was on file, the reason for its non-receipt might have been disclosed.

More thoughtful questions along the lines of why doesn't the Canadian Company solicit business from the United States and requests to know whether the English Marconi Company dividend coupons may be cashed in New York City, are decidedly more welcome. In answer to the first, the Canadian Company, having just secured a contract with its Government for the construction and maintenance of nine additional stations, as reported elsewhere in our pages, have sufficient business to occupy their attention for some time to come; and besides their charter does not permit of operations outside of Canada. As to the second question, dividend coupons of the English Marconi Company may be cashed at the Hanover National Bank in New York City.

A subscriber notes that in the November number our "Queries Answered" Department states that under, the new law a license is required if a set is sensitive enough to receive signals from another State. At the time this question was answered the Department Regulations had not been issued, and we understood, from those who were supposed to know, that a license would be required for a receiving station so equipped. The details of the new regulations, printed in the same issue, settle this point conclusively. These were received at the last moment before we went to press, and knowing them to be of particular interest, we inserted them, but did not have sufficient time to correct the error.

As a final word, readers who have asked for solutions to technical problems will find their questions answered in the regular department conducted for that purpose.

Telefunken Admits Marconi Priority

It has been officially announced in England that the Gesellschaft fur drahtlose Telegraphie, Berlin—better known as the Telefunken Wireless Telegraph Company, of Germany—has authorized the public statement that it admits the full validity of the well-known and much litigated Marconi Patent No. 7,777, owned by Marconi's Wireless Telegraphy Company, Ltd.

This is recognized as the most important patent in the wireless world of to-day, as it embodies and lays the first claim to tuning in wireless telegraphy. It will be remembered that this patent was fully sustained in the action brought by the English Marconi Company against the British Radio-Telegraph and Telephone Company wherein its full validity and priority was established. Judgment was rendered against this concern for a perpetual injunction restraining it from making wireless apparatus which came under this patent. An accounting was also ordered and as it was unable to continue the business as formerly carried on and was not willing to treat for the licenses the English Marconi Company was willing to grant, the concern ceased doing business.

The admission of the validity by the parent Telefunken Company of the Marconi 7,777 patent is particularly interesting to us in America as patent No. 763,772, owned by the Marconi Wireless Telegraph Company of America is identical in its terms and claims with that patent, and strengthens the hand of the Marconi Wireless Telegraph Company of America in the actions now before the courts against several wireless companies for infringement of American Company's patent.

Equipment Bought for High Power Installation

Work on the high-power stations being constructed by the Marconi Wireless Telegraph Company of America is being rapidly pushed forward. An order for approximately 3,000 tons of steel has just been placed with the McMyler Interstate Company, of Cleveland, Ohio. This order covers the material required for seventy-two masts to be erected for the new high-power installations, anchorage foundations and 2,358 steel composite cylinders.

The Share Market

New York, December 11th.

The decline in prices of Marconi stocks is due to the demoralization bordering on accute apprehension which has overcome the general stock market in consequence of repeated attacks by the aggressive bearish faction which has been exploiting to nefarious advantage many factors making for concern in the financial world. Reasons for the cumulative weakness of the stock market are not hard to find. The Supreme Court's interpretation of the anti-trust law and the animating purpose of the so-called money trust inquiry have been the basis of damaging deductions spread broadcast by professional speculators.

It happens also that the nefarious activities of professional traders have included Marconi securities. A well and favorably known brokerage house making a specialty of Marconi stocks has this to say in regard to the present situation:

"Owing to a clever piece of misrepresentation and fraud on the part of a brokerage house of questionable standing the prices of Marconi stocks have been steadily declining. Circulars have been sent broadcast inviting the public to subscribe for and buy 'additional' Marconi stocks by putting up their present holdings as collateral security. When the stock is received these brokers simply sell it in the open market regardless of prices, making no attempt to cover themselves with a view to fulfilling their contracts. In consequence of the hundreds of shares thus obtained being thrown on the market the price has declined.

"We spoke to one of them the other day and were told that they were selling additional stock to their customers on the instalment plan, the last instalment falling due in about two years from now, and that they (the brokers) were gambling on the probability that the instalment purchaser, between now and that distant period, would fall down on one or the other of the instalment payments, thereby rendering the customer's contract void and enabling the brokerage house to retain the collateral and instalments paid.

Thus Marconi stocks have declined through no fault of the company, its management or progress. We believe that Marconi stocks are a good buy now and those who have money to invest should add to their holdings on every decline."

Bid and asked prices to-day:

American, 5¼—5¾; Canadian, 4¼—5; English, common, 23—25½; English, preferred, 20—22¾.

WIRELESS ENGINEERING COURSE

EDITOR'S NOTE:—This course of instruction has been prepared with the view of teaching both the beginner and the practical radio operator basic principles and the electro-magnetic phenomena encountered in the wireless art. While much of value to the experimenter of some experience will be found throughout the course it has been designed primarily for those who are sufficiently interested in wireless telegraphy to apply themselves diligently toward the mastering of basic principles before attempting to construct apparatus and arrange circuits. Due to the tendency of youth to miss the first rung in the ladder of progress there are many amateurs operating sets at the present time who are not in the slightest degree informed upon the why and wherefore of the experiments they are conducting. They know that a certain result may be obtained under certain conditions and that various arrangements of circuits will produce various effects, but they have no conception of the electro-magnetic phenomena that make these possible. To this ignorance of fundamental principles may be ascribed most of the difficulties and discouragements experienced by those who have the ambition and enthusiasm to accomplish something of note in the wireless field but lack the patience to first acquire a true understanding of the subject. Those who will apply themselves to mastering the contents of this course will find that the art of studying properly will soon be acquired. Upon this trait is based the chief factor in education, enthusiasm, without which none can hope for success.

The publishers of this magazine have given weighty consideration to every detail connected with the proper instruction of serious students and are confident that this course will receive recognition as the most valuable work of its kind ever attempted. With the world's greatest authorities to choose from they have selected the man who, in their judgment, was best qualified to handle the subject and our readers will unquestionably recognize the wisdom of the choice as the instruction progresses.

The achievements of Mr. Shoemaker are familiar to every one engaged in wireless work throughout the world. One of the pioneers, he first commenced devoting his energies to the subject in 1900 with the American Wireless Telegraph & Telephone Company, remaining with that concern until it and its successors were merged into the American De Forest Company. Soon after the merger was effected he severed his connection with the combination and organized the International Telegraph Construction Company, which he sold in 1908 to the United Wireless. When the assets of the latter company were acquired by the Marconi Company he was appointed Research Engineer and his exclusive services are now given to the development of the Marconi system. His present high position in the commercial field, together with the fact that he has designed and built a great number of wireless sets for the Army and Navy Departments of the United States and foreign governments are the best indications of his rating as a wireless expert.

That Mr. Shoemaker can explain in understandable English the principles and use of each component part of the apparatus used in wireless telegraphy will be clearly demonstrated to careful readers.

By H. Shoemaker

Consulting Engineer of the Marconi Wirelss Telegraph Company of America

INTRODUCTION

A great number of books have already been written on the art of radio-communication; in fact, the field has been so thoroughly covered by different writers that there is practically nothing new to be written, except, perhaps, descriptions of various new devices which, from time to time, are invented by some of the workers in this field. Improvement is constantly being made by those who are in touch with the practical operation of the apparatus, and by those who make a study of the theory and principles involved. These improvements are mostly confined to the apparatus itself.

In 1896 Marconi showed to the world how messages could be sent and received by the employment of electrical oscillations. To-day all practical systems employ these same electrical oscillations in some manner or other. In the last ten years we have learned to use them to better advantage than before, thus making them an indispensable means of communication.

There are at present nearly two thousand wireless telegraph stations in the world employing nearly 5,000 men. Most of these men are employed in operating the stations, while others are engaged in the manufacture and installation of the apparatus. Many of those engaged in this field have had a technical training and considerable experience, but the majority, including the operators, have not been sufficiently trained to take proper care of the apparatus which is placed in their charge. At present the Government requires those in charge of a station to pass an examination covering this subject. This has been a hardship to many.

The object of this treatise is to put before those desiring to enter this field, or those who desire to become better informed, such facts and information as will enable them to pass the Government examination and manipulate the apparatus in a practical manner. I will assume that the reader has a fundamental knowledge of electricity and physics. He should also understand simple algebra and the use of logarithms. Without this knowledge it is impossible to understand the simple relations existing between the different elements used in the circuits employed.

In many instances I shall refer to standard books where space will not permit the full treatment of the subject, so that the reader may become familiar with the derivation of formula and theory.

To those who are not well informed on the subject of electricity, I refer them to "Elementary Lessons in Electricity and Magnetism," by Silvanus P. Thompson. I shall also refer to "Principles of Electric Wave Telegraphy," by J. A. Fleming, which is one of the most complete books on this subject, and again to "Principles of Wireless Telegraphy," by Prof. G. W. Pierce, who has made a great many original investigations on this subject.

Also to enable the reader to learn and fully comprehend all the terms used throughout this treatise, I will define and endeavor to fully explain each of these. Like all new subjects the terms used differ in various countries and with different users. I will employ only those terms which are most generally used.

There is no particular branch of the electrical art which employs so many different kinds of apparatus and circuits as does wireless telegraphy.

Direct current motors, alternating current generator, transformers, condensers, low potentials or voltages, high potentials or voltages, low frequency and high frequency currents are all employed. As certain relations must exist between all these parts, they should be understood by those engaged in their use.

It is necessary to produce electrical oscillations of the order 500,000 to 1,000,000 per second and to properly employ them to produce electric magnetic waves. These waves are propagated through space in all directions, except where modified by the use of special apparatus.

When cutting or passing through properly designed circuits these waves have their energy converted into electrical oscillations in that circuit. If we have some means of detecting their presence we then have a complete means for sending signals through space and receiving them. Of course some device must be employed to properly group the oscillations into intelligible signals.

In its essential features, a complete wireless telegraph system must consist of a producer of electrical oscillations, a key or device for grouping them, and means for converting them to electro-magnetic waves. This constitutes the transmitter. For receiving it is necessary to have a circuit for converting the electro magnetic waves into electrical oscillations and means for detecting or making them manifest.

It is necessary to employ a considerable amount of electrical energy to produce the electrical oscillations. Due to the fact that this energy must be in the form of a high potential, it is necessary to use alternating current and a transformer. Where alternating current is not available, it is necessary to produce it by means of suitable generators. For this reason the transmitter is much more complicated than the receiving apparatus.

There are three constants or elements which control the time period or character of an oscillating circuit, viz., capacity, inductance and resistance. In all practical apparatus the resistance is kept as low as possible as its effect on the oscillations is to dissipate their energy and change their character. The capacity and inductance effect them in another manner, viz., by changing their time period, or the number per second.

The reader should become familiar and fully comprehend the two systems of electrical units, viz., electro static and electro magnetic units. These are derived for the fundamental or C. G. S. units. From these units are derived the practical units use in the electrical art. See arts 280, 352, 353, 354, 355, 356, 357, 358, 359, 360, in "Elementary Lessons in Electricity and Magnetism," by Thompson. It will be seen from the above that all the units are based on the centimeter (unit of length), gram (unit of mass), and the second (unit of time). These units are invariable and enable us to construct standards from dimensions of the apparatus. Thus, if we have an accurate scale (for measuring length), a clock (for measuring time), and a balance (for measuring the weight or mass) we can determine the value of any of the elements in terms of the above units. Electrical potential can be determined by measuring the force exerted between two bodies. Electrical current can be measured by measuring the force exerted between two conductors carrying current. Electrical capacity can be determined by the dimensions of a conductor or system of conductors. Inductance can be determined by the dimensions of the circuit. All of the above determinations will be in terms of the centimeter, gram and second. As all absolute standards are determined by the above methods, the importance of these fundamental units will be apparent.

In the following chapters I will discuss more fully the relations between the different systems of units, and their application to this subject.

I shall endeavor to show in a simple manner the functions of the different elements used in the practical apparatus, as well as the methods of use. After taking up the elementary circuits and their characteristics, I will then treat each element of that circuit in detail, showing methods of measurements and instruments used for such measurement.

As electrical oscillations are a form of alternating current and have common properties, I will begin this treatise with alternating current and its properties.

(To be continued in our next issue.)

Nine New Marconi Stations for Canadian Government

An announcement has just been received to the effect that the Marconi Wireless Telegraph Company, of Canada, has entered into an agreement with the Canadian Government for nine additional stations in the Great Lakes regions.

The Canadian Marconi Company is to receive an annual subsidy of $31,500 for their operation and maintenance over a period of nineteen years.

Canada on Compulsory Equipment

The Minister of Marine has introduced in the House of Commons a bill requiring all Canadian vessels carrying fifty or more passengers and plying between ports 200 miles apart to be equipped with wireless telegraph apparatus. An amendment was presented requiring all passenger ships, Canadian and foreign, to be so equipped.

The bill applies to lake and St. Lawrence River ships, and will take effect April 1, 1913.

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 an individual can be answered. To receive attention these rules must be rigidly observed.

A. L. D., Springfield, Ill., inquires:

Are there any fire underwriter rules to be observed in the construction of an amateur station?

Ans.—Yes; you will find, generally speaking, that every city has definite rules regarding the installation of an amateur set. These rules refer more specifically to the grounding of the antennae outside of the building and condenser protection for the primary power circuit. Write to the fire underwriters of your home city. It is far best to comply with their rules in every detail.

A. F. L., Pittsburg, asks:

What is the wave length of the Sayville, L. I., Wireless Station?

Ans. — The Sayville Station has two transmitting sets and works on two different wave lengths. The small set of 5 kw. uses a wave length of about 600 meters, and is used for ordinary ship business. However, when sending press on the 9.15 p. m. schedule the large set is employed, using a wave length of somewhere in the vicinity of 2800 meters.

C. K. A., Cleveland, writes:

Which is the most efficient for wireless work, a closed core or open core transformer?

Ans.—The open core transformer is generally used by commercial companies, and although it is not to efficient in the transfer of energy as a closed core transformer, yet it is more efficient for wireless work. Where the maximum transfer of energy from the primary to the secondary circuit of the transformer is desired, the closed core is the best. The advantage of the open core transformer lies in the fact that it is a constant current transformer, and that it will give th esame current in the secondary on short circuit as it will when employed in the charging of condensers in the regular way; consequently, when the condensers are discharging there will not be an enormous rise in current in the secondary due to the fact that it is short circuited by the condensers while discharging, across the spark gap.

H. W. A., New York City, asks:

Please give the main points of difference between the Edison and the Electric Storage Battery Company's chloride cells.

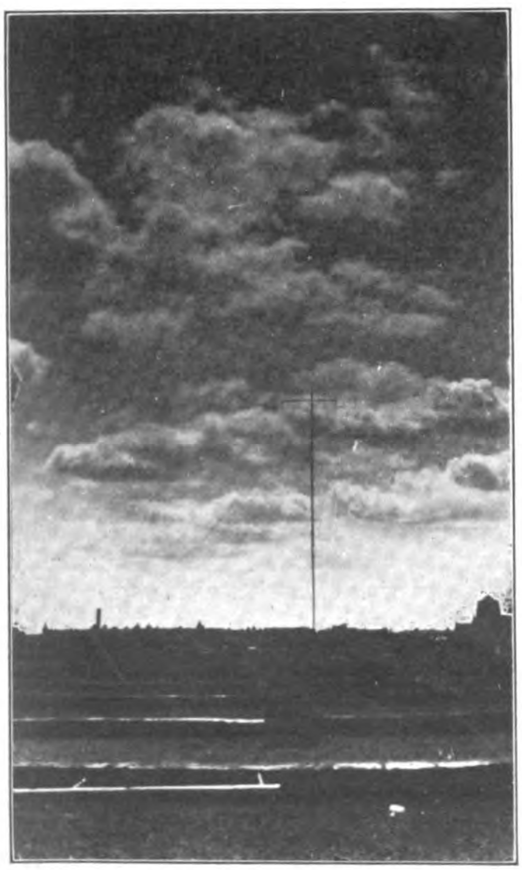
Ans.—In the chloride cell the active elements are lead plates and about a 20 per cent. solution of sulphuric acid. The negative plate consists of spongey lead, while the positive plate has chloride of lead buttons on it. On the other hand, the Edison is an alkali cell, and the active elements are iron and nickel. The negative plate consists of a nickeled steel grid with corrugated pockets, which are packed with iron oxide. Owing to the fact that the iron oxide is a poor conductor, it is mixed with metallic mercury to give better conductivity.

The positive plate is a nickel steel grid consisting of perforated tubes, which are packed with alternate layers of nickel hydrate and pure flaked nickel. The pure flaked nickel is inserted between the layers of nickel hydrate to give better conductivity.

The electrolyte in the Edison cell consists of a 21 per cent. solution of potassium hydrate mixed with lithium hydrate. The normal discharge voltage of an Edison cell is 1.2 volts, while the chloride cell has a normal discharge voltage of approximately 2.1 volts per cell.

In this department the affairs of the various wireless clubs and associations will receive attention. Believing that all amateurs are interested in the experiments and research work of others the publishers plan to give readers each month distinctive items on the progress made by club members, thus offering all an exchange of ideas in organization and experimental matters and bringing students in closer touch with each other. To this end we will also publish a Wireless Club Directory. The names of the officers and the street address of the secretary are requested from all clubs. Notification of any changes should be forwarded at once. Short descriptive articles of experiments or new stations with distinctive features, accompanied by drawings or photographs, will be published.

Wireless telegraphy is to be made a part of the curriculum of the high schools of Chicago. The first station to be installed will be at the Lake View High School.



Aerial of Station Built by Alfred J. Seeley, of Philadelphia.

The new course is the result of a plea on the part of the Wireless Club of the school, composed of students. For a long time the boys have been interested in the science of wireless telegraphy, and recently they prevailed upon Benjamin F. Buck, principal of the school, to ask for the installation of wireless apparatus. The school management committee recommended to the committee on buildings and grounds that the apparatus be installed.

Mrs. Ella Flagg Young, Superintendent of Schools, is strongly in favor of the plan.

"It is likely," she said, "that we will have many more such stations if this is a success. I think that it is a good idea and will do what I can to help it."

Wireless Club Directory

Amateur wireless clubs and associations are requested to keep us posted in regard to any changes that should be made. New Clubs will be entered in the issue following receipt of notices in the form given below.

ARKANSAS

Little Rock—Arkansas Wireless association: G. A. Rauch, president; Edward Vaughn, 2622 State St., Little Rock, Ark., secretary and treasurer.

BRITISH COLUMBIA

Vancouver—Wireless Association of British Columbia: Clifford C. Watson, president; J. Arnott, vice-president; E. Kelly, treasurer; H. C. Bothel, 300 Fourteenth Ave., E. Vancouver, B. C., secretary.

CALIFORNIA

Long Beach—Long Beach Radio Research Club: Bernard Williams, 555 E. Seaside Blvd., Long Beach, Cal., secretary.

LOS ANGELES — Custer Wireless Club: Franklin Webber, president; Oakley Ashton, treasurer; Walter Maynes, 438 Custer Ave., Los Angeles, Cal., secretary.

NAPA—Aero Wireless Club: A. Garland, president; W. Ladley, vice-president; D. Beard, Napa, Cal., secretary and treasurer.

OAKLAND — Fruitvale Wireless Club: Joseph C. Brewer, president; Alan Downing, vice-president; Chrissie Eiferle, treasurer; Abner Scoville, 2510 Fruitvale Ave., Oakland, Cal., secretary.

OAKLAND — Oakland Wireless Club: H. Montag, president; W. L. Walker, treasurer; W. R. Sibbert, 916 Chester St., Oakland, Cal., secretary.

SACRAMENTO — Sacramento Wireless Signal Club: E. Rackliff, president; J. Murray, vice-president; G. Banvard, treasurer; W. E. Totten, 1524 "M" St., Sacramento, Cal., secretary.

SANTA CRUZ — Santa Cruz Wireless Association: Orville Johnson, president; Harold E. Sentor, 184 Walnut St., Santa Cruz, secretary and treasurer.

CANADA

PETERBORO, Ontario — Peterboro Wireless Club: G. B. Powell, president; C. V. Miller, vice-president; E. W. Oke, 263 Engleburn Ave., Peterboro, Ontario, Can., secretary and treasurer.

WINNIPEG, Manitoba—Canadian Central Wireless Club: Alexander Polson, president; Stuart Scorer, vice-president; Benj. Lazarus, P. O. Box 1115, Winnipeg, Manitoba, Can., secretary and treasurer.

COLORADO

DENVER—Colorado Wireless Association: William Cawley, president; Thomas Ekren, vice-president; W. F. Lapham, 1545 Milwaukee St., Denver, Colo., secretary and treasurer.

CONNECTICUT

NEW HAVEN—New Haven Wireless Association: Roy E. Wilmot, president; Arthur P. Seeley, vice-president; Russel O'Connor, 27 Vernon St., New Haven, Conn., secretary and treasurer.

WATERBURY — Waterbury Wireless Association: Weston Jenks, president; Alfred Upham, treasurer; H. M. Rogers, Jr., 25 Linden St., Waterbury, Conn., secretary.

GEORGIA

SAVANNAH — Wireless Association of Savannah: Philip C. Bangs, president; Arthur A. Funk, vice-president; Hugh Jenkins, treasurer; Lewis Cole, 303 Price St., Savannah, Ga., secretary.

ILLINOIS

CHICAGO — Chicago Wireless Association: John Walters, Jr., president; E. J. Stein, vice-president; C. Stone, treasurer; F. D. Northland, secretary; R. P. Bradley, 4418 South Wabash Ave., Chicago, Ill., corresponding secretary.

CHICAGO — Lake View Wireless Club: E. M. Fickett, president; R. Ludwig, treasurer; R. F. Becker, 1439 Winona Ave., Chicago, Ill., secretary.

CHICAGO — Northwestern Wireless Association of Chicago: Rolf Rolfson, president; H. Kunde, treasurer; Edw. G. Egloff, 2720 Noble Ave., Chicago, Ill., secretary.

DE KALB—De Kalb Radio Transmission Association: Bruce Lundberg, president; Walter Bergendorf, vice-president; De Estin Snow, treasurer; Bayard Clark, 205 Augusta Ave., De Kalb, Ill., secretary.

INDIANA

FAIRMOUNT—Southeastern Indiana Wireless Association: R. F. Vanter, president; D. C. Cox, vice-president and treasurer; H. Hitz, Fairmont, Madison, Ind., corresponding secretary.

HOBART—Hobart Wireless Association: Asa Bullock, president; Charles Clifford, Hobart, Ind., secretary.

INDIANAPOLIS — Wireless Club of the Shortridge High School: Robert C. Schimmel, 2220 N. Penn St., Indianapolis, Ind., president; George R. Popp, vice-president; Bayard Brill, treasurer; Oliver Hamilton, secretary.

RICHMOND—Aerograph Club of Richmond, Ind.; H. J. Trueblood, president; Richard Gatzek, vice-president; James Pardieck, 320 South Eighth St., Richmond, Ind., secretary.

VALPARAISO—Alpha Wireless Association: L. L. Martin, president; F. A. Schaeffer, vice-president; G. F. Girton, Box 57, Valparaiso, Ind., secretary and treasurer.

KANSAS

INDEPENDENCE — Independence Wireless Association: Boyce Miller, president; Ralph Elliott, secretary; Joseh Mahan, 214 South Sixth St., Independence Kan., vice-president.

LOUISIANA

NEW ORLEANS — Southern Wireless Association: B. Oppenheim, president; P. Gernsbacher, 1435 Henry Clay Ave., New Orleans, La., secretary.

MARYLAND

BALTIMORE—Wireless Club of Baltimore: Harry Richards, president; William Pules, vice-president; Curtis Garret, treasurer; Winters Jones, 728 North Monroe St., Baltimore, Md., secretary.

MASSACHUSETTS

ADAMS — Berkshire Wireless Club: Warren A. Ford, president; William Yarkee, vice-president; Charles Hodecker, treasurer; Jas. H. Ferguson, 18 Dean St., Adams, Mass., secretary.

HAVERHILL — Haverhill Wireless Association; Riedel G. Sprague, president; Charles Farrington, vice-president; Leon R. Westbrook, Haverhill, Mass., secretary and treasurer.

ROSLINDALE—Roslindale Wireless Association: O. Gilus, president; E. T. McKay, Treasurer; Fred C. Fruth, 962 South St., Roslindale, Mass., secretary.

SOMERVILLE — Spring Hill Wireless Association: R. D. Thiery, president; H. P. Hood, Second and Benton Road, Somerville, Mass., secretary and treasurer.

SPRINGFIELD—Forest Park School Wireless Club: W. S. Robinson, Jr., president; William Crawford, R. F. D No. 1, Springfield, Mass., secretary.

SPRINGFIELD — Springfield Wireless Association: A. C. Gravel, president; C. K. Seely, vice-president; D. W. Martenson, secretary. Club Rooms, 323 King St., Springfield, Mass.

WEST MEDFORD—Independent Wireless Transmission Co., Starr W. Stanyan, 76 Boston Ave., West Medford, Mass., secretary.

MICHIGAN

JONESVILLE — Jonesville Wireless Association: Frederic Wetmore, president; Webb Virmylia, vice-president; Richard Hawkins, treasurer; Merritt Green, Lock Box 82, Jonesville, Mich., secretary.

MINNESOTA

ST. PAUL—St. Paul Wireless Club: Thos. Taylor, president; L. R. Moore, vice-president; E. C. Estes, treasurer; R. H. Milton, 217 Dayton Ave., St. Paul, Minn., secretary.

MISSOURI

HANNIBAL — Hannibal Amateur Wireless Club: Charles A. Cruickshank, president; J. C. Rowland, vice-president; William Youse, treasurer; G. G. Owens, 1306 Hill St., Hannibal, Mo., secretary.

MONTANA

BUTTE—Wireless Association of Montana: Roy Tusel, president; Elliot Gillie, vice-president; Harold Satter, 309 South Ohio St., Butte, Mont., secretary.

NEW HAMPSHIRE

MANCHESTER — Manchester Radio Club: Homer B. Lincoln, president; Clarence Campbell, vice-president; Elmer Cutts, treasurer; Earle Freeman, 759 Pine St., Manchester, N. H., secretary.

NEW JERSEY

WILDWOOD—Wildwood Wireless Association: Russell Kurtz, president; Walter Nefferdorf, vice-president; J. Crozier Todd, treasurer; Chas. E. Rockstraw, Jr., 110 East Pine Ave., Wildwood, N. J., secretary.

NEW YORK

BUFFALO — Frontier Wireless Club: Chas. B. Coxhead, president; John D. Camp, vice-president; Franklin J. Kidd, Jr., treasurer; Herbert M. Graves, 458 Potomac Ave., Buffalo, N. Y., secretary.

GENEVA—Amateur Wireless Club of Geneva: H. B. Graves, Jr., president; C. Hartman, vice-president; L. Reid, treasurer; Benj. Merry, 148 William St., Geneva, N. Y., secretary.

GENEVA — Geneva Wireless Club: Charles B. Hartman, president; Charles Smith, vice-president; Benj. Merry, treasurer; Henry B. Graves, Jr., 448 Castle Ave., Geneva, N. Y., secretary.

MT. VERNON—Chester Hill Wireless Club: Waller Morgan, president; Richard D. Zucker, 46 Clinton Place, Mt. Vernon, N. Y., secretary.

NEW YORK — Gramercy Wireless Club: James Platt, President; John Gebhard, vice-president; John Diehl, treasurer; John Jordan, 219 East 23d St., New York, secretary.

NEW YORK—Metropolis Club: J. T. Smith, president; William E. Meyer, 131 West 60th St., New York City, secretary and treasurer.

NEW YORK—Plaza Wireless Club: Paul Elliot, president; Myron Hanover, 156 East 66th St., New York, secretary and treasurer.

NYACK — Rockland County Wireless Association: W. F. Crosby, president; Marquis Bryant, secretary; Erskine Van Houten, 24 De Pew Ave., Nyack, N. Y., corresponding secretary.

SCHENECTADY — Amateur Wireless Association of Schenectady: D. F. Crawford, president; L. Beebe, vice-president; C. Wright, treasurer; L. S. Uphoff, 122 Ave. "B," Schenectady, N. Y., secretary.

NORTH DAKOTA

FARGO — Fargo Wireless Association: Kenneth Hance, president; John Bathrick, vice-president; Earl C. Reineke, 518 Ninth St., Fargo, N. D., Secretary.

OKLAHOMA

MUSKOGEE—Oklahoma State Wireless Association: T. E. Reid, president; G. O. Sutton, vice-president; Ralph Johns, Box 1448, Muskogee, Okla., secretary.

OREGON

LENTS — Oregon State Wireless Association: Charles Austin, president; Joyce Kelly, recording secretary; Edward Murray, sergeant-at-arms; Clarence Bischoff, Lents, Ore., treasurer and corresponding secretary.

PENNSYLVANIA

LEETSDALE — Allegheny County Wireless Association: Arthur O. Davis, president; Theodore D. Richards, vice-president: James Seaman, Leetsdale, Pa., secretary and treasurer.

PITTSBURG—Greenfield Wireless Association: Edward M. Wolf, president and corresponding secretary, 4125 Haldane St., Pittsburg, Pa.

WILLIAMSPORT — Y. M. C. A. Wireless Club: Lewis Holtzinger, president; Christian Coup, vice-president; Robert Templeman, treasurer; Lester Lighton, 211 West Fourth St., Williamsport, Pa., secretary.

RHODE ISLAND

NEWPORT — Aerogram Club: J. Stedman, president; A. Hayward Carr, chairman Board of Directors; Albert S. Hayward, treasurer; Donald P. Thurston, secretary; Walter B. Clarke, 17 May St., Newport, R. I., corresponding secretary.

TENNESSEE

MEMPHIS—Tri-State Wireless Association: C. B. De La Hunt, president; O. F. Lyons, vice-president; T. J. Daly, treasurer; C. J. Cowan, Memphis, Tenn., secretary.

WISCONSIN

MILWAUKEE—Cardinal Wireless Club: K. Walthers, president; F. Dannenfelser, vice-president; Miss A. Peterson, South Division High School, Milwaukee, Wis., secretary.

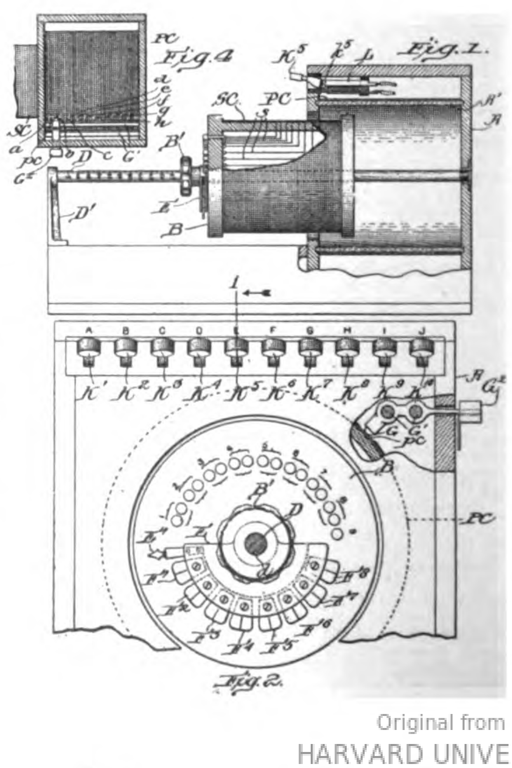
Notable Patents

William L. Walker, of Boston, inventor of an interference-preventer for wireless telegraph circuits, describes his apparatus thus:

My invention relates to tuning instruments for wireless telegraph receiving stations, and consists in improvements in the construction of inductance coils and associated apparatus, whereby the operator has at his disposal a large variety of inductance values, with control and handling devices which enable him to select different inductance values with ease, precision and rapidity.

By employing my improved tuning apparatus, the receiving operator can readily minimize or prevent interference from wave sources to which his resonant circuit is not attuned, and at the same time may preserve or emphasize the clearness and intensity of the signals he desires to receive. As sharp resonance obtained by a given adjustment of the circuit may result in failure to obtain desired signals—the circuit being slightly out of the exact proper adjustment—the invention includes an arrangement by which dull resonance may be utilized when the operator is waiting for signals of which the periodicity is not known.

The orderly arrangement and simplicity of the mechanical adjuncts of my improved tuning apparatus afford an easy and accurate mode of tuning the station with any known antenna within range, or a receiving instrument for a suitable standard wave-length, and



in general enables the operator to utilize existing conditions to best advantage.

In the drawings, which illustrate my invention in its preferred form, Figure 1 is an elevation, partly in section (taken at the dotted line marked 1 in Fig. 2), showing a mode of mounting the coils of a transformer; Fig. 2 shows, on a larger scale, the front of a part of the apparatus, in elevation, a portion being broken away to show parts of the interior; Fig. 3 shows the electrical arrangement of the tuning apparatus, diagrammatically, and Fig. 4 is a horizontal section on a smaller scale taken through the case just above the primary coil.

Referring to Figs. 1 and 2, which illustrate the mechanical arrangements and convenient grouping of the several parts of the tuning apparatus, A represents a casing in which is mounted an inductance coil PC, the turns of which are wound upon a spool or cylinder A′. This coil, which we may regard and for convenience term a primary coil, is composed of a suitable number of inductance sections wound upon the cylinder A′ and connected in the manner presently to be described with reference to Fig. 3. A complementary inductance coil which we may regard as the secondary, is shown at SC wound upon a spool or drum B, and this coil is also subdivided into a series of inductance sections, connected, arranged and controlled as will be described with reference to Fig. 3. The casing A is provided with an aperture preferably circular and concentric with the coils PC and SC and the spool B is mounted to slide axially upon a track represented by the rod D mounted in front upon the standard D′ and at the rear upon a portion of the casing A. By means of a feather and groove connection indicated at *d* in Fig. 2, the spool B and its inductance coil SC may slide but not rotate upon the supporting rod D. A controlling handle B′ is mounted at the front of the spool B and carries the plate E and fingers E′, F′, F^2, etc., of a fan switch. The index finger E′ of this fan switch is electrically connected through plate E to the rod D, which affords means for making connection with an outside lead. The fingers F′ to F^8, inclusive of the fan switch, are mounted in an insulating sector.

Contact pieces arranged in pairs and seated in insulating material at the face of the spool B are shown in Fig. 2 at stations 1, 2, 3, 4, 5, 6, 7, 8 and 9, and these contact members, as will be described in connection with Fig. 3, afford, in co-operation with the fan switch, convenient means for determining and selecting the inductance values of the secondary coil SC.

The subdivisions of inductance sections of the primary coil PC are selectively included in circuit by means of the keys K′ to K^{10}, inclusive, which are shown in Fig. 2 as occupying stations marked on the casing with letters from A to J inclusive. These keys operate upon contact members generally designated in Fig. 1 by L, by the action of wedge-shaped ends such as k^5, also seen in Fig. 1. One of the inductance subdivisions or sections of the primary coil PC is in contact with a sliding member G, which is joined electrically to one of the main leads of the apparatus. This sliding member is indicated in part in Fig. 2 and is carried by the handle G^2 which operates the

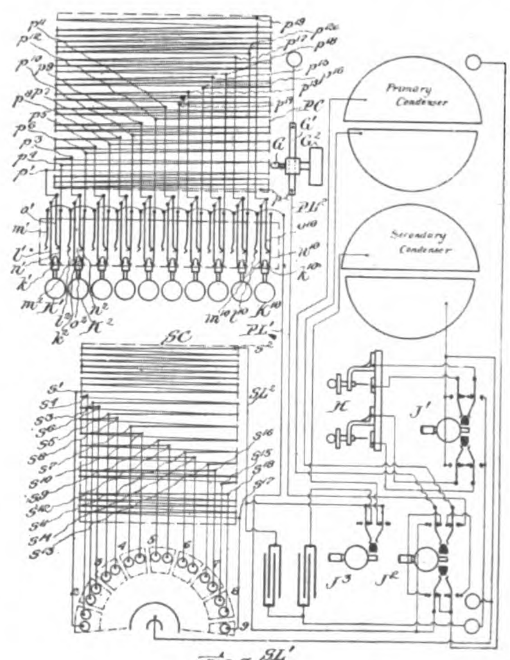


Fig. 3. SL′

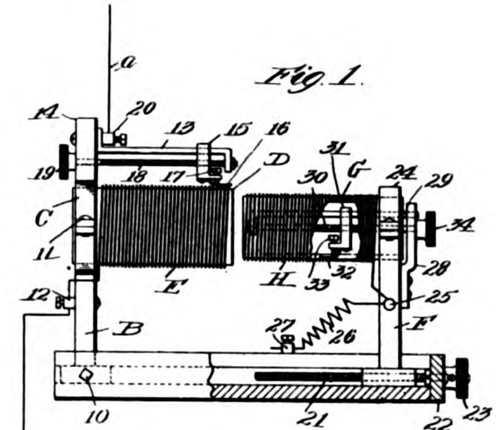
contact member by sliding back and forth upon the slide or track G′. The track or rod D will preferably be marked or calibrated with a scale as shown in Fig. 1 for convenience in determining the position of the spool B upon the track. The sliding member G travels on slide-rods G′, G′ and is operated by the handle G^2. The insulation of the wires which form the first section of the primary coil PC is removed as at *pc* (Fig. 2) so that the conductive member G may make electrical contact with any turn of the wire. In Fig 4 the sectional character of the coil PC is indicated, the first section having its terminal at *a*, and succeeding sections at *b, c, d, e, f, g, h,* and so on. Lead wires, shown in part in Fig. 1, connect these terminals with the contact members L in the manner diagrammatically illustrated in Fig. 3. Connections collectively designated as *s* (Fig. 1) establish communication between sections of the secondary coil SC and the contact points at stations 1, 2, 3, 4, 5, 6, 7, 8, 9, in the manner presently to be described, and illustrated diagrammatically in Fig. 3.

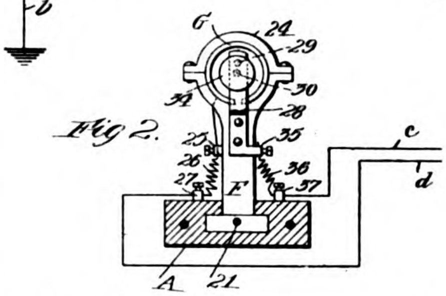
Referring now to Fig. 3: The two mutually complementary inductance coils PC and SC are shown in diagram. The coil PC is subdivided into inductance sections. The first section included between points p, p^2, which we will regard arbitrarily as the first section in the coil, makes contact with the sliding contact shoe G, which is carried on the track G′ and operated by the handle G^2 previously referred to in connection with Fig. 2. This sliding contact affords a fractional adjustment of inductance values by connecting in at individual turns of the coil between p' and p^2, and it is through this sliding contact piece that connection is made to the main lead PL^2. The other main lead PL′ terminates in a plurality of contact points of which the first is marked m' and the last in series m^{10}, any one of which may be selected as the lead connection to PL′. The keys K′ to K^{10}, inclusive, provided with wedge-shaped operative ends at k to k^{10}, inclusive, operate upon spring members or contact pens l' n' to l^{10} n^{10}, inclusive. The contact members which (under the control of keys K′ to K^{10}, inclusive) determine the selected inductance values in the coil PC are arranged in groups, each group comprising two pairs. Thus the first group comprises the pair of contact members m' l' and another pair o' n'. All of the contact members n to n^{10} inclusive are connected with the main lead PL′; the members l' o', one from each pair of the first group of contact members, are connected with the terminal p' of the first inductance section of the coil PC. The remaining member n' of the second pair of the first group is connected with a terminal p^4 of the coil next in series to the first coil which lies between p' and p^2. The arrangement of the other groups of contact members is identical with that of the first with the exception that the last group, though shown as identical in construction with the others, includes a member n^{10} which performs no electrical function but is provided merely for the sake of uniformity in construction and for facility in building up a longer series of contact groups if it should be desired. The inductance sections or subdivisions have for their respective terminals the points p^1, p^2, p^3, p^4, p^5, p^6, p^7, p^8, p^9, p^{10}, p^{11}, p^{12}, p^{13}, and so on to p^{19}, p^{20}. The odd numbered terminal points from p' to p^{10}, may be selectively connected through the pairs of contact members l' n' to l^{10} n^{10} inclusive with the main lead PL′. The controlling keys K′ to K^{10} are shown in Fig. 3 in the positions represented by Figs. 1 and 2 so that the wedge shaped ends k' to k^{10} inclusive are withdrawn to allow the contact members l' m' to l^{10} m^{10} inclusive to be cut out of contact and the pairs of contact members n' o' to n^{10} o^{10} to be in contact. If, now, one of the keys as K′ be depressed so as to swing its wedge shaped end k' forward and upward, the contact members l' n' will be forced apart breaking the contact between n' and o' and making contact between m' and l' and thus connecting the terminal point p' with the main lead PL′. The other main lead PL^2 will make connection with the coil between points p' and p^2 at any desired turn by means of the sliding member G thus completing the circuit from one main lead to the other through an inductance section of the coil PC. When the keys K′ to K^{10} are in elevated position as shown in Figs. 1 and 2, the disposition of the groups of contact members is such that all of the inductance sections of the coil PC are connected in series and the first coil is always in electrical connection with the main lead PL^2. The connection with main lead PL′ is selectively determined by the depression of one of the keys so that whatever key is depressed the inductance sections between the first section and that controlled by the key selected will be included in the series between the main leads, and all those inductance sections which are not so included are left completely open or dead-ended so that they do not produce disturbing resonance and are entirely eliminated to all practical intents and purposes.

* * *

A tuning device for wireless telegraphy is the joint invention of W. E. D. Stokes, Jr., and George M. Davis, of New York City and Galilee, N. J., respectively.

Fig. 1 is a side elevation partly in section and Fig. 2 is an end view.





The device consists of a base-piece A of insulating material having a T-slot cut through the same.

B designates a standard made of insulating material, and having a foot which fits into said T-slot, and which standard can be permanently attached to the base-piece A by a screw or bolt 10 threaded into the side thereof. The upper part of the standard B is made semi-cylindrical in shape, and fitted to the same is a yoke C, which is held to the standard B by screws 11. Clamped between the standard B and yoke C is a hollow cylinder D, made out of insulating material as hard rubber. Wound on the outside of this cylinder is a coil E of wire, which coil can have its spirals separated from each other or which can be formed of insulated wire. A binding post 12 is connected to the left-hand end of the coil E. A metallic rod 13 is secured to an arm 14 projecting up from the yoke C. Fitted to slide on the rod 13 is a traveller 15, which carries at its lower end a flat spring 16, the tension of which is adjusted by a screw 17. This spring is adjusted to bear tightly on the convolutions of the coil E, and if the coil E is formed of insulated wire the insulation is scraped away on the line where the spring 16 engages the coil. A screw 18 is fitted in the projection 14, and in the rod 13, which screw has an operating head or knob 19. This screw is threaded into the traveller 15. A binding post 20 is secured to the rod 13. One wire *a* is connected to the binding post 20, and another wire *b* may lead to the ground if it is desired to use the device with this circuit. By turning the knob 19 the position of the carrier 15 can be adjusted longitudinally, and hence the number of turns of the coil E included in the circuit *a*—*b* can be adjusted, whereby the inductance of said circuit can be varied or adjusted.

Another standard F of insulating material is provided with a foot to fit in the T-slot in the base-piece A. The position of this standard F longitudinally can be adjusted by a screw 21, which is threaded into the foot of the same and which screw is journaled in a plate 22 secured on the end of the base A. The screw 21 is provided with a knob 23, and by turning this knob the position of the standard F can be adjusted. The top of the standard F is made in the form of a semi-cylinder, and secured to the top of the same is a yoke 24. A cylinder G of insulating material is held between the top of the standard F and the yoke 24. Wound on the outside of this cylinder is a coil of wire H. The inner end of this coil is connected to a post 25, which connects by a spring wire 26 to a binding post 27.

Secured to the movable standard F is a metallic arm 28, which has a rod 29 projecting inside of the cylinder G. A screw 30 is secured in the arm 28, and in the end of the rod 29. This screw engages a traveller 31 fitted on the rod 29, which traveller has a spring-arm 32 working through a slot cut in the cylinder G, the tension of which spring-arm can be adjusted by a screw 33. The screw 30 is provided with a knob 34. The arm 28 has a post 35 secured thereto which connects by a spring wire 36 to a binding post 37. The second circuit *c*—*d* is connected to the binding posts 27 and 37. By turning the knob 34 as many turns or coils of the coil H can be included in this circuit as desired. The diameter of the coil H is such that the same will fit inside of the cylinder D, and the cylinders D and G are arranged in line so that the coil H can be adjusted inside the coil E as far as desired. By this arrangement the inductance of each circuit can be quickly and accurately adjusted, and the position of the two coils can be adjusted relatively to each other, whereby the action between the two coils can also be regulated.

The device can be used for adjusting the inductance of any two circuits, and for adjusting the action of the two circuits on each other.

* * *

Lee De Forest has invented a new system of duplex transmission. Full description later.

Personal Items

On the ninth day of November at Calvary Episcopal Church, in New York City, Miss Nancy Oldham became the bride of Mr. John Young, auditor of the Marconi Wireless Telegraph Company of America. The ceremony was followed by a reception to relatives and intimate friends, after which the couple departed for Washington to spend the honeymoon. Upon their return Mr. and Mrs. Young were presented with a handsome case of silver, a token of esteem from the staff of the company.

* * *

Mr. R. H. Marriott, formerly of the engineering staff of the American Marconi Company, has been appointed government radio inspector, with headquarters at New York.

France to Have Wireless Girdle

The French Government has decided to establish a series of wireless stations connecting Paris with the various French colonies and with North and South America. The project as laid before the chamber contemplates the expenditure of $4,000,000.

Allege Continental 'Phones Fraudulent

Fraudulent tests of alleged wireless telephones by which investors were induced to put their money into the Continental Wireless Telephone & Telegraph Company were described by Assistant United States District Attorney Stephenson at the opening of the trial of the four alleged proprietors of the company.

The defendants in the United States District Court before Judge Hunt are Cameron Spear, alleged compiler of the famous "sucker list;" Archie F. Collins, an inventor of wireless apparatus; Charles L. Vaughn, former vice-president and treasurer of the Continental company, and Joseph H. Reall. They are charged with defrauding Walter N. Altman, of Topeka, Kan., and others, and Spear is alleged to have been the moving spirit.

The Progress of Wireless Telegraphy

By Guglielmo Marconi

Being an abstract of a paper read before the New York Electrical Society.

THE mystery enveloping electricity began to dissipate when it was suggested by Ampère that the theory of a universal ether, possessed of purely mechanical properties, might supply the means for explaining electrical facts: this view was upheld in America by Joseph Henry and in England by Faraday.

When Maxwell published, in 1864, his splendid dynamical theory of the electromagnetic field, and worked out mathematically the theory of ether waves, and Hertz proved experimentally the correctness of Maxwell's hypothesis, we obtained perhaps the greatest insight into the hidden mechanisms of nature which have yet been made by the intellect of man.

An age of progress such as this has made wireless telegraphy possible. Its basic principles are established in the very nature of electricity itself. Its evolution has placed another great force of nature at our disposal.

The phenomena of electo-magnetic induction, which was chiefly revealed to us by the researches and discoveries of Ampère, Faraday and Henry, had long since shown how it was possible for the transmission of electrical energy to occur across a small space between a conductor traversed by a variable current and another conductor placed near it; but the fact that waves of electrical energy could be created in space was not realized until Hertz proved experimentally in 1887 the correctness of the dynamical theory of the electromagnetic field enunciated by Maxwell in 1864.

I shall not take up your time in explaining what is now well known to the majority of engineers, as to the method used for producing waves by early experimenters. I will, however, mention that Hertz first clearly demonstrated that if two metallic bodies are charged with opposite electricity and then suddenly discharged, high frequency oscillations are set up in the two bodies or plates, and as a result energy in the form of electric waves is transmitted or radiated into space.

These waves were demonstrated by Hertz and others to follow the laws of refraction, polarization, etc., in the same manner as the waves of light. The length of the electric waves used in wireless telegraphy is, however, very great in comparison with that of light waves, and the former, therefore, although invisible to the human eye, have the advantage over light of not being absorbed by fog or mists, and of being able to go through or round obstacles which stop the propagation of light

With the apparatus available up to 1895 it had been possible to detect the effects of electric waves over only very short distances—not more than a few hundred yards—hardly further, in fact, than the space over which one can make oneself heard by shouting. It is, therefore, not surprising that the useful application of these waves to actual telegraphy was not then attempted, or I might say, even realized.

In August, 1895, I discovered a new system which enormously increased the distance over which one could transmit and detect electric waves, and which at once removed the limitations besetting the transmission and detection of electric waves over long distances.

The interference of obstacles began to disappear and by means of suitable transmitters and receivers capable of being worked, not simply as laboratory apparatus, but as real and efficient telegraph instruments, the range over which one could telegraph was increased at a surprising rate.

The apparatus with which I carried

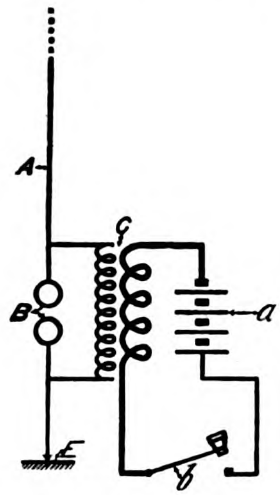


Fig. 1.

out my first tests in 1895 and 1896, and which embodies the principle upon which practical wireless telegraphy is now worked, is shown in diagrams Nos. 1 and 2, No. 1 showing the transmitter and No. 2 the receiver.

The main feature of the system consists in the use of elevated capacity aerials or vertical wires, attached to one pole of high frequency oscillator and receiver, the other pole of which is grounded. In other words, the earth is made to be part of the oscillating system.

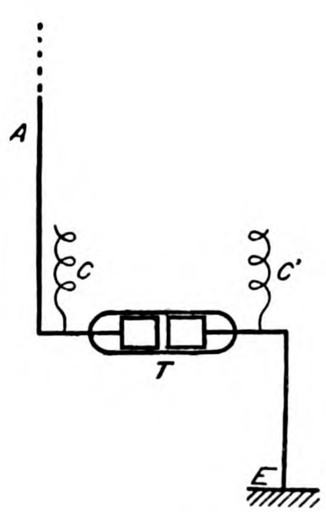


Fig. 2.

The practical value of this innovation was not understood by many physicists for quite a considerable period, and the results which I obtained were by many erroneously considered simply due to efficiency in details of construction of the receiver, and to the employment of large amounts of energy in the transmitter; others did not overlook the fact that a radical change had been introduced by making these elevated capacities and the earth form part of the high frequency oscillators and receivers.

Professor Ascoli, of Rome, gave a very interesting theory of the mode of operation of my transmitters and receivers in the "Elettricista" (Rome, 1897), in which he correctly attributed the results obtained to the use of elevated wires or antennae.

Prof. A. Slaby, of Charlottenburg, after witnessing my tests in England in 1897, came to a somewhat similar conclusion.*

Many technical writers have stated that an elevated capacity at the top of the vertical wire is unnecessary. This is true if the length or height of the wire is made sufficiently great; but as this height may be much smaller for a given distance if a capacity area is used, it is more economical to use such capacities, which now generally consist of a number of wires spreading out from the top of the vertical wire.

I am glad to see my early views of fifteen years ago confirmed so recently as last month, in *The Electrician,* of London, which reproduces an article by L. W. Austin, director of the United States Naval Wireless Laboratories. The latter, in referring to some quantative experiments in long-distance radio-telegraphy carried out with the United States cruisers *Birmingham* and *Salem,* states: "The experiments also indicate that for the greatest efficiency of a flat-top antennae the vertical lead wires should be bunched so as to reduce their capacity as much as possible, and concentrate the capacity at the greatest height."

*See A. Slaby "Die Funkel Telegraphie," Berlin, 1897, Verlag von Leonard Sinuon. Also A. Slaby—"The New Telegraphy." *The Century Magazine,* April, 1898, vol. 55, p. 867.

The transmitter (1) works as follows:

When the key is pressed, high tension current is allowed to charge the vertical wire or aerial which when discharging across the sphere causes a rapid succession of sparks to pass across the spark gap.

The sudden release caused by the spark discharge, of electrical strain or displacement created along the lines of electrical force through space by the charged wires, throws off into space a large amount of energy in the form of a displacement wave in the ether, and, as a consequence, the vertical wire becomes a radiator of electric waves. It is easy to understand how, by pressing the telegraphic key which controls the charging current for longer or shorter intervals, it is possible to emit a long or short succession or series of waves which, when they reach a suitable receiver, will induce in it minute sympathetic currents for corresponding long or short periods, and in this manner faithfully reproduce the Morse or other signs transmitted from the sending station.

It is well known that the rapid electrical oscillations in the wire produce two effects in external space, called respectively electric and magnetic force. In the case of a simple vertical air wire the magnetic force is distributed along concentric lines embracing the wire, while the electric force is distributed along certain looped lines in the plane of the wire. As the currents in the air wire reverse their direction the magnetic and electric forces in space also reverse, but not everywhere at the same moment.

The magnetic and electric forces are affections or states of the ether, and in virtue of the inertia or elasticity of the medium they are propagated from point to point with a definite velocity which is the same as that of light.

We can explore the field near the air wire or antennae by means of a neon glow tube, which becomes illuminated when held in the electric field. by means of an antennae which for the necessities of space has been made spiral wound, it is here possible to show whether the same is excited to its fundamental or to a harmonic.

The receiver (Fig. 2) also consists of an air wire connected to ground through some form of detector, which makes it possible to detect by means of a telephone, or record by an ordinary telegraph instrument, the effects of the minute currents induced in the receiver by the action of the waves transmitted to it by the sender.

Although the transmitter to which I have referred in Fig. 1, has extraordinary efficiency in regard to the radiation of electrical current, it has numerous drawbacks. The electrical capacity of the system is very small, with the result that the small amount of energy in the aerial is thrown into space in an exceedingly short period of time. In other words, the energy, instead of giving rise to a train of waves, is all dissipated after only a few oscillations, and, consequently, anything approaching good tuning between the transmitter and receiver is found to be unobtainable in practice.

A straight rod in which electrical oscillations are set up forms, as is well known, a very good radiator of electrical waves. In all, what we call good radiators electrical oscillations set up by the ordinary spark discharge method cease or are damped out very rapidly, not necessarily by resistance, but by electrical radiation removing the energy in the form of electrical waves.

It is also a well-known fact that when one of two tuning forks having the same period of vibration, is set in motion, waves will form in the air; and the other tuning fork, if in suitable proximity, will immediately begin to vibrate in unison with the first. In the same way a violin player sounding a note on his instrument will find a response from a certain wire in a piano near by; that particular wire, out of all the wires of the piano, happening to be the only one which has a period of vibration identical with that of the musical note sounded by the violinist. Tuning forks and violins, of course, have to do with air waves, and wireless telegraphy with ether waves, but the action in both cases is similar.

It is very important to take into consideration the one essential condition which must be obtained in order that a well-marked tuning or electrical resonance may take place. Electrical resonance, like mechanical resonance, essentially depends upon the accumulated effect of a large number of small impulses properly timed. Tuning can only be obtained if a sufficient number of these timed electrical impulses reach the receiver. For to set a pendulum in vibration by small taps, we must not only time the taps properly, but keep on tapping for a considerable period. It is, therefore, clear that a dead beat radiator, i. e., one that does not give a train or succession of electrical oscillations, is not suitable for tuned or syntonic telegraphy.

In 1900, I first put into practice the arrangement which is now in general use, and which consists (as shown in Fig. 3) of the inductive association of the elevated radiating wire with a condenser circuit which may be used to store a large amount of electrical energy and impart it at a slow rate to the radiating wire.

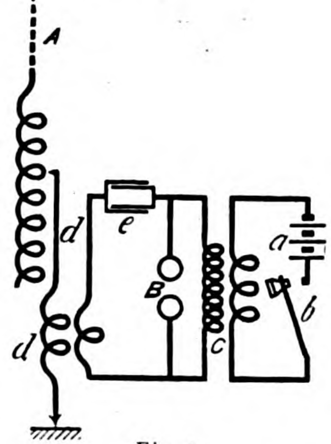


Fig. 3.

As is now well known the oscillations in a condenser circuit which were studied so profoundly by Franklin, Henry, Faraday, Maxwell and Kelvin, can be made to persist for what is electrically a long period of time, and it can be arranged, moreover, that by means of suitable aerials or antennae, these oscillations are radiated into space in the form of a series of waves, which, through their cumulative effect, are eminently suitable for enabling good tuning or syntony to be obtained between the transmitter and receiver.

The circuits, consisting of the condenser circuit and the elevated aerial or radiating circuit, were more or less closely coupled to each other. By adjusting the inductance in the elevated conductor and by the employment of the right value of capacity or inductance required in the condenser circuit, the two circuits were brought into electrical resonance, a condition which I first pointed out as being essential in order to obtain efficient radiation and good tuning.

The almost universal practice at present is to induce high frequency oscillations in the air wire, or antennae by means of a reservoir condenser circuit coupled with it, in which the electrical oscillations are excited and maintained by means of a spark or arc. If the spark method be used, then the condenser is one of relatively large capacity and the induction is kept small.

Taking the capacity in electro-static units and the inductance in electromagnetic units, the ratio of capacity to inductance may be something of the order of five to one, or even twenty to one.

As I have explained before, the oscillations are set up in the air wire by coupling in inductively with the condenser circuit. If an ordinary form of oscillation transformer is used consisting of two coils, one coil being inserted in the condenser circuit, the other one in the radiating air wire circuit, according to how much these circuits are near or far apart, or constituted of a greater or lesser number of terms in respect to the remainder of the circuit, they are said to be closely or loosely coupled.

These two circuits are tuned so as to have approximately the same natural period of electrical oscillation. They then—like tuning forks—have been adjusted in syntony. It is well known that when using an ordinary spark discharge in the primary circuit, unless weak coupling is employed, the oscillations set up in one circuit create oscillations of two frequencies in both circuits. This has the disadvantage that the radiated energy becomes divided between two waves of different length, and if the receiver is tuned to only one of these wave lengths, it will utilize or absorb only part of the energy reaching the receiver—the energy of the other wave being lost.

With the new disc transmitters, which are utilized in my long-distance stations, or by the method of quenched sparks, investigated by Professor Max Wien, of Dantzig, it is possible by interrupting or quenching the spark in the condenser circuit at the right moment, to open the primary circuit and thereby render it incapable of oscillating by means of energy which would otherwise be retransferred to it by the antennae of the radiative circuit, and in this manner prevent the inter-action of the two circuits which is the condition causing the production of two waves, and consequent waste of energy.

The receiver (as shown in Fig. 4) also consists of an elevated conductor or aerial, connected to earth or capacity, through an oscillating transformer. The latter also contains the condenser and detector, the circuits being made to have approximately the same electrical time period as those of the transmitter circuits.

It is also possible to couple to one sending conductor several differently tuned transmitters and to a receiving wire a number of corresponding receivers, each individual receiver responding only to the radiations of the transmitter with which it is in resonance.

When, thirteen years ago, communication was first established by means of wireless telegraphy between England and France, over a distance of thirty miles, much discussion and speculation took place as to whether or not wireless would be practicable for much longer distances than those then covered, and a somewhat general opinion seemed to prevail that the curvature of the earth would be an insurmountable obstacle to long-distance transmission, in the same way as it was and is an obstacle to signaling over considerable distances by means of light flashes. Difficulties were also expected as to the possibility of preventing mutual interference with short-distance stations, and also in regard to the practical control of the large amount of energy necessary to cover long distances.

What often happens in pioneer work repeated itself in the case of radiotelegraphy. Supposed obstacles or difficulties were often purely imaginary, or else easily surmounted; but in their place unexpected barriers manifested themselves; and recent work has been mainly directed to the solution of problems presented by difficulties which were certainly neither expected nor anticipated when long distances were first attempted.

In January, 1901, I carried out some successful experiments between two points on the south coast of England, 186 miles apart, namely, St. Catherine's Point, in the Isle of Wight and the Lizard in Cornwall. The total height of these stations above sea level was only a fraction of what would have been necessary to clear the curvature of the earth. The results obtained from these tests, which at the time constituted a record distance, seemed to indicate that electric waves would most probably be able to make their way round the curvature of the earth, and that therefore even at greater distances—such as those dividing America and Europe, the fact of the earth's curva-

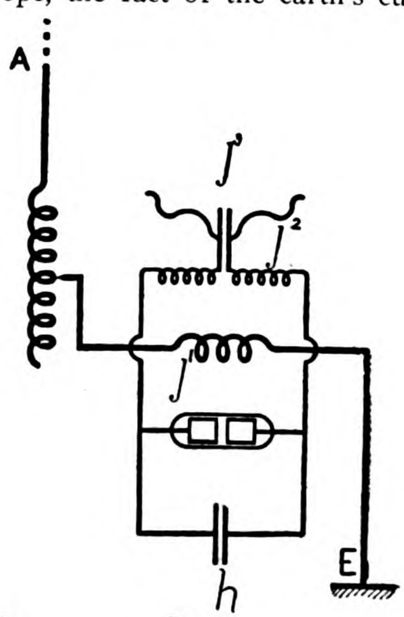


Fig. 4.

ture would not constitute an insurmountable barrier to the extension of telegraphy through space.

The belief that the curvature of the earth would not stop the propagation of the waves and the success obtained by syntonic methods in preventing mutual interference, led me in 1900 to decide to attempt the experiment of proving whether or not it would be possible to detect electric waves over such a distance as 2,000 miles.

The experiment was, in my opinion,

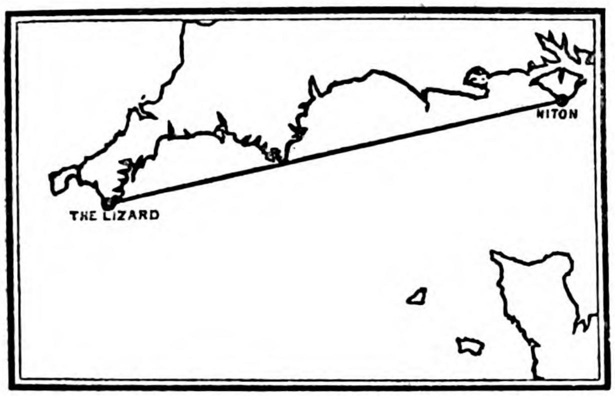


Fig. 5.

of great importance from a scientific point of view, and I was convinced that the discovery of the possibility of transmitting electric waves across the Atlantic Ocean and the exact knowledge of the real conditions under which telegraphy over long distances could be carried out, would do much to improve our understanding of the phenomena connected with electric wave transmission.

The transmitter erected at Poldhu on the coast of England was similar in principle to the one I have already referred to, but on a very much larger scale than anything previously attempted. The power of the generating plant was about 25 kilowatts.

Numerous difficulties were encountered in radiating and controlling for the first time electrical oscillations of such power.

My previous tests had convinced me that when endeavoring to extend the distance of communication it was not merely sufficient to augment the power of the electrical energy of the sender, but that it was also necessary to increase the area, or height of the transmitting and receiving elevated conductors.

As it would have been too expensive to use vertical wires of very great height, the only alternative was to increase their size or capacity, which, in view of the facts I had noticed in 1895, seemed likely to make possible the efficient utilization of large amounts of energy.

The transmitting elevated conductor employed at Poldhu during the experiments with Newfoundland, consisted of fifty almost vertical copper wires, supported at the top by a horizontal wire stretched between two masts 48 meters high and 60 meters apart. These wires converge together at the lower end in the shape of a large fan, and were connected to the transmitting instruments which were placed in a building. (Fig. 6.)

Tests were commenced by myself early in December, 1901, at a tempor-

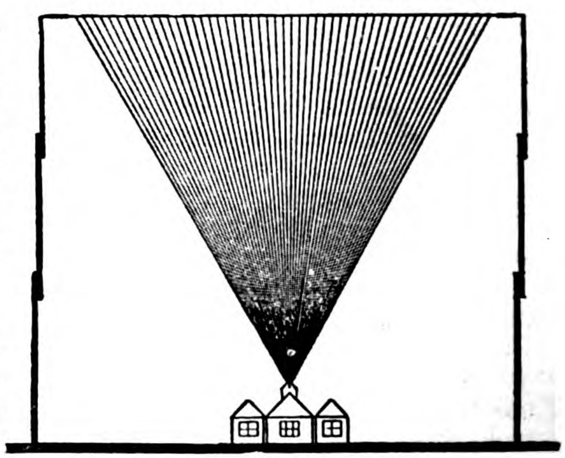


Fig. 6.

ary receiving station erected at St. Johns, Newfoundland, and on the 12th of that month the signals transmitted from England and chiefly consisting of repetitions of the letter "S" were clearly and distinctly received by myself and my assistants in Newfoundland.

(*To be continued in the January issue.*)