THE MARCONIGRAPH

An Illustrated Monthly Magazine of
WIRELESS TELEGRAPHY

EDITED BY J. ANDREW WHITE

Volume 1. JUNE, 1913 No. 9

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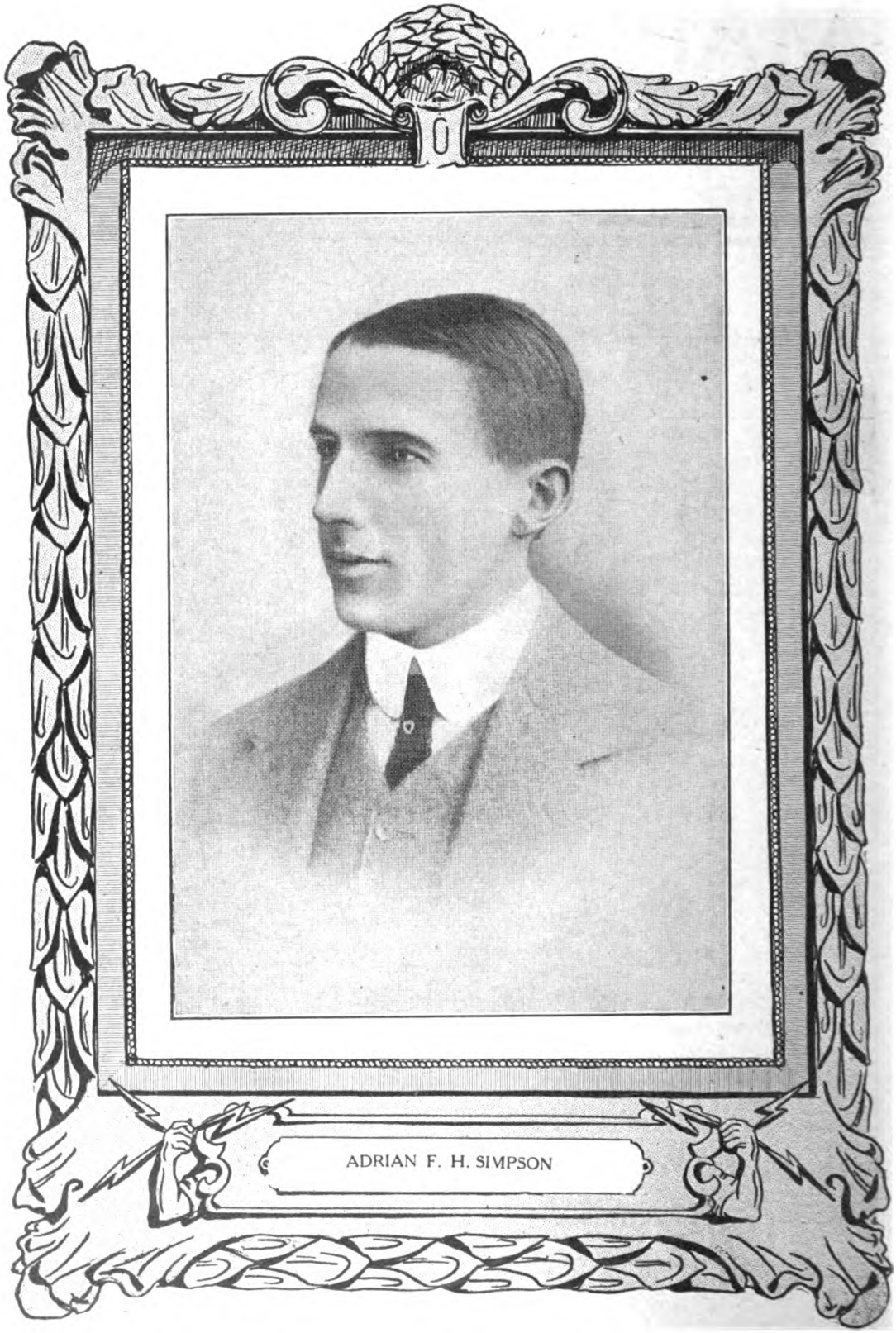
ISSUED MONTHLY BY MARCONI PUBLISHING CORP'N. 456 FOURTH AVE., N. Y. CITY
YEARLY SUBSCRIPTION. $1.00 IN THE U. S.-$1.35 OUTSIDE THE U. S.: SINGLE COPIES, 10c.

Entered as second class matter at the Post Office, New York



ADRIAN F. H. SIMPSON

THE MARCONIGRAPH

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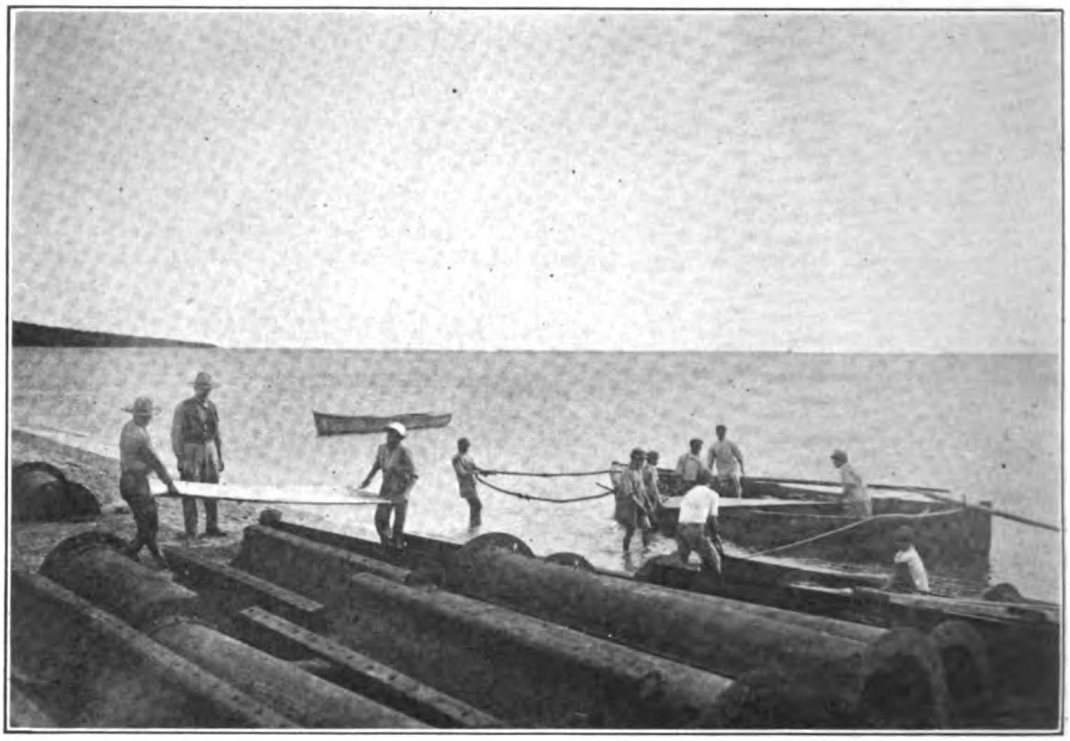
Vol.I. June, 1913 No. 9

THE words used by Vallentine about Proteus, "His years but young; his experience old," may fittingly be applied to the subject of our sketch this month—one of the young but brilliant coterie of co-adjutors which the outstanding genius and magnetic personality of Mr. Marconi have gathered with irresistible force round the throne of his mighty discoveries.

Adrian F. H. Simpson, managing director of the Russian Company of Wireless Telegraphy and Telephony, is a son of Surgeon-General Sir Benjamin Simpson, K. C. I. E., and was born in Edinburgh in 1880. His early years were passed amid the cultured and inspiring influences of his native city, where he attended Clifton College and, later, the Royal Military College. Shortly after the outbreak of the South African War he gained a commission in the British Army, being gazetted to the Thirty-first East Surrey Regiment, then stationed at Lucknow. After a short service with this regiment he joined the Hyderabad contingent of the Indian Army. This step marked the opening of a varied and interesting career, which brought Mr. Simpson in touch with life in several countries and considerably enlarged his experience in dealings with men and the handling of affairs. He served first of all in the Bengal, Bombay, and Madras Residences; afterwards he was placed in command of a detachment of native troops in charge of one of the large camps in which were housed the Boer prisoners captured in the South African War; later he served on plague duty in Central India. He went to Russia in 1903 in order to learn that difficult language, and so proficient did he become in this subject that in the examinations for interpretership in the army he gained the highest possible degree. Moreover, he obtained Government awards for proficiency in Persian and Hindustani, and to the linguistic laurels which he gained, by sheer merit and ability, must be added a knowledge of French. Mr. Simpson spent two years in Russia, and during that time he travelled extensively, his travels taking him from the Arctic circle to the Persian frontier. Indeed, the all-pervading *wanderlust* of the modern Anglo-Saxon seems to have absorbed him, for at various times he travelled in Cashmir, Finland, Norway, Sweden, Denmark, India, Russia, and elsewhere. In 1904, when the Armenian troubles were prevalent in the Caucasus, he succeeded in safely carrying the "Foreign Office Bag" from St. Petersburg to Teheran.

Leaving the service in order to make a thorough study of wireless telegraphy, Mr. Simpson commenced work with the English De Forest Wireless Telegraph Syndicate, Ltd., and continued afterwards with the Amalgamated Radio-Telegraph Co., Ltd. (owning the Poulsen patents). During his service with the last-named company he obtained an excellent opportunity, of which he took full advantage, to study wireless telegraphy, not only as practised in England, but also on the Continent, where he spent considerable time in Berlin and Copenhagen, becoming subsequently associated with the Lepel Wireless Telegraph Co., Ltd. Mr. Simpson's connection with Marconi's Wireless Telegraph Co., Ltd., commenced with the field station department, but on the formation of the Russian Company of Wireless Telegraphy and Telephony he was appointed managing director of that company. His unique experience, his commercial and technical attainments, his extensive travels, his linguistic ability, and, last, but by no means least, his knowledge of the language and people of that interesting country, encourage highest hopes for the success of his new enterprise, which all who know his kind and courtly nature, and his sound judgment and energy, are confident of seeing the happy realization.



Landing material on the beach at Koko Head.

Some Details of the New High-Power Stations

THE wireless girdle of the world is now to be a reality. The Marconi Company is building a chain of stations for commercial work that will link the great nations of the globe and bring them closer than is possible with any other means of communication. From London to New Jersey, from San Francisco to Honolulu, from Honolulu to Yokohama, from Yokohama to India, from India to Egypt, and from Egypt to London the messages will fly both night and day in their course around the world.

As links in this stupendous chain the American Marconi Company is now building three high-power stations in this country which will be larger and more powerful than any wireless stations in the world at present. This high power apparatus will insure perfect communication under the most adverse weather conditions during both day and night service. It is well known that it is possible to maintain communication at night with a very much less expenditure of power than in daytime, and that the same power apparatus will transmit messages over a much greater range at night.

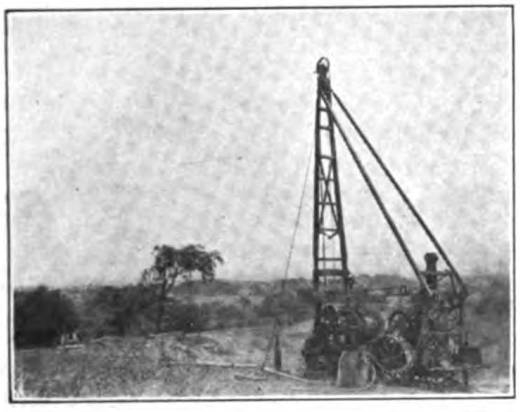
The stations are all being built duplex, that is, the transmitting and receiving apparatus are located some distance from each other, and with a definite directional relation so that signals can be transmitted and received at the same time, which obviates shutting down the transmitting apparatus while receiving from a distant station, thus doubling the capacity of each station. Each sending station is being equipped with two alternators and all machinery and electrical apparatus is to be in duplicate, so that in case of accident to any machine a spare one is at once available.

The general scheme is to have every station work at a separate wave length and frequency, differing sufficiently from all other stations to eliminate all

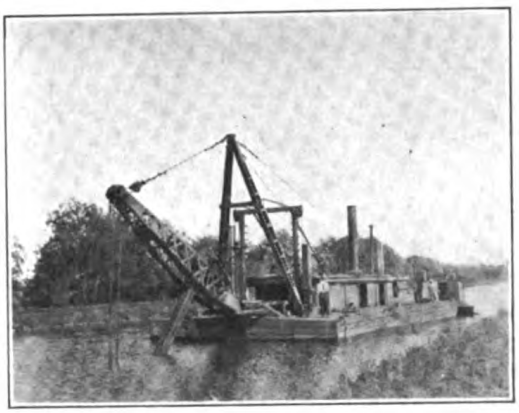
possibility of interference. Because these stations will work only with each other and not with any ship or small land station the wave lengths selected are much greater than it is customary to use.

The New Jersey station will work only with the station near London and the sites selected for the transmitting and receiving stations are so chosen that a line connecting them is at right angles to the great circle of the globe running through them and those in England. One of the distinctive features of these installations is that the antennae are directional, that is, the radiation sent out in the desired direction will be very much stronger than in any other direction. This result is accomplished by running the longest wires of the antennæ or aerial parallel to the earth and in the direction of transmission, and at a height sufficient to be unaffected by local earth disturbances. The aerial wires are brought down to ground at the power house end; that is, the end nearest the English station. This arrangement constitutes the Marconi system of directional transmission.

The receiving aerial consists of two wires mounted on high towers and pointing toward the station from which the messages are to be received; at the nearest end the wires are brought down to the receiving or operating house. Both of the New Jersey stations, for example, have their aerials pointing toward England, the best direction for



Wells are being sunk for the water supply.



Dredging the canal adjoining the New Jersey transmitting station.

transmission and reception of the energy, and are thus approximately parallel to each other; or in the poorest arrangement for the New Jersey receiving aerial to absorb energy from the New Jersey transmitting aerial. The receiving apparatus is tuned to the wave length of the English station, which differs greatly from the New Jersey transmitted wave. Besides this excellent arrangement there is a further precaution taken to prevent the transmitted energy from interfering with the receiving apparatus. A balancing aerial is added to the receiving antennae and at right angles to it at the operating house end, together forming a T-shaped aerial. This balancing aerial points toward the transmitting station or in the best direction to receive and absorb whatever waves are emitted at right angles from the transmitting station, and is arranged to absorb and destroy a large proportion of the small amount of energy that would otherwise be taken up by the main receiving aerial and cause interference with the messages from the English station.

High speed automatic transmitters will be used with a capacity of from 60 to 80 words a minute. The receiving will also be done automatically by photographing the received wave on sensitized paper strip, thus affording a permanent record of all messages. Although the stations are located twenty or more miles apart, the operating will all be done at the receiving sta-

tion by use of a telegraph line working, through an automatic relay, the main high power transmitting keys at the sending stations.

The American stations are to be located as follows:

In New Jersey the transmitting station is being built near New Brunswick on the banks of the Raritan River and the receiving station near Belmar at the head of the Shark River. In California the transmitting station will be at Bolinas Point, just north of San Francisco, with its receiving station at Tomales Bay, about twenty-five miles further north. At Honolulu the transmitting station will be located at the northern end of the Island of Oahu and its receiving station on the southern end of the island.

Rapid progress is being made with the excavations for the transmitting station at New Brunswick.

At each transmitting station two especially designed Crocker-Wheeler alternators, 2000 volt, single phase, 300 K. V. A. each are to be used; in New Jersey and California these are to be driven by 500 h. p. synchronous motors, 440 volt, three phase; at Honolulu by 500 h. p. De Laval geared turbines. In each case the power plant conforms to the very best American practice and no expense is being spared to make the operation most reliable and efficient. Efficiency is especially important in Honolulu, where all fuel must be shipped from the coast; here Babcock & Wilcox oil fired boilers will deliver highly, superheated steam to the turbines. The two auxiliary generators are to be driven by 100 h. p. Terry turbines direct connected to Crocker-Wheeler D. C. 125 volt generators. This current is used for exciting the alternators, for lighting, for blowers and all other auxiliaries.

The New Jersey transmitting station at New Brunswick will have thirteen towers 435 feet high, supporting silicio bronze aerial wires of great length. The towers are made up of half cylinders, flanged vertically and at the ends bolted together, as erection proceeds, to form a tubular mast. These towers are stayed by plough steel cable one inch in diameter. It is necessary to break up every cable with insulators so that no length will be long enough to have a natural vibration period corresponding to that of the wave of transmitted energy for should that occur much of the energy would be absorbed by the guys and lost to any practical work. The length

of aerials and arrangement of the wireless apparatus in this station are designed to work at long wave length. The alternators deliver single phase current at 2000 volts stepped up to 20,000 volts, which is the condenser charging voltage. The condenser is a bank of 384 tanks.

The Marconi disc discharger mounted on the end of the alternator shaft will work in synchronism with the alternator and take the place of the vibrator and spark gap used on small sets.

The San Francisco stations follow the same general outline as the New Jersey stations except that the wave length is shorter and the transmitting aerial, about half the length used in New Jersey, is mounted on eight 335 foot towers, and the receiving aerial is mounted on seven 335 foot towers. As a shorter wave length is to be used it will only be necessary to have condensers with a capacity of 270 tanks.

At Honolulu a two-way station is being erected; one side to work with San Francisco and the other with Yokohama. This requires a double set of aerials, one pointing toward San Francisco and the other toward Yokohama. The aerials to work with San Francisco will be mounted at the top of towers 335 feet high. The part of the station to work with Yokohama will be mounted on 14 towers 480 feet high. The receiving aerial will be carried by six towers 480 feet high.

Operators Strike Off

The strike of the wireless operators was officially declared off by the Commercial Telegraphers' Union on June 5th.

The officials of the Marconi Wireless Telegraph Company of America state that the strike was engineered by agitators working in their own interests and that there was no complaint from any operator in regard to wages, hours or anything else in connection with the service.

The statement recently given out by the Commercial Telegraphers' Union that the Wireless Operators in the Atlantic Coast Division had voted unanimously for a strike is without the slightest foundation of truth. Dependable inside information discloses the fact that the local organizer, notwithstanding his most earnest endeavors to entice the wireless operators into joining the Union, received but four applications for membership.

The North Wales Stations

The English Marconi Company reports good progress at the North Wales stations. Excavations for all the mast and stay foundations have been completed and the rope haulage railway required by the mountainous site is practically completed. A large crushing machine and mixer has been installed and the mixing of concrete for the foundations of masts and stays has commenced.

The large brick building for the transmitting station at Ceunant (or Cefndu), is now under construction; the contractors expect to have the roof on by the middle of June, and the building completed by the middle of July.

The greater portion of the machinery and apparatus will be delivered by the first of August, and the station should be completed and in running order by the beginning of October.

At the receiving station temporary receiving buildings have been constructed and receivers installed, advantage having been taken of the mountainous site to fix a receiving aerial supported on high telegraph poles. A receiving expert has been sent to Towyn Receiving Station to check the strength of the signals as received from Glace Bay. It is anticipated that with this mountain aerial the signals will be sufficiently strong and the receiving aerial suspended from high masts, may be dispensed with. Should this not be found possible, however, the receiving masts will easily be completed before the end of August. The permanent receiving buildings at Towyn Station are also in the course of construction, and will be completed before the end of August.

THE IMPERIAL CONTRACT

The Technical Committee's Report and Mr. Marconi's Evidence

FURTHER details have been received from London on the report of the technical committee appointed by the British Postmaster General in the investigation of the Marconi agreement.

The May issue of THE MARCONIGRAPH contained the substance of this report from a wireless dispatch received just as we were going to press. The overwhelming victory won by the Marconi system over others is more fully revealed in the following extracts from the complete report:

"The only continuous high frequency generator we have yet seen tried with success over long distances is the Marconi high frequency machine, to which we have already referred. For the purpose of witnessing Transatlantic experiments with these machines we paid a second visit to Clifden and experiments were made with it in our presence. Using it, Mr. Marconi, on the 26th and 27th of April, 1913, sent from Clifden to Glace Bay messages prepared by us for the purpose, such messages being at our request at once repeated from Glace Bay by means of the company's ordinary plant and correctly received at Clifden. The power put into the aerial by this machine for the purpose of the experiments was not sufficient for commercial purposes, but there seems no reason why higher power should not be obtained."

Report on Poulsen

It will be remembered that the testimony of Godfrey Isaacs brought out the fact that there had been a well defined plan on the part of certain Unionist members of Parliament to discredit the Marconi contract to such an extent that it could not be accepted, with the result that another contract might be drawn with the Poulsen interests. Here is the result of the technical committee's investigation of Poulsen's operations:

"With reference to the Poulsen system we are satisfied that is practicable for short distances. The Poulsen arc has been tried between San Francisco and Honolulu, a distance of about 2,100 miles, but as to practicability over this distance we have no evidence except that which was in the possession of the Post Office long before our appointment. The result obtained did not appear to have been very satisfactory in our opinion. The power used was insufficient. No one tendered any evidence on behalf of the company which is working between San Francisco and Honolulu and the firm controlling the system in this country was comparatively in ignorance of how it is now working in America. We have recently been informed of important experiments between Arlington and the U. S. S. *Salem* and between Arlington and Gibraltar, using both the arc and spark transmission, but full details are not yet before us. We conclude that if the Poulsen system is to be so developed as to be practicable for commercial purposes over distances of 2,000 miles or upwards, the arc will have to be constructed so as to supply the aerial with higher power or use will have to be made of a more sensitive receiver."

In our previous article mention was made of conclusions of the committee after full examination of Marconi, Telefunken, Poulsen, Goldschmidt and Galleti systems; that the Marconi system was at present the only one of which it could be said with any certainty was capable of fulfilling the requirements of the Imperial Chain, but that this statement did not imply that the Marconi Company must necessarily be employed as contractors for all the work. The committee thought that in some respects it might be better for the

Government to undertake the construction and the equipment of the stations under the direction of the best technical staff obtainable and through employing contractors for the various portions of the work. In the full report this statement is qualified thus:

"On the other hand, it may be said and is no doubt the fact, that at the present moment the Marconi Company alone has had practical experience of the sort of long distance work required, including experience in putting down stations, in organizing the traffic and staff, and in coping with the difficulties that arise in a new industry; and the value of such experience and organization may well outweigh other considerations if rapid installation and immediate and trustworthy communication be desired."

Directive Aerial Upheld

Another important point made was: "The directive aerial used in the Marconi system has the advantage of not requiring very great height and of giving preference in the desired direction. Its use in connection with the separate receiving station comparatively close to the transmitting aerial makes duplex working practicable. We see no reason why this form of aerial should not be capable of use with any form of high frequency generator; moreover, the development of the aerial may facilitate the use of still longer waves for long distance work, and this may profoundly affect the problem of the high frequency generator by rendering possible the employment of simple alternators for the production of the frequency required, high though it must still be."

Taken as a whole, the technical committee's report conclusively proves that there was little, if any, reason for the repeated attacks made for the purpose of discrediting the Marconi system.

The evidence of Mr. Marconi, given about a week later before the Select Committee of the House of Commons, has now been made public and for the first time Americans will have the opportunity to judge for themselves just how deliberate and malicious were the onslaughts of the alleged "experts" testifying in behalf of the opposition faction.

Mr. Marconi's Evidence

Mr. Marconi's evidence opened with a résumé of his professional career and early wireless experiments, up to the time when his famous patent, No. 7777, was granted. After stating that the validity of this patent had been upheld by the courts of England, America, and France, Mr. Marconi said:

"By this invention I demonstrated that it was possible to transmit or receive two or three messages simultaneously on the same aerial without mutual interference.

"In 1900 I demonstrated this to the British Admiralty. It is, therefore, wrong and improper for a witness to have stated upon oath before this committee that this constitutes a recent invention and an advantage over others."

Before commencing an exhaustive description of the most important of the tests which determined many vital issues in long distance communication, Mr. Marconi stated:

"I would like the committee to know that all the distances referred to by me in my evidence are measured in sea miles, with some exceptions which I shall mention. In passing I would draw the committee's attention to the fact that many of the distances between certain points already stated by former witnesses to this committee must have been given without any attempt at verification, and are wrong in nearly every instance—that is, they are greatly overestimated where they are mentioned in connection with other systems and under-estimated when dealing with the Marconi system.

Distances Verified

"Distances are one of the few things on which there should be no mistake or misunderstanding, as they, at any rate, can be reliably measured. The distances I will refer to in my evidence have been measured by me and my figures confirmed by both a sea captain and an ex-lieutenant in the Royal Navy."

Considerable emphasis was laid by the witness on the thoroughness of the experimental work which has made possible the present-day continuous long distance communication by the Marconi system, as compared with the occasional working of other systems.

Newspaper Reports Misleading

Very often it is reported in the newspapers that some system other than the Marconi has *established* communication over a long distance, where if the truth was known, these reports generally originate in some single message which has managed to span a considerable distance. Mr. Marconi mentioned that although he "had communicated between this country (England) and New Foundland in the daytime, as early as 1901, I did not claim to have mastered the difficulties of long distance communication in daylight, for I had already learned sufficient of the varying conditions to satisfy me that an occasional successful communication was but an elementary stage. . . . Under favorable conditions (1902) it was found possible to transmit messages at night time to Poldhu, 2,669 miles away, with an expenditure of only about 5 kw."

The importance of the technical committee's report on the Marconi directive aerial, appearing earlier in the article, is shown in the following extract from the inventor's evidence:

"In 1905 my experience had led me to patent and introduce the horizontal directional aerial, which at once brought about the most marked improvement in the strength of signals. It is from this point and by this new discovery that real progress in long distance work has dated.

"It would be interesting here to note that Dr. Austin, who has already been mentioned in evidence as the wireless expert of the United States Navy, in the *Journal* of the Washington Academy of Science, March 4th, 1912, pages 111 and 112, stated that in measuring the strength of signals received during daytime at Brant Rock, near Boston, from our wireless station at Clifden, a distance of 2,456 miles, he would have been led to believe that if the bases for his calculations were correct, the effective power used for the transmission of these signals must represent 660 kw. The fact, however, is that at no time have more than a 150 kw. been used at Clifden. Dr. Austin, however, very rightly came to the conclusion that if his assumptions were correct, the bent antenna at Clifden must show decided directive effect. The Advisory Committee has appreciated some of the advantages of this directional aerial.

"This invention enabled me for the first time to transmit over short distances and receive over long distances without masts, the horizontal wires being laid upon the ground.

"The mastless method has not yet, however, proved efficient for commercial work, but I used it for war purposes in Tripoli. Sir G. Croyden Marks having read of some experiments of this nature lately, has supposed that they constituted a new discovery.

Importance of Directional Aerial

"The horizontal form of aerial has been criticised by some of the witnesses before this Committee. I think that I should explain that up to 1906 I had always used vertical aerials and what are called umbrella aerials, which were then supposed to be the principal feature of what was known as my system, and were covered by my patents. These older aerials, which are still used at my short-distance stations, have now been generally adopted, and are used by Poulsen and others.

"I have, however, satisfied myself that however effective this class of aerial proves for my short-distance work, the directional horizontal aerial which I have subsequently introduced is a great step in advance in long-distance work."

A great deal is heard of the advantages of continuous wave systems over the method employed by the Marconi Company and it has even been stated on numerous occasions that Mr. Marconi has purposely neglected to investigate and experiment with this method

of communication. Our readers will recall that we have repeatedly denied these allegations and should be particularly interested in the following portion of the evidence:

Intermittent Waves Best

"During 1907 I patented and developed a system for producing and utilizing continuous waves, and a long series of tests were carried out at Poldhu and other places to ascertain whether it would be best to adopt continuous waves or discontinuous waves for commercial long-distance work. The result of these tests showed that the efficiency of continuous or discontinuous waves in respect to the power employed was about equal, but the discontinuous waves or intermittent waves, radiated and received in the special manner which I had devised, proved conclusively that they possessed the advantage of being far less interfered with by other stations or atmospheric disturbances. For this reason we adopted discontinuous waves for the long-distance stations which my company was erecting in Ireland, Italy and Canada. I should, however, like to make it clear that the system of the intermittent waves adopted at Clifden and Glace Bay is by no means the ordinary spark method of 'spasmodic impulses, as referred to by Mr. Taylor, and it is surprising to me that one who should give evidence as an expert should so expose his complete ignorance of anything but elementary wireless telegraphy. Without going too much into the technical matters, I may say that the high-speed disc dischargers which I patented in 1907 are one of the notable features of these stations, and possess the following advantages:—

"1. They cause to be radiated trains or groups of electrical waves of low damping, which groups, in consequence of their high frequency and regularity, produce a clear musical note at the receiving end, which is easily distinguishable from the noises or notes produced by other stations or by the effects of free atmospheric electricity.

"2. Due to their high frequency and regularity, they also enable the employment of high-speed senders and receivers, just as can be done by continuous waves.

"3. The spark gap is closed, and for all practicable purposes eliminated during most of the time in which one wishes to transfer the energy to the aerial.

"4. The primary circuit being suddenly opened, immediately quenches any further oscillations in the condenser circuit and prevents the reaction referred to by a witness, and which takes place under certain conditions between the aerial and the condenser circuit when the ordinary spark method is employed, with the result that by my disc system, instead of two bad waves, one pure wave is radiated; but of these most important developments of my system for long-distance work neither Mr. Madge nor Mr. Taylor would appear to have any knowledge whatsoever, or if they had the knowledge they certainly abstained from mentioning it."

Land Lines Retard Delivery

After comparing the speed of transmission of cables and wireless, respectively, and showing that the most serious of the injuries which the wireless has suffered have been caused by the breakdown of the land lines between the stations and the commercial centers, and then showing that the inferiority of communication by wireless as compared with the cable was principally due to the cable systems having the advantage of running directly into New York, Mr. Marconi stated that though there were periods of two or three hours' duration during which communication is difficult, they are now of rare occurrence. "This is caused," said Mr. Marconi, "by reason of the insufficient effective power available at the Clifden and Glace Bay stations and satisfies me that my original calculations that to effectively encounter the medium at all periods during all seasons 300 kw. of effective power was needed.

"A number of interesting tests with the Clifden installation were carried out in September and October, 1910, with a view of obtaining some data as to the maximum range of that station. These tests were carried out with an Italian ship, *Principessa Mafalda,* and it was found that their messages could be obtained without difficulty by day up to a distance of 3,473 nautical miles from Clifden, the ship being then in the tropics en route for Buenos Aires. Signals were received at night from Clifden at Buenos Aires, the distance being 5,849 miles. No failures to receive at Buenos Aires at night being recorded when tests had been arranged would indicate that the night range at Clifden is greater than 5,849 miles.

Marconi Works Longest Distance

"The longest distance over which wireless telegraphy is worked regularly by day and by night is by means of stations working on a Marconi system. The Post Office and the Committee have already had, I think, some information in regard to the installations erected by the Italian Government and operating between Coltano and Massaua. The distance between Coltano and Massaua is 2,238½ nautical miles, whilst the distance between San Francisco and Honolulu, in regard to which the Committee has also had some information, is 2,078 miles. Further, it is exceedingly valuable to this inquiry to note that Massaua is well in the tropics, and that the electric waves, in passing between Coltano and Massaua, have to traverse 1,599 miles of land, mostly desert."

Proofs were then submitted showing that all during the hostilities between Italy and Turkey, the Coltano station carried out regular service by day and Italy and Turkey, Coltano station car-

Mr. Marconi next dealt with his practical experience in the wireless field, saying, "I do not think that any member of the Committee would have any doubt of the very wide practical experience I have had in the matter of wireless telegraphy. I may say, however, that I have examined and been responsible for the designs and apparatus installed on over 1,000 ships; that I arranged all the details of the wireless plant of four stations of 2,000 or more miles range—namely, Clifden, Glace Bay, Coltano, and Massaua; and at least twenty other stations in England, America, Italy, Africa, and Spain having ranges of 1,000 miles and upwards. I have crossed the Atlantic sixty times on ships fitted with wireless telegraphy, and have closely observed the working of such stations, and have also considerable experience of the working of wireless on British and other warships, the total time I have actually been embarked on warships running into years. I have also had the rather unique experience of assisting in and being in part responsible for the organization and the working of the wireless service on behalf of the Italian Government at sea and on shore during the recent war between Italy and Turkey, for which work I have just received one of the highest honors it is possible for the Italian Government to bestow. I have traveled over a large portion of the Mediterranean and north coast of Africa, during the hostilities, and one of the most important problems with which I had to deal was the elimination of interference or jamming, intentional or otherwise, which was constantly resorted to by the stations worked by the enemy and others, and in this work I was generally successful."

The Four Sevens Patent

Speaking of the four sevens patent of 1900, Mr. Marconi reviewed the important part it had played in the development of wireless, representing what was originally known as his syntonized system, which is the simple spark system found to be most efficient for ship and shore and short distance communications. It is commonly known that the system used for long distance work differs, although it also embraces, the four sevens patent. In this connection Mr. Marconi said: "This patent alone, however, would be totally ineffective for long-distance commercial service. My long-distance

system of to-day comprises a number of important patents, several of which for their purpose I believe to be as important as my four sevens patent, and these, together with my work, experience, and knowledge, combined with that of some 200 able engineers associated with my company, added to many long years of hard work and experiment, entailing an expenditure of £360,000 (about $1,800,000), which amount our long-distance experience and work have cost, constitute to my mind the right which my company had in demanding and receiving what I regard to be but very reasonable terms for the long-distance stations required by His Majesty's Government.

Contract Included Services

"In addition, however, to supplying the long-distance stations required, His Majesty's Government receives what I contend is further very valuable consideration so long as this contract remains in force, viz., the benefit of all the experience, in all parts of the world, in all climates, and in all conditions, of the 200 engineers engaged in our service, and who alone represent annual cost to my company of close upon £40,000 (about $200,000), plus the benefit of my services, advice, and inventions, for whatever they may be worth."

Expressing his gratitude for the interest and encouragement given by the Post Office authorities during his early trials, Mr. Marconi observed: "I wish, however, most emphatically to state that at no time have I ever received from the Post Office or any Government Department anything in the nature of a favor which would not have been in common courtesy afforded to any scientific worker by any Government in any other country of the world."

British Navy Uses Marconi

Then followed a very interesting synopsis of the relations of the Marconi Company with the British Government from the company's inception, including the details of legislation enacted and contracts entered into. Restricted space does not permit of giving this in full, although it would undoubtedly prove of great interest to our readers, as showing the extensive use of Marconi apparatus by the Admiralty. We consider, however, that the following observations are too important to be overlooked: "It has been stated by several of the Admiralty witnesses at this inquiry and before the Select Committee of 1907 that the Admiralty are now using a system of their own, or, at least, as Mr. Madge put it, what could be considered a development of the Marconi system.

"I am at a loss to understand on what grounds this statement can be made. For some years the Admiralty has been negotiating with us, as witnesses have testified, to obtain a consideration from us for their causing to be entered in the Berne List that the system used on the ships of His Majesty's Navy was the Marconi system. At no time, however, in the course of these negotiations was it ever stated by the Admiralty that, if we conceded what was demanded of us, the consideration to be paid to us would be anything other than that for which they were negotiating, viz.: The registration in the Berne List that the ships of His Majesty's Navy were fitted with the Marconi system. It is difficult to conceive that the Admiralty when negotiating with us to grant this concession, as they termed it, and our right, as we consider it, were offering to cause this entry to be made in the Berne List if it were not true. Further, I would say that I have on many occasions in different parts of the world, intercepted the signals transmitted from many of His Majesty's ships, and, in my judgment, there is nothing to suggest that these signals are transmitted by means in any way differing from that of our principal system, and, finally, I would state that in September, 1911, one of my engineers was notified to inspect the wireless apparatus on one of His Majesty's ships, and I accompanied him, and I state that the system installed upon that ship was the Marconi system pure and simple.

"I will now deal with technical points and particularly with continuous waves, in respect of which evidence has been submitted to the Committee which has caused me some surprise.

Poulsen System A Misnomer

"I might say, first of all, in referring to the Poulsen and other so-called systems, that it would be more correct to refer to them under the name of the Poulsen arc or Goldschmidt generator, as the case may be, the reason being that, if we examine what is called the Poulsen system, we find that its only important particular feature consists in the use of the arc in place of the spark or high frequency alternator, all other essential parts of the system being more or less identical with those used in other and particularly in my systems. The same remarks equally apply to Goldschmidt, in this latter case the novelty consisting in the particular form of construction of a high-frequency alternator. High-frequency alternators have existed for some 15 or 20 years or thereabouts.

"In the same manner it would be impossible to assert that the Marconi system is so and so, for the reason that numerous and essential modifications of the Marconi system are now in use in order to fulfill different conditions and requirements. It would, therefore, be only fair to say that there are at least a dozen or so different Marconi systems. I may, peraps, make this point more clear. I have now at Clifden a system utilizing continuous waves and employing no spark whatever in the transmission of messages, and I am right in saying that it is still a Marconi system, but more often than I care to mention during this inquiry has it been stated that the Marconi system is a spark system and so-and-so's system is not."

Recalling that Sir John Gavey and Sir Oliver Lodge expressed in their evidence before the 1907 Select Committee the same view as to the questionableness of the term "system," Mr. Marconi mentioned there was also the legal aspect of the question.

"The courts of justice have held that the so-called Balsillie system was nothing but a copy of the Marconi system. The same thing has occurred in America in regard to the system of the United Wireless Company and in France the system of the Compagnie Générale Radiotélégraphique, referred to by Mr. Taylor in his evidence, has suffered the same fate since the time Mr. Taylor gave evidence before this Committee, and I prophesy that before long the courts of this country and abroad will have given other similar decisions. The same remarks apply to the system known as that of the Société Francaise Radioélectrique."

Undamped Waves Not Superior

Mr. Marconi then explained how the Marconi system was able to receive at two closely adjacent stations different messages transmitted by the same wave length, and stated that the Marconi Company also attached considerable importance to the method contained in a patent granted in 1911 concerning the balancing of the receiver, which also tends to greatly minimize outside interference.

Since it has been stated by a number of witnesses, including Mr. Madge, that continuous waves require less power than discontinuous waves, Mr. Marconi called attention to the fact that Mr. Madge himself had stated that he had no experience of continuous waves. The inventor said that his personal experience obliged him to state that he was in absolute and unqualified disagreement with such an opinion, and further added, "there has never been submitted here or elsewhere one scintilla of evidence to prove that the continuous or undamped waves have any advantage over intermittent or feebly damped waves for long-distance working in radio telegraphy." He then produced the published opinion of several high authorities in support of this contention.

"It has, I think," continued Mr. Marconi, "been generally understood by this Committee on the evidence so far given that the so-called Poulsen system is a

continuous wave system. I wish to state there is grave doubt as to whether it is anything of the kind. Professor Fleming, whose competence in the matter has already been referred to before this inquiry, in a lecture before the Royal Institution on May 24th, 1907, stated, referring to the Poulsen Arc:—'It has been contended that these oscillations are undamped and continuous, but I can show you a remarkable experiment with a neon tube, which proves that they are not always interrupted.' He described his experiment, and concludes:—'It appears to me that this proves incontestably that the oscillations are not uninterrupted, but are cut up into groups of various lengths.' It might at once be said in criticism that if discontinuous waves are better than continuous waves by the evidence I adduce, Poulsen waves are discontinuous, which would be, therefore, in favor of the system, but I beg to point out, according to the researches of Dr. Fleming and others, the waves of the Poulsen system have been found to be 'cup up into groups of various lengths.' This nullifies at once any advantage of discontinuous waves, because, in order to obtain the great advantages of a discontinuous wave system, these waves should be cut up into regular groups of equal length, and not into irregular groups.

Arc Difficult of Regulation

"My personal experience of the Poulsen arc has taught me that it is extremely difficult of regulation and that the wave tends to vary continually. This variation of wave length destroys the advantage which should be derived from the wave continuous and unvarying."

Referring again to Professor Fleming's lecture before the Royal Institution the attention of the Committee was called to the fact that this high authority had stated in regard to the Poulsen arc: "No one who has worked practically with the apparatus can say that it is a simple and easy one to use. A very little want of exact adjustment causes the arc to be extinguished or else fluctuated greatly in current, and, compared with the extremely simple appliances required for spark telegraphy, the advantage in ease of working is largely on the side of the spark."

Then Mr. Marconi said: "An interesting and practical proof of the opinions just quoted was demonstrated in a competition which was conducted by the Turkish Army in May, 1911, when the Telefunken system, the Poulsen system, and the Marconi system were in competition for the purpose of demonstrating which was the most efficient system for the Turkish Army to adopt. The trials were carried out during a period of ten days. The Telefunken system failed to get a complete message through until the last two or three days of the trial, and then only at night time. The Marconi system maintained good communication throughout the whole period; the Poulsen apparatus failed entirely; their arc blew out on the average once a minute. The Turkish Army adopted the Marconi system.

Turkish Tests Important

"I would draw particular attention to these tests in view of the evidence which has been given before this Committee, that the Poulsen system is believed to be more simple and efficient for short-distance communications. It is unnecessary for me, perhaps, to state that the first essentials for military stations are simplicity, eificiency, reliability; and military stations such as these, are short-distance installations."

Taking up the question of what weight could be attached to the opinion hitherto given as to the amount of power required for Transatlantic communication, Mr. Marconi called attention to the fact in a lecture delivered at London in 1906, Mr. Valdemar Poulsen stated that Transatlantic communication should be readily obtained by utilizing the power of some 10 kw. "If he referred to occasional communication," Mr. Marconi observed, "he was quite correct, for I had already done it with less than 10 kw., but if he was referring to constant communication,

as it would appear he must have been, he must have altered his mind since, as I understand that Mr. Gandil, acting on his advice, now proposes to use 150 or 200 kw. for a distance of 2,000 miles, and I agree with him that he will require all this power or more if he be able to construct an arc of such a power, and, when constructed, if he can discover the means of effectively utilizing that power.

Power Used With Arc Limited

"Although I have made diligent inquiry I have failed to learn of an arc that has been constructed to effectively utilize more than 40 kw. power.

"It is fair that I should admit, in common with Dr. Poulsen and others, I started also with the idea that long distance work could be conducted with small power, and it is only as a result of years of hard, active work, without any intermission, and continuous experiment, that I have claimed to have proved incontestably that for an efficient commercial wireless telegraph service over long distances to meet the varying conditions of every day in the year high power is an absolute essential.

"Reference has been made to various stations working under different conditions in widely separated parts of the world, whilst the only fair manner would be to compare stations over the same range under the same conditions of work and utilizing the same system of masts, and that these should be the same height. For example, it is stated that the Poulsen system between San Francisco and Honolulu sent a message by day between those two places using only 40 kw., and that the Marconi system would require much more power for a similar distance. I point out here that nobody has any exact knowledge of what is now being used by the Poulsen Company for communication between San Francisco and Honolulu, and I have information which convinces me that at San Francisco the Poulsen Company are not using continuous waves at all, nor have we any information as to the 'new design' Poulsen generator mentioned by Mr. Beach Thompson. There is no evidence that the 'new design' referred to is in any way connected with what is called the Poulsen system. Poldhu station has occasionally sent messages by day with less than 40 kw. to Glace Bay, which is over a greater distance than that separating Honolulu and San Francisco. Further, I am prepared to show and prove to any honorable member of this Committee the transmission of messages across the Atlantic from Clifden to Glace Bay on any average day, utilizing not more than 20 kw. of electric energy, and on an especially favorable day it would very probably use much less.

"In the evidence of Sir A. King it has been stated that Poulsen has been working between Cullercoats or Newcastle and Lyngby, Denmark, the distance being 479 miles, and which distance was called 600 miles.

"I can state that I have worked with stations belonging to the Italian Government during the Turkish War situated in Tripoli and in Italy, which communicated over a distance of 500 miles by day as well as by night with a power of only 5 kw.

Marconi Continuous Waves Demonstrated

"It is quite erroneous to come to the conclusion that the possibility of the application of continuous waves is in any way neglected by the Marconi Company. It at present possesses two methods, patented by myself, of producing and utilizing continuous waves. The first is based on the employment of a discovery for producing undamped oscillations, in which discs revolving at a high rate of speed are employed. The second method is a high-frequency alternator."

The Committee's attention was called to the fact that the first method had been published and discussed in many technical papers and described in Mr. Marconi's lecture before the Royal Institution, March 13th, 1908, and in his Noble Lecture. It was then suggested that, "The experts who have given evidence before this Committee must

either forgotten all about these developments or have been in complete ignorance of them. Not a word did any one of them say in respect of them, yet mine was the only system of continuous waves successfully demonstrated to the Advisory Committee over a distance of 2,000 miles.

No Proof On Alternator Methods

"In regard to the alternator method of creating continuous waves, I think I can say that, whilst experimental work has been done with the alternator generator producing undamped waves, no evidence has been educed to show that regular communication is taking place by the above means between any distances of the order of even 1,000 miles. The difficulties of regulation of a high frequency alternator are very great, the variations of speed due to variations of load destroying the advantage which one could otherwise gain in wave tuning by means of the continuous waves radiated, and even if we grant that a high frequency alternator method for the direct production of the oscillations in the sending antennae may be an ideal system of radio-telegraphic sending, yet, nevertheless, there is no proof that the practical difficulties of construction and use have yet been overcome, and no proof that these difficulties may not yet take years to surmount, whilst meantime the practically operative spark system and combined spark and disc system are conducting nearly the whole of the radio-telegraphic work in the world.

"I would point out that there has been no evidence before the Committee that any high frequency alternator or so-called continuous wave system has ever worked for twenty-four successive hours, and I have never yet heard of any high-frequency machine which has done twenty-four hours' consecutive work. I am aware that Mr. Beach Thompson has stated in evidence that he has worked between San Francisco and El Paso, a distance which he said was 1,150 miles, but which on measurement proves to be 863 nautical miles; but I have evidence that this statement was inaccurate. A manager of the stations of the Federal Telegraph Company, which is known as the American Poulsen Company, a Mr. J. M. Harrison, who has read the evidence of Mr. Beach Thompson, states that up to the end of June, 1912, the company had never communicated directly between San Francisco and El Paso in the daytime, and that their telegrams were normally sent viâ Los Angeles and Phoenix to El Paso—that is to say, by two re-transmissions. He further states that in the summer months the El Paso station was able to work to Fort Worth only during some four to five hours a day sometimes, and viâ Kansas City to Chicago. On some days communication was altogether impossible, and the messages received from the public at El Paso were sent over the land wires. Mr. Harrison also states that automatic high-speed working was never done successfully during the two years that he was in the service of the Federal Company. I understand that Mr. Harrison has written to this Committee submitting a precis of the evidence which he was willing to tender, a copy of which is in my possession, and signed by him. His evidence is a direct contradiction of the answers given by Mr. Beach Thompson.

Nothing Remarkable in Pacific Messages

"A great deal has been made before this Committee of the fact that Mr. Beach Thompson has succeeded in transmitting messages during the daytime from San Francisco to Honolulu with 40 kw. of power. It does not at all surprise me that with such power some messages have been successfully transmitted. I would undertake with my system to successfully transmit messages on favorable days from San Francisco to Honolulu with considerably less power, but there is a vast difference between transmission of occasional messages in favorable conditions and the conduct of a continuous commercial telegraph service. Small open boats have successfully crossed the At-

lantic in fine weather, but I very much question whether any honorable member of this Committee would care to make a habit of crossing the Atlantic by such means."

Mr. Marconi then stated that it had been the experience of his engineers that the normal prevailing conditions of the Pacific Ocean were far more favorable for wireless messages than most other parts of the world, and gave some examples to bear out this statement. The question of automatic working was then taken up and it was shown that this was done through a mechanical arrangement applied to, but not directly connected with wireless telegraphy, and was not as new as the Committee would have been led to suppose, for an automatic system of transmission has been used at Cape Cod for some time.

Poulsen Master Patent Invalid

"It has been stated in evidence," continued the witness, "that my company recently endeavored to purchase the Poulsen patents. I give an absolute denial to this statement. My company has had more than one opportunity of purchasing the Poulsen patents, in years gone by, and it has not purchased them because, in my opinion, firstly, there was no advantage to my company to use the system; secondly, had there been, there has never been any reason why we should not have developed or used the system, for I believe it is not protected by any valid patent. In support of my opinion the German Patent Courts, for which everybody who has to do with patents has the highest respect, has declared the Poulsen master patent to be invalid and has annulled the German patent. The case was taken to the German Court of Appeal, and in November last that court affirmed the judgment of the court below in respect of the chief claim of the patent."

Mr. Marconi said that before concluding he desired to refer to some of the questions and answers given in evidence before the Committee, limiting himself to points which he deemed of sufficient importance. Space does not permit us to set all of these down, but a few interesting extracts are given.

Beach Thompson's Inaccuracies

"The fact of the statement made by the Advisory Committee in their report to the effect that they witnessed at Clifden a speed of sixty words per minute, and that they saw no reason why this speed should not be increased, seems to me to be a sufficient answer to an assertion made by a member of this Committee, who has now retired, as to the impossibility of a speed of fifty words per minute being attained by any spark system.

"On page 141, question 3,163, Mr. Beach Thompson states that from San Francisco to Honolulu is about 2,400 geographical miles. I have had this distance carefully measured; it is 2,078 geographical miles.

"In answer to question 3,251 Mr. Beach Thompson said: 'We also read a message from a White Star boat on the North Atlantic which must have been at least—I could not tell exactly, but I have looked it up since—8,000 miles from Honolulu.'

"I fail to find any point in the North Atlantic on the track of the White Star liners which is 8,000 miles from Honolulu. If, however, such a message were read, the merit lies with the Marconi Company, for their installations alone are on board all the White Star boats, and it must have been their station with 1½ kw. or 5 kw. of power which transmitted the message the 8,000 miles which Mr. Beach Thompson says they read. The feat lies in the transmitting such a distance far more than in its reception; but, personally, I do not accept the statement.

Opinion of Eminent Scientists

"In reply to question 3,550, Mr. Beach Thompson said: 'All the experts in America that I know of on wireless telegraphy think that the Marconi Company have held back the art about fifteen years.'

"I think that the evidence which I have already tendered of my continuous work in the development of this art since the year 1895 will enable this

Committee to form a due appreciation of Mr. Beach Thompson's statement, but inasmuch as the statement has been made, I would state that the most eminent scientists in America, including Mr. Edison, Mr. Tesla, Professor Elihu Thompson, Professor Pupin, Professor Steinmetz, and many others have expressed the reverse opinion. I can produce that evidence if required.

"On page 161 Mr. Beach Thompson was questioned about the power at the Poldhu station.

"Question 3,552 he was asked: 'Do you know the station at Poldhu in Cornwall?' Answer: 'I do not know that station, but I have heard of it, of course.'

"Question 3,553: 'That is a Marconi station, and between Poldhu and Chelmsford operations are carried on, and they have a 500 kw. power there, I believe?' Answer: 'I have been told they use 500 kw. in crossing the Atlantic, but they have much more than that installed for emergency.'

Power at Poldhu Overestimated

"Again it is obvious that members of the Committee have been misled in in the information which they have received, which was responsible for the questions which they put, but Mr. Beach Thompson was giving evidence on oath, and I can see no excuse for his reply. The power of the Poldhu station is 75 kilowatts; it has never been more. The station does not carry on communications between Poldhu and Chelmsford, except on occasions by special permission for experimental purposes.

"On page 302, question 6,310, Mr. Madge says: 'With that qualifying statement my general opinion is that the Marconi Company's station would use more power, that the cost of working, as far as coal and upkeep of power plant is concerned, would be higher.'

"I contend that Mr. Madge was wrong in the opinion he has expressed. Assuming that Marconi and Poulsen stations of equal kilowattage can transmit an equal distance—and I think I have already submitted sufficient evidence to prove that by the Marconi system this at least is the fact—the cost of the production of each kilowatt of power would necessarily be the same, no matter what system were employed; but inasmuch as so long as the Poulsen arc is burning it is consuming the full power required, the consumption of power by a Poulsen station is as 100 is to 60 in a Marconi station. This is explained in the following way:

"The Marconi station consumes full power only during such periods as the transmission key is down and waves are being actually radiated; during the intervals or spaces between the dots and dashes which are being transmitted, the key is up, and during that period, which is calculated to be 40 per cent. of the whole, practically no power is being consumed; whereas with the Poulsen system practically the same power is consumed whether the key be up or down.

"With much of the evidence submitted by Mr. Taylor in his memorandum I totally disagree, and am surprised that he, being a Government expert, it should be in many instances so inaccurate and misleading.

"Upon the question of the relative efficiency of continuous versus discontinuous waves I have already stated the result of my experiments and experience, which differ entirely from the opinion expressed by Mr. Taylor.

Currents Not Spasmodic

"On page 404 of the shorthand notes, in speaking of the Marconi transmitter, Mr. Taylor is inaccurate in stating that part of the apparatus consists of 'high-frequency apparatus for converting the high-tension alternating current into spasmodic currents of high-frequency or electric oscillations.' If Mr. Taylor had any sound knowledge of the Marconi transmitter he would know that the succession of currents are regular and properly timed and are in no sense spasmodic. The only explanation that I can conceive that Mr. Taylor can give of this statement is that he was referring to the early Marconi installations of many years ago under my first

original patent of 1896, and subsequently the four sevens patent of 1900, pure and simple, without the subsequent improvements and inventions which represent my system of to-day, and with which he ought to be acquainted.

"If this be what he meant, I contend he should have said so, and not led the Committee to suppose, as they must suppose from his evidence, that he is speaking of my system in connection with long-distance stations, in respect of which alone this Committee is concerned.

Errors in Prepared Table

"In the table prepared by Mr. Taylor showing particulars of various wireless installations, he estimates the range over sea of the Clifden station as being 2,200 miles, although I have publicly stated in my lectures that I have communicated 6,000 miles. He states that the power of our station is 250 kw. In this he is wrong. He states that there are twelve masts at the station. This is wrong. He states the height of the masts, in which he is wrong. He names the type of a receiver which we use at the station, but does not state that this only one of many types which we employ.

"With regard to Poldhu, he states the range of the station as being 1,000 miles. This is wrong. The statement that all matter is signalled twice, without the explanation which Mr. Taylor should have been able to give, is distinctly misleading. The matter which is signalled twice from the Poldhu station is the news which is sent out to the ships at sea for the purpose of their daily newspaper. The principal reason that it is signalled twice is that it occurs that many vessels at the hour specified for the transmission of the news are engaged in important traffic, and, therefore, after a given interval, the news is signalled a second time, so that those ships may know that they need not at once interrupt the traffic which they are conducting, because they know that they will have a repetition of the news.

"In quoting from the company's pamphlet, Mr. Taylor refers to a standard 5 kw. shore installation as having a range of 400 miles; he, however, does not point out that this is the guaranteed minimum range, and that normally under moderately fair conditions such an installation is capable of communicating a much greater distance.

"In quoting the Telefunken Company's pamphlet, he mentions a standard 8 kw. land station as having a range of from 80 to 1,600 miles.

"Again, he gives the range of the British shore station, Bolt Head (Marconi system) as 250 miles over sea, whereas he should be aware that the Post Office, to whom he was an expert, has exchanged traffic from that station with ships up to 1,100 miles. If Mr. Taylor had this knowledge I think it would have been fairer had he mentioned it.

Greatest Station Not Mentioned

"It is extraordinary, too, considering the purpose for which this table was prepared, that Mr. Taylor should have given particulars of the Norddeich station, the Nauen station, the Eiffel Tower station, and the United States of America Poulsen station, and should have omitted any mention of the Coltano station, which is the last and biggest powered station yet constructed, and, as the Post Office have been informed by the Italian Government, has been in regular communication day and night with Massaua, 2,238½ nautical miles distant, of which some 1,599 miles is over land, mostly desert, and Massaua itself is situated well in the tropics.

"The Coltano station is the one which most nearly approaches the conditions required for the Imperial stations, and I should have thought, for the purpose of furnishing this Committee with information in respect of existing wireless telegraph stations, their ranges and the conditions under which they work, that the first duty of a Government expert would have been at least to have referred to this station.

"On page 426, in replying to questions anent the working of the Poulsen system as compared with the spark system (which presumably was intended to refer to the Marconi system) during atmospheric disturbances, Mr. Taylor says, in reply to question 8,502: 'I consider that the disturbances were so powerful that had it not been for the fact of being able to use a very weak coupling for receiving, the signals would not have been received.' And in reply to question 8,504: 'You say you are of opinion that communication by a spark system in the ordinary manner would have been impossible?' Mr. Taylor says: 'Yes, in the ordinary manner.'

"I would point out that this answer of Mr. Taylor's is certainly ambiguous, and I do not know what he means by 'the ordinary manner,' but Mr. Taylor ought to be aware that very weak coupling is only one of the methods employed in modern practice for avoiding atmospheric disturbance, and that it is by no means the one which is the most effective.

Witness Admitted Inexperience

"Owing to the many inaccuracies in Mr. Taylor's evidence, I have paid more attention to it than I otherwise should have done, particularly in view of his statements on pages 435 and 438. In reply to question 8,689, he says, 'Yes. Of course, I have had very little experience in long-distance wireless telegraphy'; and in answer to 8,694, he says, 'I suppose so, but, of course, I have already stated in my evidence in chief that I have no experience in long-distance working'; and on page 438, in answer to question 8,726, he says, 'I am certainly not a long-distance expert, my connection with long-distance wireless telegraphy is very small.'

"There are many things stated by Sir Henry Norman with which I utterly disagree, but inasmuch as he is in no sense an expert in wireless telegraphy, I propose to confine myself to correcting the misstatements which he has made in question of fact.

"On page 524 in his evidence in chief he states that he believes that the Marconi system is not in use in the United States Government stations. This is utterly wrong. The United States Government has a number of Marconi stations, and a number are now in the course of construction for the United States Government.

Arlington Station Mainly Marconi

"The Arlington station, I think, it will be found, is mainly a Marconi station, although it has Fessenden apparatus. The Federal Court of Appeals has already held that the main Fessenden patent is borrowed from Marconi and Lodge.

"He further states on the same page that the Marconi Company is not officially recognized in France. This is made as a definite statement, and is not qualified by the words 'I believe.' We have importannt agreements with the French Government and contemplate commencing important work in France in the near future.

"On page 537, question 10,351, by Lord Robert Cecil, 'There is no experience of anybody working 2,000 miles largely over tropical lands?' he answers, 'No, I believe not.' Question 10,352, 'Would it be your anticipation that difficulties might arise in connection with it?' He replies, 'Enormous difficulties.' And to 10,353. 'From atmospheric disturbances?' his reply is, 'Yes, from atmospheric disturbances. . . .'

"I wish to state that on September 28th, 1912, Sir Henry Norman, through the courtesy of the Italian Government, together with my permission, was admitted to the long-distance station at Coltano to which I have referred. It is a curious fact that, like Mr. Taylor, Sir Henry Norman has avoided all mention of this station; yet I have here and produce an affidavit stating that during Sir Henry Norman's visit to Coltano he was informed by the Marquis Solari, who accompanied him, that that station had communicated and does communicate with the station at Massaua, which is 2,238½ miles distant, is situated on the east coast of

(*Continued on page 412.*)

THE MARCONIGRAPH

An Illustrated Monthly Magazine of WIRELESS TELEGRAPHY

Published by

THE MARCONI PUBLISHING CORPN.,

456 Fourth Ave., New York.

JOHN BOTTOMLEY, President. JOHN CURTISS, Treasurer.

J. ANDREW WHITE, Editor.

SUBSCRIPTION

$1.00 PER ANNUM IN THE UNITED STATES

$1.35 PER ANNUM OUTSIDE THE UNITED STATES

SINGLE COPIES, 10 CENTS

Forms close the 15th of each month. Advertising rates on application.

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. JUNE No. 9

Statement of the ownership, management, circulation, etc., of THE MARCONIGRAPH, published monthly at New York, N. Y., required by the Act of August 24, 1912. Editor, J. Andrew White, 456 Fourth avenue, New York; Business Manager, John P. Curtiss, 456 Fourth avenue, New York; Publisher, Marconi Publishing Corporation, 456 Fourth avenue, New York.

Stockholders holding 1 per cent. or more of total amount of stock, Marconi Wireless Telegraph Company, 27 William street, New York City. Known bondholders, mortgagees, and other security holders, holding 1 per cent. or more of total amount of bonds, mortgages, or other securities: none.

JOHN P. CURTISS,
Business Manager.

Sworn to and published before me this 25th day of March, 1913.

J. BOTTOMLEY,
Notary Public,
New York County No. 806.
New York Register, No. 4882.
Commission expires March, 1914.

The complete flattening out of the Parliamentary investigations into the Imperial contract after Mr. Marconi had been heard on the stand shows, probably better than anything else could have done, how extremely farcial were the entire proceedings.

A world-wide stir was created over the alleged misdealings of the Ministers concerned, the end of which has not yet been heard. For since it appears that there was absolutely no foundation for the libelous statements which appeared in print it is likely that a series of proceedings will be instituted against the unscrupulous journalists who maliciously attacked men of unquestioned integrity. The managing director of the English Marconi Company has already vindicated himself before the courts, and the others will undoubtedly follow his example.

One of our readers who closely followed the alleged investigation from the beginning notes that "it seems rather unusual, to say the least, that a whole lot of so-called experts should be heard and their opinions given wide publicity, yet the inventor of wireless telegraphy should be prevented by obvious subterfuges from testifying in behalf of his own invention. It would certainly interest us in America to hear what he has to say."

Knowing that this letter expresses the opinion of Americans generally, it gives us considerable pleasure to place before our readers a comprehensive digest of Mr. Marconi's evidence when he was finally called to the witness stand. Space did not permit publishing the full evidence, but the most important points have been covered, and the careful reader will find much of interest in the summary which appears elsewhere in our pages.

During the cross-examination Lord Robert Cecil asked Mr. Marconi what reflections had been made on the Marconi Company on account of the Government contract.

Mr. Marconi replied that suggestions had been made that his system could not do what it pretended to do. He added that he strongly objected to his name being mixed up in these attacks.

He could go out and see placards bearing the words: "Marconi Scandal" and "Marconi Scenes." He went on:

"I strongly object to my name being made a by-word of party politics and a peg on which to hang all kinds of scandalous accusations with which it is not suggested that I am in any way concerned."

An apology is certainly due Mr. Marconi for the manner in which his name has been dragged through the mire of a political melee, as well as for the pernicious attacks made on his system. Just how flimsy was the whole fabric intended to destroy confidence in the Marconi system is revealed in the evidence of the inventor. We earnestly commend it to your attention.

* * *

Mr. Marconi, incidently, is due to arrive in New York on June 11, to testify in the patent infringement suit brought by the American Marconi Company against the National Electric Signaling Company.

* * *

The committee of the British Board of trade which has been considering the subject of Atlantic derelicts, has just issued a report declaring that the danger from these obstructions to navigation is steadily diminishing. It says that the number of dangerous derelicts on the high seas is not great, and the risk of vessels striking them is chiefly confined to the western portion of the north Atlantic. The committee points out that the larger derelicts met with are usually wooden vessels and that, as such vessels are gradually displaced by steamships, the danger from them will grow less and less.

The committee would make it obligatory on masters of vessels fitted with wireless apparatus to send reports of dangerous derelicts sighted by them to coast stations, as well as to other ships within reach, and to pass on any such information received by them. All wireless reports of derelicts received at the coast stations should, it is suggested, be transmitted to Lloyd's free of all charges and should have priority over ordinary messages at both the ship and shore stations. Further, reports of all derelicts considered by Lloyd's to be dangerous to navigation should be transmitted from Lloyd's free of all charges for a reasonable number of days to vessels upon the route where the danger exists.

The Share Market

NEW YORK, June 9.

The liquidation from abroad followed by much local selling has put the market under such pressure that the general level of prices of standard industrials has declined to the lowest point recorded since the early part of 1908, when the market was recovering from the panic of the previous fall. Much of the selling is the sort of liquidation which is forced by a decline in prices irrespective of any views which the holders of stocks entertain regarding the value of their property or the probable future of business.

Naturally, in such a general depression Marconi issues have suffered a decline, although the brokers report that the trading is light and the few sales are generally credited to forced liquidation on the part of investors.

Bid and asked prices to-day:

American, 3¾—4; Canadian, 2—2¾; English, common, 16—17½; English, preferred, 13—15.

American Marconi Annual Meeting

The Annual Meeting of the Marconi Wireless Telegraph Company of America which was to be held on the third Monday in April, was postponed this year by order of the Board of Directors on account of the inability of the Auditors to prepare and get up the usual statement of accounts which is submitted to the stockholders.

The meeting has now been called for the third Monday in June by order of the Board of Directors and at that meeting or prior thereto, statement of accounts, together with report of the directors on the work during the past year will be delivered to the stockholders or mailed to those who are unable to be present.

The meeting is to be held in the offices of the company, with the Corporation Trust Company, Jersey City, N. J.

Chesterton Guilty of Criminal Libel

On June 7, Cecil Chesterton, editor of the *Eye Witness*, an English weekly newspaper, was found guilty of criminally libeling Godfrey Isaacs, managing director of the English Marconi Company. The court fined Chesterton $500 and placed upon him the burden of the costs, which will be considerable.

In his weekly newspaper Mr. Chesterton had charged that Mr. Isaacs had exerted evil influence upon certain officials of the British Government in relation to the contract for wireless telegraphic service. He could place before the court no evidence to support his charges, and could only say that he believed what he wrote when he wrote it.

The verdict, with its vindication of Mr. Isaacs, was accepted by the London newspapers as the only possible judgment in view of the evidence produced. The *Chronicle* said that what must have impressed the jury was plain truth. Chesterton slung mud without having, or apparently troubling to get, the slightest evidence. His state of mind toward his victim was, as the Judge said after the verdict, one of "invincible ignorance." *The Chronicle* congratulated Godfrey Isaacs on the result of an action which few city men, however high their reputation, would care to bring.

The Chronicle's Parliamentary correspondent, discussing the reactions of the Chesterton trial on the political situation, said that had the case ended in the acquittal of the accused it would have been interpreted as an unfavorable omen for the Government. "The proceedings," he wrote, "at the interminable inquiry of a most amazing select committee had helped to create an atmosphere of distrust which reacted unfavorably on the Government and of which the Opposition had been quick to take advantage on every opportunity. The Chesterton trial served a useful purpose in exposing the lies which have nourished the outrageous campaign of calumny. A London jury having found Chesterton guilty of the charge of criminally libeling Godfrey Isaacs, this has had the effect of a battering-ram vigorously directed against the monstrous fabric of misrepresentation. The structure has come clattering to the ground, and great was the fall thereof. No impartial person who followed the proceedings at the trial can doubt that the verdict is a just one."

The *Daily News* voiced the opinion that the verdict in the Chesterton case will command the approval of every one concerned for the decencies of journalism and public life. Referring to the Judge's description of the conduct of Chesterton as the result of "invincible ignorance," *The News* said:

"Invincible ignorance there was in the crusade of criticism, which was without parallel alike for its venom and perversion of facts; but it is not ignorance of innocent purpose; it is wilful ignorance, inspired by deliberate ulterior motives."

In any event, the charges against the managing director of the Marconi Company were evidently inspired by ignorance and wrong-headedness, if not by malice, and it is gratifying to have the attempt to associate political corruption directly with an invention and an enterprise of such vast benefit to mankind defeated and punished in this definite way.

Increase in Bonus to Operators

The system introduced by the American Marconi Company at the commencement of the year, whereby wireless operators are paid a bonus on all fully paid messages sent from ships to shore stations of the company, has proven a means of considerably increasing the efficiency of the service.

The work of checking the traffic returns of the ships is being rapidly attended to and it is hoped that the bonus due for the quarter ending March 31, will be paid within the next two weeks. From then on, the bonus will be paid monthly instead of quarterly. The company has issued an official statement which says, in part:

"It is the earnest desire of the management to do everything possible for the welfare of our operators and it was for this reason that the bonus scheme was established. It has now been de-

cided that instead of allowing the commission originally provided for traffic originating on ships and transmitted via our coastal stations, we will allow a still larger percentage of the ship tolls on all paid business originating on steamers entitled to the bonus privileges. This amount will be divided between the first and second operators.

"It is hardly necessary to remind operators that the company's transoceanic stations will be in operation in a few months' time, and that the policy of the company is to promote the most deserving operators to the important and well-paying positions which the advent of these stations will bring about." At the head office of the company a staff record of every operator in the service is kept, in which all particulars regarding the general conduct and the manner in which telegraph and clerical duties have been conducted, are recorded.

Wireless Telegraphy as an Aid in Railroad Construction

A contract has just been awarded to the Marconi Company of Canada by the Department of Railway and Canals of the Dominion Government, for the erection of two stations at the terminals of the proposed Hudson Bay Railway, viz.: one at Port Nelson on the Hudson Bay, the northern terminal of the railway, and the other at Le Pas, in Manitoba, the connecting point of the new line with the Government Railway system.

This is the first instance recorded in which the assistance of wireless telegraphy has been resorted to in connection with railway construction on the North American Continent. It has, however, been employed with great success in Brazil, where the Marconi Company some years ago erected two stations on behalf of the Madeira Mamore Railway Company, one at Manaos, where the local offices of the railway are situated, and the other at Porto Velho, about 1,000 miles distant, at the head of the railway, the only access to which point is by means of boats on the Madeira River. The results of the application of wireless on that line have proved its value in railway construction.

The object of the Hudson Bay Railway, which will be about 440 miles long, is to give the grain growers of the Northwest means of cheap communication between the Interior and Europe, via Hudson Bay and the Atlantic. The Canadian Government is doing its utmost to have the line completed before 1914.

The wireless stations will play an important part in the construction, as they are primarily intended to serve as intermediaries for the ordering and forwarding of material and labor from the base of the scene of operations. The town of Port Nelson is cut off from communication with the Capital during nine months of the year, but once the stations are erected the work of the officials at Ottawa and elsewhere will be greatly facilitated, as they can then remain in close touch with the progress of the work on the line.

The stations will be of 10 kw., the power for which will be obtained from 20-h.p. Canadian Fairbanks engines, and each station will have a range of 500 miles.

The settlement of Le Pas was formerly one of the Hudson Bay Company's posts in the Northwest, and enjoys considerable historical importance through being perhaps the last place in civilization from which word was received from Explorer Franklin, of Arctic fame, when on his last trip to the North. An interesting feature of Le Pas is the little Anglican Church where Franklin held divine service.

Port Nelson, the site of the corresponding station and the Northern terminal of the railway is destined to become a summer port of considerable

importance, for during the period in which it will be open to navigation millions of bushels of grain will be shipped. The wireless station at Port Nelson will have an additional installation designed to communicate with vessels trading with that port.

It is rumored that the stations may form the commencement of a wireless chain to extend through Northern Ontario and Quebec, eventually linking up the Hudson Bay Straits with the Newfoundland Government's stations on the Labrador coast. This would be the first step towards the opening up of those territories, the development of which has hitherto been handicapped by their extreme isolation.

Evidence of Mr. Marconi.

(*Continued from page 407.*)

Africa, well in the tropics, and separated from Italy mainly by desert land. This visit could scarcely have escaped Sir Henry Norman's memory, and if it had, inasmuch as in reply to question 10,510, page 546, by Mr. Macmaster, 'Have you read through the whole of the evidence which has been presented to this Committee?' Sir Henry Norman replied, 'I have read every word of it.' I wonder that he was not reminded of the visit by the statement made by Sir Alexander King, that the Post Office had been informed by the Italian Government that the station of Coltano successfully worked to Massaua.

"Sir George Croyden Marks, in his evidence, stated that a message had been transmitted from America to Germany without masts being used. I would mention that the statement is totally erroneous. The signals in question, as stated in the *Electrician* of March 8, 1912, to which he refers, were transmitted by the Marconi station at Glace Bay, which has some sixteen masts.

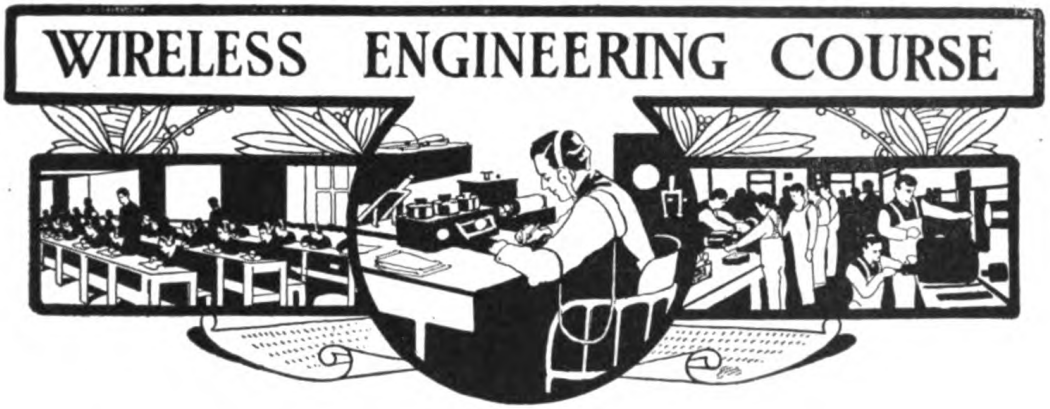
"On page 560, in replying to question 10,718, Major Archer Shee said that the Marconi Company rely upon the Balsillie patent, amongst others. This is either wrongly reported, or Major Archer Shee is mistaken. The Balsillie patent has already been declared by the High Courts of this country to be an infringement of the Marconi four sevens patent.

Mr. Marconi concluded his evidence with this statement:

"I wish to state that I have never at any time speculated in any of the shares of my companies. I have always supported them whenever money has been required and frequently to very large sums. I have occasionally sold shares, not in consequence of markets or circumstances connected with the company's business, but only when I have required monies for business in which I am interested other than that of the Marconi companies. During the whole of the period of the boom in shares in the Parent Company or the American Company, or any other of the companies with which I am associated, I have never bought or sold a share. I have never taken part in any syndicate, nor do I believe any syndicate ever existed in connection with any of the shares of any of the Marconi companies. Neither I, nor my company, have in any way been responsible for the fluctuations of the price in the market, but I believe that these prices have varied entirely according to the natural supply and demand, in the same way as prices of any security upon the Stock Exchange will fluctuate.

"I do not wish to conclude without expressing my resentment at the reflections which have been made upon my company and upon me for having innocently entered into a contract with His Majesty's Government. I resent the enquiry into and publication given to the affairs of my company which have had no relation whatsoever to the contract entered into with His Majesty's Government, and in this respect I would particularly refer to the business carried out by Mr. Isaacs and me in America, as related by Mr. Isaacs in his evidence, which I fully endorse and confirm, and I regret that the services which my company and I have for so many years rendered to the post office, the Admiralty, the Mercantile Marine, and in fact, the whole Nation, should not have been deemed worthy of higher consideration."

WIRELESS ENGINEERING COURSE



By H. Shoemaker

Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER VI.

ALTERNATING CURRENT GENERATOR.

In figures 1, 2, 3 and 4 of the preceding article I have shown the alternating current generator in its elementary form. In commercial machines it is necessary to modify this elementary machine so that the required voltage, frequency and output is obtained. To obtain the required frequency it is necessary to construct the machines with a great many poles in the field, instead of two poles, as shown in the figures 1, 2, 3 and 4.

The relation which the number of poles, the speed of the armature and the frequency bears to each other is expressed by the formula:

$$\text{Frequency} = \frac{\text{number of poles} \times \text{speed per second.}}{2}$$

$$\text{or } \sim = \frac{N \times S}{2}$$

Where $\sim$ = frequency or number of complete alternations per second

N = number of poles

S = speed per second.

If a generator has two poles and speed of 1800 r.p.m. (revolutions per minute) or 30 per second, then it will give a frequency of 30 per second.

In constructing generators for high frequencies it is the general practice to increase the number of poles and keep the speed low. In some cases, however, it is desirable to use a high speed, as in cases where the generators are driven by steam turbines or other high speed motors.

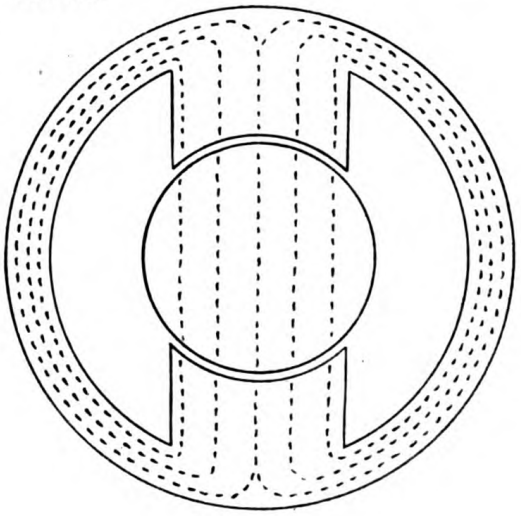


Fig. 18.

When a generator has two poles the magnetic flux passes from one pole to the other, as shown by the dotted lines in Fig. 18. When it has four poles the flux takes the path shown by the dotted lines in Fig. 19. It will be seen that in this case the flux produced in each field pole divides, half going to the

right and half to the left adjacent pole, while in the two pole machine the flux passes diametrically across the armature from pole to pole. It will also be seen that the poles alternate in the order, north, south, north, south. This holds for generators with any even number of poles.

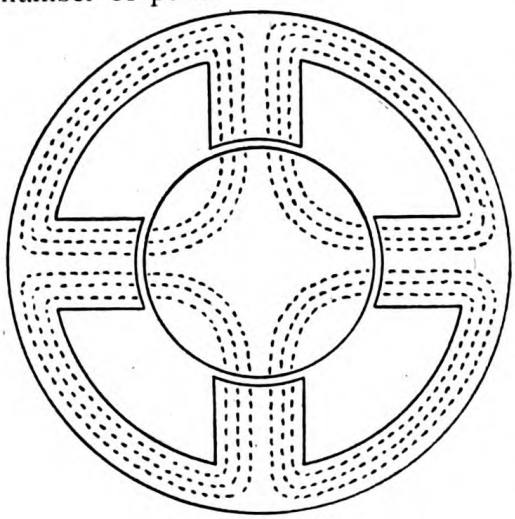


Fig. 19

The flux is produced by coils placed on the field poles through which a direct current flows. It is therefore necessary to have a source of direct current to excite the fields of the alternating current generator.

For frequencies up to 120 ~ the fields are generally made of cast iron or steel, but for higher frequencies the fields are made of laminated iron clamped in a cast iron frame, which also carries the armature bearings.

The revolving loop or coil of the elementary machine is replaced by a number of coils which are laid on the iron armature core. The coils are either laid on the surface of the armature core or laid in slots in the core. In most cases there are the same number of coils in the armature as there are poles in the field.

By the use of iron in the armature the reluctance of the magnetic circuit is decreased and a strong support is supplied for the armature coils.

At present there are numerous makes of A. C. generators in use which differ greatly in design and appearance, but operate on the same principle. I will not therefore attempt to describe any particular make of machine, but will treat the subject in a general manner. I have of course assumed that the reader understands the theory of the elementary generator shown in Figs. 1, 2, 3 and 4 of the preceding articles.

Fig. 20 shows a section of the A. C. generator through the fields and armature in a plane at right angles to the shaft of the armature. It will be seen that the field poles project radially toward the center of the armature, while the armature poles project radially outward. These poles are shown opposite each other. The dotted lines show the path of the magnetic flux. In this position the armature coils which surround the armature poles have the maximum flux passing through them, and therefore a minimum voltage generated at the terminals. When the armature has the position shown in Fig. 21 the coils have a minimum flux passing through them and are then generating a maximum voltage. The dotted lines show the path the flux takes in this position of the armature.

If the armature coils are connected to a resistance so that a current can flow in the coils, then these coils produce a flux through the armature poles which is a maximum when the voltage is a maximum. If, however, there is less induction in the circuit, which is generally the case, since the armature itself has self induction, then the current is a maximum later than the maximum voltage. If the circuit has capacity, then the maximum current occurs before the maximum voltage, as the magnetic flux produced by the current in the armature is opposite to that produced by the fields and it tends to weaken the fields when the armature poles are in a certain position or strengthen them when in another position. The effect on the field produced by the armature therefore depends on the character of the external circuit or load of the generator. It also depends on the structure of the magnetic circuit of the generator. In designing an A. C. generator it is therefore necessary to consider the char-

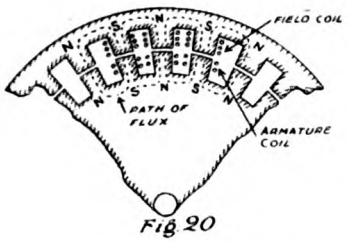


Fig 20

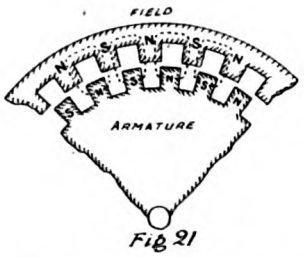


Fig 21

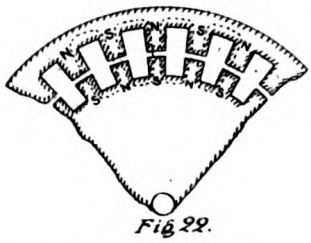


Fig 22.

acter of the external circuits which the generator is required to operate.

In Figs. 20, 21 and 22 the armature is shown in three different positions relative to the field poles. In Fig. 20 it is in the position of maximum flux, and zero voltage; in 21 it is in the position of minimum flux and maximum voltage, and in Fig. 22 it is in the position of maximum flux and minimum voltage. It will be seen that while the armature moves the angular distance of two poles, the current goes through a complete cycle, as was the case with the loop in Figs. 1, 2, 3 and 4, when it turned one revolution. If while in the position shown in 21 a current is flowing, then the flux produced by this current tends to demagnetize the trailing field pole, and magnetize the leading pole with the result that there will be no total decrease in the flux. It will not therefore effect the voltage to any extent. However, if the current lags, then the flux produced by it in the armature pole reaches a maximum when approaching the leading pole and demagnetizing it by an amount depending on the leg of the current. If the leg is 90°, then it will have the maximum demagnetizing action, as the maximum current is flowing when the armature is in the position shown in 22.

If the current is large and there are enough turns on the armature pole, the armature current will completely demagnetize the field poles. This is the case when the ampere turns on the armature pole equals on the field poles.

If the current leads, as it would if there were capacity in the external circuit of the generator, then the maximum current will occur when the armature pole is near the trailing field pole and the current will aid in magnetizing the field poles, thus increasing the voltage generated. The greatest increase will take place when the current leads 90° or reaches its maximum when the armature is in the position as shown in Fig. 20. As the field poles in all machines are operated near mag-

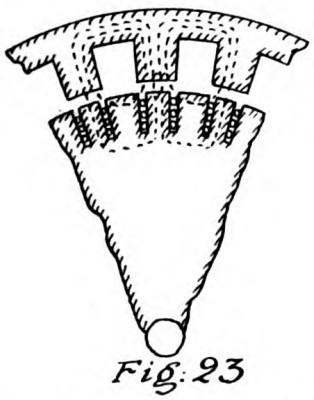


Fig. 23

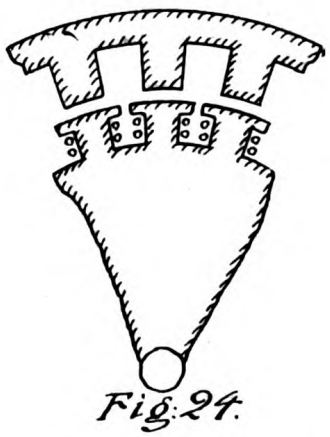


Fig. 24.

netic saturation, this effect will not increase the voltage to any great extent, but will cause a rise in voltage until the current in the armature cannot produce any additional flux.

If the capacity and inductance are both present in the circuit, then the

effect will depend on which one predominates. If the reactance due to inductance (positive reactance) equals that due to capacity (negative reactance), then the generator will act as if it had an non-inductive load or just resistance in the circuit.

As the armature will always have some inductance, it is impossible to

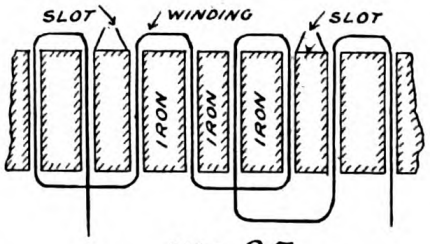


Fig. 25

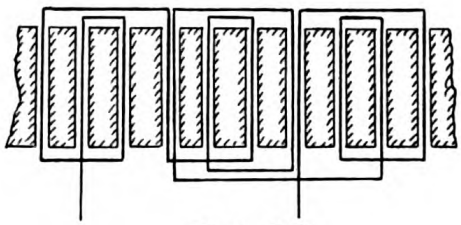


Fig. 26.

have the current and voltage in step unless there is a negative reactance in the circuit, consequently there will always be a fall of voltage as the current increases unless the fields of the generator are strengthened by increasing the magnetizing current. This regulation of voltage is effected by the use of a rheostat in the field circuit, which by adjustment increases or decreases the current to the desired value.

It will be seen from the foregoing that to prevent a variation of voltage with a variation of load it is necessary to keep the self induction of the armature as low as possible and have as few turns on as possible.

In a generator constructed with armature poles, as shown in Figs. 20, 21 and 22, the reluctance of the magnetic circuit will be varied continuously, as the air gap is greatly increased when in the position 21; this causes a pulsating field instead of a constant field. This can be prevented by filling the space between the armature coils with iron, as shown in Fig. 23. This construction gives constant reluctance in the magnetic circuit. The same thing can be accomplished by constructing the armature poles as shown in Fig. 24. Figs. 25 and 26 show the two methods of winding the armature which are most in use in commercial machines.

In A. C. generators for lighting and power it is necessary to keep the voltage constant. This is accomplished by the use of special regulating devices which automatically increase the field current when the voltage drops. When used for wireless telegraphy it is desirable to have the voltage fall when the current exceeds a certain amount.

In this case the machine gives a high voltage on an open circuit and falls to approximately zero on short circuit.

Why generators of this type are best adapted for wireless work will be explained in a later chapter, where the operation in conjunction with the transformer and condenser will be treated.

If the reader desires to go further into the construction and operation of the alternating current generator, he will find an excellent treatise on this subject in book entitled "A Treatise on the Alternate Current Transformer," by J. A. Flemming.

(To be continued.)

This course commenced in the December, 1912, issue.

Flood Disaster May Bring Interior Wireless

The installation of a wireless system of telegraphy covering the interior of the United States may be one of the results of the flood disasters throughout Ohio, Indiana and the Middle West, at the suggestion of Representative R. J. Bulkley, of Cleveland.

The Ohio delegation in Congress will join in the introduction of a resolution at the special session of Congress asking the War Department to submit to Congress estimates and plans for such an extension of wireless telegraphy.

The New Call Letters

THE Department of Commerce has issued instructions concerning radio call letters, pending the publication of a complete list of the wireless stations of the world, which will not be ready before July.

The Service Regulations of the Berlin and London Radiotelegraphic Conventions provide that the call letters of stations in the international system must each be formed of a group of three letters which shall be distinguishable from one another The London International Radiotelegraphic Conference made a partial allotment of call letters among nations which signed the convention and the International Bureau at Berne, with the consent of such nations, has modified and added to this assignment of call letters. The distribution of call letters among nations thus authorized is printed here for the guidance of operators of all stations, ship and shore, of the United States.

A .....All to Germany and protectorates.
B .....All to Great Britain.
CAA to CMZ..Not yet assigned.
CNA to CNZ..Morocco.
COA to CPZ..Chile.
CQA to CQZ..Monaco.
CRA to CTZ..Portugal and colonies.
CUA to CUZ..Not yet assigned.
CVA to CVZ..Roumania.
CWA to CWZ.Uruguay.
CXA to CZZ..Not yet assigned.
D.....All to Germany and protectorates.
EAA to EGZ..Spain and colonies.
EHA to EZZ..Not yet assigned.
F .....All to France and colonies.
G .....All to Great Britain.
HAA to HFZ..Austria - Hungary and Bosnia-Herzegovina.
HGA to HHZ..Siam.
HIA to HZZ..Not yet assigned.
I .....All to Italy and colonies.
J .....All to Japan and possessions.
KAA to KCZ..Germany and protectorates.
KDA to KZZ..United States.
LAA to LHZ..Norway.
LIA to LRZ...Argentine Republic.
LSA to LWZ..Not yet assigned.
LXA to LZZ..Bulgaria.
M .....All to Great Britain.
N .....All to the United States
OAA to OFZ..Not yet assigned.
OGA to OMZ..Austria - Hungary and Bosnia-Herzegovina.
ONA to OTZ..Belgium and colonies.
OAT to OZZ..Denmark.
PAA to PIZ...Netherlands.
PJA to PJM..Curaçao (Dutch).
PJN to PJZ...Surinam (Dutch).
PKA to PMZ..Dutch East Indies.
PNA to PZZ..Not yet assigned.
Q .....Reserved for code abbreviations.
R .....All to Russia.
SAA to SMZ..Sweden.
SNA to STZ..Brazil.
SUA to SUZ..Egypt.
SVA to SZZ...Greece.
TAA to TMZ..Turkey.
TNA to TZZ..Not yet assigned.
UTT to UMZ..France and colonies.
UNA to UZZ..Austria - Hungary and Bosnia-Herzegovina.
VAA to VGZ..Canada (British).
VHA to VKZ..Australian Federation (British).
VLA to VMZ..New Zealand (British).
VNA to VNZ..South African Union (British).
VOA to VOZ..Newfoundland (British).
VPA to VSZ..British colonies not autonomous.
VTA to VWZ.British India.
VXA to VZZ..Not yet assigned.
W .....Allto the United States.
XAA to XCZ..Mexico.
XDA to XZZ..Not yet assigned.
YAA to YZZ..Not yet assigned.
ZAA to ZZZ...Not yet assigned.

PUBLIC SERVICE STATIONS.

The call letters assigned to the Unit-

ed States are all combinations (676) beginning with the letter N and all (676) beginning with the letter W and all combinations (598) from KDA to KZZ, inclusive. The total number of international call letters assigned to the United States is thus 1,950 and these are reserved for Government stations and stations open to public and limited commercial service.

(*a*) All combinations beginning with the letter N are reserved for Government stations and in addition the combinations from WUA to WVZ and WXA to WZZ are reserved for stations of the Army of the United States.

(*b*) The combinations KDA to KZZ, with a few exceptions, are reserved for ship and coast stations on the Atlantic coast and Gulf of Mexico.

(*c*) The combinations beginning with W (except WUA to VWZ and WXA to WZZ, as already indicated) are reserved, with a few exceptions, for ship and coast stations on the Pacific coast and on the Great Lakes.

AMATEUR STATIONS.

The call letters for amateur stations in the United States will be awarded by radio inspectors, each for his own district, respectively, according to the following system:

(*a*) The call will consist of three items; number of radio district; followed by two letters of the alphabet. Thus, the call of all amateur stations in New England (which comprises the first district) will be the figure "one" in Continental Morse, followed by two letters; in California (in the sixth district) the figure "six" followed by two letters; in South Carolina the figure "four" followed by two letters; in Missouri the figure "nine" followed by two letters, etc. The letters X, Y, Z, must not be used as the first of the two letters. The territory of each district is as follows:

1. Boston, Mass.—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.
2. New York, N. Y.—New York (county of New York, Staten Island, Long Island, and counties on the Hudson River to and including Albany, Rennselaer and Schenectady), and New Jersey (counties of Bergen, Passaic, Essex, Union, Middlesex, Monmouth, Hudson and Ocean).
3. Baltimore, Md.—New Jersey (all counties not included in second district), Pennsylvania (counties of Philadelphia, Delaware, all counties south of the Blue Mountains, and Franklin County), Delaware, Maryland, Virginia, District of Columbia.
4. Savannah, Ga.—North Carolina, South Carolina, Georgia, Florida, Porto Rico.
5. New Orleans, La.—Alabama, Mississippi, Louisiana, Texas, Tennessee, Arkansas, Oklahoma, New Mexico.
6. San Francisco, Cal.—California, Hawaii, Nevada, Utah, Arizona.
7. Seattle, Wash.—Oregon, Washington, Alaska, Idaho, Montana, Wyoming.
8. Cleveland, Ohio—New York (all counties not included in second district), Pennsylvania (all counties not included in third district), West Virginia, Ohio, Michigan (Lower Peninsula).
9. Chicago, Ill.—Indiana, Illinois, Wisconsin, Michigan (Upper Peninsula) Minnesota, Kentucky, Missouri, Kansas, Colorado, Iowa, Nebraska, South Dakota, North Dakota.

(*b*) The three items; a given figure first, followed by two letters of the alphabet, thus may be combined in 598 different calls, which will probably suffice for the amateur sending stations in most districts for some time to come.

(*c*) Radio inspectors will insert amateur station calls in station licenses according to this system, and will keep a permanent chart, of 598 squares, lettered with the alphabet from left to right and from top to bottom (A to W), inserting in the appropriate square the serial license number of the station to which the call letters were awarded. Within these limitations radio inspectors will use their discretion in the award of calls, avoiding, of course, duplications.

(*d*) When a station is abandoned and the license canceled, or if a license shall be forfeited for violation of law, the call assigned to it may be allotted to another station.

(*e*) If the entire 598 calls have been exhausted, radio inspectors will issue additional calls, consisting of the figure of the district followed by three letters. From such combinations should be excluded the combinations SOS, and PRB, all three-letter combinations beginning with QR or QS,

all combinations involving the repetition of the same letter three times, three-letter combinations beginning with K, N, W, X, Y, Z, and other combinations, which, for various reasons, international, national, local, or individual, may be objectionable. With such exclusions, over 10,000 calls will remain for each district.

LIMITED COMMERCIAL STATIONS.

Calls for limited commercial land stations will be allotted by the Bureau of Navigation in a special manner to indicate, if practical, the different radio districts over which such stations usually radiate messages, as well as to identify the stations.

SPECIAL CLASSES OF STATIONS.

Calls for special classes of stations, such as experiment stations for the development of radio communication, technical and training school stations, and special amateur stations will be allotted by the Bureau of Navigation.

The call will consist of three items, the number of the radio district, followed by two letters of the alphabet. The first letter will be: X, for experiment stations; Y, technical and training schools; Z, special amateur stations.

Twenty-six different combinations for each class in each district, of course, are possible. If more should prove necessary for any class in any district, a third letter will be added to the call.

Fire at Cape Race Station

The wireless system on the Newfoundland coast suffered a loss through the destruction by fire of the Cape Race operating house on May 5.

Immediately after the fire, work was commenced on the erection of a temporary station, and permission being obtained from the Department of the Marine and Fisheries of the Canadian Government, the Cape Race Lighthouse engine was belted to the wireless transmitting apparatus and the temporary installation put in running order. It is gratifying to report that within three days of the date of the fire a continuous twenty-four hour service had been again established and the station was able to effect communication with all vessels on the Canadian route.

The Cape Race station, erected by the Marconi Company which controls it as an aid to navigation for the Canadian Government, will be remembered as the station which first caught the distress signals of the ill-fated *Titanic* and immediately flashed the alarm to vessels in her vicinity.

In view of its importance as a strategic point, the new station building to be erected at Cape Race will be of a special fireproof construction. The new apparatus will be sufficiently powerful to maintain communication with vessels half way across the Atlantic.

Time Tests to Be Resumed

Beginning next October, extensive wireless tests, lasting six months, will be resumed between Paris and Washington on lines similar to those of the tests carried out under the auspices of the Bureau of Longitude last March.

A report on the tests already made by the French mission which visited Arlington was read to the French Academy of Sciences recently. According to it, despite unfavorable weather, important results were obtained. It was found possible to make frequent comparisons of time by the radiographic system, while on the night of March 28 Paris and Washington were able to converse. Attempts were also successfully made to photograph records of wireless signals.

When the tests are resumed next autumn the speed of Hertzian waves across the Atlantic will be determined. As at present calculated, the speed is equal to that of light.

The report also says that as soon as various Colonial wireless stations are completed, around-the-world tests will be made, with the Eiffel Tower as the first transmitting station.

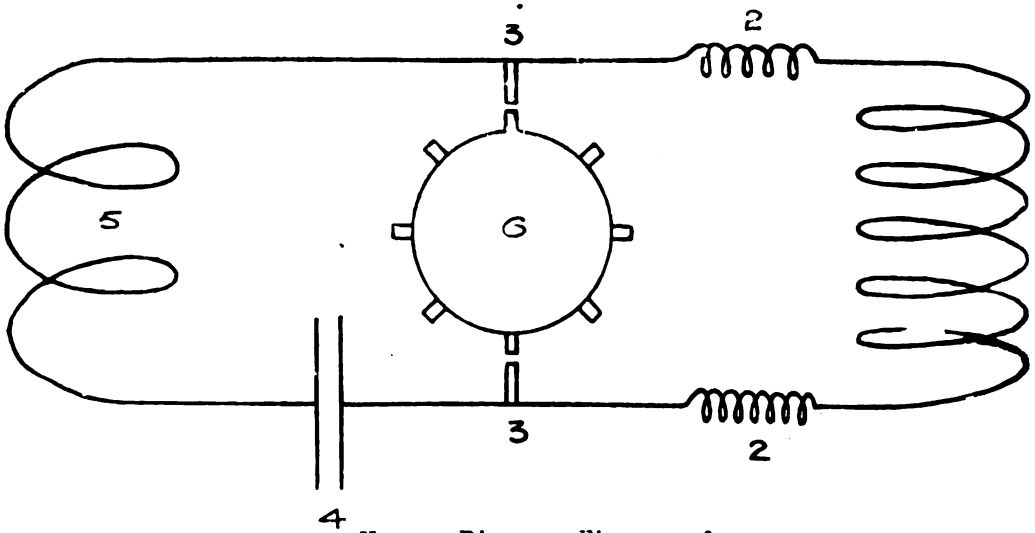
It is reported that a wireless telegraph message recently sent from Key West was picked up at Cairo, Egypt about 7,000 miles distant.

The Marconi Disc Discharger

THE Marconi disc discharger offers many advantages over other existing dischargers for the production of pure musical notes of high efficiency. No form of fixed condenser gives, under practical conditions, a pure note corresponding to the frequency of the alternator, because in order to obtain a pure note under these conditions the voltage must be absolutely constant. If the voltage is a little too low for the spark length, a spark will not pass at every half period, but will frequently miss, and thus give a mixture of alternator note and its lower octave. This makes it impossible to efficiently syntonize the receiver to the note. On the other hand, if the voltage is too high there is more energy than is required for the charging of the condenser to the voltage corresponding to the fixed spark length, with the result that each spark is prolonged into an arc giving a bad note and high damping.

In the disc discharger, on the other hand, a spark is never missed, because at the moment when the studs pass the fixed electrodes they are separated by a very small distance, and the length of the spark is not determined by this fixed distance, as the spark begins when the disc studs are approaching the fixed electrodes. If the voltage is lowered the sparks begin to pass when the disc studs have approached a little nearer to the fixed electrodes, but no sparks are missed. And in the same way, if the voltage is raised the sparks begin to pass a little earlier, but their frequency and note remain the same, and there is no tendency to arc, as the condensers are able to absorb and discharge the full amount of energy.

The following is a point in connection with the disc discharger which is frequently overlooked: While the spark is passing the disc stud is rapidly approaching the fixed electrodes, and thus reducing the length and resistance of the sparks, and consequently the loss of energy in the spark is considerably less than with fixed dischargers. By a suitable syntonization of the alternating current circuits to



Key to Diagram—Fig. 1.

1. *Transformer Secondary.*
2. *Protecting Chokes.*
3. *Fixed Electrodes.*
4. *Transmitting Condenser.*
5. *Jigger Primary.*
6. *Rotating Disc.*

the frequency of the alternator, the spark can be made to pass at the time when the alternator internal electromotive force is zero, thus preventing any tendency to arc, and the sparking points begin to separate before the secondary voltage has risen appreciably. Fig. 1 gives an idea of the way in which the condenser charging current, the condenser voltage, and the alternator internal electromotive force vary during a half period. When the alternating current circuits are perfectly adjusted the power factor approaches 100 per cent, and in practice power factors

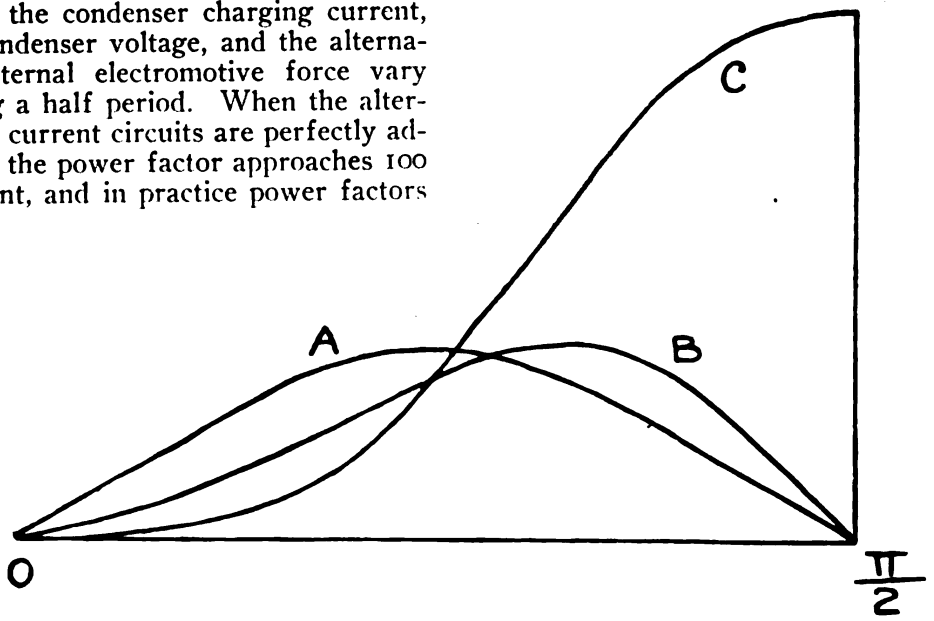


Fig. 2.—Key to Curves Illustrating Action of Disc Discharger During a Half Period 0 to $\frac{\pi}{2}$.

A. Alternator Internal Electromotive Force.
B. Charging Current.
C. Condenser Voltage
Discharge takes place at time $\frac{1}{2}$

of over 90 per cent. have been obtained. This, of course, facilitates the action of the manipulating key, and reduces the heating of the alternator and transformer.

In connection with the question of the efficiency of the different forms of discharger it is interesting to compare the action of the disc discharger, as described, with that of the two other types of discharger which are being used for the production of musical note sparks. The prevention of the formation of an arc, which is so easily effected by the mechanical separation of the electrodes of the disc discharger, presents some difficulty in the case of fixed dischargers. This is because the sparks follow each other at such short intervals that even the introduction of choking coils in the supply circuit does not suffice to prevent the formation of a continuous arc. It has, in fact, been found necessary to adopt special measures to put out the arc, either by blowing it out with a strong blast of air, or by using electrodes with a very large cooling surface, which is brought into close contact with all parts of the hot gases. In the case of the air blast discharger, the spark takes place directly between the electrodes, and is blown out into a bow shape by the air blast, its resistance being thereby rapidly increased, thus giving the worst possible conditions for the efficiency of the spark-gap.

In the case of the large cooled electrode discharger, the result is almost as bad, because, in order to effectively prevent arcing, it has been found necessary to reduce the length of spark-gap to very small dimensions, which, as well known, produces a very high-resistance spark.* In fact, in this case

*See Rempp, "Annualen der Physik," 1905, vol. 17, page 627, or Fleming, "The Principles of Electric Wave Telegraphy," 1906, page 186.

the increase in spark resistance is so great that the electrical oscillations in the spark circuit are very quickly destroyed, and the only energy available for transmission is the residue which has been transferred to the aerial before the primary spark was quenched. Those who are interested in the recommendation of this type of quenched spark discharger are very careful to impress on possible purchasers the fact that the energy is so quickly transferred to the antenna, and show interesting curves illustrating the manner in which they suppose this transfer to take place. But they naturally omit to mention the great waste of energy which takes place in the discharger before the transfer is complete.

Wireless in Vital Question

In an attempt to reduce the high cost of living Mayor John F. Fitzgerald, of Boston, has a plan to ask all coastwise steamers and United States naval vessels to report by wireless as soon as a school of mackerel is sighted. The mayor believes that giving masters of fishing schooners the exact location of the schools would greatly aid the fishermen and the public.

Crocker Land Expedition

After many setbacks, the Crocker Land expedition has completed arrangements for departure on its Arctic trip on July 3, under command of Dr. Donald B. Mac Milan in the ship *Diana*.

Crocker Land is a supposed large island or continent which was seen from a distance by Rear-Admiral Peary in 1906. Dr. Mac Milan hopes to learn denitely whether Crocker Land is really an Arctic continent, an island or only an illusion.

A large wireless plant, furnished by the United States Government, will be set up for communication to Cape Wolstenholme, in Hudson Bay, 1,600 miles away, where the Canadian government is completing a wireless station and will delay all messages.

A wireless station is being installed on Juan Fernandez Island—made famous by the story of Robinson Crusoe.

Canadian Traffic Facilities Increase

The duplex system at Louisburg, which is to work in connection with Glace Bay with the English Company's station at Clifden, Ireland, has been completed. Apparatus for automatic reception and transmission has been fitted at Glace Bay. Demonstrations held have resulted eminently satisfactory. The work on the installation at Clifden is also nearing completion. The Canadian Marconi Company is only waiting word from the other side to commence operations with the increased capacity. The company, therefore, announces officially that it will shortly be able to deal with practically unlimited trans-Atlantic traffic and, as has been proved by the demonstrations made, the rate of transmission and reception will be sixty to seventy words per minute on an average. It is further announced that great increase in revenue is anticipated from that branch of the Canadian Marconi Company's business.

Sues United Reorganization Co.

Trial of an action to impress a trust upon 150,000 shares of the stock of the Marconi Wireless Telegraph Company of America, valued at $1,500,000, was begun on May 27, before Justice Scudder in the Supreme Court, Brooklyn, by Joseph V. Witherbee, who named the reorganization committee of the United Wireless Telegraph Company and the Wireless Liquidating Company as defendants in the suit. Mr. Witherbee owns fifty shares of the stock of the United Wireless Company, which was declared a bankrupt in the fall of 1911.

The plaintiff believes that the shares of Marconi stock turned over to the Reorganization Committee in payment for the assets of the United Wireless Company should be distributed pro rata among the stockholders of the bankrupt.

In their answer to the complaint the defendants say that Mr. Witherbee and the stockholders he represents, since they did not comply with the conditions laid down by the Reorganization Committee, are entitled to no consideration.

AMATEUR CLUB NEWS

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.

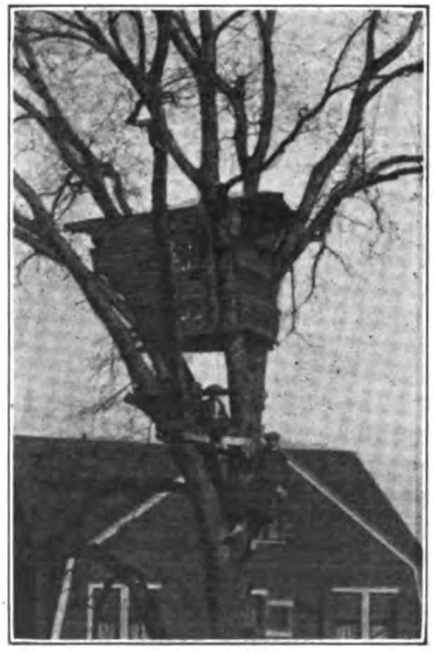
The illustration on this page gives a good idea of the unique office of the Robin Hood Wireless Club, located in a lofty elm tree on Mason terrace, Brookline, Mass.

A group of boys from Brookline High and Devotion Schools conceived this as the most startling office which could be devised for the purpose of attracting new members to their recently organized club, already set up in a nearby barn. The tree in which the office is lodged is one of the tallest on the slope of Corey Hill, the highest elevation adjacent to Boston, and the lads can see the country for miles around by poking their heads from its window. Not only this, they can grin down on the neighbors who predicted that the construction could never be accomplished.

The officers of the club, A. Leonardi (Di Pisa), president; E. Wason, treasurer; S. Nixon, secretary, are going to add loose coupling and a larger coil to the wireless equipment, so that they may converse with other wireless owners in Brookline. At present they are using a tuning coil, a combination detector and ½-in. sending coil.

* * *

Four members of the St. Paul Wireless Association have done some extra good long distance work during the past months. They have read the naval stations at Colon and San Francisco; and every night for a week the Key West station, besides, CX, SH, GO, MK, HX, DM, etc. These young men state that they have also heard the Cape Cod and Sayville Stations, but strange to say, no one in the twin cities has ever heard the powerful Arlington station, though they use loading coils, with their home-made instruments.



The office of the Robin Hood Club is lodged in a lofty elm tree.

Colgate is perhaps the first college in the country to add the wireless telegraph to its equipment in keeping its students in touch with the march of events in the outside world. The immediate need of the innovation was felt when it was found that the students could not learn the major league baseball results until the day after the games are played. Unsuccessful attempts were made to secure telegraphic reports of the results every evening, and in response to the insistent demands of the fans the college Y. M. C. A. decided to equip a wireless station on the hill and receive the tidings every night from New York. Arrangements have been made with a New York newspaper to receive reports at the close of each day from their wireless station. Bulletins are posted every night in the college postoffice in Taylor Hall, where the men scan them when they assemble for the evening mail.

The first private wireless telegraph station in Germany has just been erected at Halle. It belongs to a watch and clock factory there, and is designed to receive time signals sent out by the big Government station at Norddeich.

The army and navy authorities in Germany foresaw from the beginning the dangers and embarrassment, above all, from a military point of view, resulting from the indiscriminate construction of private stations, which was so well illustrated in the United States at the time of the *Titanic* disaster, and with the aid of the law giving the Government a monopoly of the means of communication have interposed an absolute veto on the construction of private wireless equipment.

Even the station now licensed will be equipped with receiving apparatus only, adapted to catching the time signals and nothing else.

Notable Patents

THE primary object of the wireless receiving transformer invented by Edward L. Colby, of Auburn, N. Y., is the provision of an apparatus of this character which is of comparatively simple and inexpensive construction and so designed as to make extremely sharp tuning possible and capable of preventing interference, tuning up weak signals, and cutting out unwanted stations.

Another object of the invention is to provide a novel arrangement of primary and secondary windings inductively related and having means whereby the effective length of the windings can be changed, there being combined therewith a shiftable or adjustable winding of varying effective length which is connected in series with either the primary or secondary and adjustable back and forth axially, with respect thereto for obtaining the desired inductive result between the primary and secondary windings under unusual conditions.

In the accompanying drawings, which illustrate one embodiment of the invention, Figure 1 is a perspective view of the receiver transformer, loose coupler or inductive tuner. Fig. 2 is a central longitudinal section. Fig. 3 is a transverse section Fig. 4 is an end view.

Similar reference characters are employed to designate corresponding parts throughout the views.

Referring to the drawing, 1 designates a tubular or other support for the primary and secondary windings, P and S, respectively, which windings may be formed of insulated wire or bare wire having their adjacent convolutions and layers insulated in a well-known manner. The windings are arranged on the ends of the tube 1 and separated by an air space at 2 between their adjacent ends. With the primary winding co-operates a slider 3 movable back and forth on a supporting conductor 4, whereby the effective length of the primary wind-

ing may be changed. The secondary winding may also be provided with means for changing the effective length thereof such as a slider 5 movable back and forth on a supporting conductor 6, which supporting conductors 4 and 6 are preferably fastened to the heads or end pieces 7 and 8 of the tubular support 1. These heads are connected together by a pair of longitudinal rods 9 whereby a rigid structure is formed.

Means is provided within the tubular support 1 for changing the inductive relation of the primary and secondary windings, such means taking, in the present instance, the form of one or more coils or windings 10, 11, 12 and 13, mounted on a tubular body 14 that is slidable back and forth on the rods 9, said body 14 having a rod 15 connected therewith and extending out of an opening 16 of one of the end pieces or heads and having on its outer extremity a knob 17 of hard rubber or other insulating material, whereby the small winding within the transformer can be moved axially of the primary and secondary windings. This adjustable inner winding may be connected in series with either the primary or secondary, but in the present instance, it is shown connected by a flexible wire 18 with the primary winding. Flexible taps 10*a*, 11*a*, 12*a* and 13*a* lead from the coils 10, 11, 12 and 13, to contracts 10*b*, 11*b*, 12*b* and 13*b* on one of the end pieces or heads, and co-operating with these contacts is a switch arm 19 which can move back and forth over the contacts and thereby vary the effective length of the inner adjustable winding. Any other suitable means may be employed for effecting this change. The switch blade 19 forms one terminal of the primary winding, while the other terminal is the binding post 20. The binding posts of the secondary windings are shown at 21 and 22.

With a device of the character referred to, a large variety of inductive effects can be obtained by shifting the sliders 3 and 5 of the primary and secondary windings; by shifting the

Fig. 1.

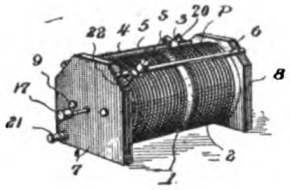


Fig. 2.

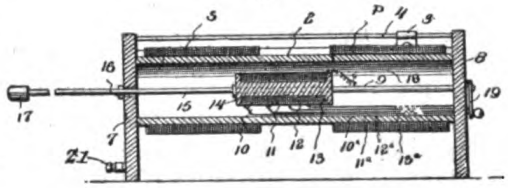


Fig. 3.

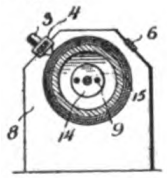
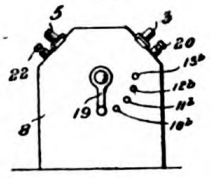


Fig. 4.



inner winding axially of the primary and secondary winding at the air g between them; and by manipulating the switch blade 19 so that it is possible to tune up weak signals to a considerable extent and otherwise give sharp tuning results.

* * *

Melville Eastham, of Cambridge, Mass., has been granted patents on a method and apparatus for producing tone effects in wireless telegraphy. In his specifications he describes his invention thus:

The objects of my invention are as follows: To produce tone effects, similar in musical regularity to those obtainable by the use of high frequency generators and synchronized spark interrupters, while employing generating apparatus of ordinary commercial frequency and securing the economy, advantage and efficiency due to the use of such generators. To eliminate the necessity for accurate tuning by effective damping of spark oscillations. To adjust the tone to any pitch desired within the practicable acoustic limits, particularly to regulate the tone pitch to suit the

peculiarities and limitations of telephonic receivers. To employ low potentials (as contrasted with those which have prevailed in the operation of wireless telegraphic circuits) by utilizing the acoustic efficiency of comparatively faint regular musical tones, as contrasted with unmusical irregular crepitations, and thus to facilitate the insulation of condensers and antennæ. To render the operation of wireless apparatus practically noiseless.

My invention is characterized by the production of a train discharge, and by breaking the normal continuity of the train into recurrent train groups, separated by intervals of no discharge, and determining the frequency of recurrence of these train groups; then producing a tone effect in correspondence to the train group frequency, and therefore independent of the generator frequency. The tone produced is the simple tone which corresponds to the frequency of recurrence of the group of trains and is not sensibly—or perceptibly at least—affected or modified by the generator cycle undulations, or by any superpositions of disturbing overtones or crepitations (by the trains themselves).

My invention may advantageously be practised with an apparatus such as illustrated in the drawings hereto annexed, in which—

Figure 1 diagrammatically represents parts of a wireless telegraphic circuit and shows a form of my novel spark gap device, in side elevation; Fig. 2 shows in diagram details of the spark gap devices; Fig. 3 shows in diagram certain details of the said devices; Fig. 4 shows a portion of a spark gap disk; Fig. 5 illustrates diagrammatically a single train discharge; Fig. 6 illustrates diagrammatically the separation of groups of train discharges, the groups occurring at acoustic frequency, independent of generator frequency, and Fig. 7 illustrates diagrammatically the division of discharge into groups of trains, the groups occurring as units at acoustically satisfactory frequency.

Referring to Fig. 1: G represents an alternating current generator set, which includes the step-up transformer T. The cycle frequency of the generator is preferably that of the usual commercial type and practice, say, 60. The circuit which is excited by the transformer T also, as usual, comprises the wires 1 and 2, capacity K, inductance T′ and a spark gap device, comprehensively designated by S. The frequency of the generator G is immaterial, except that for economy and convenience it should be low. Indeed the circuit which comprises the spark gap S may be excited by a constant potential generator. The spark gap device S is herein represented by two disks A and B; being mounted on the shaft C to rotate in the bearing D, driven by the pulley P from any suitable source of power; the disk A being mounted in the insulating plate E. Adjusment of the two discs A and B is provided for by securing the pulley P to the shaft C by means of a set screw *g′*, so that the face *g* of the pulley may be adjusted to bear on the end of the housing D and secure any desired spacing of the disk B from the disk A. The face *g* may be held against the housing by some simple means, as by leading the driving belt (not shown) from the pulley P at a slight angle. The housing D is extended to form a box to inclose the disks A and B, the core E, of insultaing material, being secured as shown. The plat A, mounted in the core plate E, may be provided with external fins or plates F, for heat radiating purposes. The two disks provide the spark gap in the circuit. The opposed faces of the disks A and B are circular. Each is milled to form salient sectors *a* on the disk A, and *b* on the disk B (see Figs. 3 and 4). The sides of these sectors are not truly radial, but are inclined to the radius by such an angle that when in the rotation of the disk B a sector *b* is symmetrically opposite the interval between two sectors *a* on the disk A, that is to say, is just midway between the two sectors *a*, the edges of the sector *b* shall

be parallel to the edges of the respectively adjacent sectors *a*, and distant therefrom by slightly more than the extreme sparking distance. The relation between the disks and their sectors is shown in diagram in Fig. 3, where the outline of the developed edge of the disk A is shown in dotted lines. The opposed parallel faces of the sectors *a* and *b* are brought close together by adjustment of the disk B so that the distance between them, measured parallel to the axis of the disks, shall be very small, say from four to eight thousandths of an inch. The two members A and B of the spark gap devices, or train interrupter, are composed of highly heat conductive material, such as silver or copper, and are connected in circuit as indicated in Fig. 1. The circumferential are subtended by a sector *a* or *b* is less than that subtended by an interval (*a'* or *b'*) between two salient sectors, preferably about three-fifths thereof. By making the two members A and B alike, an ample extent of surface is provided and arc formation effectively restrained. By adjusting the surfaces of the opposed salient sectors *a* and *b* so that they are but slightly separated, a spark may be established between them at relatively low potentials.

The operation of the apparatus is as follows: Assuming that a 60 cycle generator is employed the rotary sector disk B is rotated at such speed that each salient sector *b* passes an opposite sector *a* with high frequency as contrasted with the generator frequency, say 600 times a second. The establishment and interruption of spark communication thus will produce, say, 600 isolated train groups per second. If the circuit is, for instance, adapted to charge the condenser about 18,000 times per second the operation of the train interrupting devices will produce 600 train groups per second, with 15 discharges per group on the average assuming the discharge to take place about half the time. The number of discharges will vary from group to group, depending on the amount of power consumed in the circuit and on the stage in the generator cycle undulation at which a discharge occurs. The abundance of highly heated conductive material in the spark members causes effective damping of oscillations, so that the excitation of the coupled circuit represented at T^2 is by impact, and tuning is unnecessary. The rate at which the train groups occur can be regulated simply by regulating the speed of rotation of the disk B. The telephonic auditory receiver at the receiving station responds by emitting a clear musical tone of high acoustic efficiency, determined as to pitch by the train group frequency at the sending station above described. The shape of the salient sectors *a* and *b*, above described, insures such separation along the entire length of each sector edge as will produce spark discharge interruptions without fail.

The train groups produced by the above described apparatus according to my method will be established at that point where the potential attains sparking intensity, and will be discontinued when the decline of the electromotive force the potential falls below the sparking intensity. Theoretically therefore there will be interruptions in the regular continuity of the train

Fig. 1.

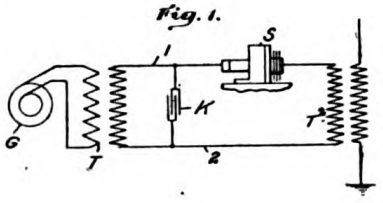


Fig. 3.

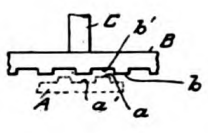


Fig. 2.

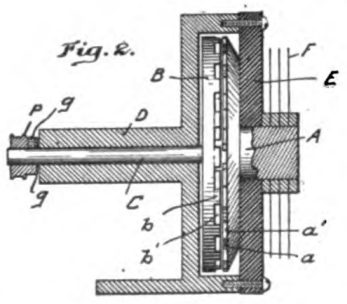
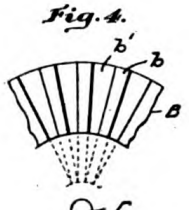
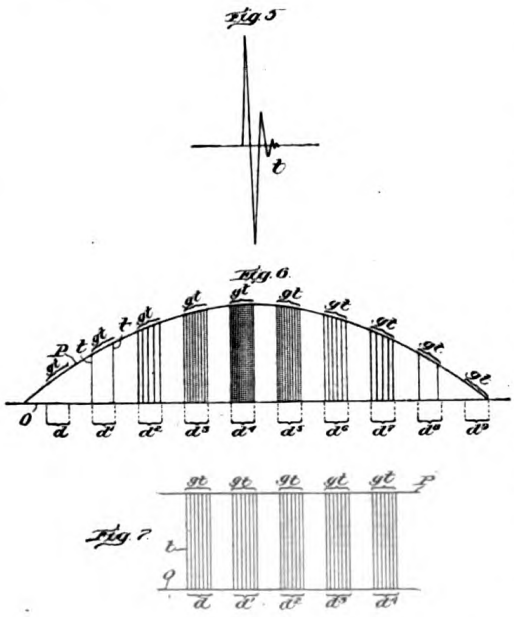


Fig. 4.



group series, and electrically speaking this discontinuity must exist. Acoustically, however, no such discontinuity is perceptible. It might be supposed that the recurrence of maxima in synchrony with the generator cycle would produce an undertone, but so far as I have observed this does not occur.

The high heat conductivity and relatively large mass of the sector disks and the metal part of the housing will suffice, in apparatus of moderate capacity, to control temperatures. It is advantageous to have the housing of these disks closed, since constant circulation of fresh bodies of air tends to oxidize the metal surfaces and thus deteriorates their efficiency. Complete closure of the housing also suppresses the noise of the sparking devices and quiets the operation of the apparatus.



The method may still further be explained by reference to Figs. 5, 6 and 7, in which the irregular line *t* represents a single discharge train, which oscillates to a point of rest in an infinitesimal of time. These trains follow each other with greater or less rapidity according to the stage in the potential cycle at which they occur, and, with a sparking apparatus as above described, the trains are produced only when segments of the spark terminals are within spark distance of each other. Thus, in Fig. 6, P denotes the current curve in the sparking circuit, during one-half a generator phase. The abscissæ laid upon the line of origin O, representing time elapsed, the times in which the positions of the spark terminal segments *a*, *b* (Figs. 3 and 4) will permit discharges are represented by the distances d', d^2, d^3, etc., to d^9. At the stage represented by d, suppose the potential too feeble to cause spark discharge, while at the stage d' the potential rise produces two discharge trains. The lines *t*, *t* each represent a discharge train such as is more completely illustrated in Fig. 5. At station d^2 the discharge trains number five. The two discharge trains which occurred during stage d' constitute a train group; so also the five discharge trains during stage d^2. Each train-group is designated as *gt*. For stage d^3 the train group *gt* comprises nine trains *t*, at d^4 twelve or more, while at d, d^6, d^7 and d^8, the falling current produces fewer and fewer train discharges to each group, while d^9, like d, is silent. If, as hereinabove suggested, a source of constant potential be employed, the frequency of the generator becomes zero; yet, with the provisions for producing regularly recurrent groups of train discharges, the result may be the same, acoustically considered, as with, say a 60 cycle alternating generator. Thus, in Fig. 7, P indicates constant potential, and O the line of origin on which time-abscissæ are laid off. d, d', d^2, etc., represent the regularly determined sparking stages, *t* the discharge trains, and *gt* the groups of trains, which, other conditions being supposed to be the same, will each comprise the average number of discharge trains *t* as represented by the cyclically increasing and decreasing group densities represented in Fig. 6. The silent stages which occur when alternating current generators are employed, do not sensibly affect the acoustic results.

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.

Wm. B. asks:

(1) Is a double slide loose coupler better than a one slide?

Ans.—Certainly, because one slider is connected to the antenna circuit and the other to the closed circuit, consequently you have a range of adjustment in wave-lengths which is decidedly of advantage. It also allows you to obtain resonance in both the open and closed circuits which could not be had with a single sliding contact.

(2) Whose loose coupler do you recommend for excellent work?

Ans.—We refer you to any of the advertisers in our publication, whose instruments you will find trustworthy and reliable.

(3) Are the Navy type 2,000 ohm 'phones the most sensitive?

Ans.—They are sensitive but not necessarily the "most sensitive." Excellent head-'phones are made by various companies. The American Marconi Company can furnish you with excellent head-'phones equal in construction and sensitiveness to any made.

(4) How much would they cost?

Ans.—Address a letter to the Engineering Department of the American Marconi Company, 27 William street, New York.

* * *

E. L. T., Alpha, Ill., requests answers to the following:

(1) How are wave-lengths measured?

Ans.—Wave lengths are measured by means of an instrument known as a wave-meter, which consists of a variable condenser and a coil of inductance. The pointer is mounted on the variable condenser and made to move across a scale which is graduated directly in wave-lengths. The actual wave-length reading on the scale is obtained by means of a crystal detector and a pair of head-'phones.

(2) Is there any formula for finding the sending radius of a station when the wave-length is given?

Ans.—No, because you might have a wave-length of 300 meters and a 5-kw. transmitting set, or you might have a 100-kw. set and use the same wave-length. There are formulæ for showing the distance a station will radiate when a definite wave-length is used with a definite amount of current value in the antenna. We refer you to pages 188, 189 and 190 of the "Naval Manual of Wireless Telegraphy for 1911," by Commander Robinson, giving Dr. Austin's formula for above.

(3) Is there any way to tell the receiving distance of a set besides testing it? If so, how?

Ans.—No. It is possible, however, to measure and calculate the energy required to operate a detector.

* * *

R. J., Muskogee, Okla., asks:

(1). What is the average life in hours of the valve detector used by the Marconi Company.

Ans.—600 hours.

(2). What instruments are necessary to use with this valve in order to obtain the best results? Can the ordinary amateur equipment, viz.: loose coupled inductance, variable capacity, detector, phones, etc., be used with this detector with good success?

Ans.—Fair results can be obtained with the ordinary receiving circuits, but for the best results the secondary of your loose coupler should have about double the value of turns ordinarily furnished with this equipment. Remember when you are using the valve detector, the other detector which you refer to should be "shelved."

(3). When an impedance coil is connected in series with an open core transformer on 110 V. A. C., does the

impedance coil itself take any current?

Ans.—Current does pass through the impedance coil and undoubtedly energy is consumed in overcoming the resistance of the same; however, ordinarily speaking, when an impedance coil is inserted in series with the transformer, the total consumption of current from the electric light mains is less than it would be with the impedance coil not in use.

* * *

W. S. F., Bridgeton, N. J., writes:

(1). What has become of the stations, "AX," "B," "BS" and "NF"?

Ans.—These stations are closed up with the exception of "B," the Baltimore station.

(2). Will you kindly tell me what the abbreviations "G," "QST" (Cape Henlopen uses "QST" before he sends the weather) and "TR," and what does Cape May (MCY) mean when he says "here"?)

Ans.—The abbreviation "G" is a Marconi signal to go ahead; this has been superseded by the International signal "K," which is a command for an operator to go ahead and transmit his business.

"QST" is a preliminary signal signifying a storm warning or weather report.

"TR" means "time rush" and is a comparison of time between a ship and shore station. It also serves to notify the land station that any particular ship is within the range of the station. The signal is void in the American Marconi Company. The word "here" is an American Morse abbreviation used on the U. S. telegraph lines to call attention, but its use in wireless work is illegitimate. The Berlin Convention specifies that "KA" should be used. The Marconi signal for the same purpose is "CQ."

* * *

J. H. M., Patton, Pa., tells the following:

During my experiments, which are conducted usually from 8 to 11 P. M. and often all night, I encounter some very strange phenomenon. Some I am able to work out, while others have me guessing.

In using a Clapp Eastham loose coupler in connection with other receiving apparatus, I can cut out high-tension line interference. By touching any metal part of secondary circuit I get noise that can be heard with receivers on table three feet away. With this outfit I have had best results and all goes O. K., until I touch something. The electric lighting in town is very defective, due to poor wiring. Can you give any suggestions?

In using a double slide tuning coil in connection with the usual receiving instruments I hear (C. I.), Erie; (B. F.), Buffalo, and other nearby stations. They come in good for a while, then gradually the sound decreases until they can no longer be heard. I may also be listening and have the signals start gradually and increase in strength. This I believe is due to aerial swinging unless I have been incorrectly informed. I have tried all forms of connections and have used all types of aerials, but cannot cut this out. It is to be noticed mostly during winter and on stormy nights. Do you know of any system by which this can be cut out?

Ans.—The inductive effects which you notice are undoubtedly due to the A. C. current power lines in your vicinity and we have no doubt that in your receiving apparatus you will experience a succession of "clicks" and unexplainable sounds which are due to high-tension currents which, especially in wet weather, cause sparks on the power line between "swinging" circuits.

Regarding the gradual increase and decrease of signals which you refer to: This does not lie in your instruments at all. It is a most noticeable factor in night transmission in the United States and is what is universally known as freak work, that is, in our zone of the universe a transmitter that will have a daylight range of 200 miles will manifest itself at night anywhere from 200 to 2,000 miles. There is always a soaring of signals in such freak transmission and the actual cause of it has not yet been explained. Sometimes it is due to poor construction of the transmitting apparatus, but more generally the causes are outside of our control.