THE WIRELESS AGE

APRIL, 1914

THE RADIO REVIEW

AMONG the many fine tributes paid to the memory of Ferdinand Kuehn of the ill-fated Monroe, this editorial in the Hartford Times is well worthy of reproduction:

"A Brave and Courteous Gentleman"

When the Republic sank, Jack Binns, her wireless operator, who went, immediately after the collision, to his key, and therewith expressed the fervent hope that somebody from somewhere would come hastily to the assistance of his companions and himself, became by virtue of this appeal a hero. There were the usual accompaniments of newspaper encomium, moving pictures and vaudeville offers.

The wireless operator of the Titanic, who cried out for help until he went to the bottom with the 1,500, was also a hero. So was the surviving operator who worked hard aboard the Carpathia.

Young Kuehn of the Monroe sent his spark shrieking for aid until the rising waters stilled his instrument. Then he stepped outside and took the life preserver from his body to give it to a woman passenger.

"I can get another," he said.

The terrified woman was not to have the added distress of knowing she had deprived a fellow human of his chance, although when he gave her that cork jacket Kuehn gave her also his life.

So if young Kuehn was not the kind of a hero we have been making in the newspapers these latter days he was at least a brave and courteous gentleman; as now, humble subordinate seafarer that he was,

Greater than Drake or Frobisher,
Than all their peers together,
He is a brave discoverer
And far beyond the tether
Of them that seek the frozen pole.

May his great voyage of discovery be the more glorious because of the knightly gallantry that signalized its start.

AFTER examining the junior Marconi wireless operator of the ill-fated steamer Monroe the Board of Steamboat Inspectors at Philadelphia reported that wireless telegraphy has yet to prove that it can prevent collisions of ships within a short distance of each other in a fog. The Inspectors did not know of the tests recently made on the steamer Northland, on the United States revenue cutter Seneca, and in the laboratories of the United States Navy of a direction finder, or "radio compass"—its technical name is

Eliminating the Dangers of Fog

radiogoniometer—which shows accurately the direction from which signals come.

This Marconi apparatus is independent of the regular wireless outfits on shipboard, and it requires no power for operation. It requires a separate installation of aerial wires, presenting two triangles that bisect each other at right angles. Its range is from forty to fifty miles, according to the size of wires employed. It can be manipulated very simply either by the wireless operator or by the navigating officer.

The direction finder should ultimately be relied upon quite as much as the foghorn, although the sounding apparatus can never be dispensed with until all vessels, big and little, have complete wireless equipments. But wireless has already been of great service in locating vessels in a fog. Messages exchanged between ships and shore stations have served to keep sailing masters informed about vessels near them, and experienced operators can gauge the proximity of another vessel by the increasing strength of received signals as the distance diminishes. The direction finder has not yet been adopted for general use on shipboard, but the installation is well begun.

Marconi's Patents Upheld

AFTER an admirably comprehensive study of wireless signaling from its almost historic beginning, in beacon fires on hilltops, down to the utilization of Hertzian waves, Justice Veeder of the United States Circuit Court has decided that Marconi was the first man to make of wireless telegraphy a practical means of communication and that the patents for which he applied in 1886 and secured in 1897, 1898, and 1904 are valid. As such litigation goes in matters of such financial importance, this is quick work, but that the decision just rendered should end the controversy—that it should put an end to any use of Mr. Marconi's devices unauthorized by him—would be expected only by those who have given no attention to the workings of our wonderful patent law.

Litigation over wireless telegraphy will doubtless continue, in one form or another, for years to come, but Justice Veeder's decision, confirming, as it does, others to like effect rendered in England and France, gives Mr. Marconi a strong position from which to conduct his battle. It is in harmony, too, with public sentiment everywhere, for there has never been any question in the general mind as to the originator of wireless telegraphy, or to whom fame and gratitude should be accorded for the almost inestimable benefits which the world has derived and will derive from this remarkable invention.

That in addition to fame and gratitude the inventor should have exclusive control of a means of communication so important, and should monopolize its profits, was vehemently denied by the counsel of his rivals, but the various Governments of the world are quite competent to protect themselves against abusive exploitation of the rights they grant.

BUT a few weeks ago foreign dispatches noted that Mr. Marconi had gone to Sicily to make some experimental tests of his wireless telephone scheme; and now reports are received that these tests conducted between vessels of the Greek navy, under the official supervision of the Duke of the Abruzzi, have proved entirely successful.

Successful Wireless Telephony

Marconi has repeatedly expressed his belief that he would be able to prove that telephoning without the intervention of wires is altogether as feasible as telegraphing without wires. Very recently wireless telegraphy was a chimera in the public mind; now everybody understands it is a certainty and apparently an indispensable necessity. The telegraph itself was once in the same position of doubt and so was electric lighting. So indeed was the propulsion of vessels by steam, and it is a fact that it is less than 100 years since the first successful ocean steamer went into the water.

What a period in the world's history the past 100 years has been! Sum up the achievements of that time and they seem to include almost everything greatly useful but the arts of printing and weaving. They include antiseptic surgery, the development of the cooking stove, heating by hot water and steam systems, photography, the extraction of the aluminium from clay, the Bessemer system of making steel, the development of the railway, discovery of the office of nitrogen bacteria and of the X-ray, anesthesia, the germ agency in disease—almost everything which gives people of the present day large control over the material world around them.

With successful wireless telephony added to the list no man can foresee what will yet be accomplished in the mystery of the universe of which we have only learned the rudiments.

Since Mr. Marconi is quoted as saying the problem of the wireless telephone has been "practically solved" it can, of course, be taken for granted that the quiet experiments in progress for several years have at last had the hoped-for success.

PERHAPS the solution of the "safety first" matter is going to come through the wireless agency on land as well as on sea.

During a recent blizzard, when the wires were down and railroad telegraphy was out of condition, the trains on the Lackawanna road were operated wholly by Marconi wireless and without mishap.

Anent the Railroad Slogan — Safety First

It is likely that the time will come when a wireless equipment will be a part of the outfit of every train and at least supplement the present more complicated outfit of poles, wires, block signals, etc., in the control of traffic whether in sunshine or in storm.

The Editor.

Marconi Wins Sweeping Victory in Patent Suits

AN opinion handed down on March 17 by Judge Van Vechten Veeder, of the United States District Court, Eastern District of New York, contains a sweeping decision upholding the validity and priority of the patents of Guglielmo Marconi. The opinion is a comprehensive and exhaustive compilation, reviewing the early history of wireless telegraphy from the speculative period down to the method in use by Mr. Marconi in 1904.

The decision was the outcome of two suits instituted by the Marconi Wireless Telegraph Company of America against the National Electric Signaling Company. One action was instituted on May 3, 1912. In this suit the plaintiff alleged that the defendant infringed the claims of Mr. Marconi's patent, No. 11,913, and the patent of Sir Oliver Lodge, No. 609,154 issued in 1898. In a second suit instituted by the Marconi Company on May 23 of the same year it was charged that the National Electric Signaling Company infringed the claims of Mr. Marconi's patent, No. 763,772 issued in 1904 for circuit tuning. The latter patent is a counterpart of the patents of Mr. Marconi which were sustained in Great Britain and France by the courts of these countries.

Particular stress was laid by the defendant upon publications and prognostications by various scientists previous to the discoveries by Marconi. It is emphatically held in the opinion that not one of these earlier publications disclosed a complete wireless telegraph system.

Marconi First in the Field.

After a chronological review of the events of the period prior to the taking out of Marconi's first patent in 1896 or in the words of the court, "To sum up the results of this period of speculation and experiment," the conclusion is reached that

No one had described and demonstrated the system of wireless telegraph apparatus adapted for the transmission and reception of definite intelligible signals by such means. This was the state of scientific knowledge and practice when in 1896 Marconi applied for his first patent.

The original Marconi patent dated July 13, 1897, and reissued June 4, 1901, is treated from every possible standpoint and in an interesting manner. Reference is made to the early tests conducted by Marconi and to statements made by representatives of various governments who had personally witnessed such tests.

The Bristol Channel Tests.

A particularly interesting quotation is cited. This was published in Berlin in November, 1897, and in it the noted savant and electrical scientist, Professor Adolphus Slaby, who had witnessed the wireless tests conducted by Marconi across the Bristol Channel on March 18, 1907, unconditionally expressed himself as to the novelty of Marconi's invention, giving the inventor the full honor for the discovery of a complete wireless telegraph system.

He says:

> What I saw was something new; Marconi had made a discovery; he worked with means the full importance of which had not been recognized, and which alone explained the secret of his success. I ought to have said this at the commencement of my subject, as at a later date, especially in the English technical press, the novelty of Marconi's process was denied. The production of Hertz waves, their radiation through space, the sensitiveness of the electric eyes—all are known. Very good; but with these means 50 meters were attained, but no more. In the first instance Marconi has devised for the process an ingenious apparatus which, with the simplest means of assistance, attains a sure technical effect. He has thus first shown how by connecting the appa-

ratus with the earth on one side, and by using long extended vertical wires on the other side, a telegraphy was possible. These wires form the main feature of his invention.

Particular stress is laid upon the value of Mr. Marconi's discovery of the vertical aerial wire and the connection to earth or water and the advantage he gained in adopting such methods. The opinion gives Marconi the full credit for the disclosure of the adaptability of such means. It says:

> I think that the described characteristics of the grounded vertical conductor plainly indicate its utility for a long distance transmission, as does also the statement that "the larger the plates of the receiver and transmitter and the higher from earth the plates are carried the greater is the distance at which it is possible to communicate."

After a review of some of the earlier publications mentioned by the defendant in which it is claimed that disclosures as to the value of the aerial wire and ground connection had been made prior to Marconi's discovery, it is stated in reply in one case:

> The defendant's contention is untenable.

In another case it is said:

> The fact that Lodge made no reference to ground connections in his subsequent lecture on the work of Hertz shows that his earlier statement is nothing more than an incidental reference to an abandoned experiment.

Evidence Supports Inventor's Claim.

The opinion adds:

> Accordingly I find that **the evidence establishes Marconi's claim that he was the first to discover and use any practical means for effective telegraphic transmission and intelligent reception of signals produced by artificially-formed Hertz oscillations.**

The Lodge patent dated August 18, 1898, is discussed in detail, and he is given the credit for the first realization of the advantage to be derived in the matter of sharpness of tuning by the use of feebly damped or more persistent oscillations. However, it should not be forgotten that in Marconi's original patent he specified that his elevated capacity areas or plates are "preferably electrically tuned with each other," that is, of similar electrical dimensions. It cannot be denied that Marconi thoroughly understood at the date of issue of his first patent the necessity of tuning the open circuit of his transmitter to the open circuit of his receiver.

Comparing the early work of Hertz in his experimental investigations in respect to tuning with that of Marconi at the time of his discovery of the complete wireless system the opinion states:

> While Hertz effected whatever tuning was possible in his structure by adjusting the capacity and inductance in the closed receiving circuit, Marconi adjusted the capacity of his open transmitting and receiving circuits.

The Discovery of Lodge.

Mention is then made of the fact of the inability of an open oscillatory circuit, not having a self-induction coil in its path, to accumulate sufficient energy to emit feebly damped waves. While it was true that the use of self-induction coils in connection with closed oscillatory circuits was old, their value had not been sufficiently demonstrated prior to the work of Lodge.

The opinion continues:

> Lodge solved the problem by a compromise between the radiatory and oscillatory qualities of his transmitter on one hand, and between the absorbing and accumulating qualities of his receiver on the other hand. He was the first to realize that if he could get a long train of waves he could afford to diminish the amplitude of the first few of them, the desired result being secured by cumulative effect. The principle disclosed by him was that, although a radiator with several swings is less violent at its first impulse than a momentary emitter, the lessened emitting power of a radiator may be largely compensated by a correspondingly prolonged duration of vibration on the part of the receiver or absorber, thus rendering the radiator susceptible of tuning to a special similarly tuned receiver. The tuned receiver then re-

sponds, not to the first impulse of the radiator, but to a succession of properly tuned impulses, so that after an accumulation of the first few swings the electrostatic charges in the terminal plates become sufficient to overflow and spit off into the coherer, thereby effecting its stimulation and giving the signal.

While Lodge undoubtedly understood the sharp resonance effects to be had in the use of feebly damped oscillations his apparatus left much to be desired in obtaining long distance communications. Even while recognizing the value of his system, he stated in one of his publications: "For the most distant signaling the single pulse or whip crack is the best." Thus for covering distances, according to his own statements, it would be necessary to revert to the apparatus of Marconi.

These difficulties were later solved by Mr. Marconi himself and the method was completely disclosed in the Marconi patent of June 28, 1904. A lengthy discussion is devoted to this patent. This is the famous "four circuit" tuning patent which covers the basic principles upon which all wireless telegraph systems in the universe depend.

The opinion states that although Lodge in his 1898 patent had come forward with a new idea he recognized the impossibility of having a circuit which should be at once a good radiator or absorber and a persistent oscillator. He therefore proposed a compromise.

Difficulties Overcome by a Compromise.

To quote the opinion:

He increased the persistence of vibration of his radiating circuit at the expense of its radiating qualities, and increased the accumulative power of his receiving circuit at the expense of its absorbing qualities. Effecting this compromise by means of the introduction of an inductance coil in an open circuit, he obtained a train of waves of approximately equal amplitude and thus rendered effective syntony possible. But the syntony thus obtained was utilized for selectivity alone. It was attained at the expense of the radiating and absorbing qualities of the circuit; and Lodge still supposed that for distant signaling the single pulse or whip crack was best.

Improvements Made by Marconi.

Marconi's improvement, in his second patent, upon his own prior apparatus, and his solution of the difficulty involved in Lodge's compromise consists in the substitution for a single circuit in both transmitter and receiver of a pair of circuits, one of which is so constructed as to radiate or absorb readily, and the other to oscillate persistently and be a good conserver of energy. By using two linked circuits in his transmitter, in which the circuit of the primary contains a condenser of any desired capacity, with the usual provision for its discharge through the spark gap, and in the circuit of the secondary the vertical wire, any required energy may be imparted to the radiator, since the closed circuit of the primary is a good conserver or reservoir of energy for the radiating open circuit of the secondary. This arrangement would be futile, however, without means whereby the stored energy of the reservoir circuit could be transmitted to the elevated conductor at the rate at which that conductor could effectively radiate it. The mode of getting the energy from the reservoir circuit into the radiating circuit, in like measure as it is radiated, is the tuning of the persistently oscillating circuit to the radiating circuit. In this way the principle of resonance is fully utilized between the two circuits. Similarly, the two circuits of the receiver are linked through a transformer so that electrical oscillations in an open and absorbing primary build up similar oscillations in a closed and conserving secondary until the coherer breaks down. Finally, the four circuits must be tuned together.

That this apparatus overcame the difficulties emphasized by Lodge is not disputed. Where Lodge compromised, Marconi reconciled.

The opinion distinctly states that with Marconi's apparatus he was not only able to obtain the persistency of oscillation of the apparatus of Lodge, but also obtained such effects without any sacrifice of radiating qualities, and furthermore allowed an increase in the available amount of energy drawn from the local circuits of the transmitter.

The opinion continues:

> With this definite control over radiation effective selectivity was maintained. . . . In combination with the increased available energy in the transmitter the distance over which messages could be sent was enormously increased.
>
> **With this apparatus Marconi communicated across the Atlantic in 1901, and the claims in issue constitute the essential features of apparatus which has since made possible communication over a distance of 6,000 miles. It is used in more than 1,000 installations by Marconi, and is admittedly an essential feature of the wireless art as at present known and practiced.**

In connection with the claims of the defendants that various inventors had disclosed previously to Marconi his method of "four circuit" tuning, the opinion in each instance disproves and casts aside the allegation. There is no proof or mention whatsoever in the publications or lectures of Fessenden that he recognized the necessity of "four circuit" tuning in a complete wireless telegraph system.

Tesla's Conception Remote from Marconi's.

In reference to the patents of Tesla which now and then are brought to the front as being prior disclosures of the inventions of Mr. Marconi in respect to "four circuit" tuning, the opinion clearly states the impossibility of obtaining wireless telegraph communication with apparatus such as Tesla describes, for by calculation it is shown that the local oscillatory circuits of the Tesla transmitter were vibrating at a wave length of 1,200 meters while the elevated wire, which he suggested should be somewhere in the vicinity of from six to seven miles in height, would have a wave length of from 28,000 to 56,000 meters. The coupling up of these two circuits would in no sense bring about a condition of resonance and Tesla's conception was entirely remote from the subject matter of Marconi's patent.

In reply to the argument of the defendant that Dr. Pupin had been instrumental in the discovery of "four circuit" tuning, ample evidence was introduced to disprove such statements, closing the matter once and for all.

Summing up certain statements made by Dr. Pupin in 1899 the opinion states:

> It is absolutely incompatible with the supposition that Pupin himself or anyone else so far as he knew had solved this problem.

Mr. Nally Talks of the Decision.

Edward J. Nally, Vice-President and General Manager of the Marconi Wireless Telegraph Company, commenting on the decision of Judge Veeder, said:

> The Marconi Company is much gratified because the Court sustains the validity of all three patents and holds that the Lodge patent and the Marconi patent, having the longest term to run, are infringed. The eulogistic remarks in the opinion as to both Mr. Marconi and Sir Oliver Lodge as inventors are also exceedingly gratifying to the company.

Mr. Nally believes that the ruling will be upheld in the higher court if an appeal should be taken, and that this decision will have a far-reaching effect on competing wireless companies and also upon steamship companies proposing to acquire wireless telegraph apparatus from competitors of the Marconi Company. He spoke further concerning the decision as follows:

> Practically all other companies use the basic principles involved in these patents. In some of them there is a slightly different form, but they all use the Lodge patent in some way or other, and they also use Mr. Marconi's four-circuit tuning principles. These patents cover devices which tend to make commercial wireless telegraphy a practical thing and a financial success. By this decision, Marconi is now for the second time officially recognized in this country as the inventor who made commercial wireless telegraphy a possibility, and without Marconi and Lodge there would be no practical wireless telegraphy; to them belongs not only the credit for the invention, but the returns.

Setting the Clocks of the World by Wireless Telegraphy

M. Darboux, who presided at the International Time Conference

WHETHER in the wastes of the Sahara Desert, or on populous Broadway, New York City, you can to-day, through wireless telegraphy and the efforts of the International Time Conference, set your watch to the exact moment of the zone you may be in. The mariner, lost on the seas, can obtain the time from the air and steer his vessel accordingly; the explorer, wandering aimlessly over the ice fields of the far North or through the wilds of Africa, can ascertain his position by means of the radio signals sent from remote points.

Time, as is well known, is regulated by the travels of the sun. Therefore if watches indicated the true hour they could not be correct in two places east and west of each other. The difference in time is quite perceptible even in places close together. At noon in City Hall in New York it is 12h. 00m. 21s. at the Brooklyn Navy Yard, and 11h. 59m. 39s. at Newark. The sun rises at New Haven, Conn., 4 minutes, 11½ seconds before it creeps over the horizon in New York. Between the time at New York and Sandy Hook there is a difference of seven seconds.

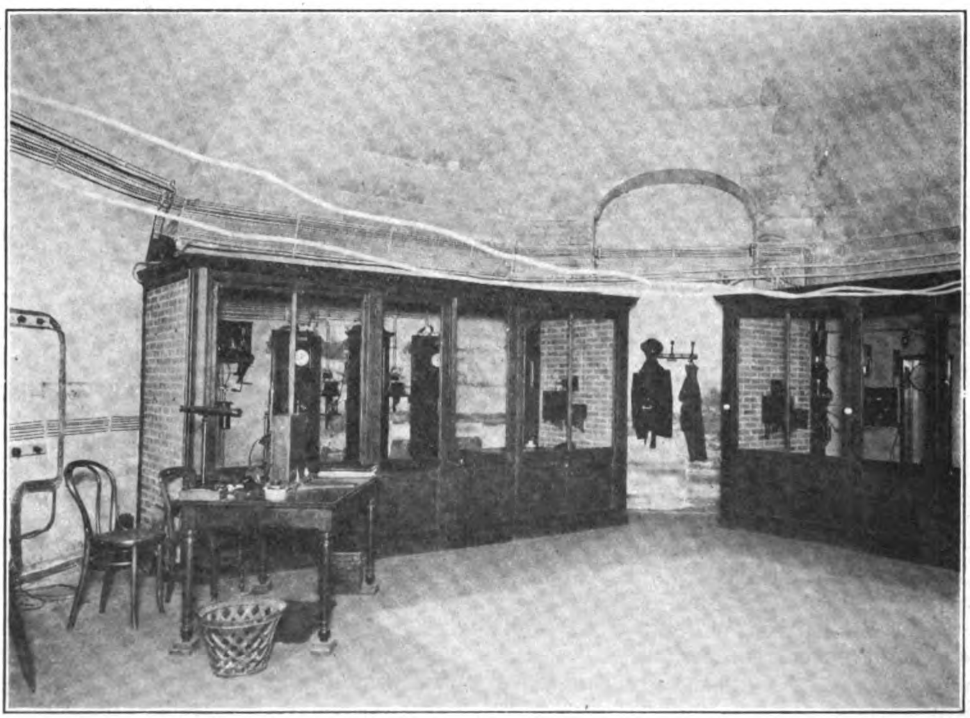
With the appearance of the first watches came the difficulties of attempting to keep correct time. It was obviously necessary to establish a uniformity of time and consequently various cities adopted a certain standard by which to set their clocks. Afterward the countries of the world adopted a standard of time. The standard of time in the capital or most important city in each country was selected. The clocks in England were set to conform with Greenwich time, those in France to that of Paris and those of Ireland to that of Dublin.

Difficulties were met with when this plan was applied to America and other nations similar to it geographically because of the vast extent of territory. This is illustrated by the fact that the difference in actual time between the Eastern and Western states in this country is so great that when it is noon in Maine it is only about eight o'clock in the morning in Oregon. The difference in time in Canada is even greater.

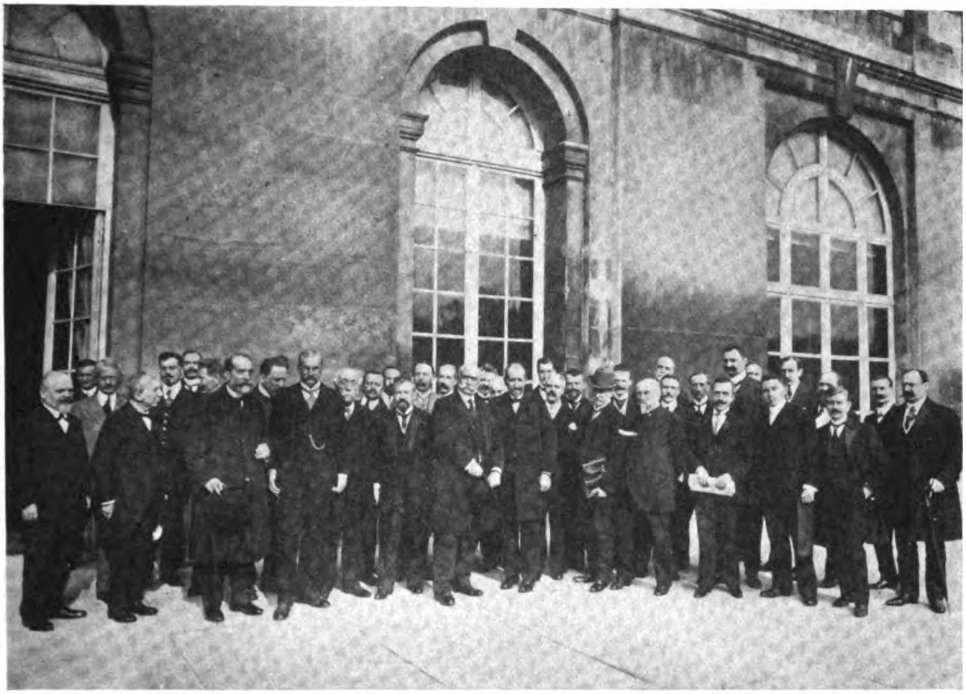
Sir Sandford Fleming, a Canadian statesman, evolved the idea of time zones. Canada first put into practice his suggestion and the United States afterward adopted it. The entire continent under this plan is divided into zones running north and south, in each of which the time used is that of its central meridian. These zones are fifteen degrees in width; in each the time is one hour in advance of that in the next zone to the west of it and one hour behind that in the zone adjoining it on the east.

Professor Charles Nordmann, astronomer of the Paris Observatory, has likened the earth to a melon with twenty-four sections. It has been agreed, as the sun apparently makes a circuit of the earth in twenty-four hours, to divide the earth into twenty-four zones each of fifteen degrees, running from pole to pole. All over each zone the time is that of its central meridian.

The reckoning begins in the zone which is bisected by the meridian of Greenwich, from which longitude is counted east and west. Each country, until a few years ago, reckoned longitude east and west of an arbitrary meridian of its own. International commerce and wireless telegraphy, however, are bringing the various points of the world closer together, and it was therefore necessary to determine upon a common meridian. France, by setting her clocks to Greenwich time, decided the question; to-day Greenwich time is the basis upon which all but a few of the countries set their clocks. Russia still has a time system of its own and Holland remains loyal to Amsterdam time; Ireland sets its watches by Dublin time. Greece and one or two other countries remain independent of the common meridian. The international time union, however, in-



This photograph shows the Hall of Time Clocks in the Paris Observatory. Paris is called the time capital of the world, and the Central Time Bureau is at the Observatory in that city. From the Observatory run wires to the antennæ on the Eiffel Tower



Group of members of the International Time Conference. These men arranged a time table for the world and adopted the laws governing it. Central points all over the globe were chosen to send the time broadcast twice a day by means of wireless telegraphy

cludes both North and South America; all Africa, all Europe with the exception of the countries mentioned; China, India and Australia.

The International Time Conference governs the time of the nations and Paris is the official time capital of the world. The Conference has arranged a time table for the world and adopted the laws governing it. Central points all over the globe were chosen by the Conference to send the precise time broadcast twice a day by means of wireless telegraphy.

The places from which the time is announced are as follows:

San Fernando (Brazil), Arlington, Va., Manila, Mogdishu (Magadoxo), on the coast of Italian Somaliland; Timbuctoo, Norddeich (Germany); Massowah (Eritrea) and San Francisco. It is planned to add Melbourne, Australia, and Tananarivo, Madagascar, to this list of wireless time stations. In order to prevent confusion the time is signaled in a code that is independent of language and can be understood by all nations. Greenwich time is sent from each center. Three minutes are required to send each signal, which is divided so that the recipient has abundance of time to regulate his chronometer by it.

The Eiffel Tower in Paris begins sending signals at 9h. 57m.

From some stations these signals are sent twice a day and from others once, but at different hours. Paris sends signals at oh. (midnight) and at ten o'clock. San Fernando sends at 2 and 16; Arlington at 3 and 17; Manila at 4; Mogdishu at 4; Timbuctoo at 6; Norddeich at 12 and 22; Massowah at 18 and San Francisco at 20.

It has been necessary in the past for explorers, geographers and surveyors to rely upon the accuracy of the chronometers they took with them in order to calculate their longitude. Wireless time signals were used in surveying the frontier between French and Spanish Morocco. A similar method will be used to survey the Congo-Cameroons frontier and that of French Guinea and Liberia. The Belgians have used the same method to survey their Congo possessions.

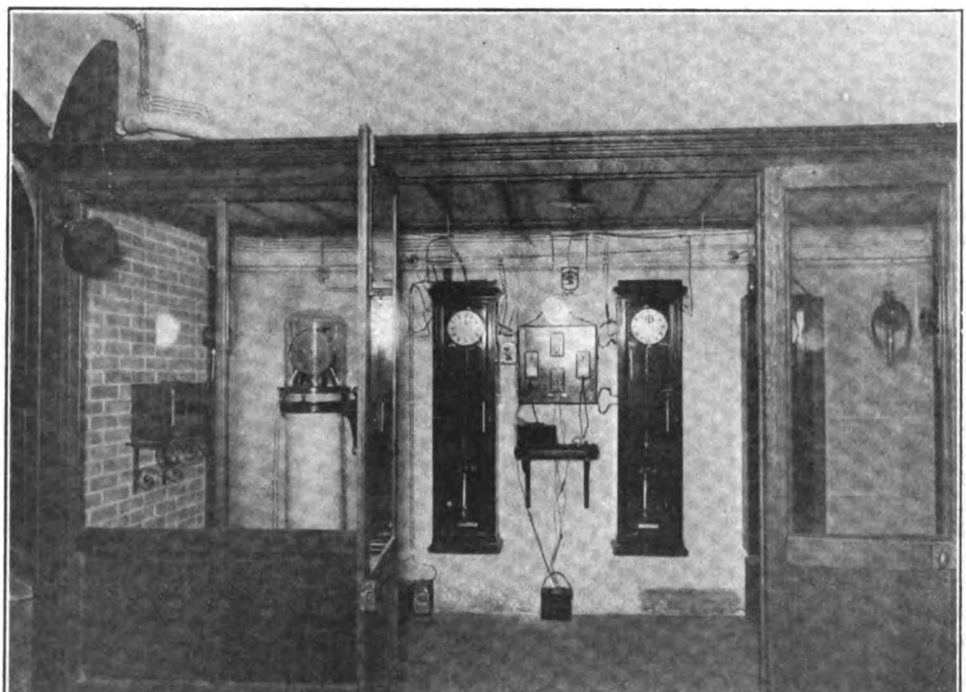
Commandant G. Ferrie, of the French

Navy, has interesting views concerning the use of wireless time signals. He says that the principal disseminating agents of the time had been the railways and the telegraph, for which the knowledge of the precise time is particularly necessary. The principal centers of administration received the time directly from the neighboring observatories, by telegraph or telephone, and retransmitted it in like manner to the important stations or telegraph offices. These sent it again to other secondary points where special agents or watchmakers received it and transmitted it to widely scattered places by means of watches which served to regulate public clocks, from which, finally, individuals took their time.

The number of retransmissions necessary before the time from an observatory reached any particular clock was often very considerable, and the precision obtained was slight because of the accumulation of errors of the intermediaries. For the needs of individuals this defect in exactitude generally had no serious inconvenience; but it was not so with public services—the railroads for instance, where a relatively small error in time at a station might cause an accident. Navigators required still greater precision; for geodists, seismologists and explorers the precision necessary was still greater.

The use of wireless telegraphy avoids all the difficulties and solves all the problems by suppressing totally, when necessary, all the intermediaries between an observatory and any particular clock. All that is necessary is to connect the observatory with a wireless station equipped to send time signals. These signals, sent out in all directions with the speed of light, can be perceived on land or sea at considerable distances by any number of operators having timepieces to regulate.

M. Darboux is president of the International Time Conference. He has remarked very aptly that "the same sun shines successively all over the world, determining in his course this universal time of which we aspire to be not the masters but the servants."



Receiving time at the Paris Observatory. The use of wireless telegraphy eliminates difficulties by suppressing totally, when necessary, the intermediaries between an observatory and any particular clock. The stations keep so closely in touch with one another that they can compare notes without difficulty

How to Conduct a Radio Club

By E. E. BUTCHER

ARTICLE III

WIRELESS apparatus of the nature described in the preceding article should be constructed under the personal supervision of the president of the Radio Club.

The possession of an ultra-sensitive receiving apparatus of this type, the direct result of the members' labor, will bring a sense of satisfaction, amply repaying the effort expended. The president of the club should at all times require accurate workmanship, counseling the members in this respect from time to time, for once the method of doing things well is acquired it easily becomes a habit.

Very often the careless amateur will be inclined to the belief that definite principles need not be followed in order to obtain certain results, an assumption based on the generally accepted opinion that anybody can make wireless apparatus. Nothing could be further from the truth, for experience has proven that success comes only to the experimenter working with scientific accuracy.

Delicate apparatus should be placed in the hands of the senior members known to be skilled in the wireless art. A committee should be appointed to determine those qualified to operate such apparatus and all others should be excluded until they have acquired a certain degree of knowledge of amateur wireless telegraphy.

Since the appearance of the January issue of THE WIRELESS AGE a number of inquiries has been received from wireless organizations on the relative merits of Fleming valve and Audion detectors. These communications invariably request information as to whether the Fleming valve is available as an amplifier.

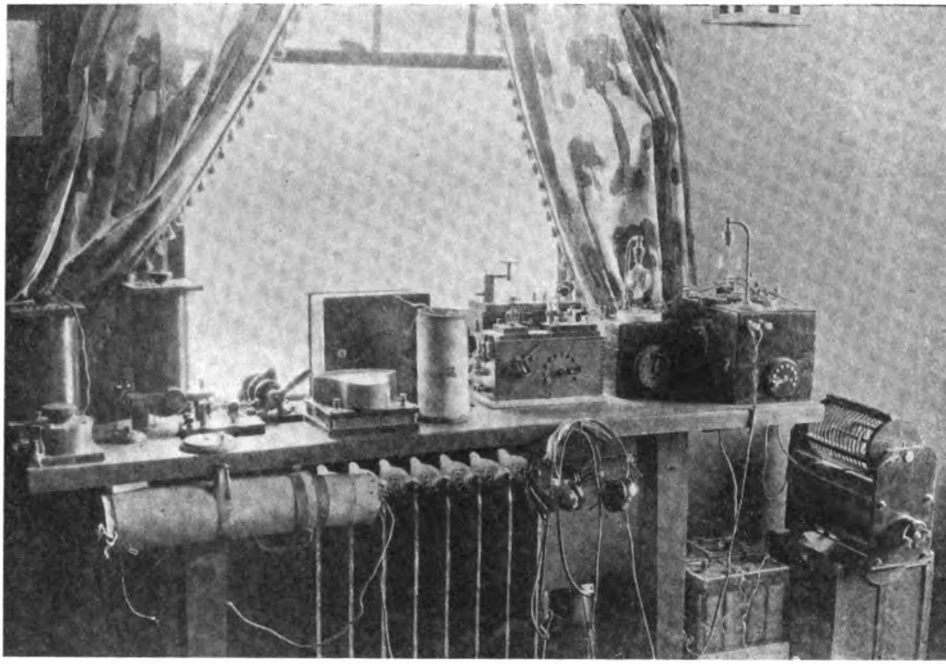
This, the writer's reply, must not be considered as the final analysis of the situation, but an unbiased opinion based on several years of experiment: While the Fleming valve is not quite so sensitive as the Audion—that is to say, will not give the same intensity of signals produced by the Audion under similar conditions—yet it is not so difficult to adjust, and apparently has longer life. Consequently, from the standpoint of commercial practice, the Fleming valve is the more desirable of the two.

Commercial equipments should not be encumbered with "laboratory" devices. The apparatus should be capable of easy handling, quick adjustment and protected against loss of sensitiveness. The amplifier, in the writer's opinion, is more or less a "laboratory" device of considerable scientific interest.

Regarding the "hook-up" for the valve as an amplifier: Apparently, the Audion and the valve work on a different principle and to date the Audion is the more successful as an amplifier. Some promising experiments with the valve as an amplifier are now in progress, but details of this "hook-up" are not available for publication.

Among the inquirers, "T. B. Jr." seems to have had more experience with the Audion than the average amateur. He says in part: "I note that the Audion decreases in sensitiveness and the adjustment of the voltage for best results is not the same from day to day. Is the same true when the Audions are used as an amplifier? Is there any method by which this gradual decrease can be corrected?"

The inquirer has already found out that when the sensitiveness of this de-



The daylight range of this club receiving apparatus is 1,400 miles; the night range, 2,800 miles

tector is on the verge of decline variation of the voltage of the filament battery and a corresponding correction in the high voltage battery will maintain normal working conditions to a marked degree. This is not a difficult adjustment, but an understanding of the method can only be attained through practical experience.

A New Method for Retaining the Sensitiveness of the Audion

The writer has made a number of experiments with Audion bulbs under rather unusual conditions and has found that when any particular bulb has become critically weakened it may be restored to a considerable degree of sensitiveness in the following manner: A cardboard or other insulating tube 3½" in diameter by 9½" in length, is wound closely with No. 30 S. C. C. magnet wire in the same manner as the coils of a receiving tuner. This winding is then connected to an 8 or 10 volt dry-cell battery in series with which is connected a 10 or 15 ohm battery rheostat. A tubular magnetic field is produced, the intensity of which may be regulated by means of the rheostat. The circuit for this arrangement is shown in Fig. 1.

If the tube is then placed directly above the Audion bulb in such a manner as to cause the magnetic flux to act directly upon the vacuous space a considerable increase in the strength of radio signals may be expected. Although it has not been proven, the explanation offered is that the magnetic field so produced materially assists the passage of the ions from the filament, hence the increased sensitiveness.

The polarity of the magnetic flux issuing from the tube is important and must not be overlooked. Of course, it may be reversed by changing the direction of the flow of the battery current. The strength of the magnetic flux is not necessarily regulated by the rheostat; the same effect may be obtained by simply raising or lowering the tube as indicated in Fig. 1. The tube should be so mounted that it may be gradually raised and lowered. During more recent experiments it was found that for best results with a certain Audion, the tube should be placed 12 inches above it. The test also indicated the necessity of very careful regulation of the magnetic field. It was further observed that with some Audion bulbs the tube did not give increased strength of signals, but a decided decrease. When a triple amplifier is used the magnetic tube seems to be of no assistance to the first Audion, but if applied to the second or third bulb an increase of signals to five times the original strength is obtained.

One of the decided peculiarities noted was the fact that when the magnetic field from the tube was abnormal in strength the Audion suddenly became inoperative; in some cases it required a wait of a minute or two (without any changes of voltage adjustment) to restore normal conditions, and then it seemed to have been accomplished automatically.

In another experiment the electrical conditions inside the Audion bulb were completely changed through simply exciting the secondary of the receiving tuner (while connected to the bulb) with a magnetic field produced by a 60-cycle alternating current. It necessitated a complete change of the filament voltage and the local circuit voltage to obtain best results. The effect, however, was to increase the sensitiveness. From these preliminary experiments it is at once evident that the progressive amateur has before him a field of research having unlimited possibilities.

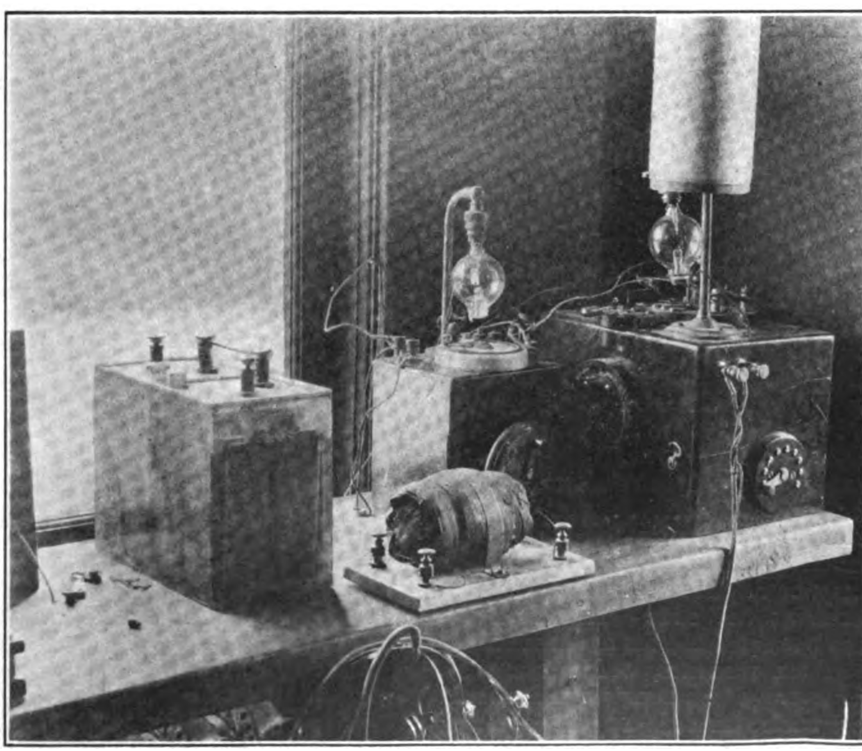
Members of radio clubs should construct this device and give it a thorough test.

Telegraph Codes

It is a matter of no small importance that members of wireless organizations become good telegraphists.

The necessity for such knowledge arises primarily from two sources: first, because the United States laws require the wireless telegraph amateur to be capable of receiving a certain number of words per minute before he is allowed a license, and none but licensed telegraphists are allowed to manipulate the equipment at a radio club.

Second, experimental tests cannot be



If the magnetic tube is placed directly above the Audion bulb a considerable increase in the strength of signals may be expected

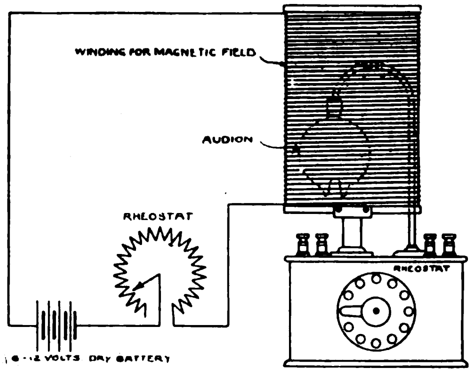


Fig. 1.—Details of the circuit for increasing sensitiveness of the Audion

conducted skillfully unless the one in charge is a capable operator. Knowledge of the code removes all doubt as to what station is doing the sending, and observation of the uniform regulation of commercial message traffic gives one a general idea of the wireless practice not otherwise obtainable.

The radio engineer lacking the ability to manipulate the telegraph key is seriously handicapped. It should be the aim of every club to assist members toward early skill in key manipulation.

Code Practice

Generally speaking, proficiency in the telegraph codes cannot be acquired quickly. From six to twelve months of steady practice are ordinarily required to attain a speed of twenty words per minute. Therefore it is almost essential that the club should be equipped with a buzzer, telegraph keys and head phones, making an artificial wireless telegraph system for the members and students of the club to practice upon.

A plan for an arrangement of the table, together with a circuit diagram of the connections to be used, is given in Fig. 2. The actual dimensions are shown, but these may be adjusted to suit the available room at the club. The arrangement has been planned for the accommodation of ten students, which is ample for the average amateur organization. Another table, known as the master table, is placed crosswise to the practice table. The apparatus for the production of artificial signals is mounted on the master table, where it is under the direct charge of the instructor in the code.

After the officers of the club have decided as to the arrangements suitable for their needs they should make a thorough study of the circuit diagram as shown in Fig. 2, an explanation of which follows:

An ordinary buzzer, A, energized by either dry or storage cells, B (4 to 6 volts is sufficient), is used to operate the lead phones, P, P^1, P^2. The circuit to the buzzer is so arranged that it may be closed by the master key, K, or any of the keys, K^1, K^2, K^3. The head phones, P^1, P^2, P^3, etc., are connected in series with the condenser, C, which preferably has capacity of the order of two microfarads. The later circuit is then shunted around the contacts of the interrupter of the buzzer, A.

The operation of the device is simple. The counter-electromotive force produced by the rapid make and break of the cur-

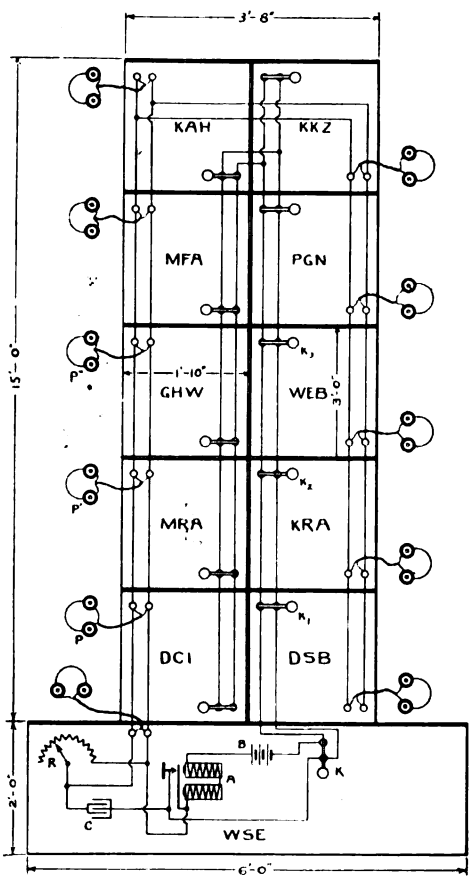


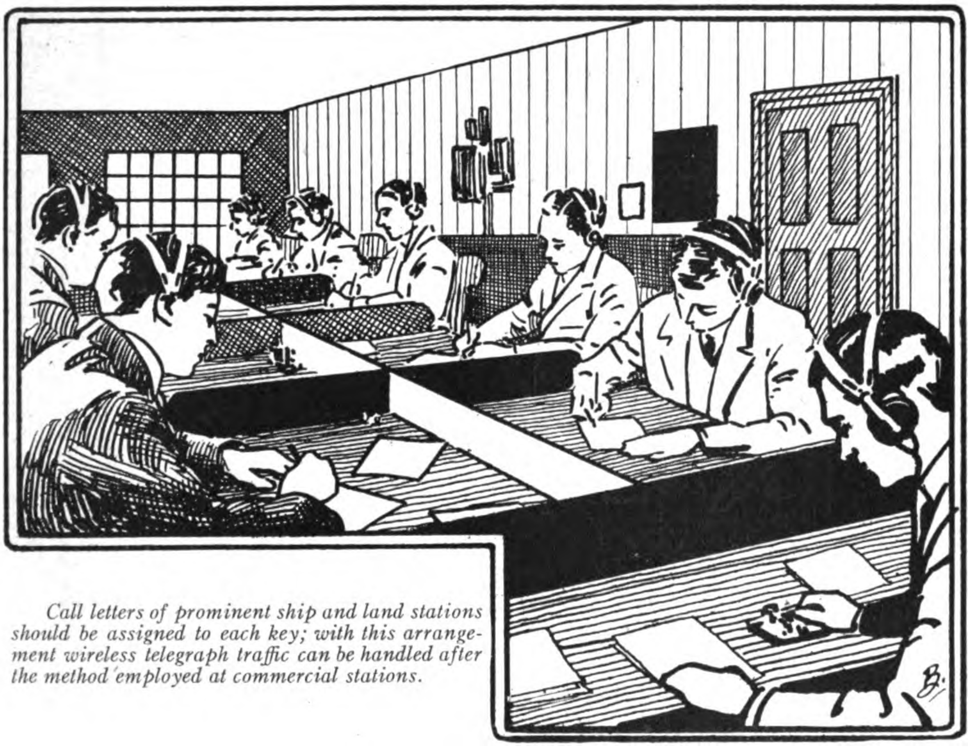
Fig. 2.—The buzzer practice system

rent passing through the coils of the buzzer charges the condenser, C, which in turn discharges through the head telephones, causing sounds, the volume of which will depend entirely upon the rapidity of the breaks made by the interrupter.

This arrangement gives an exact reproduction of the note of a wireless telegraph set and may be adjusted to imitate the 500-cycle quenched spark transmitter or the "grumble" of the induction coil

How to Make the Buzzer Squeal.

It is sometimes considered desirable to adjust the buzzer to a very high note. This is usually done to imitate the quenched spark transmitter. It may be accomplished in the following manner: The soft iron armature of the average buzzer has the platinum contact mounted on a phosphor bronze spring. This spring should be removed and the platinum point fastened directly to the soft iron



Call letters of prominent ship and land stations should be assigned to each key; with this arrangement wireless telegraph traffic can be handled after the method employed at commercial stations.

with a magnetic interrupter. If properly employed these buzzers work with great regularity, remaining in adjustment for weeks at a time.

The note produced by each key on the practice table can be made to differ from the others if a small 10 ohm rheostat is included in series with each individual key. Each key may then have a different value of resistance in series with the buzzer, which causes a corresponding variation in the current flow through the buzzer, thereby changing the note. Thus the effect of several stations communicating with one another is created.

armature. When this is done the buzzer can be adjusted to a very high note and the operation made practically noiseless. It should be added that for a time it may seem desirable to produce the high tones, but after a while the pitch becomes disagreeable and trying to the ears. Commercial operators, when asked their opinion on this matter, invariably state that they prefer the lower pitch of the non-synchronous discharger.

By reference to the diagram (Fig. 4) it will be noted that a rheostat, R, is shunted across the head phone circuit at the master table. The rheostat is used to regulate the strength of sounds produced in the head phones. Ordinarily the sounds will be of unbearable intensity unless a shunt of less than a fraction of an ohm is used.

When the code practice tables are ready for use call letters of prominent ship and land stations should be assigned to each telegraph key. For the convenience of amateur organizations the call letters have been included in the diagram Fig. 2.

A Small High-Frequency Generator.

Should the Radio Club desire a more positive method for producing imitation wireless signals, the apparatus shown in Fig. 3 will be found an easily constructed instruction device, demonstrating the principle of electric magnetic induction. Referring to the diagram: A fan motor, A, has mounted on its shaft a soft iron spider, B, made from a casting having eight radial arms.

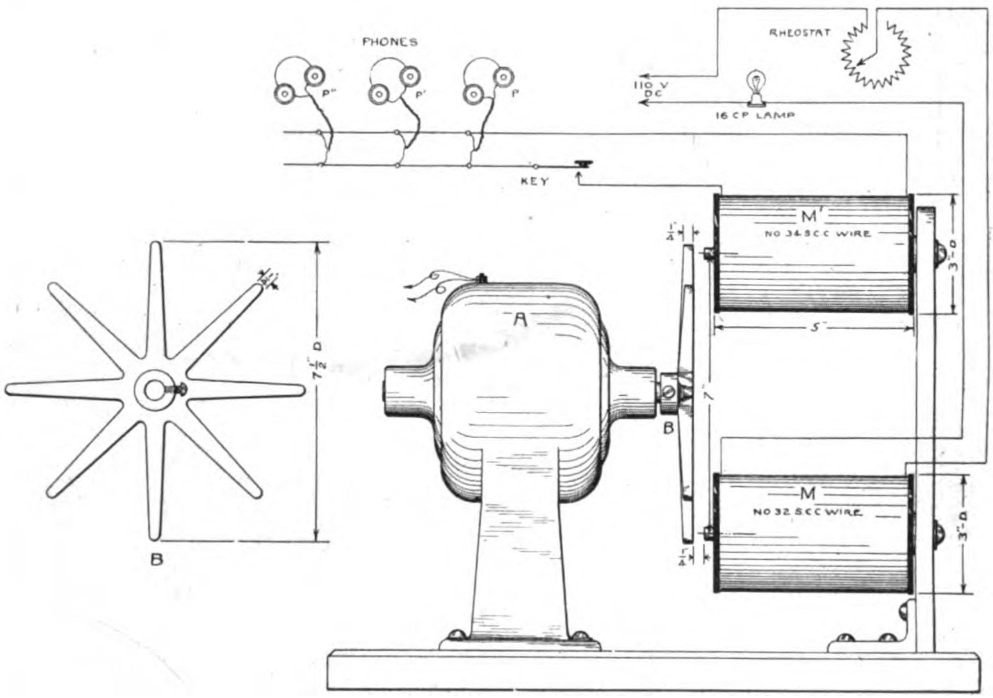


Fig. 3.—Apparatus for producing high-frequency wireless telegraph signals

With this arrangement wireless telegraph traffic can be handled after the method employed at commercial stations. The student so trained is better fitted to carry on experiments, for the knowledge thus obtained will enable him to avoid needless interference and to use better judgment when working the club's station.

As the circuit diagram indicates, but one student at a time can communicate with the land station (the master table). This is not a disadvantage as it duplicates the conditions in commercial practice.

The spider, B, revolves in front of the magnets, M and M^1, in such a manner that when two arms of the spider bridge the air gap between M and M^1 the magnetic circuit is closed, causing the lines of force to cut through the coil M^1, and to induce a current in it. This current, in turn, operates the head phones, P, P^1, P^2. The motor should not rotate less than 2,400 R.P.M. and preferably at a higher speed.

When the magnetic circuit is completed by the arms two distinct pulses are produced in the head phones, one by the establishment of the magnetic circuit and the second by the breaking of the circuit, which gives the stronger signal. What might be termed a mixed note is produced, usually somewhat higher than the rotation speed of the arm may indicate.

The greater the speed of the arm the higher will be the note's pitch. The speed of the motor is best controlled by a variable resistance in series with the field coils of the motor.

The intensity of signals in the head phones may be adjusted either by shunting the head phone circuit with a small battery rheostat, or a variable resistance may be placed in the series with the magnet, M, thereby regulating the magmetic flux and consequently the intensity of signals in the head phone circuit.

While a laminated iron core for the magnets is preferable, a solid soft iron core will serve the purpose.

The spider, N, is cast from a wooden pattern, which the members of the club can easily construct.

The dimensions of the magnets, M and M^1, are clearly shown in the drawing. Magnet M^1 is wound full with No. 34 wire; magnet M, with one-quarter pound No. 32 wire, is connected to the electric light circuit in series with one or two incandescent lamps in addition to the rheostat. The device is in reality a miniature dynamo serving to illustrate the generation of alternating currents.

If a still more elaborate device is desired the shaft of the motor can be extended and two or three sets of magnets mounted, each with its own set of "spiders."

Thus a variable tone transmitter is produced and variations of the note may be employed as desired. Constructed in this manner, it may be used as an automatic "interfering" or jamming device. Signals of two or three tones may be supplied to the line, imitating the interference encountered at a commercial wireless station.

This is the third article in a series especially prepared for radio clubs. The fourth, which will appear in an early issue, will give complete details of a novel type of transmitting and receiving apparatus suitable for the use of amateurs.

THE KING OF ITALY ENTERTAINS MR. MARCONI

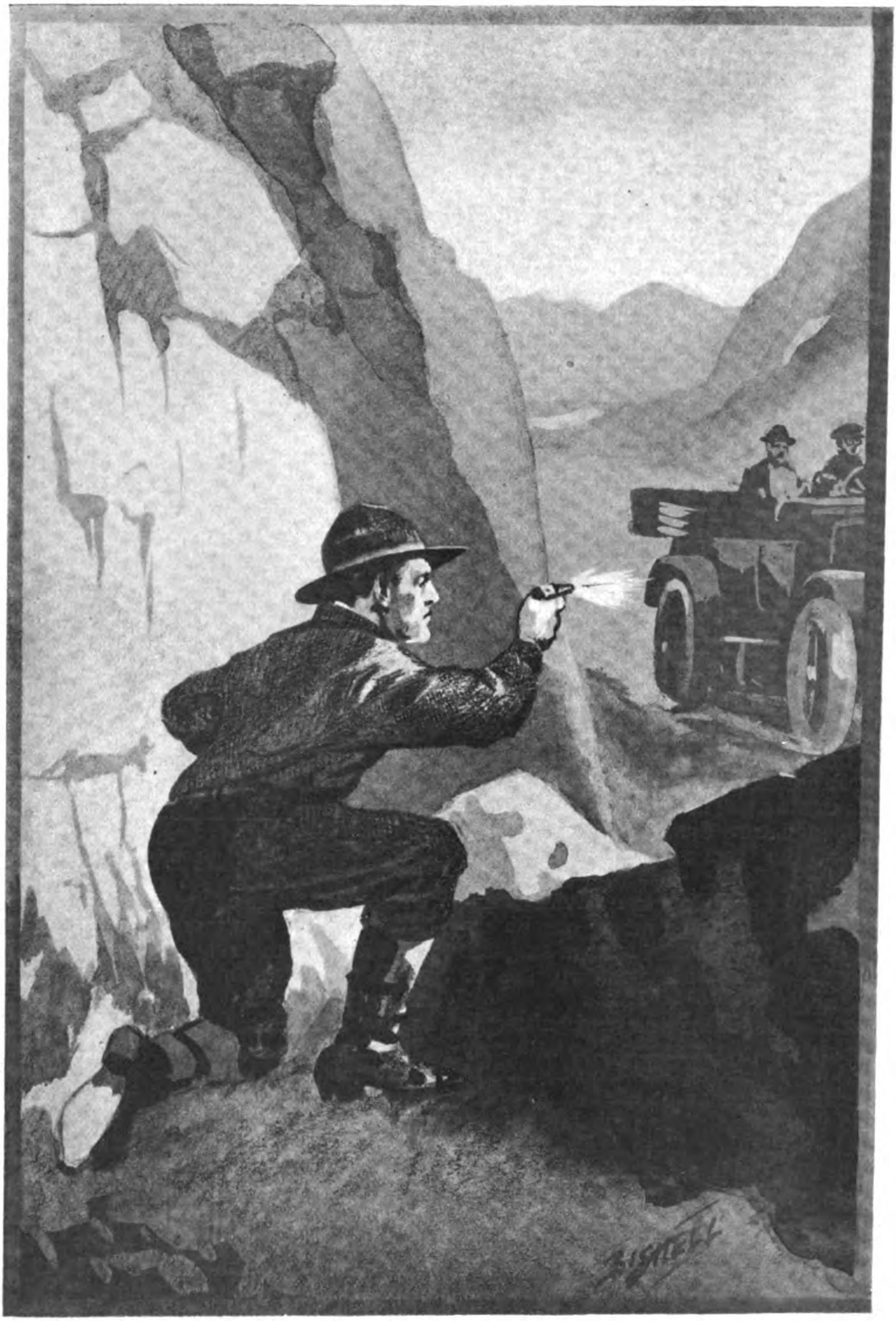
A message from Rome, Italy, says that the King, who has a special regard for Guglielmo Marconi, entertained him at dinner privately before the inventor departed for Syracuse to join the Duke of the Abruzzi on board the flagship Regina Elena.

The king said that he wished to have the great inventor of wireless telegraphy en famille, to be able to talk with him freely, and so only the queen and a lady and gentleman in waiting were present.

The queen inquired cordially for Mrs. Marconi, who has had the special distinction among foreign women of being appointed a lady in waiting to her Majesty. The queen also took an interest in the health of Mrs. Marconi's sister, regretting that her condition obliged her to return to England. When Mr. Marconi took his leave the king expressed the hope that the series of experiments he was going to make throughout the Mediterranean from the Regina Elena might reserve to the Italian warship the honor of being the first to communicate by radio-telephony at a great distance. A crowd of notabilities, including Mayor Nathan, gathered at the railway station and wished him success in the experiments.

MEDICAL ADVICE BY WIRELESS

Another instance of employing wireless telegraphy to bring medical aid for the alleviation of suffering occurred recently. While the British steamship Pectan was on her way from Chile, South America, to San Francisco J. Dempsey, an oiler, slipped on the engine room grating and received severe injuries. His condition became critical and Captain McKenzie ordered a wireless message sent to the German cruiser Nurenberg, stationed off Mazatlan, Mexico, asking the physician aboard that vessel for advice. The message was sent by H. W. Dickow, Marconi operator on the Pectan. The reply, which was in German, came two hours afterward and was translated by a member of the Pectan's crew. The treatment prescribed for the injured man brought about a marked improvement in his condition.



The automatic barked and the explosion merged into another of greater volume

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so little promise of yielding good returns that his attempt to sell it in London has met with no success. On the steamship he meets William Sidney, who buys an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against Sidney. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property. Soon afterward Rance finds on the deck of the steamship a wireless message from Kennedy, superintendent of the mine, telling Sidney that the Burton-Slocum syndicate is prepared to offer Maglory $200,000 for the property. Maglory declines to credit Rance's statement. Arrived in Arizona, Maglory becomes enraged at finding one of the despised wireless stations right in his home town; it belongs to the son of one of his neighbors, who continues to operate it in an amateur way, despite Maglory's hostility. Four days after Maglory's return a representative of the Burton-Slocum Syndicate calls and makes a spot cash offer of $200,000 for the Bonanza Mine. Maglory is prevented from accepting it by the option given to Sidney. As the stranger is leaving in his motor car Bonnie's horse takes fright and the girl is seriously injured. The nearest doctor is twenty miles away, and in the emergency the amateur's wireless station sends out an appeal for aid. The message reaches a physician passing San Simone and sends him hurrying to the bedside of the injured girl. It is also picked up by the wireless operator near the mine and communicated to Rance. The latter hastens to Bonnie and meets Maglory. Rance asks that his uncle give his consent to marrying Bonnie in the event that Jefferson succeeds in defeating Sidney's plans, enabling the girl to accept the offer of the Syndicate. Maglory orders Rance from the house without giving him a satisfactory answer.

CHAPTER XI

JEFFERSON RANCE had not been idling away his time over at Poco Tiempo; neither had he been waiting for John Maglory to accept his proposition. Rance was extremely anxious to be *persona grata* with his uncle—on Bonnie's account. He did not intend, however, to hinge his plans altogether upon the old man's change of heart.

Rance had had a crisp, but satisfactory, interview with Lafe Kennedy; he had rounded up Chet Sidney, the watery-eyed wreck, and for $5 had secured from him a certain affidavit; he had borrowed $5,000 from Dalzell, of Globe, after agreeing to pay a bonus and the highest legal rate of interest; and, last but not least, he had gone frankly to Hall, of the Syndicate, and secured his coöperation.

On the evening of the 24th a trusted messenger had brought this note to Rance:

J. Rance, Poco Tiempo.

Will hold William Sidney in San Simone until 2 o'clock in the afternoon of the 25th. On the morning of the 26th I will close either with him or with John Maglory, acting for Miss Denbigh. Personally, I am on your side and wish you success, but there is no sentiment in business, and I am directed to take over the Bonanza Mine from any one who is able to give title.

Hall.

At 12 o'clock, noon, of the 25th, no word had come to Poco Tiempo from Uncle John. Rance was bitterly disappointed, but he did not allow the disappointment to interfere in any way with his plans.

Kennedy rode over from the Bonanza on horseback, with a saddled and bridled cayuse in tow. Rance mounted the led horse and rode with Kennedy across country to a point on the San Simone-Ragged Edge trail.

"Now you can leave," said Rance crustily, after dismounting. "Mind you have the old shack in proper condition to receive us."

"I don't know what right you've got to force me into your cussedness," Kennedy grumbled.

"You don't?" Rance's voice was like velvet, but it cut like steel. "You've proved yourself a two-faced coyote, Lafe, but for the sake of the man I once believed you to be I'm letting you help undo a great wrong. If you fail me, or if you open your head about this to any one, I'll camp on your trail till I get you. That will be about all."

Rance turned away, and Kennedy rode off with the led horse. Came then for Rance a period of waiting, snugged among the rocks that bordered the trail.

At that time of the day there was little traffic between San Simone and Ragged Edge. Since the Edge had waned almost to the vanishing point, travelers had waned with it, and what few there were shunned the heat of the day. Rance had no fears, therefore, that his undertaking would be interfered with.

It was half-past two when the growing hum of a motor-car was heard in the distance. Rance drew an automatic revolver from his pocket and straightened himself out beside a boulder; his elbows were bent and his weapon was leveled in front of his eyes. A trickster was to be beaten at his own game, and the Bonanza Mine saved to Bonnie for the sale to Hall.

The rushing car drew nearer and nearer. Suddenly it flashed into Rance's view and the point of the automatic settled finely to a bead. Rance had a glimpse of a touring car, and of two passengers in front. They were the only ones in the machine, and there was no doubt that the man beside the driver was William Sidney.

There was time for impressions only, and none for extended thought. The automatic barked, and the explosion merged into another of greater volume. A rear tire was punctured, and the driver hastily applied his brakes.

"What was that?" asked the startled Sidney.

"A tire let go," the driver answered. "It's one of these demountable tires and I'll have another on in a jiffy."

"I—I thought I heard the report of a firearm."

"You did, Mr. Sidney," called Rance from the trailside, looking at the schemer along the barrel of the automatic. "Your driver will proceed to fix the blow-out. If he can do it in a jiffy, so much the better."

The suddenness with which Rance appeared was astounding. Sidney was taken all aback. While he was recovering his wits, Rance drew near enough to mount the running-board of the car.

"Is—is this a hold-up?" gasped Sidney, his eyes wide and his face a ghastly gray.

"Not exactly," answered Rance. "You're merely getting your come-up-with. No foolish moves now," he added sharply, as Sidney's hand went to his hip. "If there's a gun in that back pocket, drop it into the tonneau."

"This is an outrage," cried the other, losing his calmness as his guilty mind dealt with reprisals.

"I don't care what you call it," said Rance, "but you drop that gun into the tonneau or I'll bore you. Think I won't? Why, Sidney, I'd scotch you as quick as I'd set my heel on the head of a rattler."

A small, nickel-plated six-shooter rattled upon the bottom of the tonneau.

"Go on and fix the tire," continued Rance to the driver. "I have no grudge against you, and I shall be as kind as circumstances will permit. You'll take orders from me, for the present."

"I can't stand for any high-handed work," returned the driver, making a feeble stand for what he believed to be his duty.

"Then you're with me," went on Rance, "for if there's a greater villain unhung than this man Sidney, I have yet to find him. You were taking him out to Ragged Edge to commit a big robbery, and—"

"It's a lie," burst hotly from Sidney.

"We're not on the deck of a trans-Atlantic steamer now, Sidney. Here in the desert a man can grapple his problems with two hands and wrestle them to a fall without being interfered with. Put on a new tire," Rance finished to the driver, "and be quick about it."

The driver had to climb over Sidney's

knees in order to leave the car. While he was doing it, Sidney found occasion to whisper:

"I'll give you a thousand dollars, Dugan, if you get me to Maglory's by six o'clock."

From the ground, Dugan returned a significant glance. A little later he opened his tool-box, and from his quick repair kit he took an open knife with a stiletto-like point. This he smuggled into the breast of his dust-coat.

In ten minutes the car was speeding onward again with Rance on the back seat holding a drawn revolver and giving directions to the driver.

CHAPTER XII

For the present, at least, Rance held the whip hand. Under his orders the machine was turned into a blind trail and driven for six miles into the heart of the hills. Here, abandoned for years and almost a ruin, stood an adobe house.

Into the old structure Rance conducted his prisoners. Two cots and two chairs were in the main room and against one wall stood a table upon which was a large hamper. Canteens containing water lay beside the hamper, and flanking these were a candlestick and a supply of candles.

"You will be here over night, gentlemen," remarked Rance, closing and locking the door, "so make yourselves comfortable."

"What's your scheme?" cried Sidney, drawing his own deductions from what he saw.

"Your option expires to-night. If you don't close the deal for the Bonanza Mine within a few hours, the option won't be worth the paper it's written on; that's what I'm here for." There was savage determination in Rance's voice.

Sidney was on the point of giving way to a wild outburst of rage. He checked his anger, however, before it exploded.

"You reckless fool," he exclaimed. "Where will this piece of work land you, do you think? Even in the West, people have something to answer for when they do what you've done. And I swear to you, I'll leave no stone unturned to make you pay the full penalty."

Rance laughed. He was giving his entire attention to Sidney; he did not notice that Dugan was edging around the wall to a place in his rear.

"I'd be twice a fool, Sidney," said he, "if I went into this without covering that point. When you leave here, to-morrow forenoon, you'll sneak quietly out of the country and say not a word about me. You—"

"I'll have you sent up for this."

"No," proceeded Rance. "I have here," and he took a paper from his coat with his left hand, "an affidavit from your brother, Chet. It tells how you were 'wildcatting,' three years ago, and how you salted the Eureka Workings, cleaned up thirty thousand dollars from the widows and clerks of Phoenix, and then got out of the country between two days."

"It's a lie," yelled Sidney.

"I tell you," flung back Rance, "that I have your brother Chet's affidavit. You can't get around *that*."

"A man named Overton pulled off that deal."

"Overton is the name you were sailing under, at the time. Chet tells all about it in this very interesting paper, to which he has sworn and subscribed. And listen, Sidney. Say a word about how I have made you lose all rights under your option, and I'll publish this affidavit of Chet."

"Will you let me look at that paper?"

It was Dugan who spoke. He stood at Rance's elbow, his face white and drawn. Rance looked at the driver sharply, stepped a little to one side and held the affidavit under his eyes.

"I'll keep it in my own hands," said Rance, "but you may look at it."

Dugan's staring eyes fixed themselves on the paper, following the words slowly downward, line by line. Suddenly a crash sounded through the room, and Rance looked around just in time to catch a glimpse of Sidney, vanishing through a window opening.

Rance ran to the opening in the wall. As he did so, a second crash echoed through the room. Rance whirled quickly about; Dugan had beaten down the door and darted away.

For a moment it seemed as if Rance's plans were destined to fail; then came a surprising development in the train of events. Dugan, overhauling Sidney at the running-board of the automobile, threw him to the ground and held him pinned under one knee. He wound up his bewildering tactics by shouting:

"Here he is, Rance. I've got the whelp."

"Bring him back to the house," Rance called.

Then he watched the driver hoist Sidney to his feet and half drag and half carry him back to the adobe. As soon as they were inside the house, Dugan flung Sidney into a chair.

"For two cents," said Dugan grimly, "I'd strangle you."

"So there are two of you against me, eh?" gasped Sidney. "You're in Rance's pay—and have been, from the start. I thought matters were going pretty easy for him."

"Easy with that," stormed Dugan, his face red with anger. "I am not in Rance's pay, but if Rance is calling the turn on any of your dirty work, I'm here to help him. My father was ruined in that Eureka Mine deal—and you're the 'Overton' who did it. So help me, as sure as my name is Dugan it's all I can do to keep my hands off of you!" The driver turned to Rance. "If you don't mind," said he, "I'd like you to tell me what he was going to steal at Maglory's."

Rance told him.

"You can see what sort of a snake-in-the-grass he's been, Dugan," he finished. "I hired Kennedy to keep me advised, and *he* put up good money to buy Kennedy away from me and learn of developments a few hours before they came into my hands."

"The two-faced skunk," breathed Dugan.

"You're mighty free with your talk of underhand thieving," sneered Sidney. "I have a certified check for forty-five thousand in my pocket. By your work, Rance, I am unable to turn it over, make good on that option and secure the Bonanza Mine. What about the five thousand I gave your uncle on the boat? By keeping me here, you are filching that from my coat just as much as any 'dip' who goes after a 'leather.' You needn't be so high and mighty in your virtuous talk."

Rance brought out and displayed a thick roll of bills.

"Here's the five thousand," said he. "I've paid usury to get it, and the money must be returned as soon as Miss Denbigh makes the sale to Hall. I believe, Sidney, in giving even the devil his due, and when we part, to-morrow morning, I'll give you this bunch of *dinero* and we'll call the thing square."

"You're too generous," grumbled Dugan. "You ought to keep that, Rance, to remember him by."

"Two wrongs don't make a right, Dugan," answered Rance.

"Nor do they always land a man in the big stone *yamen*," commented the driver, "which is where Sidney should be, after that Eureka Mine clean-up and this crooked attempt to rob Miss Denbigh blind. But you know best."

CHAPTER XIII

All afternoon of the 25th, John Maglory paced up and down in front of his house, watching the trail in the direction of San Simone. According to information brought by Derry, Sidney was to leave for Ragged Edge at half-past three.

"There's nary a thing Jeff can do," mourned the old man, hopelessly, "and to-day's when that sneaking, underhanded crimp trims Bonnie out of a hundred and a half in thousands. I wish I had the nerve to kill him."

He had the nerve, and he had the inclination, but means were lacking. Bonnie had hidden his guns, and was watching him from the porch.

"Don't worry, Uncle John," the girl cried, as Maglory climbed to the top of the fence and peered down the road; "everything is going to be all right."

"If that tinhorn left Simone at half-past three," the other returned, "and if he was coming in one of them devil-wagons, it's nigh time he hove in sight."

"He'll not come," declared Bonnie, with confidence.

"Why not?"

"Because you accepted Jeff's proposition," was the serene rejoinder, "and Jeff is working for me. Which," she added with a furious blush, "you can take in two ways, Uncle John."

"If you're so plumb sure Sidney won't get here," demanded Maglory, "why are you holding out them guns on me?"

Bonnie's confusion passed in a gay laugh, but she did not explain. After a time, she went out to the road, put her arms about Maglory and walked up and down with him. The sun sank and the evening shadows began to thicken, but there was no sign of William Sidney.

"Let's go in and have supper, Uncle John," suggested Bonnie.

"Go you," was the answer, "although I don't feel a heap like eating. If Jeff pulls these chestnuts out of the fire for you, Bonnie, it'll be the biggest trick he ever turned in all his life. If he pots Sidney with a forty-four from the trail-side, I'll move heaven and earth to get the boy clear of the law—I will so!"

"He'll not do anything like that, Uncle John," averred the girl.

"What makes you so pesky sure?" asked the old man curiously.

"Why, this: Jeff knows what I expect of him."

Maglory whistled softly as he walked into the house with the girl. They ate their supper, and then they sat on the porch until the evening was far spent and Maglory was nodding in his chair.

Hope was rising in the old man's breast. Legally the thirty days had expired and Sidney could have no claims under the option; but the dawning of another day would put every doubt past debate.

It was nine o'clock the next morning when a motor drummed in Maglory's front yard and faded into silence. He went out on the porch, imagining that Sidney had arrived a trifle late. But it was Hall he found, and not Sidney. A lawyer from San Simone accompanied the representative of the Syndicate.

"Have you sold to Sidney?" asked Hall.

"Haven't seen Sidney," returned Maglory, "and his option expired last night."

Hall laughed.

"Then Rance has made good," said he, "and he has snatched the Bonanza Mine away from the smoothest schemer in the country. You ought to be proud of that nephew of yours, Maglory."

The old man looked uncomfortable. Bonnie sidled up to him and laid an arm across his shoulders.

"You are, Uncle John, aren't you?" she asked.

"I reckon," was the feeble response.

For half an hour the lawyer was busy. At the end of that time papers had changed hands, and Bonnie found herself possessed of a draft for $200,000—a fortune handed on to her from one who, years ago, had departed into the Valley of the Shadow.

"You can thank Rance for that," smiled Hall, as he turned away.

"And you can do it now," laughed the lawyer, "for here he is."

Kennedy had brought Rance's horse to the old adobe that morning and, in due time, Bonnie's sweetheart had taken to saddle and started for Ragged Edge.

"Boy," called Maglory, stepping forward, "if you've killed that two-faced cimiroon—"

"But I haven't," said Rance. "I simply met him on the trail yesterday afternoon, and conducted him to an old adobe in the hills. We spent the night there."

"Oh, ho!" chuckled the old man. "Count on me, Jeff, to stand between you and any trouble he tries to stir up."

"He'll not stir up any, Uncle John. I have the goods on him. Read that."

Rance passed over the affidavit from Chet Sidney, and it was read with interest.

"Say," cried Maglory admiringly, "it ure took headwork to copper Sidney's back-fire in that fashion! On top of that affidavit," he gloated, "Sidney's out a cool five thousand! That'll teach him to think twice, by thunder, before he tries to hornswiggle anyone else out of a mine."

"He's out nothing, Uncle John," said Rance. "I borrowed the money and paid it back to him."

"You—bor—" Maglory stared at his nephew. "I reckon you couldn't do a really brilliant thing, Jeff," he mumbled, "without playing the fool somehow or other. If I was Bonnie, blamed if I wouldn't let you pay back that five thousand out of your own pocket!"

"He'll not pay it out of his own pocket!" cried Bonnie, ranging herself alongside Rance. "What he has done is just what I would have him do."

"Oh, you!" grinned Uncle John. "Why, you're a prejudiced party. You got busy right after I accepted that proposition of yours, eh, Jeff?" he asked, drily.

Rance gave a jump.

"Did you accept it?" he asked.

"Didn't you *know* I'd accepted it?" roared Maglory.

"No. It must have been pretty late in the day. I didn't leave Poco Tiempo until noon, yesterday, and I hadn't heard from you up to that time."

"It was later than noon. I sent a wireless message." Maglory showed considerable curiosity. "And you played this through," he went on, "without ever knowing whether I'd let you have Bonnie or not?"

"I intended to keep Bonnie from being swindled by Sidney," said Rance, "whether you agreed to let me have her or not. So—"

Ollie Ryckman came into the house at that moment, waving a couple of pieces of paper.

"Two messages for Jeff Rance," he called. "Is he here?"

"I allow he is, Ollie," answered Uncle John, "big as life!" He grabbed the marconigrams. "'Congratulations,'" he read; "that's from Poco, and is signed 'Everybody.' Well, well! And the other's from—Blamed if it ain't signed 'William Sidney.'"

"What does it say?" asked Rance.

"'Don't spring the affidavit and we'll call it square,'" read Maglory.

"He's worried," laughed Rance, "but he needn't be. I told him what I'd do if he'd be peaceable."

"If congratulations are in order," spoke up Hall, "I'd like to tender mine."

"They're in order, all right," beamed John Maglory, "and Bonnie is really going to marry into the family. Eh, girl?"

For answer, Bonnie threw herself into Rance's arms.

"Mines," went on Maglory, taking Hall and the lawyer each by an arm and leading them out on the porch, "ain't the only things in life that develop a pay-streak. There are pay-streaks in human nature, le'me tell you, and Bonanza Denbigh is pure gold, through and through. And Jeff Rance is panning out a lot more color than I reckoned. Friends, I'm one happy man this day!"

And he looked it.

THE END.

The readers of The Wireless Age are invited to tell whether or not they liked "Little Bonanza"; they are also asked to express their choice of serial or short fiction; love stories or stories of adventure; stories of action or stories of mystery.

RESEARCH WORK AT COLUMBIA

Twelve men of the American Navy are at present at Columbia University for research work in wireless telegraphy. Extensive experiments and observations are being made by experts under the direction of Professor Pupin and Professor Morecraft. Last September the Government sent two Annapolis lieutenants to Columbia to study wireless telegraphy, and the results have been so satisfactory that the class was increased by ten more experts from the Navy.

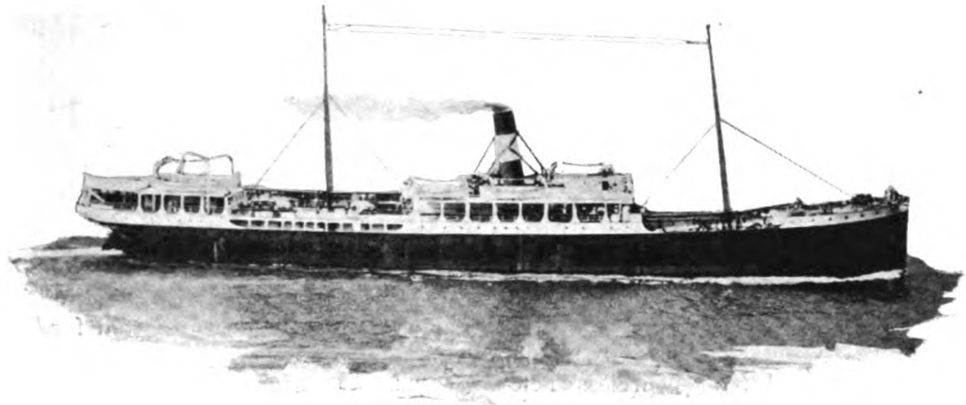
The equipment of Columbia's wireless is of the Marconi type. The sending radius has been estimated as varying from 500 miles in the day time to 1,400 miles at night. At times the operator has been in touch with the University of Michigan, and frequently with the Clifden station in Ireland, some 3,000 miles distant. The instrument is also capable of picking up messages from Berlin. The transmitting set can be used with either a synchronous rotating spark or quenched spark cap. For the generation of continuous waves a 200,000-cycle Alexanderson alternator is used. This set was installed to facilitate work in connection with experiments in wireless telephony. The antennæ, suspended between the Schermerhorn and Havemeyer buildings, are 130 feet above ground and 500 feet long.

PLAN A WIRELESS RESEARCH LABORATORY

The House Committee on Appropriations had before it recently an appeal from Secretary Redfield, in which other members of the Cabinet joined, for an appropriation of $50,000 for the establishment in Washington of a wireless research laboratory in connection with the Bureau of Standards.

Secretaries Daniels, Garrison, and McAdoo wrote expressing interest in wireless improvements and pointing out the desirability of the project. Acting Secretary Galloway of the Department of Agriculture, wrote that any advancement in the science of wireless communication would be of great assistance to the Weather Bureau.

The committee is expected to act favorably upon the request.



The Steamship City of Sydney

The Rescue of the Sydney's Passengers and Crew

WHILE the seas were threatening to demolish the Red Cross liner City of Sydney, which ran on the Sambro Rocks twenty-five miles east of Halifax, N. S., on March 17, wireless messages brought the tug Rosemary and other vessels to the rescue of those on the stranded craft. Altogether fifty-three persons were taken from the ship and landed at Halifax. Of these thirteen were passengers and forty members of the crew. The vessel, which carries a cargo valued at $300,000, will be a total loss.

Albert Blunheim of New York, one of the passengers, said he was asleep when the liner struck the rocks. The shock awoke him.

"When I went on deck," he said, "the steamship was rolling in a heavy sea. A heavy fog prevailed. Some of the passengers were not informed of the situation, and did not come up on deck for some time.

"The boat finally began to settle aft, and all of the passengers went to the forward decks. Four hours after we struck the tugboat Rosemary appeared, and the work of rescue was begun."

Blunheim said it took the crew twenty minutes to launch the first lifeboat which put out to the Rosemary.

The City of Sydney has been running regularly all winter between New York and St. John's, N. F. The vessel left New York on March 14, and, while the weather was thick though not boisterous all the way up the coast, the steamship made fair progress.

The fog was still dense, and Captain McDonald, believing that he was wide of Sambro Head, apparently steered for the entrance to a harbor.

The Sydney, according to reports, fetched up on Stag Rock, one of the outer ledges in the Sambro group, about 4 o'clock in the morning and at once began pounding, as the deep ground swell from the Atlantic was crashing onto the rocks. Within a short time the rocks had punctured the steamer's bottom in several places, and the sea sweeping in put out the fires.

The vessel was equipped with a Marconi wireless set. This continued in commission, and help was summoned from the life saving station at Sambro and from Halifax. The fog, however, was dense, and the life savers and tugs had great difficulty in locating the stranded steamer.

The Rosemary landed eleven passengers and thirty of the crew, and then other tugs reached the Sydney and began the work of taking off the remainder of the crew. The transfer was made with some difficulty as the sea had become rough. It was practically decided to abandon the vessel, temporarily at least.

Some Recent Marconi Sets*

By ROY A. WEAGANT

Designing Engineer of the American Marconi Company

THE purpose of this paper is to describe some recent radio sets designed for the Marconi Wireless Telegraph Company of America to meet the new specifications of the United States Navy, and to consider further certain interesting points in the design and operation of such sets.

The manufacturing plant and laboratories of this company are located at Aldene, N. J., where a force of approximately 200 men are engaged exclusively in the construction and testing of radio apparatus. For testing the sets under conditions of commercial operation, in addition to an artificial antenna, an outdoor aerial is provided. (Fig. 1.) This aerial is supported by two 200 feet (65 meter) steel towers, 450 feet (148 meters) apart.

For the sake of clearness, we shall consider the apparatus beginning with the point of entry of the direct current power, namely the switchboard, and pass successively through the automatic starter, the D. C. motor, the alternating current generator, the power transformer, the closed circuit of the transmitter, the open circuit of the transmitter and the relay key and receiver.

The switchboard (shown in front view of Fig. 2 and in rear view of Fig. 3) consists of a slate panel approximately 6 feet by 2.5 feet, and carries the following instruments: D. C. voltmeter, D. C. ammeter, A. C. voltmeter, A. C. ammeter, A. C. wattmeter, frequency meter, motor field rheostat, generator field rheostat, main A. C. switch, main D. C. switch, D. C. circuit breaker, solenoid switch for opening the A. C. field circuit and one side of the A. C. armature circuit (this solenoid switch is ordinarily remotely controlled by the aerial switch, but may be controlled by) a double pole switch on the panel board; a push button for controlling the automatic starter, and a spare switch.

Fig. 4 shows the marine type of automatic starter supplied by the Cutler-Hammer Company, which is mounted on a slate panel, together with seven-pole double-throw switch, the purpose of which is to connect the automatic starter to either of two motor generators. The entire assembly is enclosed in a metal case.

The motor generator provided with these sets, the armatures of which are shown in Fig. 5, is supplied by the Crocker-Wheeler Company. The machine is of the two-bearing type, semi-enclosed. It consists of a two-pole, 120-volt, 2,000 R. P. M., D. C. shunt wound motor and a 220-volt, 500-cycle, single-phase generator. The generator is of the rotating armature type, the complete rotor being shown in Fig. 6. This generator has special electrical characteristics which particularly fit it for use with quenched spark sets.

The protective devices employed consist essentially of condensers, spark gaps and resistance rods connected between each side of the line and ground. Fuses capable of carrying the total current of the circuit to which the device is connected are provided and so arranged that the short circuiting of any of the protective condensers or spark gaps blows the corresponding fuse. It is thus impossible to operate the set with a defective protective device in any of its circuits. The various units composing the device are mounted on a slab of insulating material and enclosed in a cast iron case. The points at which these devices are inserted are as follows: Motor armature and field circuits, generator armature and field circuits, primary of power

* Abstracted from the Proceedings of the Institute of Radio Engineers, Vol. 1, No. 4.

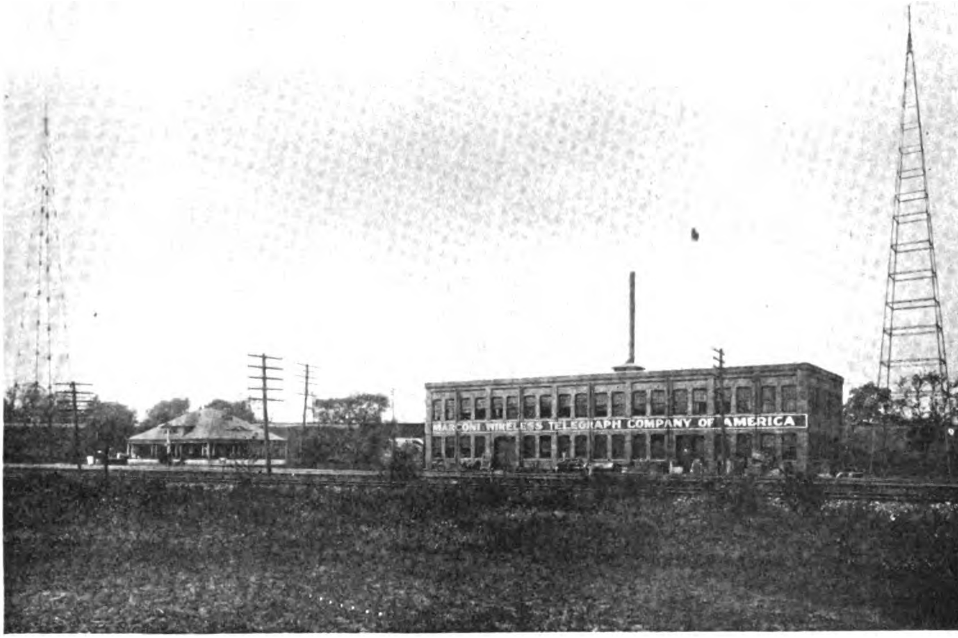


Fig. 1

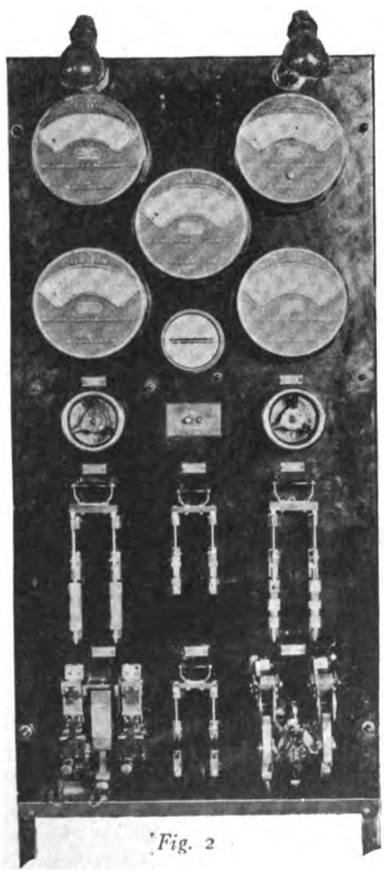


Fig. 2

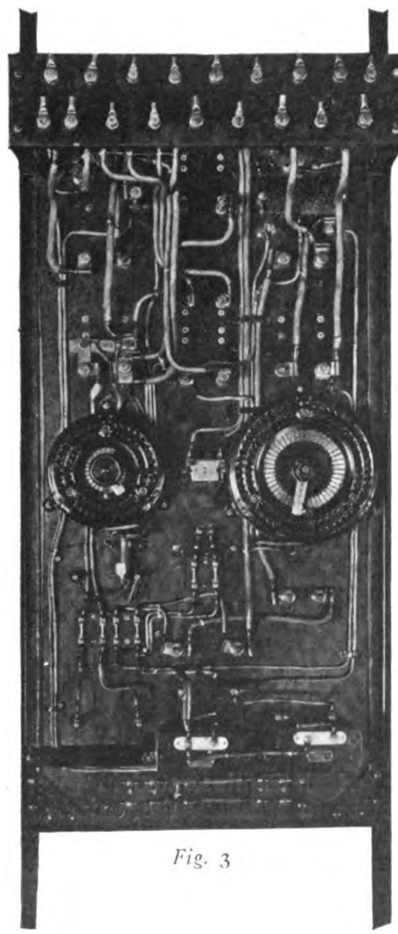


Fig. 3

transformer, blower and rotary gap motors (one protective device common to both field and armature).

The operator's key controls the relay tenna is opened, the detector is short-circuited and the telephone circuit is opened. The arrangement adopted makes it possible to receive between dots

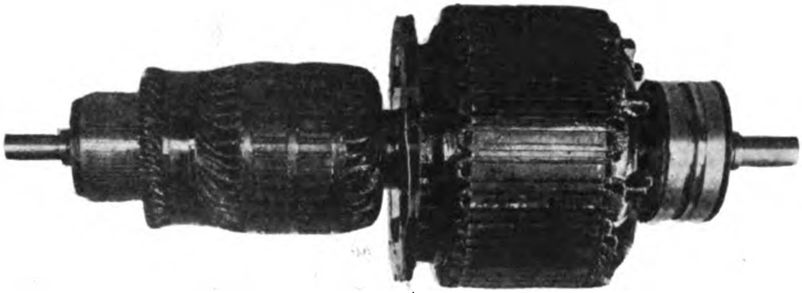


Fig. 5

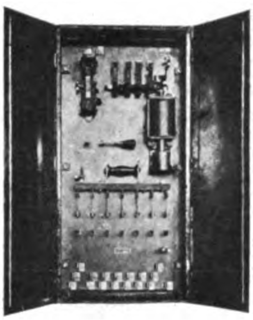


Fig. 4

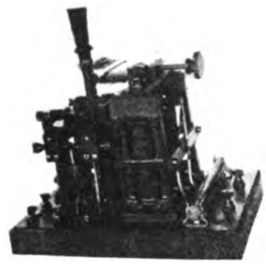


Fig. 7

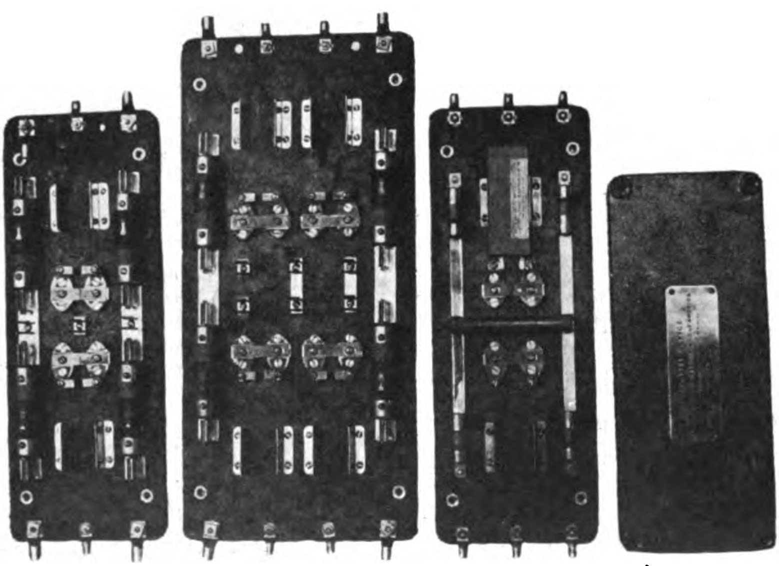


Fig. 6

key, which is illustrated in Fig. 7. In addition to breaking the main A. C. circuit, the relay key operates contacts whereby the ground circuit of the an- and dashes, while transmitting. Fig. 8 shows the relay key reactance, which can be adjusted to six different values by means of the switches mounted on its top.

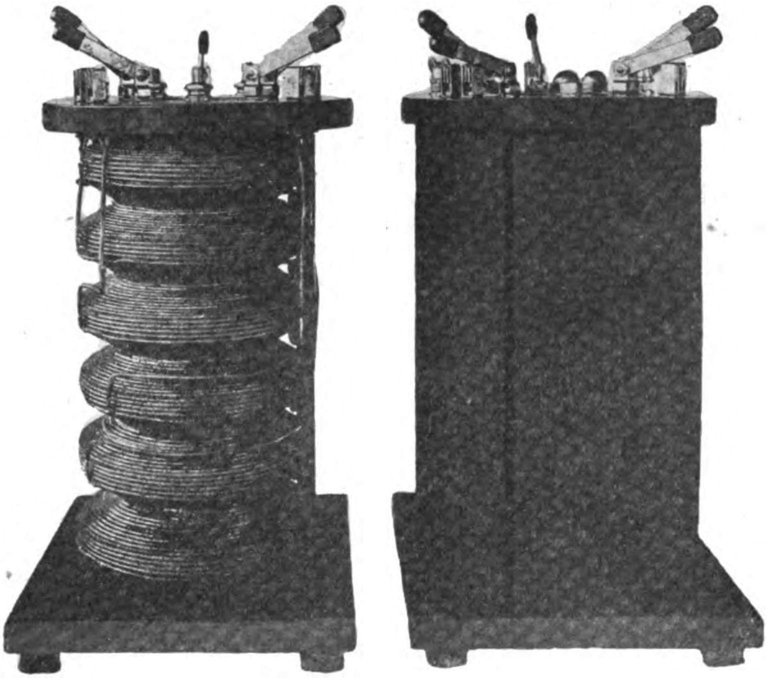


Fig. 8

This reactance is used to reduce arcing at the main A. C. contacts of the relay.

Photographs of the exterior and interior of the transformer are given in Figs. 9 and 10. The transformer is open core, air cooled. A perforated cover encloses and protects the secondary, while permitting a free circulation of air for cooling purposes. Two insulators on the top of the case carry the secondary terminals, and a third insulator carries a metallic ball connected to ground. The metal terminals at the tops of these insulators act as protective spark gaps and limit the potential strains between the secondary terminals or between the secondary winding and ground. The danger of puncturing the insulation between the primary and secondary winding through resonance phenomena (and consequent enormous rises of potential) in the transformer secondary capacity circuit, when the connections to the spark gap are accidentally opened, is thus obviated by the connection to ground on the third protective gap terminal.

The transmitter construction will next be considered in detail. The complete 5 K. W. transmitter is shown in front, side and rear views in Figs. 11, 12 and 13. The transmitter consists of a number of parts conveniently and compactly arranged and supported on a slate panel. The units are as follows: A quenched spark gap with blower (A), leyden jar

Fig. 9

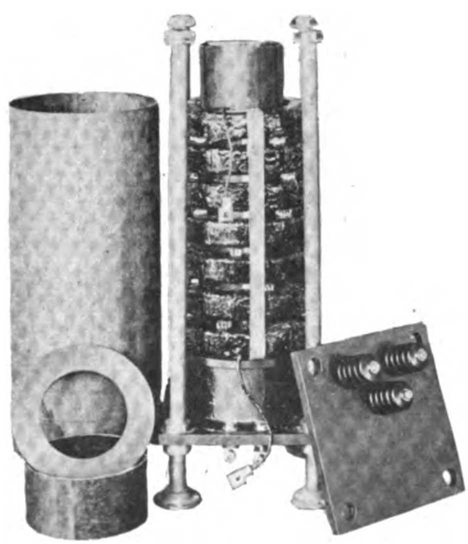


Fig. 10

condenser and rack (B), an oscillation transformer (inductive coupler) (C), the aerial inductance (D), a switch for changing wave lengths (E), and an aerial ammeter (F).

The transmitter here shown is designed so that eight definite and predetermined wave lengths lying between 600 and 2,000 meters may be instantly obtained by the setting of a single rotary switch, E, which makes connections in both open and closed circuits. A preliminary adjustment to suit the particular antenna used is necessary. The connections (which are particularly well shown in Figs. 12 and 13) from the switch in the aerial circuit to the aerial inductance are made through very heavily insulated flexible cables. The calibration of the primary circuit is accomplished at the factory. The fixed wave lengths used in these sets are 625, 750, 875, 1,000, 1,300, 1,575, 1,800 and 2,000 meters.

It is also possible to obtain any intermediate wave length between the designated limits by setting the fixed wave length switch to the wave length lying immediately below that desired, and rotating the handle of the inductive coupler, C, until the primary circuit shows the desired wave length as indicated on a wave meter. The antenna is then tuned by rotating the handle of the aerial inductance, D, until the aerial ammeter, F, gives the maximum indication. During this process, the coupling between the primary and the antenna circuits must be varied, which can be readily accomplished by pushing the handle of the oscillation transformer, C, in or out. It

Fig. 11

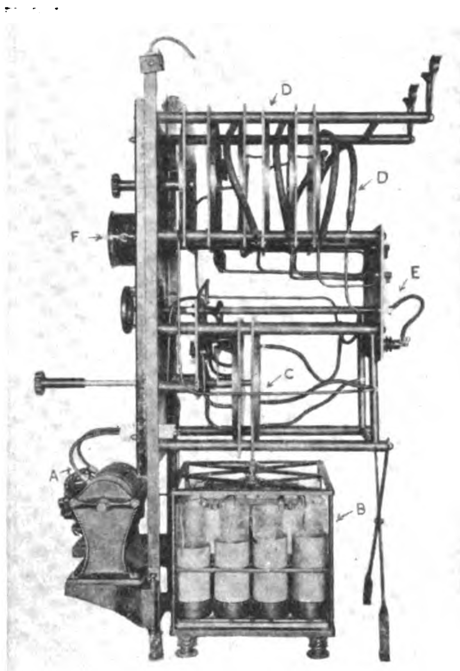


Fig. 12

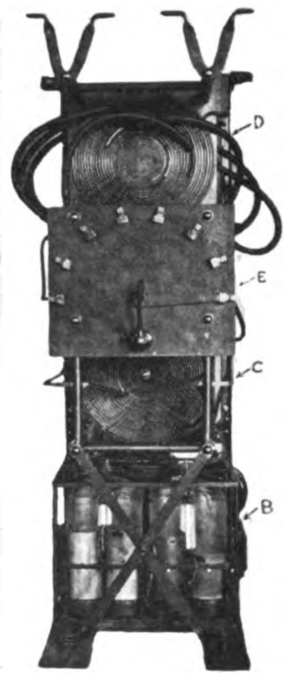


Fig. 13

will be seen by reference to the illustrations that the wave length changing switch E consists of two blades mounted on a micarta tube at a separation of about 24 inches (60 cm.), these blades being arranged to rotate with the switch handle. Supporting the jaws of the switch, which are connected to the appropriate taps on the inductances, are two micarta plates through which the micarta tube supporting the blades passes. The support of the primary switch is the one nearer the panel, and the support of the secondary switch is at the extreme rear of the unit.

The oscillation transformer consists of two spirals, the primary one being fixed and the secondary being movable in

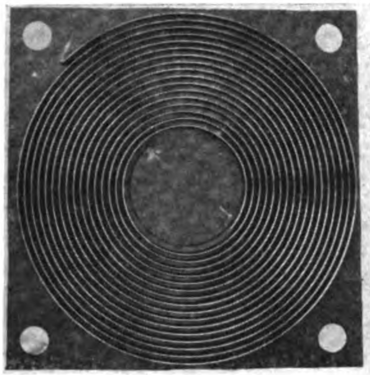


Fig. 14

such a way as always to remain parallel to the primary. These coils, which are shown in Fig. 14, consist of copper ribbon wound in a spiral groove cut in an insulating plate support. The plate supports are placed facing each other. Eight taps are taken from the primary to the wave length switch and a sliding contact is arranged so that rotation of the handle of the oscillation transformer produces a continuous variation of inductance sufficient to cover the range between any two fixed wave lengths.

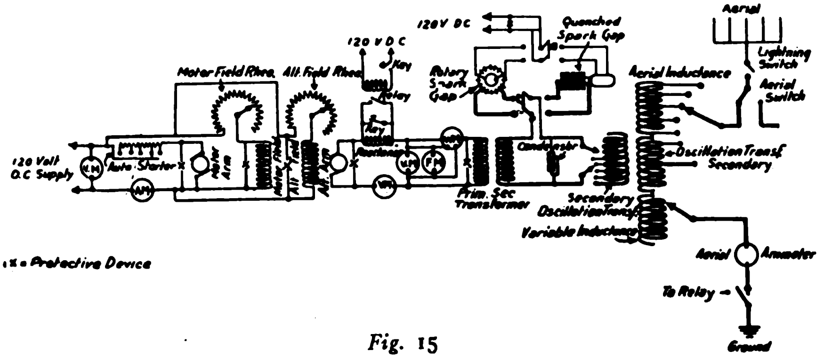


Fig. 15

Attached to the secondary are three flexible leads. The first of these is connected to the continuously variable portion of the antenna tuning inductance and thence to the ground. The second tap is connected to the first jaw of the wave length switch. The third tap is connected to the end of the antenna tuning inductance, which is variable in steps. It will thus be seen that the aerial tuning inductance consists of two portions: a continuously variable portion which is nearer the ground than the secondary of the inductive coupler, and a portion which is variable in steps, consisting of a number of coils placed nearer the antenna than the secondary of the inductive coupler. The basis of this arrangement is the necessity of using less than the entire secondary coil of the inductive coupler for tuning the antenna at short wave lengths and the further necessity of using the entire secondary coil of the coupler to obtain ***sufficient coupling*** at ***longer*** wave lengths. The advantage of placing the continuously variable portion of the antenna tuning inductance in the ground side of the inductive coupler is that it is then in circuit regardless of the position of the wave length switch. The portion of the aerial tuning inductance which is variable in steps consists of five spirals, identical in construction with those of the inductive coupler. From these, seven are brought to the remaining

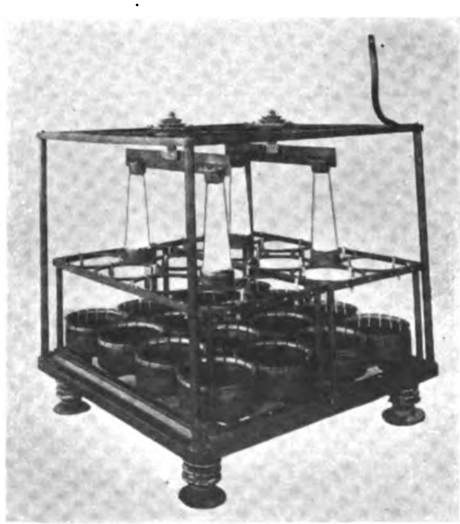


Fig. 16

jaws on the secondary portion of the wave length switch.

The primary condenser consists of sixteen leyden jars, each having a capacity of 0.002 μf. The entire number is connected in parallel. The jars are of the usual silver and copper-plated type. Each group of eight jars is mounted on a tray which can be drawn out of the rack through the front of the panel without disturbing any connections. This is accomplished after swinging the spark gap at the front of the panel on either of its hinges, so that it will no longer obstruct the passage of the tray. Broken or defective jars are thus easily replaced. The rack and the sliding trays are shown in Figs. 16 and 17.

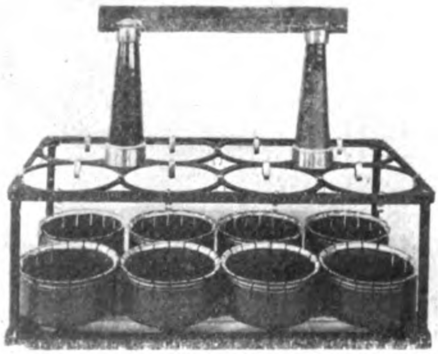


Fig. 17

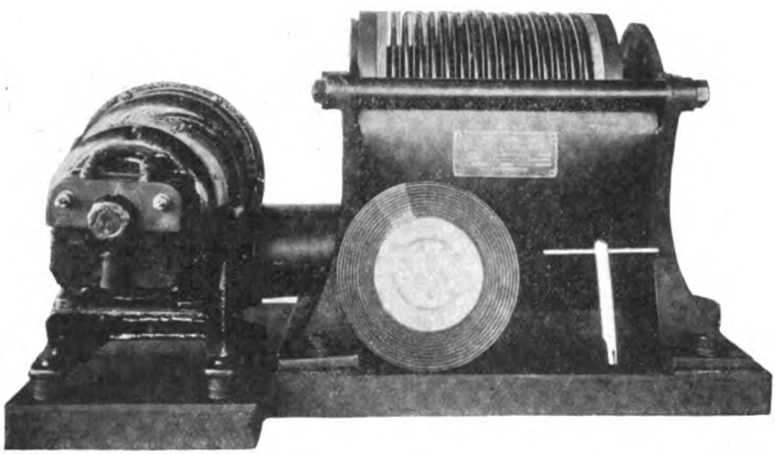


Fig. 18

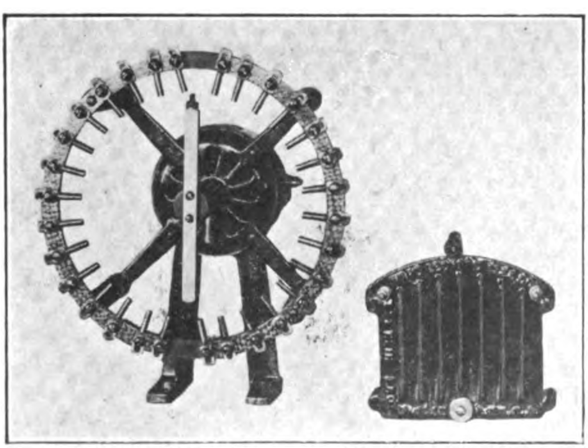


Fig. 19

The construction of the spark gap is clearly visible in Fig. 18. It consists of fifteen plates with fourteen insulating gaskets between them. These plates and gaskets rest on a tube of insulating material, and later displacement is prevented by two more tubes at the sides. Through these tubes run steel tie rods which hold the two vertical end castings rigidly in place. A set screw at one end per-

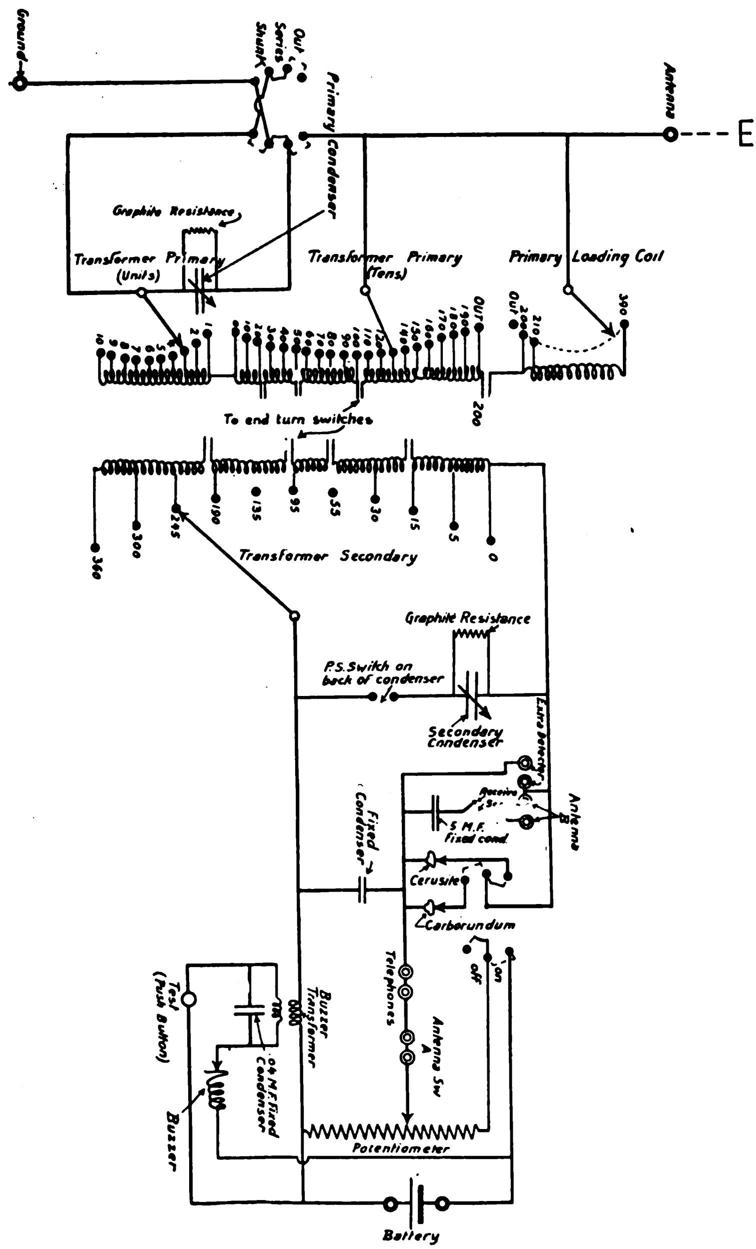

Ground
Out
Series
Shunt
Primary Condenser
Antenna
E
Graphite Resistance
Transformer Primary (Units)
Transformer Primary (Tens)
Primary Loading Coil
To end turn switches
Transformer Secondary
Graphite Resistance
P.S. Switch on back of condenser
Secondary Condenser
Extra Detector
Antenna B
S M.F. Fixed cond.
Fixed Condenser
Cerusite
Carborundum
off
on
Telephones
Antenna Sw A
Buzzer Transformer
Test (Push Button)
.04 M.F. Fixed Condenser
Buzzer
Potentiometer
Battery

Fig. 20

mits clamping the plates and gaskets very tightly against each other. Between the two end plates of the gap and the end castings are heavy discs of insulating material. The gap plates consist of copper castings. The sparking surfaces are raised above the gasket bearing surfaces to such an extent that the separation of the sparking surfaces when the gap is either side. In these sets an auxiliary rotary spark gap of the non-synchronous type is provided. It is intended for special naval service in times of war.

A six-pole double-throw-switch provides means for shifting from the manually-operated antenna switch to the relay key.

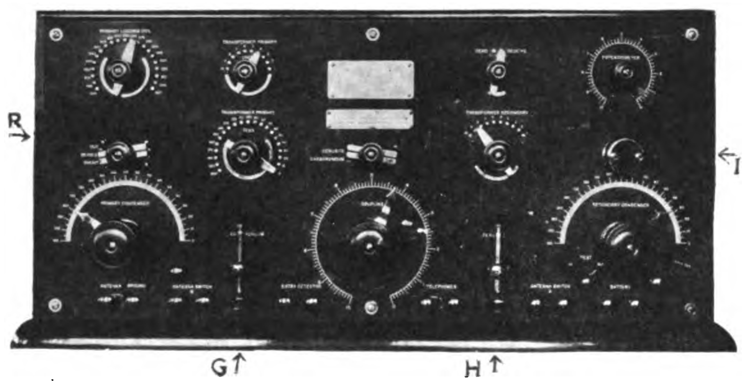


Fig. 21

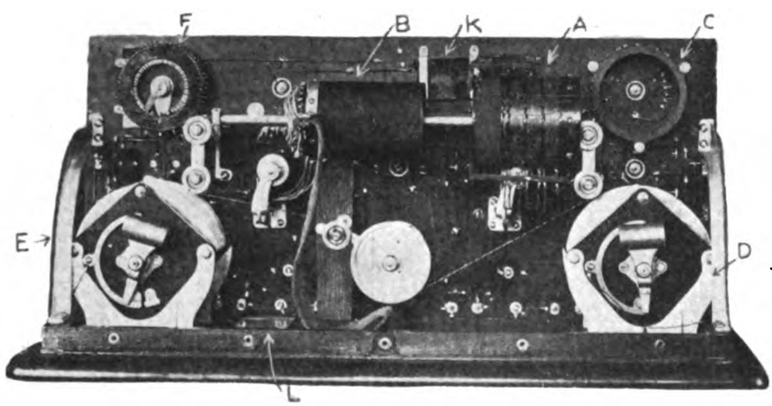


Fig. 22

assembled is approximately one-third the thickness of the gasket itself.

Attached to the gap is a motor-driven blower, which forces air up between the flanges of the plates and prevents overheating. The construction of the side of the gap is such that the cooling air must pass between the flanges before escaping. The rotation of the gap and blower motor about either of two hinges is necessitated by the limited space available in many ship installations and the difficulty of reaching the back of the panel from

The receiver, the wiring diagram of which is given in Fig. 20, is of the two-circuit, inductively coupled type. It contains the following parts: Primary of the inductive coupler (A), secondary of the inductive coupler (B), antenna tuning inductance in the primary circuit (C), primary variable air condenser (D), secondary variable air condenser (E), potentiometer (F), carborundum detector (G), cerusite detector (H), test buzzer (I), coupling controller (J), detector protective condenser (K), detector stopping condenser (L), coupling primary switch (M), (dividing the transformer primary into steps of ten turns), coupler primary switch (N) (for variation by single turns), aerial tuning inductance

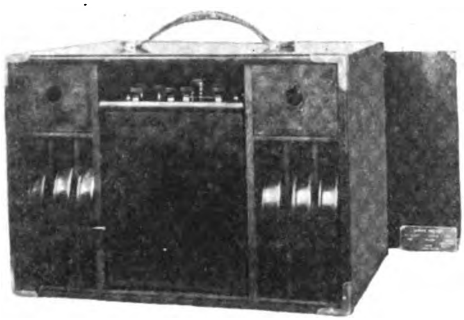


Fig. 24

switch (O), transformer secondary switch (P), test buzzer switch (Q), primary condenser switch for connecting condenser in series to or in parallel with the total primary inductance or for disconnecting it entirely (R).

The inductive coupler consists of a fixed primary, and a movable secondary mounted on a rod and controlled in its motion by a flexible metal band passing over a number of pulleys. The coupling is thus varied through a wide range by a single rotary motion of a knob. Both primary and secondary coils are divided into four sections connected to the controlling switches in such a way that dead ends are avoided. Sufficient inductance is provided in both circuits to work up to wave lengths of 7,000 meters in the case of the "long range" tuner, and up to 4,000 meters in the case of the "short range" tuner. Compactness of the coils (in combination with the unusual range of wave lengths) demands special coil construction in order that high efficiency may be obtained. The variable air condensers are of the conventional type, counterbalanced so as to rest in equilib-

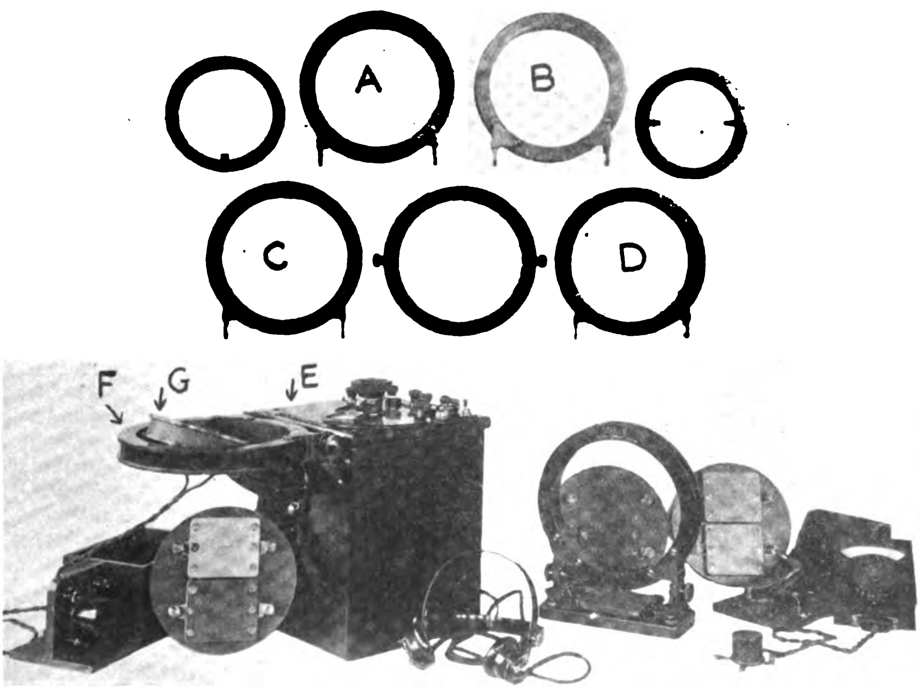


Fig. 25

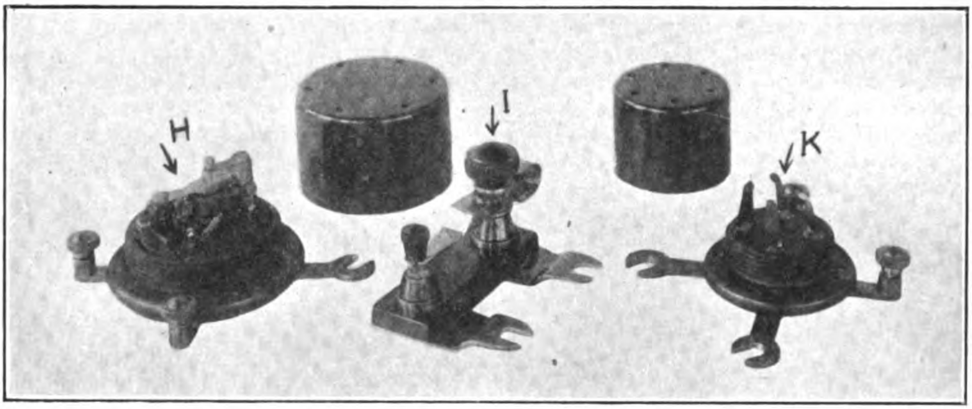


Fig. 26

rium in any position. The potentiometer, which provides for fine adjustment of the voltage across the detector, is of a rotary type.

Two detectors, of different operating characteristics, are provided. The carborundum detector is of moderate sensitiveness and great stability. The cerusite detector is of extreme sensitiveness. A switch is provided for using either of these at will. Separate binding posts are provided in order that any other detector can be connected in place of those furnished.

During transmission, a large condenser (K) is connected across the detector to protect it against being thrown out of adjustment. The entire receiving apparatus is so mounted that the exterior case can be removed without interfering in any way with the connections, all parts being mounted on the heavy front panel, which is supported by right angle brackets attached to the base.

The Marconi wavemeter, from the designs of Mr. Harry Shoemaker, is shown in Fig. 24 through 28. Fig. 24 shows the instrument in its case. Fig. 25 shows the various elements of the instrument, A, B, C and D being the coils used to cover the various ranges of wave lengths. E is the condenser case, with attached brackets for holding the inductances F

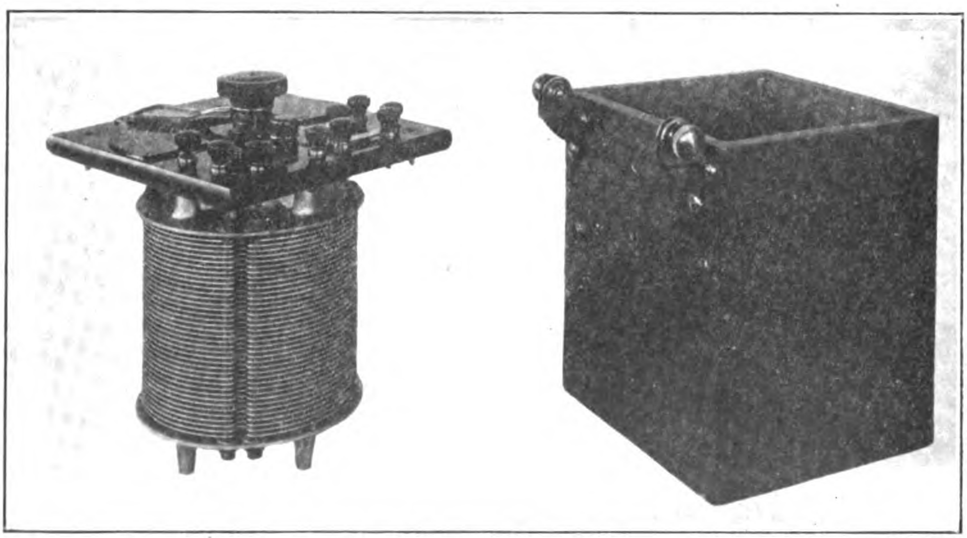


Fig. 27

and G. The buzzer, H, the detector, I, and the thermo element, K (of Fig. 26) are also mounted on this case. The variable air condenser is shown in Fig. 27, while Fig. 28 shows the complete instrument with the galvanometer, L, and the "pickup" coils, L and M.

This instrument covers a range of wave lengths from 100 to 5,000 meters, and is arranged for measurements of inductance, capacity and decrement as well as for wave length. A plug containing a known resistance may be inserted in the oscillatory circuit, and the decrement of the instrument itself at any wave length determined. In addition, coils are provided for measuring the wave length of incoming signals, in which case the instrument is employed in much the same way as an ordinary receiver.

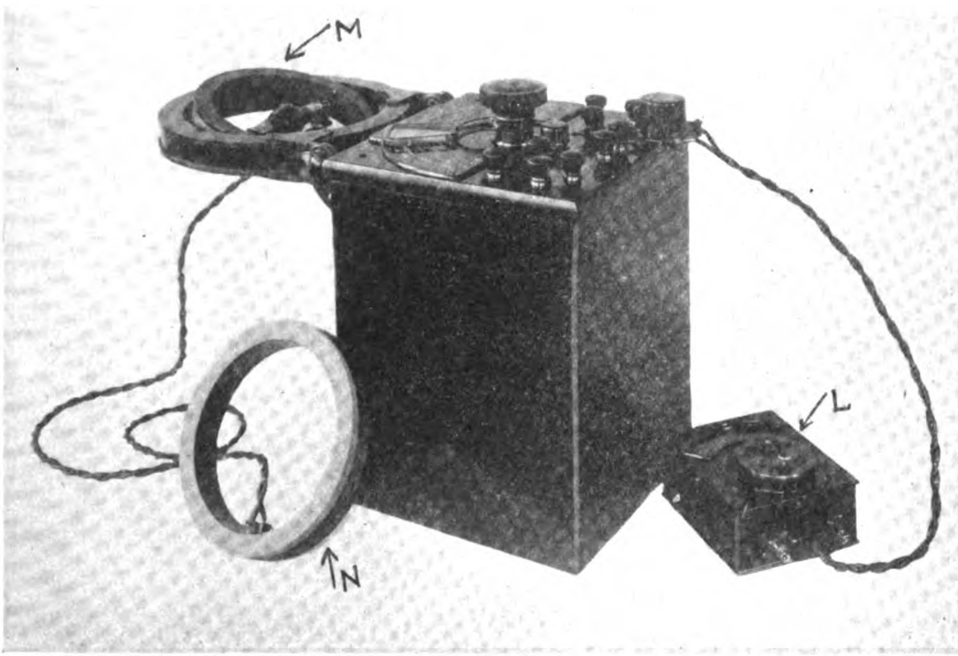


Fig. 28

We shall now discuss briefly certain matters of design and construction. The alternating current instruments on the power switchboards must be so constructed as to read correctly on wave forms differing widely from the pure sinusoidal type. The alternating current circuits need not be provided with any special protective devices against excess current, inasmuch as the characteristics of the generator are such that it is not possible to draw more than the load current. Nevertheless, these circuits have been provided with fuses. Fuses are used because it has been found impossible to construct suitable 500-cycle circuit breakers.

The motor of the motor generator set must be provided with closer speed regulation than is common with the usual commercial set, namely, from 3 to 5 per cent. The generator is purposely designed to have very poor regulation, so that the voltage drops markedly as the load is applied.

A complete theory of the action of the transformer, with particular consideration to the transient phenomena involved, is beyond the scope of this paper.

The quenched gap exerts a frequently neglected influence on the coupling required for satisfactory operation of the transmitter. The greater the number of sections and the shorter each section, the closer the coupling which must be used. It is possible therefore to work within a desired range of coupling by properly choosing the number of gap sections.

In the type of receiving set previously described, it has been necessary to cover in one apparatus an extreme range of wave lengths. However, experience shows that such receivers are preferably subdivided into those intended for wave lengths below 1,500 meters, and those designed for wave lengths greater than 1,500 meters. Radically different types of construction are required in the two cases to obtain maximum efficiency. It may also be noted that the efficiency of the modern receiver is far less than that of the transmitter, and that there is room for much improvement in this regard. It appears further, as the result of considerable experiment, that with a given aerial, the receiver must be specially designed for it if maximum efficiency is to be obtained.

The foregoing general remarks concerning quenched spark transmitter design are to be taken as merely indicative of the directions in which future research may be profitably carried on, rather than any complete solution of the problems involved.

THE NAVY CHANGES ITS PLANS

Rear Admiral Robert S. Griffin, chief of the Bureau of Construction, Washington, D. C., has announced that the Navy Department has changed its proposals of establishing a chain of wireless stations to complete wireless communication between the national capital and Manila. Wireless stations at Guam and Samoa are to be eliminated and high-power stations will be erected at San Diego, Panama, Honolulu and Manila. The station on the Isthmus, which will be located at Darien, will be completed about January 1, 1915, according to present plans.

DR. MAWSON WEDS

A dispatch from Melbourne, Australia, says that Dr. Douglas Mawson, the Antarctic explorer, was recently married to Miss Delprat, daughter of a mine owner. Dr. Mawson has just returned from a trip in which he faced many perils. Miss Delprat and Dr. Mawson became engaged before the explorer started on his last expedition. At that time she was nineteen years old.

MEMORIAL SERVICE FOR FERDINAND J. KUEHN

Although Ferdinand J. Kuehn, wireless operator on the sunken steamship Monroe, found a grave near that of the wrecked craft, the fame of his heroism still lives. Kuehn remained at his post with danger imminent and went to his death in order to save a woman from a similar fate. The Auditorium of the East Side branch of the Y. M. C. A., 153 East Eighty-sixth street, New York, was crowded to the doors when the memorial service was held for him on March 1. Wireless operators from the majority of large vessels in port at that city and several from Philadelphia, Baltimore and Boston were in attendance. Among those who expressed their appreciation of Kuehn's valor was John Bottomley, vice president of the Marconi Wireless Telegraph Company of America.

Mr. Bottomley praised Kuehn as one of the great number of wireless operators who performed their duties without faltering. He declared that Kuehn was one of the highest minded young men in the Marconi service, his name standing at the head of the long list of heroes whose deeds were coupled with wireless telegraph exploits in marine disasters. Kuehn's example, he said, was an inspiration to others.

L. E. Russell, quartermaster of the Monroe, told how he had seen Kuehn take off his own life preserver and give it to a woman. Joseph K. Van Demberg, principal of Public School No. 40, where Kuehn was a pupil for eight years, and Edward Freeman, a schoolmate and erstwhile shipmate of the wireless operator on board the Ancon, of the Panama Steamship line, also spoke. The marine band on the battleship North Dakota furnished music for the occasion.

Kuehn's name has been added to the roll of honor of Public School No. 40, which is at 320 East Twentieth street, New York. He installed a wireless set on the roof of the school building while he was a pupil in the institution.

The Monroe, which was owned by the Old Dominion line, and the Nantucket, of the Merchants and Miners Transportation Company, came into collision off Hog Island, sixty miles from Cape Charles, on January 30 last.

MARCONI SET AT REPORTERS' DINNER

A Marconi wireless telegraph set was used to add to the gayety of the annual dinner of the City Hall Reporters' Association of New York held on February 21 at the Hotel Astor. The apparatus was set up in the banquet hall and was seen in actual operation in charge of two Marconi operators. The dinner had hardly started when the "messages" began to be received. The first "marconigram" was as follows:

"You have my unconditional pardon in advance. You need not waive immunity. Go the limit.

"Woodrow Wilson."

Charles F. Murphy evidently used the wireless, too. His "marconigram," sent to Chief Justice Edward F. O'Dwyer, of the City Court, read:

"Sit down. You're rocking the boat."

Several "messages" came to Mayor Mitchell. One was as follows:

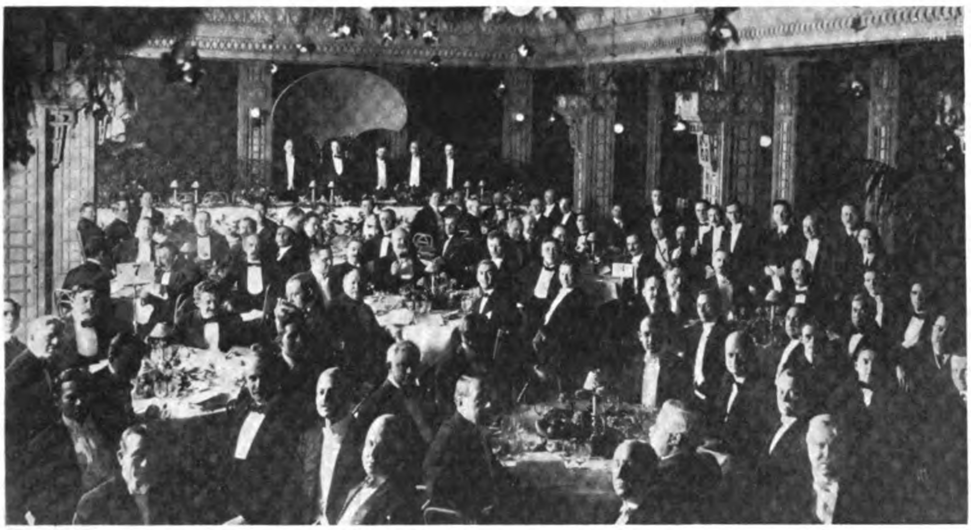
"You made me what I am to-day. I hope you're satisfied.

"Rhinelander Waldo."

A "message" to the City of New York from the City of San Francisco read:

"Shake!"

The reporters had prepared an issue of The Wrecker, an annual publication, which is a burlesque on the City Record. The Wrecker contained articles about various municipal matters.



Annual dinner of the City Hall Reporters' Association of New York at the Hotel Astor

South America was next heard from. This was the "message":

"What does Mitchell want with six secretaries? I found one, Loeb, sufficient. "Theodore Roosevelt."

Street Cleaning Commissioner Featherson was among those at the dinner. He was much surprised when the following "marconigram" was read:

"Have just read your monumental claims of success in snow removal. You've got me skinned to death.

"Doc. Cook."

OPERATOR VIOLATES THE LAW

Commercial wireless operators holding licenses issued by the Department of Commerce should be very careful to have the service record on the back of these licenses properly filled in and signed by the captain or official under whom they are employed.

Recently a commercial operator, either through ignorance or intent, forged the signatures of two captains under whom he had served to the license record. The Secretary of Commerce has referred the papers in the case to the United States Attorney in order that prosecution for forgery may be instituted.

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Radio Engineering, The College of the City of New York

ARTICLE VII

The measurement of inductance at low voltages and audio frequencies, using the Wheatstone Bridge, is fully discussed. Various types of standard inductances, of transmitting and receiving inductances, and of inductive couplers are described. A convenient form of bridge is then considered. The application of inductance measurements to the determination of mutual inductance and coupling coefficient is explained.

Section 21.—MEASUREMENT OF INDUCTANCE AT AUDIO FREQUENCIES AND LOW VOLTAGE BY THE BRIDGE METHOD. It is frequently necessary to measure the inductance of coils at low (audio) frequencies and low voltages. For example, in determining the distributed capacity of a coil, its inductance was assumed to be calculated or measured. In such a case, the inductance, if measured, should be determined at low frequencies, else the result obtained will be markedly influenced by the frequency employed, and this last is precisely what is to be avoided. In other words, in such cases the true inductance or what might be called the inductance at an infinitely low frequency, is the quantity which is desired. For ordinary air core coils, particularly of single layer types, the method here described practically meets the requirements outlined above. Furthermore, it illustrates admirably the complication introduced in the measurement of inductance by the inevitable accompanying resistance, and one of the ways in which this influence of the resistance of an inductive coil may be eliminated in measurement.

(a) THEORY. Consider the arrangement of circuits of the Wheatstone Bridge shown in Fig. 36. As will be seen, the current which is supplied by the generator, II (which we shall take to be an alternator for the present), divides at the point A. A portion will pass through the path AXB and a portion through the path AYB, assuming that the bridge is "balanced," and that no current passes through the indicator, I. The condition that no current shall pass through the indicator I is that the potentials at X and Y shall be equal. In order that the potentials at X and Y shall be equal, the following relation must hold:

(Impedance of Path AX)/(Impedance of Path AXB) = (Impedance of Path AY)/(Impedance of Path AYB).

(Since, for alternating current circuits, the drop of potential along any current-carrying element is proportional to its impedance). However, by Formula (38) of Article VI of this series,

Impedance of Path AX $= \sqrt{R_1^2 + \omega^2 L_1^2}$ and

Impedance of Path AXB $=$

$$\sqrt{(R_1+R_2)^2 + \omega^2 (L_1+L_2)^2}$$

The impedance of paths AY and AYB are merely their resistances. Consequently,

$$\frac{\sqrt{R_1^2 + \omega^2 L_1^2}}{\sqrt{(R_1+R_2)^2 + \omega^2 (L_1+L_2)^2}} = \frac{R_3}{R_4}$$

It is obvious that the relation just given is satisfied if

$$\frac{R_1}{R_2} = \frac{R_3}{R_4} \text{ and } \frac{L_1}{L_2} = \frac{R_3}{R_4}. \qquad (60)$$

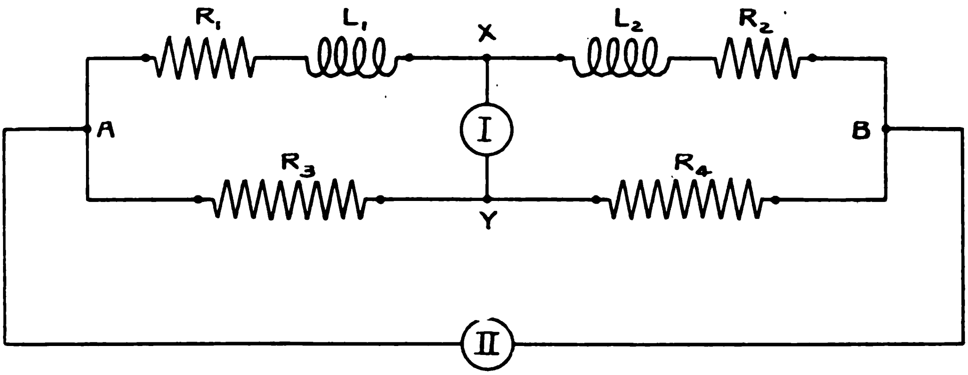


Fig. 36

The first relation given is also that holding for the bridge when balanced for direct current only, while both together express the balance conditions for alternating current as well.

From a consideration of Formulas (60), we reach the conclusion that one of the simplest ways of satisfying the two equations is first to balance the bridge for resistance, using direct current; and then to balance it for inductance with alternating current, using an alternating current indicator, such as a telephone receiver, instead of a galvanometer as before.

It will be noted that we have assumed that the inductance to be measured and the standard are both free from capacity. Strictly, this is never true, since distributed capacity is always present. Its effect could be allowed for, but since it will be very small at the frequencies employed, we shall not further consider it. In addition, we have separated the resistance and inductance of each of the coils as if they were physically distinct elements connected in series instead of being embodied in one and the same coil. No error is thus introduced under the conditions of this experiment.

It can be shown by a mathematical discussion too lengthy to be given here, that the maximum sensitiveness and accuracy can be obtained in such a Wheatstone Bridge when the impedances of the four branches are equal. Suppose that we are comparing inductances of the order of magnitude of 0.001 henry at a frequency of 500 cycles, and that the resistance of each of these coils is about 1 ohm. The impedance of each will be found to be about 3.3 ohms. Consequently, if a slide wire bridge were used, an appropriate value of the resistance of the bridge wire would be about 6.6 ohms. In practice, it is usually convenient to use a somewhat higher resistance, because the form of alternating current generator used (namely a buzzer) is incapable of supplying very large currents. Success in the measurement, since a low resistance bridge is used, will be found to be dependent on obtaining large currents through the bridge, and a step-down transformer may be used for that purpose as indicated in the description below.

(b) ARRANGEMENT AND DESCRIPTION OF APPARATUS. A wiring diagram of the apparatus, as set up, is shown in Fig. 37. At the top of the diagram is shown a typical slide-wire Wheatstone Bridge. It will be noticed that where the known and unknown resistances are usually inserted, we have placed instead the known and unknown inductances L_1 and L_n. In addition, supplementary, finely variable, external resistances, R_1 and R_n are provided. At least one of these is generally needed. The points X and Y of the bridge, which are usually connected to a sensitive galvanometer indicator, are in this case connected to the double pole, double throw switch F. This enables points X and Y to be connected readily either to the direct current galvanometer G or to the sensitive telephone receiver T, which latter is employed as the indicator for alternating currents. The ends of the slide wire, A and B, are also connected to a double pole, double throw switch. They may be connected either to the battery, E, or to the low voltage, high current side of the step-down transformer, J. One terminal of the high voltage side of the transformer J is connected directly to the buzzer pivot point S, on one side of break of the buzzer. The other terminal of the high voltage side of transformer J is connected through the large condenser K to the remaining terminal of the buzzer break, namely Q. The buzzer itself is kept in vibration by the battery N, the buzzer current being regulated by the resistance P. Every time the buzzer contact is opened, the condenser K is charged to a fairly high potential because of the effect of the inductance of the buzzer electro-magnet M. When the contact is next closed, the condenser K discharges through the high voltage side of transformer J, and a strong pulse of current is delivered at the switch H, whence it may be carried to points A and B of the bridge. It is to be noticed that the transformer *must* be so connected that the low voltage side feeds the bridge. Otherwise the sensitiveness will be very small, and no accuracy of measurement can be secured. The reason for this, as pointed out above, is the low resistance of the bridge arms, which therefore require fairly high currents to produce appreciable drops of potential across them.

A photograph of the various forms of standard inductance which may be used for this experiment is given in Fig. 38. To the left are two wooden core, single layer helices, which may be used as standards up to moderately high frequencies. Standard multi-layer inductances wound on marble, for use on low frequencies, are seen in the center. They range in value from 0.0001 to 0.1 henry. To the right are several air core inductances which are frequently used as secondary standards at radio frequencies. In Fig. 39, various types of unknown inductances are shown. They give a good idea of common methods of building transmitting inductances. To the left, in the rear row, is seen a transmitting inductance for Poulsen arc circuits. It is divided into sections which can be readily tapped. The winding itself is made of a number of heavy, solid copper, cotton insulated wires in parallel, the whole being wound on a press-board core. To the right of it is a helix of flat copper band wound edgewise, beside which stands a helix of round copper tubing. In each of these latter coils the windings are supported by notches in vertical rubber guides. In the front row, starting from the left, is shown a single, heavy copper conductor, low voltage inductance, divided into sections; a multi-layer low voltage inductance, with so-called staggered winding to diminish distributed capacity; a "litzendraht" or multiply-stranded wire helix for long wave length work on arc circuits, and a flat band coil, the band being wound into a sort of hexagonal spiral. A number of more complex types which are sometimes used in the laboratory are not shown, their consideration being unnecessary.

The most essential parts of the apparatus are shown set up in Fig. 40. In the background, the resistances R_1 and R_n, the inductances L_1 and L_n, and the buzzer exciter in its sound-proof box, are visible. In front of them stands a precision Wheatstone Bridge. The telephone receiver and galvanometer are in the foreground. In the measurement itself, a supplementary, nearly non-inductive, low resistance was sometimes used instead of the plug resistance boxes

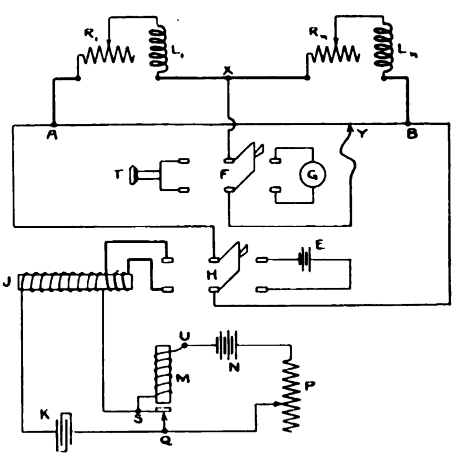


Fig. 37

shown. This supplementary resistance consisted of about 45 cm. (18 inches) of 0.02 inch diameter "Therlo" wire, having a total resistance of 1.05 ohms. A

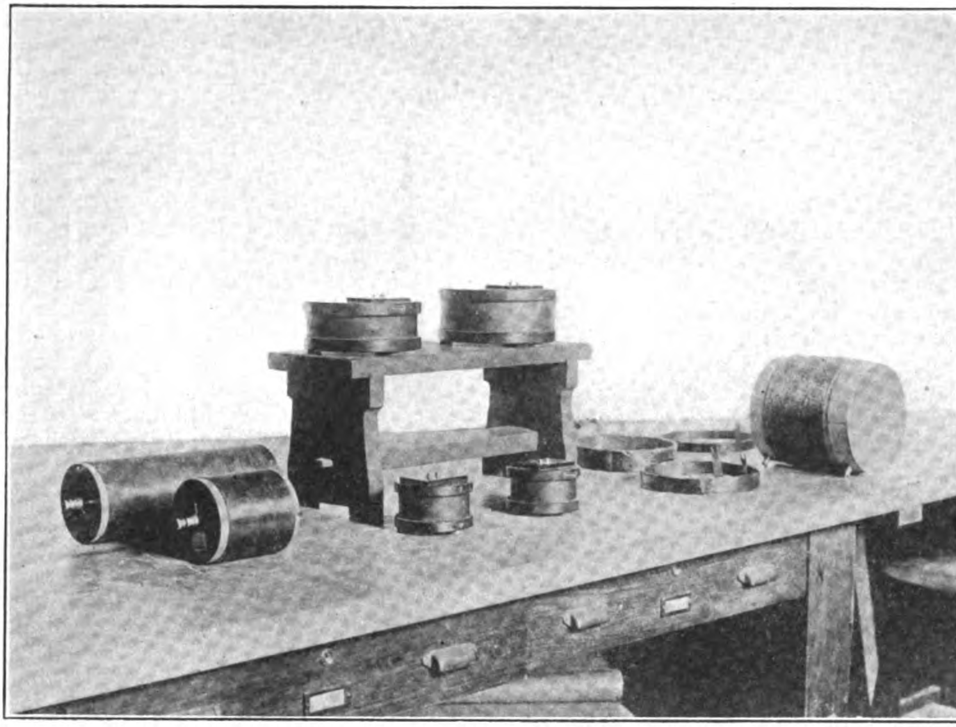


Fig. 38

slider made contact at any point of it, thus securing continuous variation. The galvanometer had a resistance of 381 ohms, and 1 division deflection represented 8.73 micro-amperes. The telephone receiver had a resistance of 2,000 ohms. Both galvanometer and receiver could be replaced by instruments of lower resistance to advantage. The buzzer used was the usual high pitch "Eco" buzzer. The condenser, K, was a 2 microfarad No. 21-D Western Electric condenser. The transformer, J, was a No. 5 Western Electric "induction coil," the resistance of the high voltage secondary being 149.2 ohms, and of the primary 0.39 ohm.

(c) PROCEDURE. The buzzer is set into operation, as high and clear a note as possible being obtained in the telephones T. R_1 and R_n are both set to zero resistance, and the slider Y is moved along the wire until a *minimum* of sound is heard. Both switches, F and H, are thrown to the left. Absolute silence in the receivers will not be obtained; the best that can be obtained at first is a comparatively weak sound at some point of the wire. When this has been secured, vary *one* of the resistances R_1 or R_n (which, as explained above, are preferably continuously variable) until the sound has become as feeble as it can be made by varying these resistances. When this is done, move the slider Y back and forth again until a new and more sharp minimum is secured. Then return to a second adjustment of the resistance R_1 or R_n. This process of adjusting alternately the resistance R_1 or R_n, and moving the slider Y till a minimum of sound is secured must be continued until the sharpest possible minimum is secured. Practically always it will be possible to localize the silence point within a millimeter or two on the scale of the slider Y. With the apparatus properly set up, and some knowledge of the resistances of the known and standard inductances, a little practice suffices to ensure a rapid and accurate measurement. Once the bridge is balanced the lengths of the arms are read off the slide wire. Thus, if the slider stands at 68.2 cm. from the left hand end of the wire, the arms are 68.2 cm. and 31.8 cm., the total length of the wire being 100.0 cm. In general, if these lengths are m and n (and assuming a uniform bridge wire), we have from Formula (60),

$$L_1 = \frac{m}{n} L_n \qquad (61)$$

(d) ERRORS OF THE METHOD, THEIR ELIMINATION; AND PROBABLE ACCURACY. It is obvious that, if the resistance of the unknown coil is quite large in comparison with its reactance (which is sometimes the unconsciously achieved state of affairs in coils used for radio-receiving apparatus), it will be more difficult to balance the bridge properly for inductance alone than when the resistances of the coils are small. In such cases, their resistance may "swamp" the inductance, and the measurement becomes less accurate. The distributed capacity of the coils is also a source of error in this measurement, though at the frequencies used and for inductances of less than about 0.1 henry, its effect will not be serious. The bridge wire, AB, has been assumed to be of uniform resistance per unit of length. This is usually not the case, particularly if very thin wire is used. For such thin wire, a small absolute change in the diameter of the wire at any point causes a larger percentage change in the cross-sectional area (and therefore, the resistance also) than for larger wire. In such cases it may be necessary to employ, instead of m and n in Formula (61), the corresponding true resistances, as measured in a Wheatstone Bridge, of the portions AY and YB of the bridge wire. The inductances L_1 and L_n, and the buzzer M and the transformer J should all be placed at considerable distances from each other to avoid inductive effects between them which would seriously influence the accuracy of the measurement. As examples of actual measurements, the following are given:

1. Standard Inductance $= L_n = 0.001$ henry. Resistance of $L_n = R_n = 1.0$ ohm. To secure balance, it was necessary to add a resistance of approximately 0.5 ohm to R_n. Balance point secured at

$$m = 73.5 \pm 0.1 \text{ cm.}$$
$$n = 26.5 \pm 0.1 \text{ cm.}$$

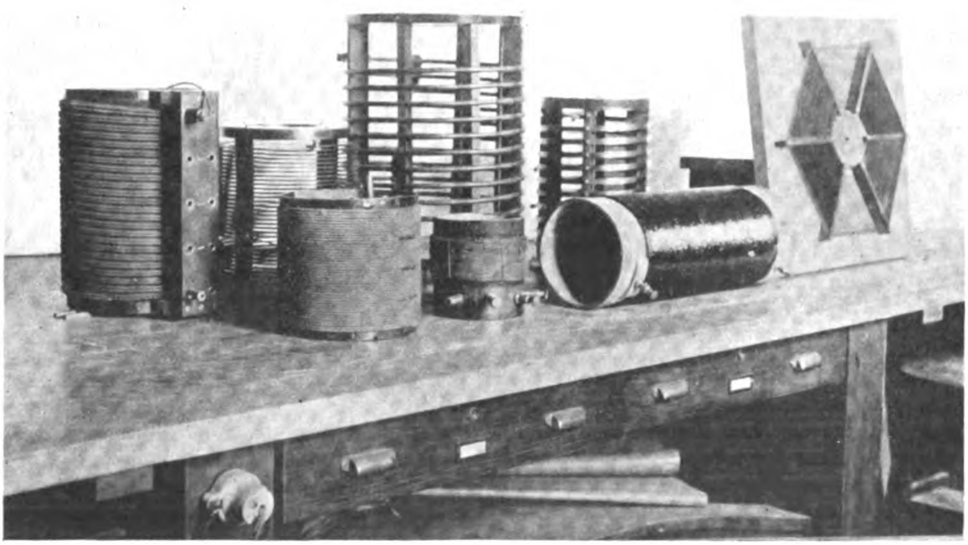


Fig. 39

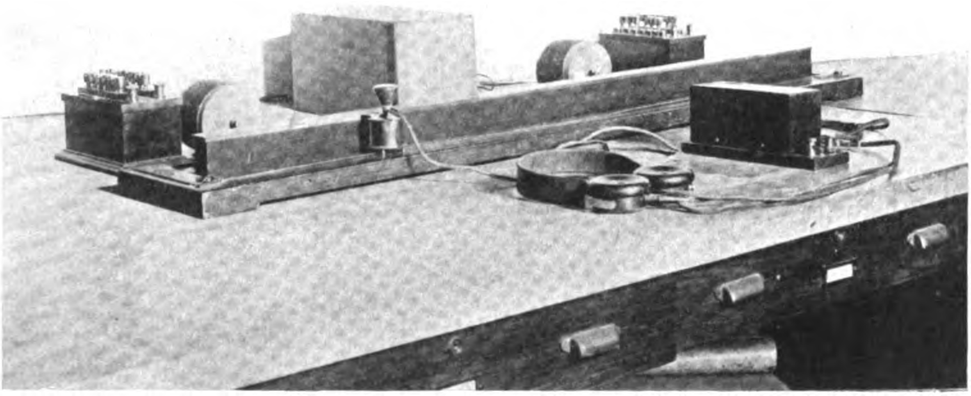


Fig. 40

Therefore $L_x = 0.000360$ hy. (Accurate to about 0.5%).

$R_x =$ approximately 0.53 ohm.

2. Standard Inductance $= L_n = 0.0001$ henry.

Resistance of $L_n = R_n = 0.23$ ohm. To secure balance, it was necessary to a resistance of approximately 0.3 ohm to R_x. Balance point secured at

$$m = 21.6 \pm 0.2 \text{ cm.}$$

$$n = 78.4 \pm 0.2 \text{ cm.}$$

Therefore $L_x = 0.000363$ hy. (Accurate to about 1%.)

It is to be noted that as the value of the inductances are decreased, the measurement has a diminished accuracy.

To verify these results further, the resistance R_x was measured on a precision Wheatstone Bridge. It was found that $R_x = 0.50$ ohm.

The inductance L_x was then measured directly on a Seibt inductance apparatus (see Article VIII of this series), at about 100,000 cycles, and it was found that $L_x = 0.000362$ hy. (Accurate to about 1%.) It will be seen that the results agree well among themselves, and that the inductance of the coil under measurement does not change appreciably between 500 and 100,000 cycles. The coil was a single layer "litzendraht" helix. Under the next measurement, further measurements on this coil will be given for comparison.

Section 22. MEASUREMENT OF INDUCTANCE AND COUPLING COEFFICIENT (MUTUAL INDUCTANCE) BY WHEATSTONE BRIDGE (Modified Form, of Siemens & Halske).

(a) THEORY. Referring to Formulas (42) and (43) of Article VI of this series, we are immediately led to a simple method of measuring mutual inductance. The two coils of inductance L_1 and L_2, the mutual inductance between which is to be measured, are connected in series. If their fields add, the total inductance, as measured on an inductance Wheatstone Bridge, will be

$$L_x = L_1 + L_2 + 2\,M.$$

If their fields do not assist (which state of affairs can be secured by reversing the connection to one of the coils), their apparent total inductance will be

$$L_y = L_1 + L_2 - 2\,M.$$

From these two equations we find

$$M = (L_x - L_y)/4. \qquad (62)$$

If we know the individual inductances, namely L_1 and L_2, we can calculate their coefficient of coupling from Formula (54) of Article VI of this series, namely:

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

The Siemens & Halske Inductance Bridge differs not at all in theory from that previously described in this article. However, by the addition of an ingenious form of variable standard inductance, no direct current and galvanometer readings need be taken, the telephone receiver used with alternating current constituting the only indicator needed. The variable standard inductance consists of a small coil into the center of which can be slid an iron core of suitable shape. The inductance is thereby gradually and continuously increased. However, if solid iron were used for the core, the hysteresis and eddy current losses would be considerable, and (because of the nature of hysteresis effects) it would hardly be possible to secure sharp silence points when balancing the bridge. Therefore the iron used is in finely divided condition, and is imbedded in paraffin wax. The resulting mass has a moderate permeability, and very small alternating field losses.

(b) ARRANGEMENT AND DESCRIPTION OF APPARATUS. In Fig. 41 are shown the two ways in which inductances L_1 and L_2 can be connected so as to cause their fields either to assist or to oppose each other. Lines 1 and 2 of that figure correspond to cases of the determination of L_x and L_y. It may be mentioned that, if the coils are then connected in parallel, Formula (53) of Article VI of this series affords a good check of the accuracy of measurement of M. In Fig. 42 a number of different types of coupling are shown. In the rear, to the right, is seen a transmitting coupler, wound with flat copper band, one of its coils being helical and the other spiral. To the left, in the rear, is a double cylinder transmitting coupler wound with round copper tubing. In the front, to the right, is a low voltage coupler for use on Poulsen arc transmitting circuits. An ordinary receiving coupler is visible in the center of the front, and to its left an efficient type of receiving coupler, the inner coil of which is wound on a spherical surface.

In Fig. 43 is given a wiring diagram of the Siemens & Halske inductance bridge. Between the points U and V a source of alternating current is applied; for example, such a buzzer and transformer as are shown in Fig. 37 (J and M, etc.). The bridge wire is short, so as to have small inductance. The unknown inductance is inserted at L_x. R_x is a small additional resistance with a delicately adjustable slider contact, forming a permanent part of the bridge. R_n is a set of resistances, which can be inserted by removing their short-circuiting plugs in the usual method, as adopted for plug resistance boxes. The resistances at

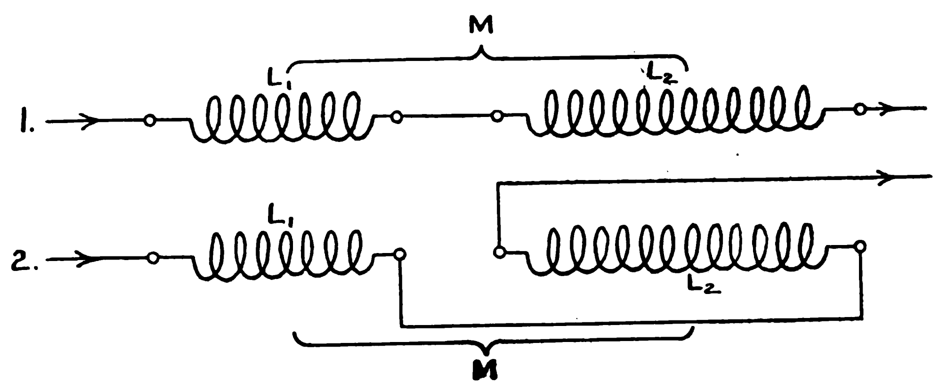


Fig. 41

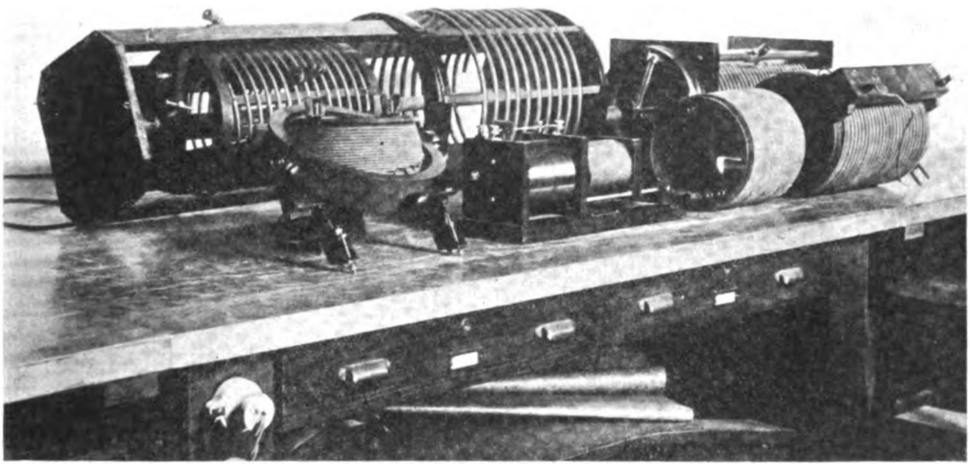


Fig. 42

R_n are 0.1, 0.2, 0.2, and 0.5 ohm. Two extra slide wires for R_x are also provided in mounted form, and are readily inserted if the one which is in place proves not to be adapted to the particular unknown inductance which is under measurement. L_n is the standard inductance, with the finely divided iron movable core. The inductance of L_n for every position of C (which moves over a graduated scale) is given in a chart which is supplied with the apparatus. The telephone receiver, T, is of low resistance. The apparatus itself is shown in Fig. 44. As will be seen, to the left of the bridge baseboard is the slider which moves over the resistance R_x. In the front and middle of this board is the small plug rheostat, R_n. The standard inductance with its movable core, C, is to the right of R_n. At the right of the photograph is the special telephone receiver, T, lying in front of the containing box for the entire apparatus. The calibration curves, covered with glass, are in the background.

(c) PROCEDURE. The procedure is precisely as in the previous measurement of this article, except that it is unnecessary to use anything but alternating current and the telephone indicator. Slider Y is first adjusted to as nearly a minimum sound as possible. Then slider X is adjusted to approach the silence point further. Alternate adjustment of

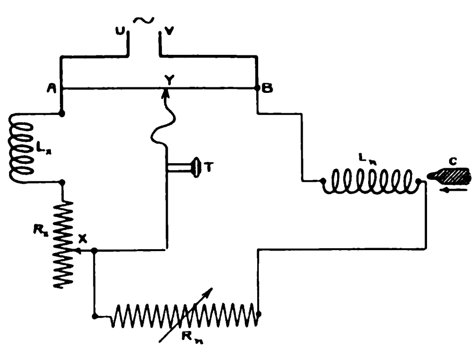


Fig. 43

X, Y, and of the position of core C will, if R_x and R_n have been properly chosen, soon lead to a sharply determined balance point.

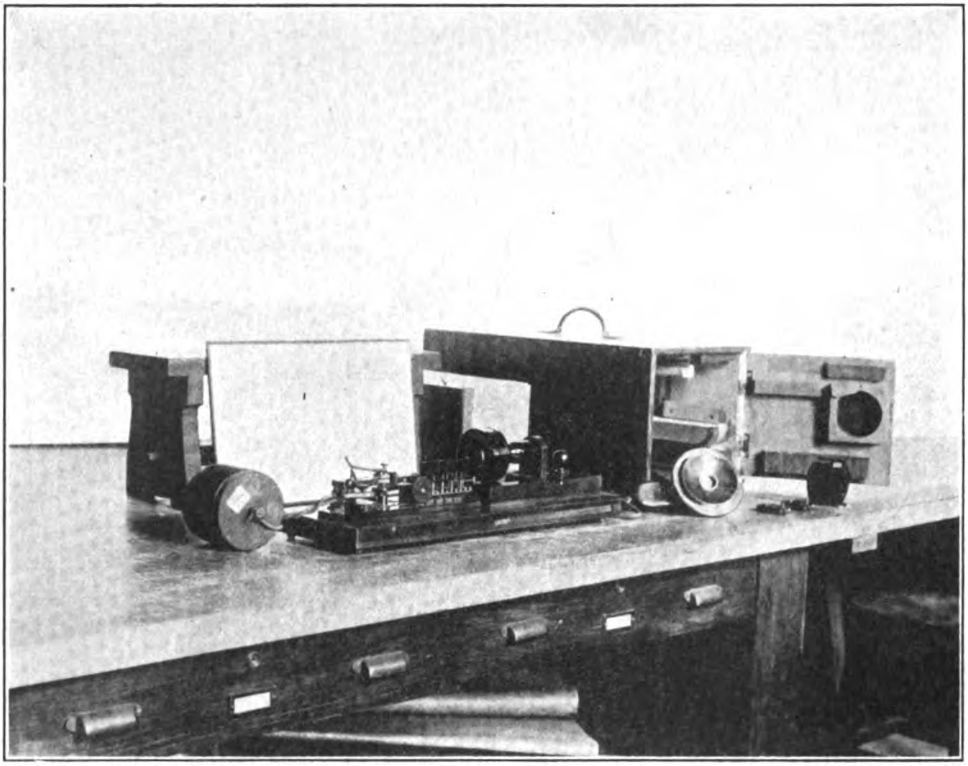


Fig. 44

(d) ERRORS OF THE METHOD, THEIR ELIMINATION; AND PROBABLE ACCURACY. The errors to which attention was called in the previous measurement of this article are all likely to be present in this method as well. In addition a new error due to the iron core C may be introduced. The inductance of L_n will depend on the current passing through it, inasmuch as the permeability of the iron core is not constant, but varies with the field strength, that is, with the current which produces the magnetic field. However, for the small currents used, this error is not serious.

The same unknown inductance which was used in the first measurement of this article was then measured on the Siemens & Halske bridge. Two trials gave the results:

$L_x = 0.000361$ hy. and $L_x = 0.000358$ hy.

The probable error was, therefore, about 0.5%.

To test the accuracy of the calibration curve furnished for the standard inductance, L_n, at two positions of the core C, very accurately known inductances were inserted at L_x and the bridge balanced. Using a known inductance of 0.0001 henry as L_x, the values of L_n found were

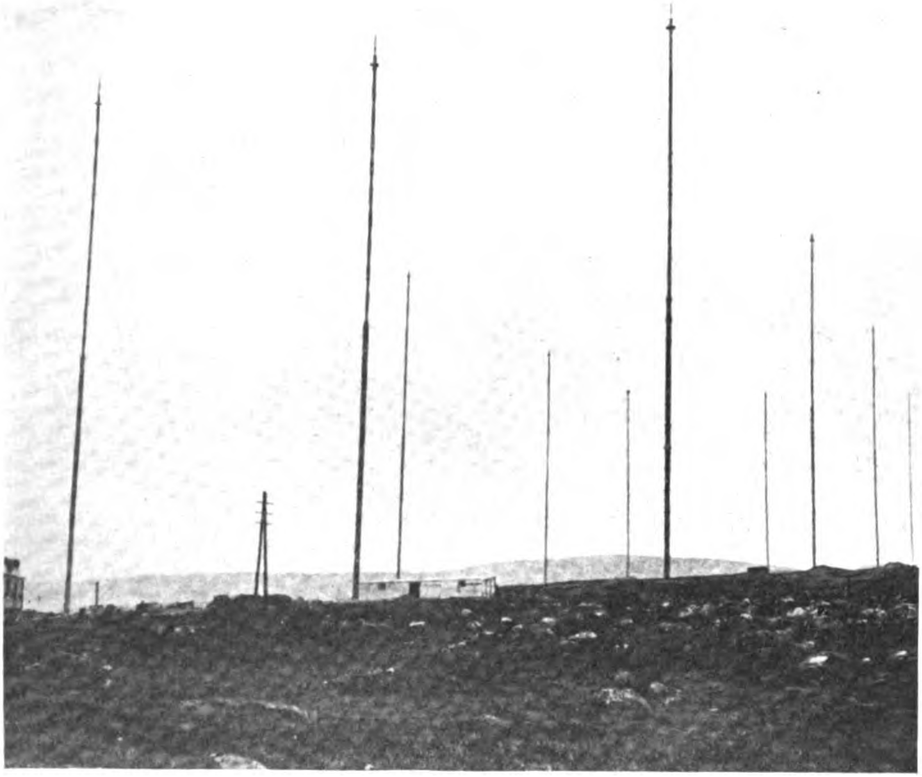
Position of core = 44.0, $L_n = 0.000233$ henry.
Position of core = 60.0, $L_n = 0.000272$ henry.

A known inductance of 0.001 henry was then used as L_x, and it was found that with

Position of core = 44.0, $L_n = 0.000233$ henry.
Position of core = 60.0, $L_n = 0.000270$ henry.

These values of L_n agreed closely with those given by the calibration curve, and, as will be seen, the probable error was again less than 0.5%.

This is the seventh article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The eighth will appear in an early issue.



The Carnarvon Station, located on the side of the Cefndu Mountain, Wales

The Wales Link in the Marconi Chain

ADDED interest has been given to the picturesque old city of Carnarvon, Wales, due to the fact that one of the Marconi high power trans-Atlantic stations is being built at Cefndu which is nearby. The station is located on the side of the Cefndu Mountain, and merely from a wireless point of view the site is admirable. The ground begins to rise as soon as the Geunant road, which stretches along the lower edge of the Marconi Company's property, has been passed, until at a point on the extreme eastern side of the site it reaches an altitude of some 800 feet. The station itself is built at a height of 750 feet and the last row of masts is estimated to stand about 1,400 feet above the sea level. It will communicate directly with the station in course of construction in New Jersey.

This is a description of the locality as it would strike a wireless expert, but from the point of view of the observer of natural beauty much more might be added. Looking toward the north from the mountain side the land lies spread out below till it reaches the water's edge. Beyond stretches the glitter of the sea, its attractiveness emphasized by the proximity of Anglesea.

Further than this the eye on a fine day can penetrate the blue haze and catch a glimpse of the white shore of Ireland far out in the distance. It is a splendid spot for those who will be in charge of the station, and though in the winter months it is cold and swept by strong winds, a quick walk down to the valley below will bring them into another climate, for in all the lower lying districts and along the coast, it is warm and mild.

The transmitting aerial of the Carnarvon station consists of thirty-two wires of silicon bronze, and is supported on ten tubular steel masts, each 400 feet in height. The foundations and anchors for these masts consist of very heavy concrete blocks, some 6,000 tons of material having been used in their construction. The earth system consists of two extremely wide circles of plates sunk in the ground with the main building as a center. Extensions to this system are buried underground immediately beneath the aerial, and they extend as far as the eastern extremity of the site.

The main building is divided into two sections — the permanent transmitting section and the experimental section. The permanent section consists of a large machinery hall which contains two generating sets of 500 horse power and the main switch boards. On the east side of the hall is an annex in which are situated all the motor generator sets used in conjunction with the transmitting plant.

Adjacent to this hall are the two silence chambers containing the two transmitting discs, and behind these are the transformer room and various offices. The experimental section adjoins the main machinery hall on the west side and will contain various machines to be used for special work in connection with Mr. Marconi's latest device for generating continuous waves.

FORTY STATIONS IN THE PHILIPPINES

A dispatch from Manila says that the Legislative Assembly has given a franchise to the Marconi Company to build forty wireless stations in the Philippines. The bill as originally proposed provided that in the event of war the American Government might take over the wireless system. The bill was amended, however, so as to accord this right to the Philippine Government instead of the American Government. The amendment was proposed by Philippine Commissioner Vicente Ilustre.

THE SHARE MARKET

New York, March 26.

A day of even lighter trading than the days which immediately preceded it closed this afternoon with only a slight net change in the general level of prices. On the Exchange and outside markets some of the standard industrials were under early pressure, but recovered the slight declines before the close of the day. Canadian Marconi remains about the same as last month, but both common and preferred English Marconis show slight declines. The brokers attribute this to the greatly exaggerated reports of the disturbances in Ulster, where considerable stock is held by individuals. It is generally accepted that the present unimportant disturbances amount to nothing, and rapid recovery is confidently looked for. American Marconi shows a slight advance following the favorable opinion handed down by Judge Veeder in the infringement suit against the National Signaling Co. and, as one broker expresses it, the advance demonstrates the confidence of the 20,000 shareholders in their company.

Bid and asked prices today:

American, 4⅞–5⅛; Canadian, 2⅜–2⅝; English, common, 17¼–18½; English, preferred, 14–16.

YACHTSMEN TO LEARN S O S

Chicago yachtsmen must learn the continental code for sending and receiving wireless calls. This was the decision reached by the yacht and motor club heads in that city following the demonstration of wireless for small boats at the recent motor boat show. Not that the skippers must learn the entire code, but before they can be known as regular skippers they must know the S O S call and the number of their boat.

The possibility that the United States government would take up the matter was expressed by Commodore William Hale Thompson. "If the yachts are all equipped with wireless it will be necessary for the life-saving stations to take the matter up," he said. "This wireless apparatus will be much more valuable than the Coston signals which we now use, for it has a much longer radius than the blue fire."

Is the Game Worth While?

A Review of the Commercial Wireless Operator's Career and a Few Comments from an Operator of Experience

By FREDERICK A. KLINGENSCHMITT

SOMETIMES it is a passenger on board ship; a boy, his father, his mother, uncle, aunt or cousin; again it has been an amateur rubbering about the Cliff Street office, or the next door neighbor's young hopeful—every so often I can expect to be asked: Is the commercial operating game worth while?

People of all shapes, sizes and ages have put the question to me; I have heard it in three languages, expressed in at least thirty distinct styles of phraseology.

Naturally, my answers have varied in construction and amplitude with the individual temperaments; the sum and substance of all, however, may be confined to two words: It is!

Now I believe that this unvarying reply has carried conviction to inquirers where we have come into personal contact; for I have seen physical reflections of my own enthusiasm awakened in hearers, and, what is perhaps more to the point, there are men in the service today whose preliminary inquiries were addressed to me.

When I speak of genuine enthusiasm where I am concerned, I really mean it. I have enjoyed my operating career; I still enjoy it and expect to be enjoying it just as much when the Powers-that-be in the home office call me to a more responsible task—a remote possibility mayhap, but one that adds a certain zest to things. Meanwhile, I am seeing the world, learning something of all kinds and classes of humanity, imbibing the basic principles of salesmanship, acquiring a fair knowledge of electrical phenomena, appreciating the respective merits of systematic effort and discipline, storing up a tremendous reserve of good health for the coming years and earning a lot more money than my erstwhile classmates who turned to more sedentary occupations.

Yet there are kickers in the wireless service—lots of them. There are kickers in every business, for that matter, with always the same grievance. Working hours too long, wages too low, promotion too slow, is the burden of their lamentations. Analyze their qualifications and you find: energy sporadic, initiative unknown, ambition negligible — and there's the answer.

In nine out of ten cases they are living on a higher scale than they ever dreamed of, have more actual spending money than they have ever known, and voice their alleged discontent only because some older operator has patronizingly referred to their humble situation in comparison with his exalted (personally exalted, usually) position in the service.

We get around to places that the tourist stopping at a hotel would never see, and we become familiar with the people and the customs in an intimate way

Matter of fact, wireless operators, collectively and individually, are to be envied. Most of them have not yet reached their majority, yet they earn from thirty to sixty dollars a month, with bonuses on message traffic and sales of the steamship daily newspaper that run an extra ten dollars a month or more with very little effort. And look at the opportunity to save! No board and lodging to pay and all the ship entertainments at their disposal. At sea or ashore the wireless operator is furnished with comfortable quarters and attendance. His food is the same supplied to officers of the ship and in most cases he is permitted to dine and sleep aboard even when the vessel is in port. The saving man, and by saving I do not mean stingy, can confine his personal expenditures to the sum earned by bonuses, leaving his salary intact at the end of the month.

Think of what that means. He can live well, far better than other self-supporting men of his own age, lead a more varied and interesting life, and still set aside every cent of his earnings. Some operators are the sole support of dear ones at home; that, of course, should be different, at least so far as the saving part is concerned; yet, paradoxically, these young men can usually show a far larger bank balance than the loud complainers of what we term the static room.

Lest there be some speculation as to just why I am jotting down these remarks it may be well to state here that my motives are purely altruistic. I am not on the defensive. I firmly believe that commercial wireless operating opens up a great future for young men and I hope that the views of an insider may influence the right kind of fellows to join the service.

Since wireless telegraphy needs men, good men, and offers rewards that should call out the best material, it occurred to me that it was time for some one who really knew something about an operator's life to show it in its proper light.

About all the layman hears of are the shipwrecks and attendant heroism. Other adventures form a large part of the literature on the subject. So the first time a young man addresses a commercial operator he is usually amazed to find that that particular individual has met with none of those amazing experiences that presumably are part of the daily work. Very often the operator will explode this theory in a supercilious dissertation on the deadly monotony of the whole business.

You hear a lot about this deadly monotony thing. Personally, I can't see where it exists. In my years of service I have never encountered what could legitimately be termed an adventure, yet my career has been anything but monotonous.

This is typical of my experience in what are termed the "long, dreary waits."

Nine A. M. on board one of the fast mail steamers bound for Havana, Cuba. Having wrapped yourself around a hearty breakfast and relieved the junior operator you are tipped back comfortably in the operating chair, head phones adjusted and feet crossed on the adjacent table. Business is slack and you are leisurely scanning the pages of a current periodical or contentedly reflecting on the beauty of the scene, the beauty back home, or the one that tripped down the companionway shortly before nine last night. Just about then your reverie is disturbed by something like this:

"Good morning, Wireless, any news this morning?"

A figure of generous proportions stands in the doorway and the genial countenance of its elderly owner beams on you cheerily.

"Morning," you reply. "News?—you betcher; couldn't have seen a copy of this morning's Ocean Wireless News! Deck steward's been around with them twice."

"Must have missed him; matter of fact, I've just turned out."

With an eye to business, you feel around a bit, remarking: "Let's see now, seems to me there are a few copies left. Oh, yes, here we are! You're lucky; here is the last one."

There is always a last one when a customer is in sight, and you turn it over, pocketing the coin it calls for and reflecting that this adds another little tinkle to the coffers being steadily piled up with commissions for you and your junior on the sale of the daily wireless newspaper.

Meanwhile the visitor has been scanning the news and market reports, and beginning with a few brief comments, he soon launches forth on a discussion of current topics, during which you learn that he is no other than the great John Affluent, with heavy interests in Cuban sugar plantations and bound there on a combined business and pleasure trip. Absorbing carefully his terse and thoughtful comments on vital issues of the day you are amazed at the breadth of his knowledge and his simplicity of expression. Later on—it may be months or years later—something arises in conversation where the few facts gleaned from that brief discourse prove of inestimable value to you. A surprising amount of useful information is acquired this way, for on board ship you encounter all classes of people and a good memory is alone necessary to provide you with a fair working knowledge on almost any subject. On foreign-owned vessels this great boon is missing; their rules do not

All the points I have visited have distinct appeals, and none more so than Curacao, a Dutch possession, commonly called Spotless Town

The Wireless Man is ever a popular figure with the feminine sex.

Scene during Neptune Service Dr. Pill making speech through megaphone as ship crosses Equator.

Tea-time on Deck is always a cheerful period.

permit an operator to mingle with the passengers and whatever association he may have with them in the line of business must be marked by deportment which upholds the dignity and responsibility of his position. On American ships a more democratic condition exists and the line between the passengers and the man who presides over the wireless room is not so closely drawn. In both services, however, the operator who attends to his duties faithfully and conducts himself in conformity with the rules of the ship is treated with every consideration.

But to return to the ship acquaintance. By this time the conversation has drifted to where the weather and the high-cost-of-living bugbear have been gracefully set aside in favor of a more interesting ocular demonstration of one of the worth-while considerations; in this case, none other than a radiant vision of feminine loveliness, whose identity is disclosed by the visitor's cheery call: "Oh, daughter—Helen, dear—come over here and see the wireless!"

Whereupon you surreptitiously fix your tie and guardedly polish the brass buttons on your sleeve. Papa makes the necessary introductions while you mentally note the charms of a Miss about 'steen years old and decide that this voyage is to be a most enjoyable one.

Having ascertained that this is the little lady's first sea trip you reply to her immediate interrogation by giving a knowing squint at the sky, shaking your head ponderously, and telling her that this is not the open season for storms and that you have arranged with the captain that nothing of that nature will interfere with the serenity of this particular trip. An answering twinkle in fond Papa's eye is just discernible as he ambles away down the deck, leaving the field clear for a nice little tête-à-tête. Grasping the opportunity you proceed to unravel the wonders of the wireless. One by one, from the anchor gap to the drip pan of the motor generator, you explain the relation of things and give the function of each particular device. Then you unwrap the mighty intellect and parade your erudition handsomely in a little lecture on the theory of transmission. It is remarkable what an impression can be created by simply going over the same old gag about throwing pebbles in a pond of water, how the waves go out in all directions, rocking the conveniently floating chip and expending their energy when they strike the shore. If time permits and it looks as if you are making a dent, you go back to the old coherer days when youthful inventors used a tin can for an antenna and wirelessed one hundred feet across their fathers' flower gardens. This is only resorted to when you are keen on making a lifelong impression. The regular conclusion of the lecture is reached when you impressively adjust the tuner, pick up some ship about one hundred miles away and invite the audience of one to listen in. Assure her, him, or it that it's San Francisco working with Honolulu and you have become the feature attraction of the ship. Start up the motor, then, make a few sparks fly and you accomplish two things: You probably jam one of the boys who is trying to get rid of a batch of paid business, and have put yourself in line for a two-dollar message.

All needed is a timely suggestion that in the bustle of departure something or somebody has been neglected at home. Why, to be sure, recalls the visitor, Grandma, or Fifi, or somebody, has been overlooked, and you take down a message reminding someone at home to give that dear little pomeranian its olive oil bath every morning—or a similar message of equal importance. Punctuated with many gasps of amazement from the bystander, the message is rattled off and you have added another clink to your message bonus money box.

Now old John Affluent's daughter, aside from her physical attractions, is well worth cultivating. You watch a glorious sunset or two with her by your side, and perhaps the moon rising over the southern sea. She is very popular with those aboard and you are made acquainted with all the young people in short order. You draw their attention to the Ocean Wireless News and organize an editorial staff among them, appointing sporting, society and dramatic editors, who are to obtain all possible local news aboard the ship and help prepare it for publication in the following morning's issue. The concert reviews are patterned after the genuine article, and the personal items are written in a jocular vein. This local news makes a tremendous hit with the passengers and those whose names get into print may be counted upon to take half a dozen copies as souvenirs. On the page assigned to these local items appear the names of the editors and their temporary titles, friendly rivalry being created by changing the personnel of the staff each day of the trip.

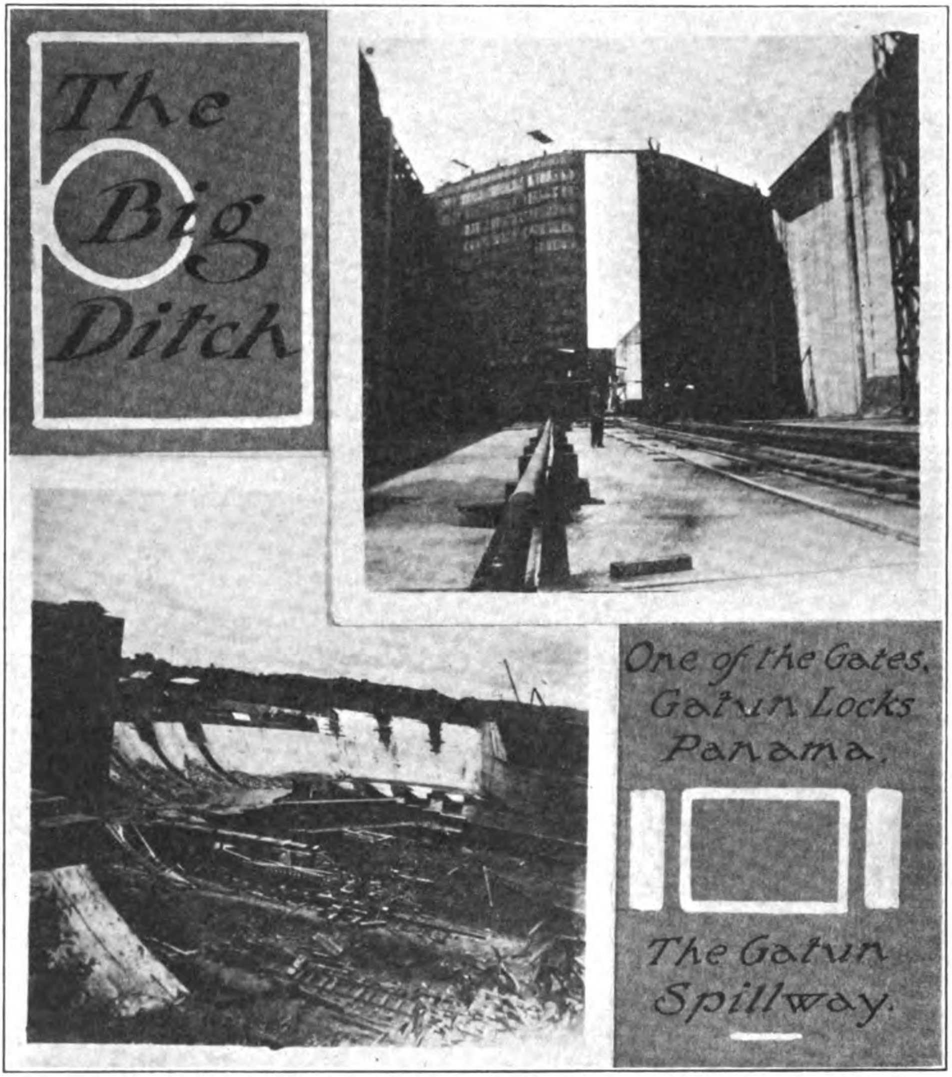
Net 'result: An increase in sales of about 100 copies per diem and a couple of dollars extra added to your commission fund.

Deadly monotony—pooh! This wireless operating business is about the most interesting game I know of. And it's about the only one where you can successfully combine business with pleasure.

Of course it isn't all a merry lark; a lot of serious work is to be done and there are a lot of exasperating interruptions.

Take another instance:

Call it about the same time of day as in experience number one. Bound for Puerto Rico this time, third day out. Instead of taking it easy you are hard at it, with the lugs down tight and the



One of the Gates, Gatun Locks Panama.

The Gatun Spillway.

static and jamming so bad you are afraid to breathe for fear of missing something. Along the deck comes an inquisitive school ma'm; she sticks her head through the doorway and engagingly remarks:

"Oh, is *this* the wireless?"

That settles it. You take off the lugs, attempt an amiable smile and turn your attention to the visitor.

"Pardon, madam; did you wish to send a message?" you inquire, reaching for the blanks.

"Oh—er—that is—no, thank you," as she makes a quick mental calculation of the contents of the bag swung at her waist. "I just thought that this was that wonderful Mr. Marconi's wireless, and I wanted to be sure."

Marvelous deduction, is your inward comment, but being a first grade operator and an officer of the ship you reply very courteously:

"Yes, ma'm. This is it. Very wonderful, too. You can't truly appreciate its fascination, though, until you see your own thoughts actually transmitted from this key through miles and miles of space to a friend back home. I will be very glad to show you how a message is sent should you care to file one—" and your voice trails off into incoherent mumblings as you see how hopeless this prospect is. The seeker of knowledge is there to stay, however, and remarks with a roguish glance: "It *is* wonderful, isn't it?"

"Yes, ma'm."

"Almost uncanny."

Once again: "Yes, ma'm."

"How does it work?"

"Oh, it is very complex. It would take me hours to explain; that is, unless you have some technical knowledge of circuits. You haven't? Well, really then, it's quite hopeless to attempt an explanation," delivered in your most sugary tones and with an engaging smile. "Anything else, ma'm?" you inquire solicitously.

"No, thanks, I hope I haven't bothered you," and as you reply in the negative and turn back to business: "Are you going to send a message now? Yes? May I stay and watch?"

Of course she can stay; but you wish the dickens she wouldn't. But then you never can tell . . . so crash, crack, go the instruments and you pound away for ten or fifteen minutes cleaning up the traffic on hand. You raise your head then, and, hello! a promising looking male figure has joined the inquisitive school ma'm in the doorway, undoubtedly attracted by the noise of the sending.

(1) The Maine being raised from Havana harbor. (2) Morro Castle. (3) Convicts cleaning city streets under guard

Business ended for the moment, you swing about and look inquiringly at the copy of the Ocean Wireless News he holds in his hand.

"Have you a minute to spare, Wireless?" he opens up, breezily. "I see that this little newspaper is rather widely read. I have been looking over the ads. Hotel man, myself, on my way to take charge of the new house in San Juan. What'll it cost me to run an eighth-page advertisement in here, do you know?"

You bet you know, if you are on to your job. From a convenient drawer you yank out the rate card, the list of steamers on which it appears simultaneously and give him all the circulation dope, the free message reservation of rooms privilege and a blank form of contract.

He will probably want to "think it over," which worries you not at all, for you can figure, sure as shooting, he'll be back before the ship docks; so you pick up the pencil and figure out what your commission will come to in dollars and cents. Easy money? The easiest ever. Experiences of this kind don't happen as often as you'd like them to, but there is nothing in the world to prevent you getting around to the shops and hotels while you are in port and picking up an order or two by a little genuine effort.

So much for the commercial spirit. The foregoing is just a sketchy suggestion of the thousand and one opportunities that may be turned to good account if you are wide awake. But an operator's life isn't all a mad scramble for additional ducats, by any means, and once ashore we are generally assiduous pleasure seekers.

Many opportunities present themselves. Here is a typical instance:

A long voyage this time—to Rio de Janeiro and Buenos Aires. It is the eighteenth day out and all hands are well acquainted. Due in Rio the following day, the deck sports are over and the prizes are to be awarded after the captain's dinner that evening. Neptune, Doctor Pill and all his satellites, followed by hearty laughter, have departed overboard after the crossing of the Equator and everybody is in a jovial mood. You have just lit up the old jimmy pipe and are taking it easy in the wireless room when along the deck comes that congenial Mr. Survey and his party of five other civil engineers, going down to take hold of a big railroad construction job in Uruguay. They are all young fellows and after eighteen days of confinement to the limits of a ship their pent up spirits are tugging for expression.

Survey starts off this way:

"Say, Sparks, you've been to Rio before, haven't you?"

"Half a dozen times," you affirm.

"At that rate you ought to know the burg pretty well."

You admit the truth of this surmise and your inquisitor tactfully suggests that you might be willing to pilot about a party of young fellows who don't know the "lingo," haven't any definite idea of what to see and imagine they would have a hard time getting about. They would esteem it a great pleasure if you will consent to be their guest, as they plan to hire an automobile for a long ride into the country, lunching at some comfortable Inn and returning in the afternoon for city sight seeing. In the evening they plan to take in a show, and—well, "Are you with us?"

The project sounds inviting and you like the fellows, so you reply: "Be more than pleased to go along, but of course I shall expect to share my proportion of the expense."

This proposition is met with: "Couldn't think of it, old man, no sir, not for a moment. You're asked as our guest, and the obligation is on our side if anywhere—why, we are a lot of greenhorns

Sightseeing de luxe at the kind invitation of passengers

The Municipal Theatre in Rio, second largest in the world

Those we stop with are only too willing to show us around and it's a great privilege for us to see things under the guidance of a man who knows the ropes."

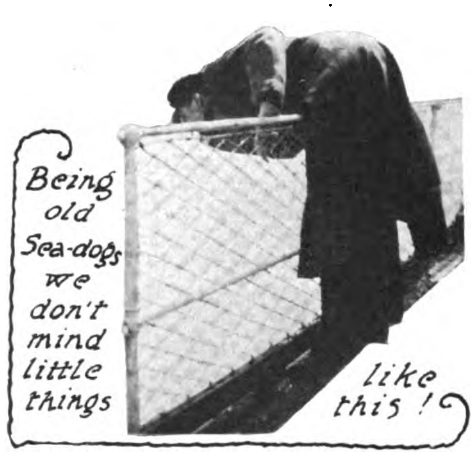
And after a few polite protests you fall in with the plan, and needless to say, spend a mighty enjoyable day amid scenes of many historical events in the most beautiful city in the world.

These trips fall to the lot of the wireless man on almost every voyage. If a fellow is but ordinarily courteous he can become very popular with the passengers and have his choice between several contesting parties anxious to secure his services ashore.

And the benefits to be derived from a knowledge of all countries can only be appreciated by those who have traveled extensively. The wireless operator gets all over the world with the same comfort and convenience that others pay thousands of dollars for. Too, he dodges that bugaboo of tourists, the hotel runner, and the jehus and the dock parasites importuning for the visitors' odd change.

Once in a while, we feel we would like a change from the ship quarters and decide to stop ashore while in port. Natives are usually pleased to accommodate us and we secure a comfortable room and excellent meals at a rate which is fixed reasonably through a ship officer's recommendation. Those we stop with know the country well and are only too willing to show us around and arrange introductions to people in a position to make things interesting during our stay. Thus we get around to places that the tourist stopping at a hotel would never see and become familiar with the people and customs in an intimate way. Which, of course, is far more beneficial than viewing them as they pose before the tourist.

Uncle Sam's "Big Ditch" at Panama is one among many interesting points I have visited as an operator. At Havana, it was my good fortune to witness the raising of the Maine, and to secure as souvenirs, the port key and a patent door catch all covered with barnacles and corroded from thirteen years' immersion in the waters of Havana Harbor; Buenos Aires—the second Paris—Rio and Montevideo, the capital of Uruguay, proved interesting and inspiring and made me realize that my first love, New York,



was not the only metropolis in the universe.

We pick up languages, too; in fact it is a service tradition that after two trips to Mexico and Cuba an operator may be expected to speak fluently "Ward Line" Spanish and to air it on future trips to other Latin countries.

The West Indies are available to the wireless man, including Puerto Rico, now run by Uncle Sam, Trinidad and Barbados, English possessions, Curacao, Dutch, and commonly called Spotless Town, Martinique, with Mt. Pelee as the attraction, and ruined St. Pierre, now covered with wild growths. The Bahamas and Bermuda Islands prove very alluring and interesting; in fact, all of the points I have visited have distinct appeals and have registered pleasurable impressions, which, for perfectly obvious reasons, I will not attempt to describe.

Mild adventure is always our lot. In Mexico I secured several photographs of the insurrectos in camp and on the march, subsequently selling them to a magazine at a very satisfactory figure. Many operators employ their cameras profitably, securing photographs of wrecks, derelicts shipping heavy seas and similar subjects of value to newspapers. As I remarked before, business and pleasure mix well and the commercial opportunities are only limited by the ingenuity of the individual operator.

Once in a while, it is true, heavy going disturbs the serenity of our existence. Caught in the middle of a West Indian hurricane, our interior arrangements are likely to be disturbed, but after a few months we are old sea dogs and don't mind little things like this.

My impressions are mostly of good times and the excellent opportunities to mingle with people of distinction. We get to know some of them pretty well. One of the men in the Marconi service recently had the honor of demonstrating the wonders of wireless to President Wilson, another, as you already know from the February issue, became quite chummy with Secretary Bryan, still another beat Colonel Roosevelt at deck shuffleboard on his recent trip to South America, and last but not least, the redoubtable Christy Mathewson became the boon companion of one of our comrades when returning from Spring training.

Thus far I have purposely refrained from mentioning the future in store for the ambitious operator, for I consider that readers of The Wireless Age are thoroughly familiar with the wonderful progress being made in commercial wireless and possessed of sufficient imagination to foresee how readily advancement may be secured with proper application to daily tasks.

The sole observation that the Marconi Company has already indicated its preference for experienced men by elevating former operators to some of the highest positions in the service should cover this entire question. There is plenty of room for *good* men in commercial wireless, and no better place to start could be selected than the operating end.

With proper application, less than a year in the Marconi Company's school will equip the right sort of fellow with sufficient knowledge to secure a ship assignment and become self-supporting. After that, it is entirely up to him. He can lead an indolent and careless existence—for a time—or he can combine a certain amount of pleasure with business and still acquire the brand of proficiency that gets him slated for something higher.

Only now, after some time in the service, am I really beginning to appreciate how much better off I am than friends of my boyhood who turned to other branches of commercial activity, for I am contented, nay, happy; and mighty cheerful about the future.

So it must be that the wireless operating game is worth while.

DIRECTION FINDERS ON UNITED FRUIT BOATS

The wireless direction finder, a Marconi invention that will reduce to a minimum the risk of collision in fog, is to be installed on all passenger steamers of the United Fruit Company. The crack cruisers Calamares, Tenadores and Pastores will be equipped within a few weeks, and will be the first passenger vessels in the world to carry this instrument.

The object of the wireless direction finder is to enable navigating officers on ships to take bearings of wireless telegraph stations with a view of finding the position of their ships, or of avoiding collision with other vessels.

It is not claimed that bearings taken with this instrument exceed in accuracy those taken with optical instruments under good conditions, but it is claimed that reliable bearings may be taken with it when direct bearings cannot be taken owing to bad weather.

When trying to locate another ship while going slow in fog the indication of the direction finder will show by a steadily increasing strength of signal if the other ship is approaching, but might leave a doubt as to whether it was approaching on the port bow or overhauling on the starboard quarter. A wireless query as to her course, addressed to the other ship, however, would remove the doubt at once.

VESSELS MORE EASILY LOCATED

The use of wireless telegraphy has lessened the number of ships that disappear leaving no trace of their whereabouts. During 1913 Lloyds posted only twenty-five vessels with an aggregate net tonnage of 31,426. This was eleven less than in the previous year, and included a large number of smaller-sized craft, such as schooners and tugs, which do not, as a rule, carry wireless.

SUPPLEMENT TO STATION LIST

Supplement No. 1 to the List of Radio Stations of the United States, covering all additions and alterations up to October 1, 1913, has been issued by the United States Department of Commerce. The new supplement contains twenty-seven pages.

The John D. Archbold of the Standard Oil Company's fleet. She is equipped with a 2 K. W. Standard Marconi set and an auxiliary set

New Marconi Equipments

AMONG the vessels which have recently been equipped with Marconi wireless apparatus is the new tank steamer John D. Archbold, of the Standard Oil Company's fleet. Built by the Newport News Shipbuilding and Dry Dock Company at Newport News, Va., the Archbold is designed to carry a total dead weight of 10,000 tons on a draft of twenty-three feet and four inches. Her cargo capacity will be about 67,500 barrels. Her dimensions are as follows: Length, 460 feet between perpendiculars; beam, sixty feet; depth, thirty-six feet and two inches. She is equipped with a 2 K. W. standard set and also an auxiliary set. The installation was made at Newport News.

The Archbold is well prepared to withstand the perils of the sea, for she carries double the lifeboat capacity called for by the United States Steam Boat Inspection Regulations. She has telemotor control of the steering gear and is equipped with a McNab revolution and direction indicator by which her captain can see immediately whether the engineer is carrying out the orders conveyed from the bridge by the engine room telegraph.

She is built to burn either coal or liquid fuel, her crew for running on the latter being about forty men. Her engines are of the quadruple expansion type (four cylinders balanced). Steam is supplied from three main boilers with Howden's forced draft; there are three furnaces in each boiler. The working pressure of the boilers is 220 pounds and in addition there is a donkey boiler designed for a working pressure of 180 pounds.

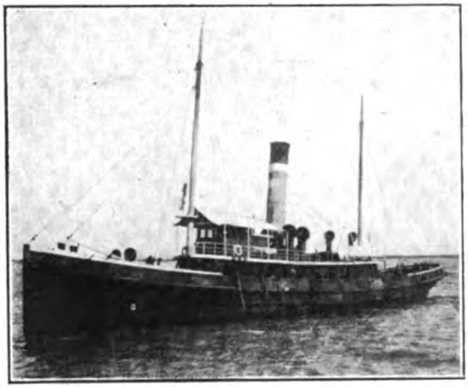
The suction and discharge lines of the Archbold are of extra large size and these, aided by a powerful pumping installation, enable her to handle her cargoes rapidly. She is able to load several grades of oil at the same time. Her oil hatches are trunked from the upper to the shelter deck to prevent gas from entering the shelter deck spaces.

The vessel has nine double main cargo tanks in addition to eight wing or summer tanks. Water ballast is carried in the main tanks, the forepeak, the forepeak tank, in the double bottom under the engine and boiler room and in the after peak tank.

There is a hold for general cargo forward of the main tanks. Forward and aft of the main and cargo tanks are the usual cofferdams for shutting off these tanks from the rest of the ship, while the pump room, which acts as an additional cofferdam, is situated about midships.

Equipped with a bronze propeller with cast iron boss, the Archbold is built to rank with the highest class in Lloyd's Register under their special survey, and to comply with the rules of the United States Steamboat Inspection Service. On her trial trip on March 11 she developed 3,600 horse power and attained a speed of 12.3 knots. She is engaged in the coastwise service.

The main saloon and accommodations for the officers are in a house on the



The tug C. W. Morse, which has been fitted out with a 1 K. W. Marconi installation

shelter deck above which is the captain's room, the captain's office and the wireless room. Above these are the wheel house and the chart room. The engineers and the crew are quartered aft.

The tug C. W. Morse which has been engaged in coast and deep water towing for a number of years, was equipped with a 1 K. W. Marconi set at Port Richmond, S. I., on March 7. The Morse is of 509 gross tons, 170 feet over all in length. She has a beam of thirty feet and her depth of hold is seventeen feet and a half. She has two Scotch boilers, thirteen and one half feet in diameter and thirteen feet in length. She has a surface condensing engine with cylinders thirty by fifty-six inches, with a thirty-six inches' stroke.

Constructed of wood, the Morse is equipped with a steam windlass, a steam capstan, a searchlight and electric lights. She carries a crew of twenty-two men and has bunker capacity for twenty days' steady steaming. She is owned by McAllister Brothers, of 109 Broad Street, New York.

INSTITUTE OF RADIO ENGINEERS

At the regular monthly meeting of the Institute of Radio Engineers held in Feyerwether Hall in Columbia University, March 4, two papers were read, one on "The Effect of a Parallel Condenser in the Receiving Antenna" by President L. W. Austin, the other on "A Method for Determining Logarithmic Decrement" by Louis Cohen of the Bureau of Standards.

In his paper Dr. Austin said in brief: "That the practice of using a variable condenser in parallel with all or part of the inductance in the receiving antenna to receive longer wave is convenient inasmuch as it does away with the necessity of small inductance steps and reduces the total amount of inductance required, but is usually found to be less efficient than pure inductive tuning. Tables showing the effects of different values of parallel capacity for two sizes of artificial antenna were shown. The readings were made with a galvanometer replacing the telephone. As the capacity was increased and the inductance decreased the galvanometer deflection decreased. Replacing one-half the inductance by capacity decreased the deflection about one-third. Practically the same results were obtained with the real antenna."

In his paper Mr. Cohen discussed the Bjerknes formula. Mr. Cohen proposed that instead of detuning the wavemeter circuit until $\frac{I^2}{2}$ is obtained as in the common method, based on the Bjerknes formula, that the resistance of the wavemeter circuit be increased until $\frac{I^2}{2}$ is obtained; then with the inductance, resistance and added resistance of the wavemeter and the frequency known the desired decrement can readily be obtained.

GOVERNMENT PENALIZES AN AMATEUR

The Secretary of Commerce recently approved a penalty of $25 to be collected from an amateur wireless operator in San Francisco, for a violation of the 15th regulation of the wireless act of August 13, 1912, in that the wave length emitted by his wireless station exceeded by 370 meters the limit fixed by law for his class of station.

SERVICE ITEMS

Edward Butler Pillsbury has recently joined the ranks of wireless workers, going with the American Marconi Company as assistant traffic manager. Up to a short time ago Mr. Pillsbury was General Superintendent, Eastern Division, of the Postal Telegraph Company, an office which he held for seven years. His connection with the telegraph business dates back some thirty years, when he served his first apprenticeship as messenger boy in Belfast, Me. He has in turn been telegraph operator, chief operator, division superintendent and general superintendent in the company with which he has just severed his connection to take up the more modern means of telegraphic communication.

E. T. Edwards, who is rounding out his twelfth year in the Marconi service, has been promoted from chief operator to superintendent of the Eastern Division with headquarters in New York.

A. R. Gardner, for three years operator at Siasconset, goes to the Marconi station at Virginia Beach as manager.

David Sarnoff has been appointed contract manager of the Marconi Wireless Telegraph Company of America, filling the vacancy occasioned by the resignation of C. C. Galbraith. Mr. Sarnoff's rapid rise in the Marconi service is notable; starting eight years ago as an office boy, he picked up the code through observation and within a year became operator in the home office, and later filled in a temporary vacancy at the Siasconset station. Shortly after his return he was appointed chief office operator, but soon returned again to the Nantucket Island station for two years' service. Following this he graduated from third operator to the position of manager of the Sea Gate station, leaving there to take charge of the Wanamaker station in New York. With the acquisition of the United assets Mr. Sarnoff was detailed as a ship inspector, and within a few months became chief inspector. Just before his recent elevation to the high position he now holds, the new contract manager received the degree of electrical engineer from Pratt Institute upon the completion of a course of night study featured by that institution.

Otto Rochs has been appointed traffic manager of Marconi's Wireless Telegraph Co., Ltd., of London.

MARCONI WIRELESS AND THE STORM

Following the successful employment of Marconi wireless telegraphy in sending reports over the area swept by the heavy snowstorm in the early part of March, the Delaware, Lackawanna & Western Railroad immediately put into emergency operation a new radio station at Hoboken, N. J. This was employed to dispatch fast freight trains after E. M. Rine, general superintendent of the Lackawanna at Scranton, Pa., had reported by wireless that the trains would find the tracks open and could get through, provided extra locomotives were used.

While the dispatching of the fast freight trains through the storm zone was much appreciated by W. H. Truesdale, president of the Lackawanna, he was better pleased by the report from the Lackawanna Limited train, which left New York at 10 o'clock in the morning of March 3 for Buffalo. It sent exhaustive reports of the exact conditions throughout the whole storm zone as it proceeded on its way to Scranton.

The Marconi wireless service also greatly aided two other railroads, the Erie and the New Jersey Central. Both called upon the Lackawanna to forward messages to New York after the telegraph systems along these railroads had been put out of commission.

These messages detailed conditions along the Erie and Jersey Central Roads to Wilkes-Barre. They were forwarded to Scranton by telephone and telegraph, after efforts to reach New York had failed. At Scranton the Marconi wireless station of the Lackawanna transmitted the messages, and the Marconi station on the roof of the Wanamaker Building in New York received them. The Erie and the New Jersey Central offices then received the reports by telephone from the Marconi station.

In the opinion of President Truesdale the great storm has proved beyond contradiction the value of wireless in modern railroading.

Besides the new station in Hoboken, the Lackawanna now proposes to build a station approximately halfway between Hoboken and Scranton, probably at Port Morris, and another station at Bath, N. Y., approximately halfway between Binghamton and Buffalo.

The Commissioner of Navigation

The Man and His Work

E. T. Chamberlain

IT is the logical thing to expect that a man who has a deal to do with navigation and ships should have his birthplace on or near the water. Eugene Tyler Chamberlain, United States Commissioner of Navigation, has lived up to expectations, for he was born on the banks of the Hudson River or, to be more exact, in Albany, N. Y. For nineteen years he has had a share not only in the administration of laws relating to vessels and shipping, but also in legislation on marine matters.

Mr. Chamberlain was appointed Commissioner of Navigation by President Cleveland in December, 1893. Soon after taking office he began carrying into effect the recommendations of the International Marine Conference held in Washington in 1889. As Secretary of the American delegation to that Conference, which consisted of Admirals Franklin and Sampson of the Navy; Justice W. W. Goodrich, Clement A. Griscom, formerly President of the International Mercantile Marine Company; Captains Shackford and Norcross and General Kimball, Superintendent of the Life-Saving Service, Mr. Chamberlain was instrumental in bringing into operation the revised international rules, inland rules and the Great Lakes rules for preventing collisions and in the establishment of lines defining the scope of application of these regulations.

He was also active in securing the passage of the White Law of December, 1898, for the improvement of the condition of seamen on American ships. The measures of 1898 which required the inspection of certain sailing vessels, and the examination of their officers and prohibited the departure of unseaworthy American ships,—all recommendations of the Washington Conference of 1898—were urged by him.

When the Department of Commerce and Labor was created in 1903, he joined others in urging the importance of wireless telegraphy as a means of promoting safety to life on merchant vessels at sea, and he has participated in the framing of subsequent legislation on that subject. The deaths of two clerks in his office in a motor boat accident led to a practical revision and extension of the laws regulating these small craft, and the establishment in 1910 of the present extended system of federal supervision over 200,000 motor boats is partly the result of his suggestions.

Mr. Chamberlain is one of the four honorary associates of the Society of Naval Architects and Marine Engineers, a member of the Maritime Law Association, and was secretary of the Pan-American Customs Congress, made up of delegates from the United States and the Republics of South and Central America and Mexico, which met at New York in 1903, to promote uniformity in customs and navigation laws among the American Republics. In 1902, by designation of President Roosevelt, he acted temporarily (without pay) as auditor for the Navy Department in addition to his regular duties.

The Commissioner of Navigation is well known to shipping men in this country and abroad through his compilation of the navigation laws issued first in 1895. These are designed primarily for the convenience of the officers and owners of vessels. He has contributed articles on maritime subjects to popular and scientific publications.

Born on September 28, 1856, Mr. Chamberlain was educated at the Albany Academy and at Harvard University. He was graduated from the latter in 1878. After teaching school one year and engaging in business for two years he engaged in newspaper work until 1893.

THE ROMA RUNS ASHORE IN A SNOW STORM

With 427 passengers and a crew of 100, the Roma, of the Fabre line, bound from Marseilles for Providence and New York, was in peril for hours on No Man's Land, south of Gay Head, Martha's Vineyard, where she struck on February 16 in a blinding snow storm. The vessel found herself in the midst of the storm while off Nantucket lightship and her commander, Captain Anton Combernous, ordered the speed of the ship reduced. The snow was so thick that it was impossible to see more than fifty feet ahead.

Heading west by north the steamship was proceeding along when suddenly No Man's Land loomed up and in a few minutes the Roma was ashore. It was then twenty minutes to three o'clock in the afternoon.

When Captain Combernous found that it was growing dark and the weather had not cleared he directed the Marconi operator to send a wireless call for assistance to the agents of the line requesting that a towboat be sent him. That was about 4 o'clock.

Newport got the message first at the training station, but as it was in French it took some time to translate it. When it was finally made out its import dawned upon the receivers and so calls for assistance were forwarded to the revenue cutters Acushnet, Itasca and Gresham as well as to towboats at New London.

The Roma was not pounding hard on the rocks. When she swung from one side to the other there was a grating noise. The absence of a southerly wind that would have sent the combers under her stern and lifted her harder on the jagged rocks gave the officers renewed hope.

When the mess bell rang at 6 o'clock the passengers went to their places and finished their meal. Darkness was then surrounding the steamer, and because of the cold the people remained inside.

Captain Combernous had the engines going full speed astern all the time, and suddenly at half past eight o'clock the bow swung to the left and a moment later the liner slid back into deep water. She scraped some of the other rocks, but not badly enough to hurt her, it is believed. The propeller escaped and as it got a good grip on the water it yanked the Roma out of danger.

In a few minutes the steamer was heading to the west to clear the island. Once out of its reach soundings were made and it was found that the Roma was not making any great amount of water. Every one was overjoyed as the steamer once more headed upon her course.

Meanwhile the revenue cutters were rushing to aid her. The Carmania and the Stepheno sent word they would go to her assistance if required. They were told it was not necessary. Heading northwest again, the course the Roma had missed was reached, and she steamed toward Providence where she landed her passengers.

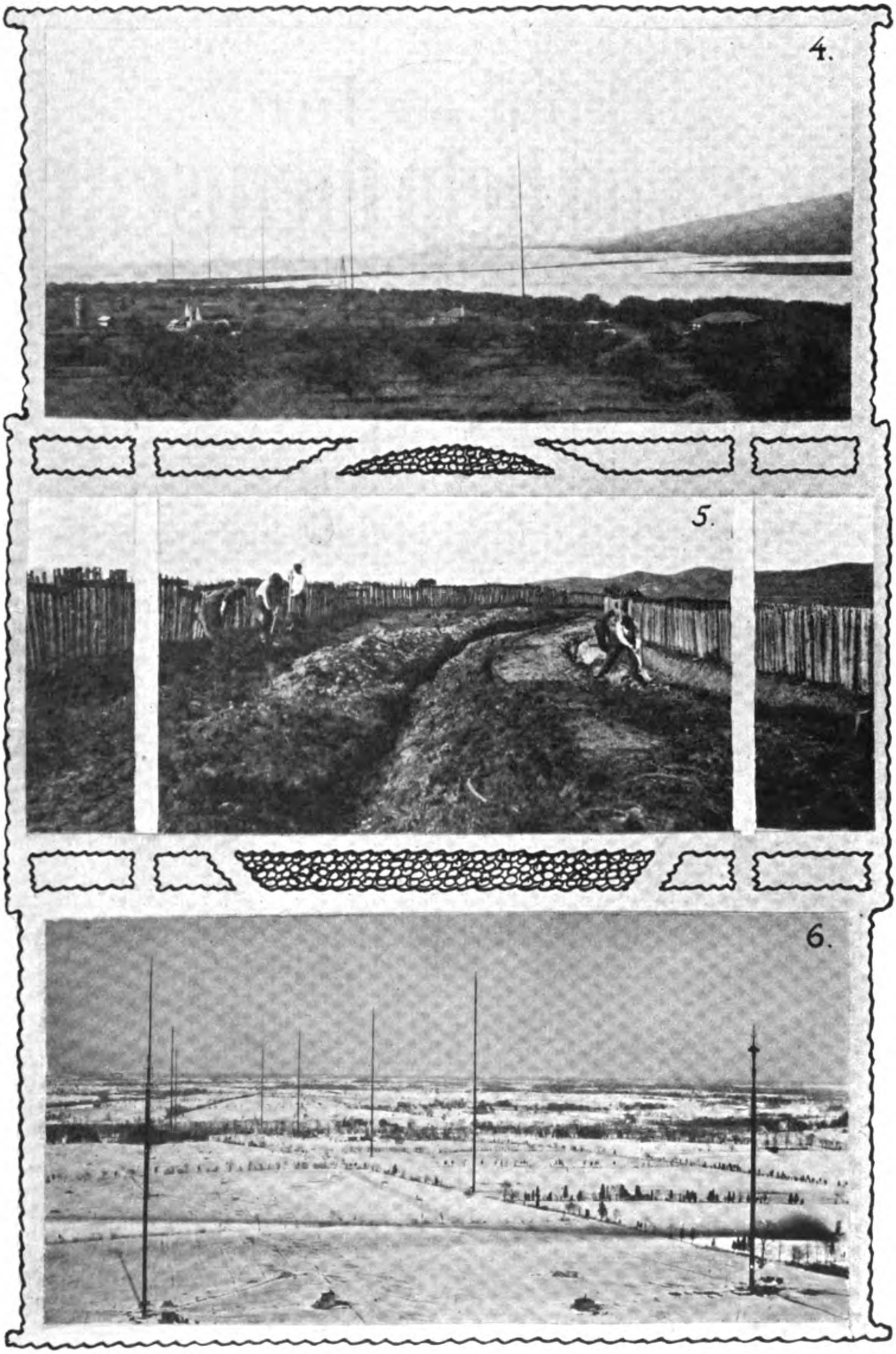
1.

2.

3.

(1) A panoramic view of the California receiving station, showing the operators' hotel and the engineers' cottages. (2) A schooner driven ashore at the Bolinas site during a January gale. (3) One of the smaller towers for the aerial balancing lines.

Trans-Oceanic Stations



(4) The line of completed masts at the Honolulu receiving station, showing a group of the buildings in the middle distance. (5) Rebuilding the road between Bolinas, Cal., and the works. (6) Looking down the line of 400-foot masts of the New Jersey transmitting unit.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

An Improved "Loose-Coupler" Designed for the Elimination of Dead Ends

The average amateur wireless experimenter is generally satisfied with one design of the "loose-coupled" type of receiving tunner. He is apt, however, to adopt a "cut and dried" form of this device, making no effort towards originality of design. I have described in this article a modified type of receiving tunner which may be easily constructed by the average amateur. While the design I show is rather elaborate in construction, it should appeal to the amateurs who desire a receiving tunner out of the ordinary.

In addition to the novel construction embodied in the accompanying drawings switching arrangements are provided so that practically all "dead-end losses" are eliminated, for the unused turns are metallically disconnected from the circuit.

A very desirable means for regulating the degree of coupling is provided. This is accomplished by a rotary handle which through a system of pulleys allows the secondary to be drawn in and out of the primary as desired.

Moreover, a double knob, as shown in the sketches, allows by a very slight movement of the hand a variation of the number of turns in use in the secondary, an important consideration in quick tuning.

THE WINDINGS.—The primary coil is wound on a cardboard tube, 5¼ inches in diameter and about 10½ inches in length. The winding consists of a single layer of No. 24 B. &. S., D. C. C.,

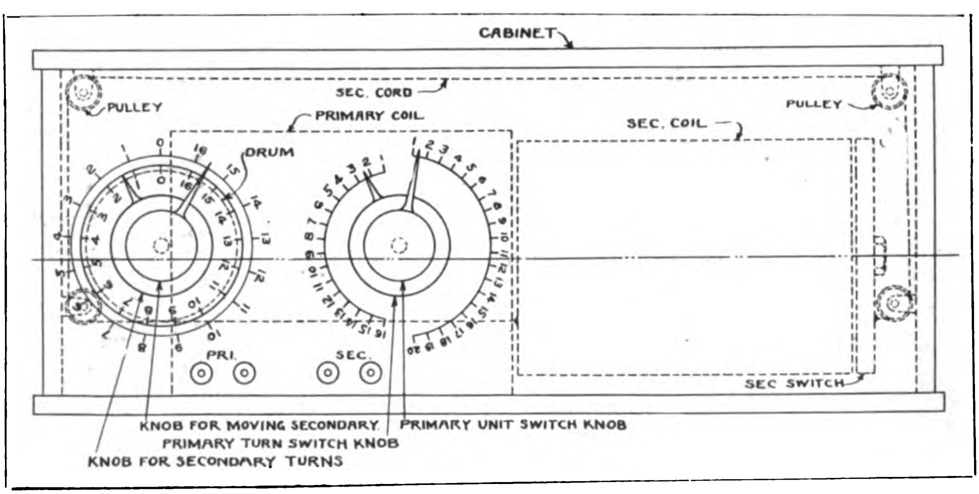


Fig. 1, First Prize Article

S. C. C. Magnet wire, comprising in all 330 turns.

The first 16 turns nearest the secondary end have "taps" or switch "leads" brought out from each turn. The remaining turns are tapped off to a switch point at every sixteenth turn. This construction calls for 16 single turn switch points and 20 unit switch points.

The secondary coil is wound with a single layer of 630 turns of No. 28 S. C. C. magnet wire, tapped off at about every 31 turns, thus requiring a 20-point secondary switch. The tube for the secondary winding is 10½ inches in length by 4⅝ inches in diameter. After completion the winding should be well shellacked for protection against dampness.

THE CABINET.—This tuner is preferably mounted in a hard wood cabinet after the manner shown in Fig. 1. The four knobs used in controlling the various devices previously described are indicated in Fig. 1. Each knob has an indicating needle or pointer which rotates over a graduated dial on the front of the cabinet.

Dials for this purpose may be made by scratching the lines of the scale, with a sharp tool, on a piece of hard rubber and then filling these cuts with "Chinese White" or simply white lead.

The movement of the secondary coil with its rotary control knob is effected by means of a strong cord running around the inside of the cabinet from small pulleys; the cord has its free end secured to the opposite ends of the secondary coil. As shown more in detail in Fig. 3 the cord also passes around a grooved fibre or wood drum and is fastened to the drum in such a manner that when the latter is rotated the cord is pulled, which in turn slides the secondary along two round brass rods which pass lengthwise through the coil.

The cabinet should be made of sufficient size so that the various parts do not interfere with one another during operation.

THE DIAL SWITCHES. — The amount of inductance in use in the primary and secondary coils is varied by the means of specially designed dial switches depicted in Figs. 2, 3 and 4.

Briefly, switches of this construction enable any number of turns from one up to the full number to be switched into the circuit, totally eliminating the unused portions of the circuit. It will be observed by the circuit diagram in Fig. 4 that the windings are divided up

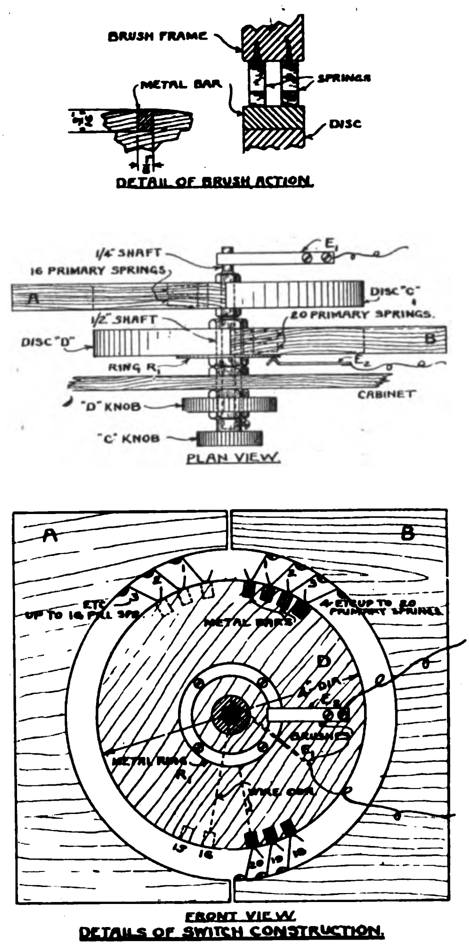


Fig. 2, First Prize Article

into isolated sections. By referring to Figs. 2 and 4 a fibre or hard rubber disc C and D is caused to rotate under a series of pairs of spring contact fingers mounted on a wood or fibre support A and D. The rotary discs carry at their periphery metal bars, as indicated, which short circuit any pair of spring fingers that may be placed underneath them.

The exact switching action will be more clearly understood from Fig. 4, which is a wiring diagram of the primary coil. As indicated, contact for the two common terminals, P^1 and P^2 of the primary winding are made through the

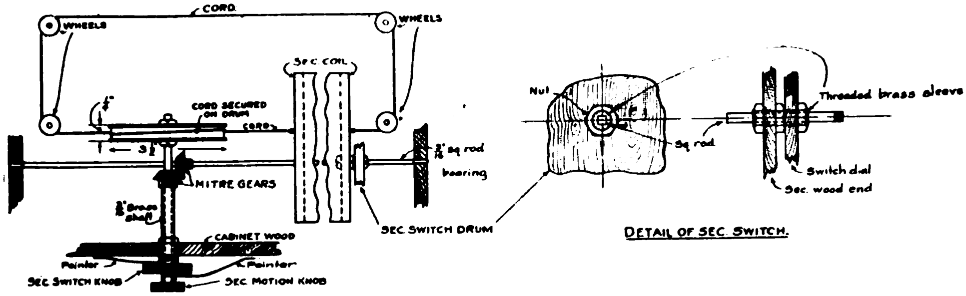


Fig. 3, First Prize Article

shaft of the disc C brush E^1 and the leading metal bar or segment. Contact from P^2 is effected through brush E^2, thence to contact ring R^1, and finally through a piece of copper wire to the leading metal bar or segment No. 20 as shown in detail in Fig. 2.

The secondary switch is not shown in detail, but is similar to the primary disc D. It has 20 pairs of spring contacts mounted on a supporting frame.

SECONDARY CONTROL HANDLES.—The method of arranging the secondary control knobs is shown in detail in Fig. 3. As indicated in Fig. 2, in this arrangement also, one knob shaft turns independently and freely within the shaft of the larger knob, thus greatly simplifying the adjustment features of the instrument.

By reference to Fig. 3, as has been previously mentioned, it will be observed that the secondary motion knob controls the moving of the secondary coil in or out of the primary by means of a fibre or wood drum about 3½ inches in diameter secured to the end of the shaft. The secondary dial switch is rotated by means of a small square brass shaft passing through the secondary coil. This shaft may be rotated about its axis by a mitre gear secured to it. This gear is in mesh with a second similar mitre gear mounted at right angles to the first gear on the knob control shaft.

Albert Johnson, New York.

SECOND PRIZE, FIVE DOLLARS

A Hot Wire Ammeter

Many amateurs try various devices to determine the energy flowing in the aerial circuit of a transmitting set, but the hot wire ammeter still remains the most satisfactory and at the same time the most reliable instrument for the indication of resonance.

The meter should not be connected to any part of the aerial circuit and then used for tuning purposes. As its name implies it measures the current and should be placed as near the ground connection as possible, because at the ground the current value is always greatest.

In an oscillating aerial the voltage is highest at the free end and lowest at the ground, and to obey Ohm's Law the current is opposite; that is, lowest at the free end and greatest at the ground. If out of tune with the closed oscillating circuit, nodes and loops of voltage will be found along its length. As these nodes and loops are shifted with every shift of the clips, it will be plainly seen that when using the meter above the helix you are really tuning to get a loop of current at that point in the circuit where the meter

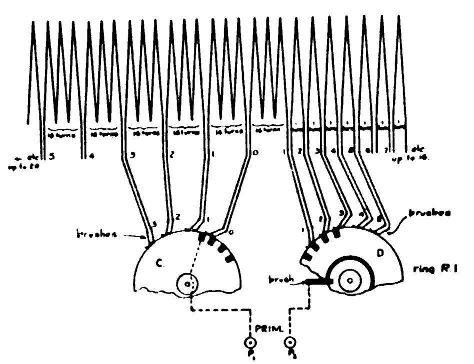
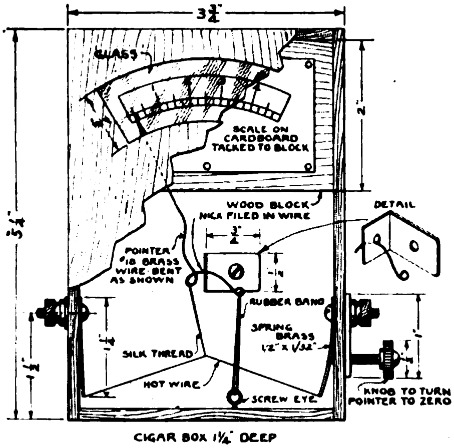


Fig. 4, First Prize Article

is located. This ofttimes results in a complex wave being emitted, and, although the meter gives a high reading, the radiation will be poor.

It will be seen that the ground connection is the proper place to put the hot wire ammeter as a loop of current exists there under all conditions and that current will be greatest when the circuits are in resonance.

The accompanying sketch shows the details of a meter I have just constructed.



Diagram, Second Prize Article

I don't believe an explanation of the sketch is necessary as the amateur generally changes some dimensions to accommodate the box or brass parts he has on hand. A No. 40 copper wire should be used for small sets up to a 2-inch coil. With higher powers use a No. 36 wire, and for still larger sets a shunt may have to be connected around the meter. This should consist of several strands of about No. 30 German silver wire. The exact number should be determined by experiment and then soldered permanently to the brass posts inside the case. While I have stated that probably no explanation of the sketch is necessary, yet it may be of interest to some to go a little more into the details of the action of the ammeter. By reference to the drawing it will be noted that the tautness of the hot wire is adjusted by the thumb nut on the right of the case. This is useful in adjusting the pointer for a zero position. When this meter is connected in series with the antenna, high frequency oscillations flow through the hot wire from the binding post at the left to the binding post at the right. The heat produced by the current causes the wire to expand, which releases the strain on the pointer at point P. This in turn allows the rubber band to contract, which, of course, pulls the pointer across the scale.

The results obtained from using this meter in the manner described will, I believe, more than compensate readers of THE WIRELESS AGE for the time and trouble spent in making it.

PETER H. MARKMANN, JR., Pennsylvania.

THIRD PRIZE, THREE DOLLARS

A Peroxide of Lead Detector

The following is a description of a peroxide of lead detector I have constructed which has given very satisfactory service and surprising results.

As shown in the accompanying illustrations the base may be made of a good piece of hard wood or preferably hard rubber. The dimensions of the base may be varied to suit the maker's fancy.

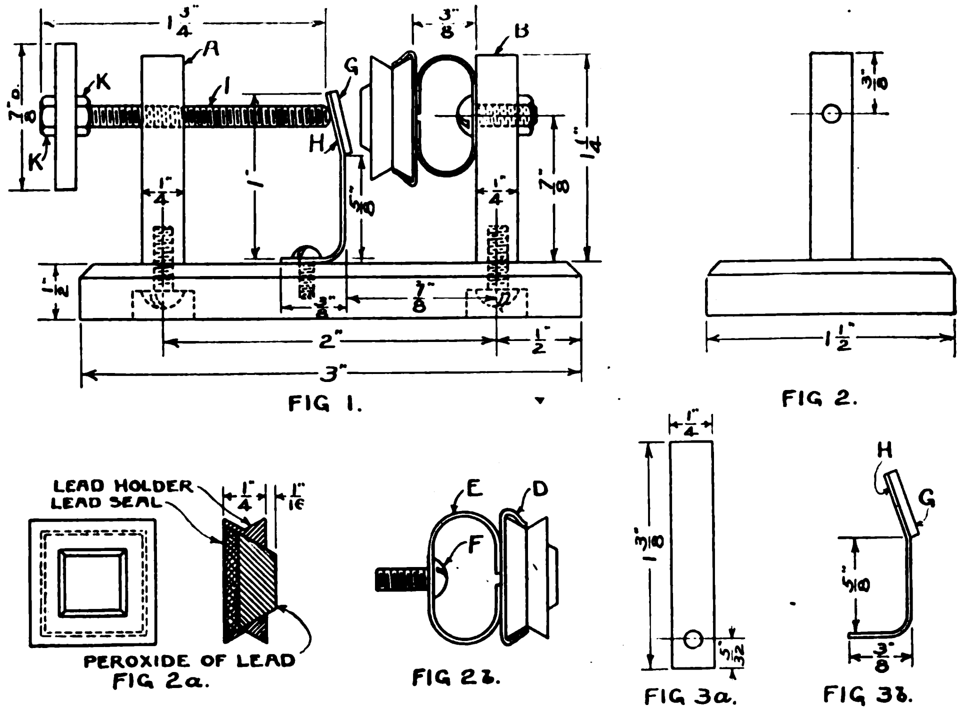
The uprights A and D are ¼ inch brass tapped to take an 8–32 inch screw in the ends for holding them to the base. They are also tapped with an 8–32 thread, ⅜ of an inch from the top and lined up as per the diagram.

From a chemical house purchase a piece of peroxide of lead, also a piece of small platinum foil. The peroxide of lead should now be cut square and should be ⅛ of an inch in thickness. The edges should then be beveled.

Secure a piece of lead a little larger than the peroxide of lead and about 5/16 of an inch in thickness, then cut a square hole in this piece of lead, beveling the inside edges to correspond with those of the peroxide of lead. Press the peroxide of lead into this lead frame so that it protrudes from the front 1/16 of an inch, but will not project all the way through the lead frame.

It will be seen that this will leave a depression in the back which is filled with melted lead. When finished in this manner the peroxide of lead will be enclosed in a lead case, except the part in front as shown in Fig. 2A.

With a knife cut a "V" groove around the lead holders as indicated in the sketch. Now cut a square piece of light sheet copper of the same size as the back of the lead holder, leaving a small piece for a tooth to grip the lead holder as shown at D, Fig. 2B. To this square



Diagram, Third Prize Article

piece of copper bend and solder a small piece of spring brass E, Fig. 2B, 2 inches in length and ¼ inch in width, drilled with an 8–32 hole in the middle as shown in Fig. 2B. Assemble the parts and mount them on the upright B, Fig. 1, with an 8–32 bolt.

The next important step is to secure a small piece of spring brass of the dimensions shown in Fig. 3A. It is then bent as shown in Fig. 3B. To the front of this spring and at the top solder a rather thick washer G. The platinum foil is then placed over the front of the washer and the ends bent around to the rear and soldered firmly. This spring is then mounted on the base with a small wood or machine screw at a small distance from the peroxide of lead base, as shown at 8, Fig. 1.

A brass rod 2 inches in length is threaded with an 8–32 thread the whole length as shown at "L," Fig. 1. A round piece of rubber ⅞ of an inch in diameter, to serve as a knob, is fastened at one end of this brass rod with two small nuts, K and K. The rod is then threaded into the upright K as shown, and when properly adjusted it forces the platinum contact against the peroxide of lead with more or less pressure as required.

In any convenient place mount two binding posts, connecting one with the upright B and marking it (—), the other with upright A, marking it (+). The detector should now be connected up in a tuner circuit in the same manner as the electrolytic detector.

While a detector of this type requires considerable time for construction it will more than compensate for the labor expended when the results to be had are obtained.

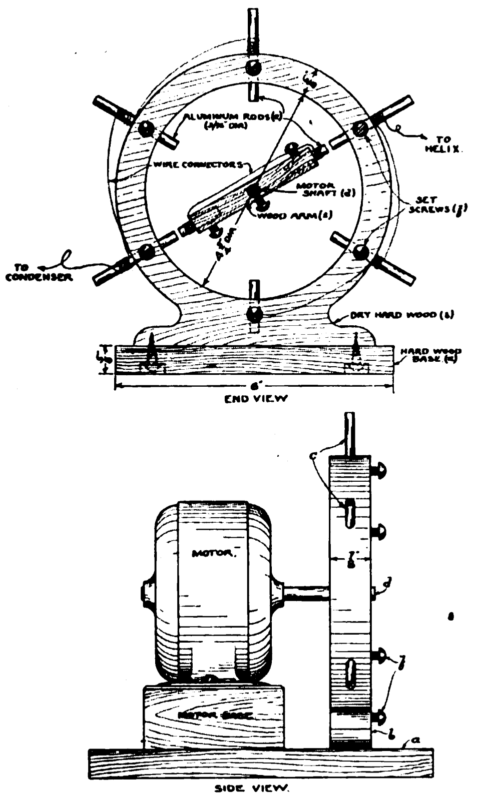
A. L. SAVAGE, New York.

FOURTH PRIZE, SUBSCRIPTION TO "THE WIRELESS AGE"

A Disc Discharger for Amateurs

During the last year rotary spark gaps have come into extensive use among amateur wireless experimenters. The type generally used consists of a small disc having metal studs, revolving between two stationary conductors.

The accompanying sketch shows a rotary gap which is something of a departure from those generally used by amateurs. It consists of an upright *b*, around which are placed at regular intervals six aluminum rods held with screws so as to be adjustable in or out. Affixed to the shaft of a small motor is a piece (*e*) of wood or fiber, having in each end a small section of aluminum similar in size to the stationary rods. The aluminum ends of the rotating piece should be electrically joined together. Three of the rods on one side are connected together, as are also the three rods opposite. The two groups are then connected in the circuit like a plain gap. The upright *b* should be of dry hard wood (preferably maple) ⅞ inch thick; the outside diameter should be about 6 inches, the inside

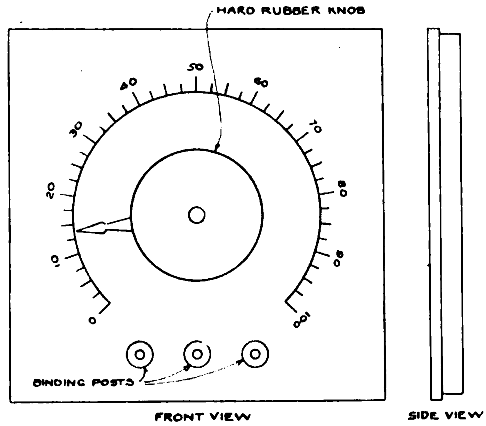


Diagram, Fourth Prize Article

4¾ inches. The aluminum rods are about $^1/_8$ or $^3/_{16}$ of an inch in diameter. The rotating piece is about ½ inch square or round and 4 inches long, including the metal ends. The distance between rotary and fixed points should be just sufficient for clearance.

Any make of small battery motor may be used. A small rheostat, which can be made of resistance wire, should be used for speed regulation.

When running at a speed of about 2,000 revolutions a minute this rotary



Diagram, Honorable Mention Article, Hayden P. Roberts

sounds more like the Marconi disc discharger than the majority of others, and has the additional advantage of starting and stopping very quickly. This gap may be used in connection with sets up to one-half K.W. capacity.

WALTER BURNETT, California.

NOTE.—A rotary gap of this type was originally developed by the Marconi Company and has been in commercial use for a number of years.

It presents a type of construction not generally to be found in amateur stations. It possesses the advantage that cooled surfaces are constantly presented in the path of the spark discharge.—*Contest Editor.*

HONORABLE MENTION

A Rotary Potentiometer

In all modern amateur stations there is a great tendency on the part of the owners to make as many instruments as possible to operate with a rotary movement. This makes the instruments easier to manipulate and improves their appearance.

A rotary potentiometer is easily made under the following directions:

First buy a graphite resistance rod of about 500 ohms; this can be purchased for 50 cents. This rod will be about 5 inches long and should be cut into 3 pieces to form A–B–C.

These are to be fastened with shellac or glue to a mahogany base about 3 inches or 3½ inches square. Four wooden strips (A, B, C, D) are fastened on this base to form the sides. Before fastening the resistance rods down on this base it is well to cut grooves into the wood and fit in the graphite end up before applying the glue.

A hard rubber handle is fastened to the lever with a threaded piece of round brass; a bushing is used out as far as the graphite. Connections are shown in one of the accompanying diagrams, and the other explains itself.

Hayden P. Roberts, Ohio.

HONORABLE MENTION

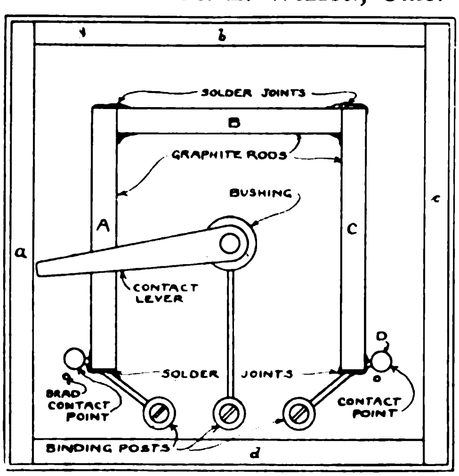
A Detector Stand

The detector which I am about to describe is made of brass rod ¼ inch square, 1 piece 2½ inches in length, and 1 piece 1 inch in length. A hole is drilled in the 2½-inch piece about 1½ inches from the bottom and in the 1-inch piece ¾ inch from the bottom.

The bent spring is of spring brass 1/32 inch thick, and the straight spring is of phosphor bronze 1/64 inch thick. The cup is of brass. The holes are drilled with a No. 29 drill and tapped with 8/32 tap. All screws are of 8/32 thread.

This detector has proved very sensitive, especially with silicon, and has a wide range of adjustment.

M. E. Wilson, Ohio.



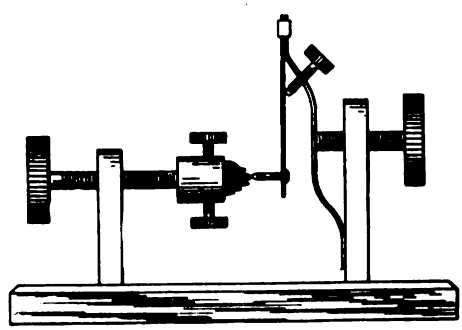
BACK VIEW.

Diagram, Honorable Mention Article, Hayden P. Roberts

AN INDOOR RECEIVING SET

Used for Reading the Time Signals from Arlington

Recently a very heavy snow storm carried away my pole and aerial. On account of inclement weather I was not able to get it fixed up for some time, so it occurred to me to try an indoor aerial for the purpose of reading Arlington's time signals. I turned off the main switch for the house lighting current, then tested the house wiring with a bell and set of batteries to make sure



Diagram, Honorable Mention Article, M. E. Wilson

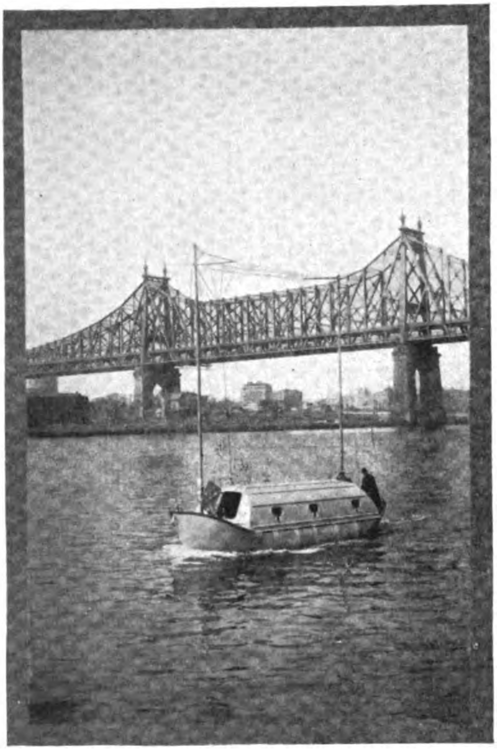
that none of the wires was "grounded" through a pipe or chandelier. After turning on all the switches in the house to increase the capacity as much as possible I connected the house wiring to my station through an ordinary socket plug.

Using a fairly large loading coil, very close coupling between the primary and secondary of the loose coupler, and quite a large capacity across the secondary, I tuned in Arlington on the 2,500 meter wave distinct enough to read with little difficulty. As my station is located on the third floor, the greater part of the aerial is below the instruments, which makes the case all the more unusual.

This was done in a place over 200 miles from Arlington, so I see no reason why such an aerial could not be used very successfully in time-signal work within a radius of at least 125 miles from Washington. In conclusion I might mention that Arlington was the only station I was able to hear outside of amateurs in the vicinity.

Edward G. Henderson, Pennsylvania.

The Lundin Life-boat



Wireless Equipment on the Unsinkable Rescue Craft Undergoes Test

PASSENGERS on vessels passing close to the Ambrose channel in New York Harbor recently witnessed a test of wireless communication between the Lundin lifeboat, designed to save persons on foundering ships, or craft driven ashore in storms, and the tug M. Moran. The lifeboat, which is equipped with a Marconi outfit, is the smallest craft carrying an installation.

The lifeboat left Gravesend Bay at fifteen minutes to nine o'clock in the morning, having Lee Gerson on board as operator. The Moran was in the neighborhood of Pier A, North River. George Gerson acted as operator on the tug, while the tests were in charge of J. B. Elenschneider, of the Marconi Company.

From the Moran came the first message which was as follows:

"How many men on board? Have you tried kite?"

This was the answer sent from the lifeboat:

"Seventeen men besides crew of five. Have not tried kite."

An hour and a half later the Moran inquired:

"Where are you?"

From the lifeboat came this reply:

"Inside the lightship (Sandy Hook)."

When this message was received the Moran had left the vicinity of Pier A and was cruising about in New York Bay. The lifeboat sighted the tug and sent the following message:

"Stop and come alongside."

Aboard the tug was A. P. Lundin, the inventor of the craft which bears his name. The steamship Berlin having Mrs. Lundin as a passenger was outward bound while the tests were taking place and the following wireless message was flashed to her:

"Bon voyage. Love. Lundin."

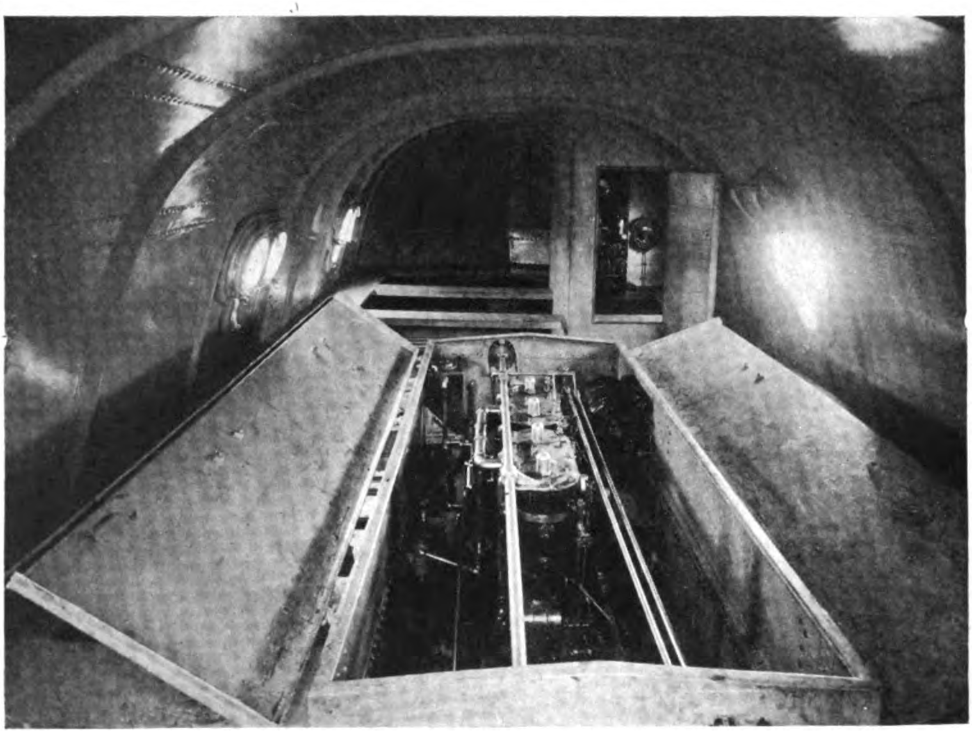
Messages can be sent from the Lundin craft in the daytime as far as fifty miles and at night as far as seventy-five miles. Messages can be received from double these distances. The boat is equipped with 1 K. W. panel set, similar to the installations on United States submarines and torpedo boats. It is operated by a small generator belted to the motor. The latest type of Marconi receiving set is used. The operator is housed in a balsa wood silence cabin.

The Lundin boat is thirty feet in length, equipped with a twenty-four horse power standard motor. The propellers work in a tunnel protected from driftwood. The boat is entirely closed in by watertight iron doors and windows. Forward and aft the boat carries large reels upon which life lines are wound. They can be shot to shore or on board a rescue ship by guns mounted forward. The double bottom has air compartments in its scuppers.

The object of the test was to induce the United States Government to indorse the boat. George Uhler, supervising inspector general of the Steamboat Inspection Service, and eight members of the service from the Atlantic and Pacific ports and the Great Lakes, witnessed the tests from the Moran and expressed themselves as pleased with the trial.

The boat was built by the Welin Equipment Company, of Long Island City, N. Y., of which Mr. Lundin is president. He talked interestingly concerning the test.

"I was aboard the tug," he said, "and was able to communicate with our Mr. Davis on the power boat and give him instructions how to proceed long before the tug came in sight of the power boat. The replies to all of my communications were prompt and accurate. It is my personal conviction, and I think the Board of Supervising Inspectors at Washington agree with me, that it is quite essential and would further insure safety at sea to have one or two boats equipped with wireless on all large ocean-going carriers, if not on all vessels."



Interior view of the Lundin lifeboat, showing the motor in the foreground, and the Marconi panel set and the balsa-wood silence cabin in the background. This boat is claimed to be unsinkable, and, although but thirty feet in length, its capacity is sixty passengers; seating accommodations for this number are provided when the engine covers are closed

Comment and Criticism

IN the matter of the reception of wireless signals on amateur aerials of various lengths, which has been discussed in a previous issue of THE WIRELESS AGE, the trend of opinion seems to point to the desirability of the short aerial.

The subject is apparently one of great interest in the amateur field as we have received a number of communications in which the views of the contributors are expressed in no uncertain manner.

The following communication is of interest:

In the experimental department of the January issue of your magazine is an article praising the efficiency of a long single wire aerial. For the past two years I have been experimenting along this line. I have used aerial wires varying in length from 1,000 feet down to about 50 feet. In order to make comparisons I used multiple strand aerials, containing four wires which if stretched out would be equal to the single wire being used at the same time. With one exception the multiple strand aerial gave far better results than a single wire. To my mind a multiple aerial should not be made shorter than 50 feet and must not contain less than four wires. To give you an idea of the results which I have obtained with the two aerials the following may be of interest.

On July 18th, 1913, at 8:30 P. M. I heard NAR (Key West Naval Station) very distinctly on a 75-foot aerial consisting of 4 copper wires approximately 75 feet in height. I was unable to hear NAA (Arlington Station) loud enough to copy on a single wire 300 feet long and of the same height as a 75-foot aerial.

N. S., New York.

We fear that our correspondents totally neglect the matter of wave lengths being employed at the sending apparatus or the receiving apparatus and do not take into proper consideration the phenomena of electrical resonance so important to long distance working.

Did N. S. take care to tune his receiving apparatus to the wave length of the two stations in question? Were the circuits of the tuner so designed as to allow accurate adjustment to the wave length of Arlington Station (2,500 to 4,000 meters)? That he heard Key West and not Arlington, on the short aerial, does not sufficiently sustain his argument. Perhaps the inability of his receiving apparatus to pick up the signals from Arlington was entirely due to the limitations of his receiving tuner.

We are inclined to believe that with the long aerial of 300 feet the signals from Arlington are apt to be received with greater strength on the single wire than on the 4-wire aerial. Of course the high frequency resistance of the multiple stranded aerial is somewhat less than the single wire and therefore the energy losses may not be so great.

But again, when receiving the longer wave lengths on the short aerial it is necessary to add considerable inductance to attain to the longer wave lengths and the resistance of this inductance may be considerably greater than the resistance of a long single wire.

* * *

Carl Dreher, the contributor of the article which appeared in the January issue on the use of single wire aerials, has made note of the criticisms appearing in subsequent issues and defends himself in the following manner, giving more complete data in respect to certain experiments along this line:

It appears that a number of my fellow wireless experimenters take strong exception to the statements made in the article, The Use of Single-Wire Antennae in Receiving, published in the January issue of THE WIRELESS AGE. The theory of the matter has been ably discussed by the editor of the Comment and Criticism department. I should like to make my position quite plain and to give additional facts and data.

My assertion is, briefly, that given a certain limited amount of wire, say 400 feet, better and more consistent distance work can be done with this conductor stretched out in one length than if it be used in the erection of a short 4-6 strand antenna. By better distance work I mean signals from all commercial stations radiating on 600 meters and up. I do not limit my statement to sets using waves from 1,500 meters up.

I know perfectly well that a great many amateurs do very good work with short antennae, and that the tuning is sharper than on long wires. However, no very great difference is noticeable. On a 250-foot single strand aerial I was able to tune out practically all amateur interference, but not the local commercial stations. Are we to understand from F. L. M. and W. W.'s letter that they can tune out local commercial installations and copy a moderately distant set, say Hatteras (WHA) or Boston (WBF)? If so, I can only say that they are doing very selective work, but that not one amateur in fifty is capable of imitating them. This question of eliminating local interference is not of very great importance in long distance receiving, because, generally speaking, the only occasions on which one can hear stations 1,000 to 2,000 miles away is when there is little static and absolutely no interference or outside noise.

In regard to the letter from the president of the Talo Wireless Club, I may say that I heard Sayville on a 250-foot, not a 400-foot aerial. Also, same is directional and does not favor Sayville. This may account for the fact that I do not get him further than 5 to 6 feet from the phones.

Now, the members of the Talo Wireless Club admit at the start that a long aerial is preferable for distance work provided there is no local interference. They go on to say:

"Getting back to the working properties of an aerial, ask any commercial operator who has plenty of real work to do whether he likes signals to 'pound in' and have interference through forced oscillations, or have a station come in loud enough to read well and not be bothered trying to tune out forced oscillations. He will invariably prefer the latter condition in localities having interference such as is encountered in New York City."

Allow me to point out that amateur work and commercial communication differ so greatly that the analogy is not valid. The commercial operators on the Atlantic seaboard do not try to do distance work. Sea Gate, for instance, communicates as a rule only with ships on the west side of Fire Island, a distance of perhaps 50 miles, and about 90 miles to the south. There are so many coast stations that transmissions of over 200 miles are seldom necessary, except at stations like Cape Cod and Sayville. Hence the aim here is to attain selective and dependable communication rather than distance. In amateur long range work a maximum amount of incoming energy is necessary and sharpness of tuning, while desirable, takes second place.

Last summer during July and August I had a receiving outfit up in the Catskill Mountains. I used a single wire about 200 feet long, directional east, 30 feet high at the open end and 17 feet at the lower. The conductor ran parallel to a clump of trees a few feet distant, and the station was entirely surrounded by heavily-wooded hills over 2,000 feet high. My ground consisted of a ½ inch water pipe about 3,000 feet long, the greater portion buried a few inches deep and some of it on the surface. Static was so bad that I feared my phones would be burned out. In spite of these adverse conditions I easily read Sayville, 120 miles, every night. I did not bother much with short wave work, but I heard Newport Navy Yard, 160 miles, Siasconset, Sagaponack and the ships fairly well. It is worthy of note that I could get none of the New York stations, and that absolutely no signals could be heard in the day time. However, to come back to the subject under discussion, I am quite sure that the gentleman who is president of the Talo Wireless Club could not have heard Sayville at all on his 40-foot antenna, although I do not doubt that he does excellent work with it in the city.

I am at present experimenting with a 4-strand 50-foot antenna on a roof about 50 feet above the ground, with the higher end fastened to a mast 13 feet high. It will be observed that the amount of wire in the flat top is almost the same as in my 250-foot single strand and that the heights are approximately equal also. Hence the conditions of the problem of best disposing of a limited amount of wire have been fulfilled. The limit of the range of this antenna is Savannah, Ga., about 750 miles. On my 250-foot aerial I could read Guantanamo, 1,500 miles, pretty consistently at night from October to March. I think that this data supports my opinion that the long antenna is in nearly all instances to be preferred, but I freely admit that a skilled operator can obtain good results with any kind of aerial. At any rate, it will pay any operator to compare the two types carefully and to draw his own conclusions.

There is no denying the fact that Mr. Dreher speaks from experience, for he has made a number of experiments under varying conditions which lead him to believe that when a limited amount of wire is available, the long single aerial will give the best results.

We note, however, that in the majority of his experiments he is engaged in the reception of wireless signals from stations operating on long wave lengths, such as Key West and Guantanamo operating on wave lengths of 1,600 meters, and Sayville, 2,800 meters.

This accounts to some extent for the benefit he derived from the long single wire because a wire of this length allows him to tune more readily to the long wave length employed at these stations.

We agree with him in connection with his experiments in the mountains that he is "quite sure that the . . . president of the Talo Wireless Club could not have heard Sayville at all on his 40-foot antenna" under similar conditions. We imagine that Mr. Dreher would have obtained still better results if he had increased the length of his aerial wire to, say, 600 or 800 feet. Of course an aerial wire of this length would afford wave length adjustments which are out of resonance with the emitted wave from the average ship station, but wou'd allow more or less efficient tuning to the waves of longer length as emitted by the high power stations.

There are many variable factors in the case to which reference has not been made by any of the parties concerned, such as the type of receiving apparatus employed, the design and proportionment of the circuits of the tuner, the type of detector used, and the degree of damping in the circuits. Accurate data in this respect is imperative before absolute conclusions can be drawn. We do not mean to infer that amateur observations are unimportant and without value even when made in an unscientific manner. In a case of this kind where so many agree on the same point the results cannot be passed over lightly.

It is obvious that an aerial, whatever its type or design, which is of such length that it is more suitable for the reception of the longer wave lengths, is hopelessly inefficient for receiving signals from licensed amateur stations operating on a wave length of 200 meters. The reverse of this statement, however, does not necessarily hold good, for by proper design of the receiving circuit it is possible to receive wave lengths of 3,000 meters on an aerial having a natural wave length of 200 meters; however, the strength of signals to be expected on a 200-meter antenna will by no means equal that to be obtained by an antenna which has a natural wave length nearly equal to that of the long wave transmitting station.

For receiving signals with the maximum degree of efficiency we prefer, as we stated in the March issue, a receiving aerial, the natural period of which is slightly below that of the antenna of the distance transmitting station. A receiving antenna of this type allows a few turns of inductance to be connected in the primary circuit of the receiving transformer for the transference of energy to the local detector circuit. We have not neglected to take account of the fact that an antenna to be receptive to a wide range of wave lengths must represent a happy medium. It can be neither too long nor too short. The actual length will depend on the range of wave lengths to which it is desired to tune the receiving apparatus.

AN AMATEUR'S TOWER

A notable example of amateur construction is shown in the accompanying photograph of the tower and aerial built by Eugene Wilson, of Belleville, N. J., from his own design, and at a cost of less than thirty dollars for material.

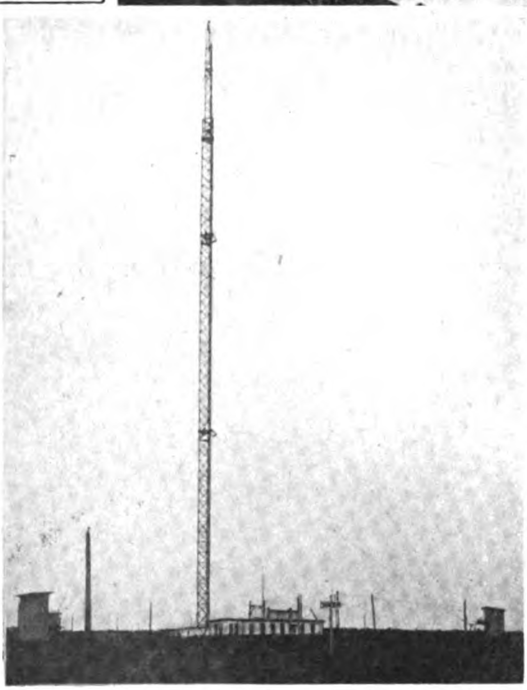
The dimensions give some idea of the size of the undertaking. Height of tower over all, 90 feet; height of tower proper,

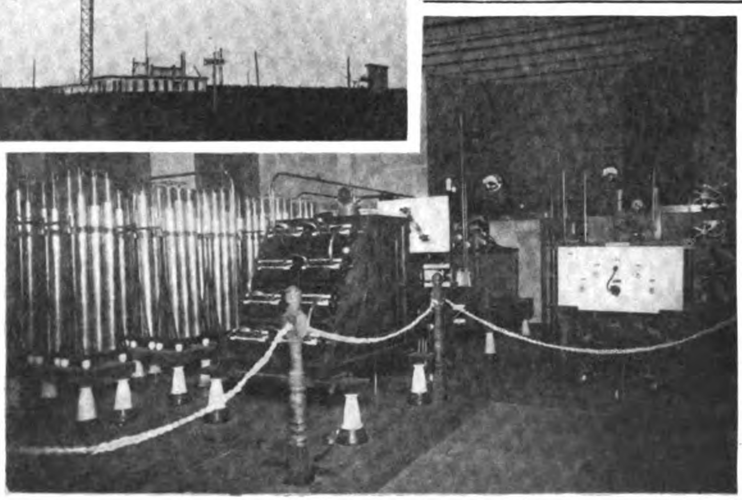
65 feet; base of tower, per side, 12 feet; top of tower, per side, 1 foot.

The main uprights are of angle iron 2 by 1/8 inches, and the cross pieces are of 1 3/4 by 1 3/4 by 1/8 inch angle iron. All the parts are secured together by means of 3/8 inch bolts. Each leg is set in solid concrete four feet deep. The pole at the top extends 25 feet above the top of the iron structure and is a 1 1/2 inch galvanized iron pipe. This pole is braced with iron cable reaching to the upper part of the tower, but no guy wires of any kind are needed to support the tower.

This tower has withstood the recent winds which have brought down so many aerials and telegraph lines, and is surely a credit to the builder.

The Sayville Station





At top, the operating room; in center, an exterior view of the station and mast: below, the transmitter

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.

Positively no Questions Answered by Mail

A. F., Washington, N. J., asks:

Ques. (1) With a station consisting of 1 blitzen receiving transformer, 1 inch variable condenser, 1 Murdock Silicon detector, 1 fixed condenser and 1 pair 3,000 Ohm Holtzer-Cabot phones, could I receive Colon, Panama? If not, could you give any suggestions for improvements upon my station so that I could receive that far? My aerial is composed of two strands of wire 525 feet long, and three feet apart.

Ans. (1) With extremely favorable conditions at night time you should be able to receive signals from the station at Colon, provided all your apparatus is in sensitive adjustment and your antennae is at least 70 or 80 feet in height.

Ques. (2) What is the approximate wave length of my station?

Ans. (2) The approximate wave length of your antennae is 800 meters.

* * *

Sergeant A. R. R., Worland, Wy., inquires:

Ques. (1) Is the umbrella aerial as good or better for general working than the common loop "T" or flat top aerial and is not the umbrella aerial cheaper to construct?

Ans. (1) The flat top aerial is cheaper to construct and, generally speaking, the more efficient of the two types. For efficiency the umbrella antennae must be supported from a mast at an excessive height; the same results can be obtained with the flat top aerial of considerable less height.

Ques. (2) Which type of aerial does the Marconi company use at its stations?

Ans. (2) The flat top inverted "L" or "T" type is invariably used.

Ques. (3) Using aerials of the various types described, what height would be necessary with the average amateur instruments to cover a distance of 12 miles with a few trees intervening?

Ans. (3) A small flat top aerial having a height of, say, 30 feet, should enable you to cover the distance with little difficulty.

Ques. (4) How far can I send with a 1½ inch coil run on 75 volts, and what other apparatus do I need to correspond with the set?

Ans. (4) We suppose your current supply is 75 volts direct current; if so, with the 1½ inch coil of the average amateur construction you will require a rheostat in series with the primary winding to control the current flow. We believe you will obtain the best results with such a small coil by simply connecting the spark gap in series with the antennae. Then connect the high potential terminals of the coil to the spark gap. An oscillation transformer is almost out of the question with a set of this size.

* * *

E. E. H., Wilkinsburg, Pa., writes:

Ques. (1) Do you have any books which treat on the theory, design, and manufacture of electrostatic condensers? If not, could you refer me to a list of books giving such information?

Ans. (1) We are not aware of the existence of any such publications, but suggest that you get in touch with some of the large book concerns in New York City.

* * *

J. E. P., Irvington, N. J., writes:

Ques. (1) What is the wave length of an aerial 50 feet long and 50 feet high, 5 wires, space 10 inches apart, lead-in 60 feet?

Ans. (1) The wave length of your antennae is about 180 meters.

Ques. (2) About what is the longest wave a loose coupled tunner can get with a primary winding 4¼ inches long, 3⅛ inches in diameter, having 114 turns, secondary 3¾ inches long, 3 inches in diameter, 300 turns? Tuning is done by switches.

Ans. (2) You should be able to reach wave length adjustments up to 2,000 meters if you have a condenser of .001 mfd. connected in shunt with the secondary.

Ques. (3) What is the best capacity of a condenser for 2,000 ohm phones?

Ans. (3) If you intend to use a fixed condenser its capacity should be about .003 mfd. Twelve sheets of foil, each sheet 2½ inches square and separated by thin paraffined paper, the whole arrangement tightly pressed together between two boards or clamps, will give a capacity sufficient to act as a phone condenser. It would be better to use a variable air condenser.

Ques. (4) What is the cost of the back numbers of The Wireless Engineering Course up to the November issue, 1913?

Ans. (4) Twenty-five cents per copy, but only a few back numbers can be obtained.

* * *

F. M. L., Algona, Iowa:

Ques. (1) Approximately, what is the range of this receiving set with a single wire aerial No. 12 copper, 300 feet long, 100 feet high, non-dead end loose coupler, variable condenser, audion detector, Brandes navy phones and fixed condenser?

Ans. (1) Under extremely favorable conditions and at night time you should be able to hear Arlington, and possibly the Telefunken

Station at Sayville, L. I. Your range is rather hard to estimate as we do not know the general conditions surrounding your station.

Ques. (2) Give hook-up for the outfit described.

Ans. (2) The proper hook-up is given in the January issue of THE WIRELESS AGE in the article entitled, How to Conduct a Radio Club. Do not insert a fixed condenser in the audion circuit in the same manner as you would when employing a "loose coupler" in connection with crystal detectors. Connect the fixed condenser around the head phones.

Ques. (3) The high end of the aerial is fastened to the city water tank, which is of iron construction and is 100 feet in height. Would this have a tendency to cut down my efficiency or would it only cut me off from one direction?

Ans. (3) The presence of the iron water tank would have the effect of decreasing the efficiency to some extent, but not seriously.

Ques. (4) Approximately, give my receiving wave length.

Ans. (4) We are not familiar with the constants of your receiving tunner, but if it is of the average size you should be able to receive signals at wave lengths up to 2,500 meters.

Ques. (5) What kind of a loading coil is most efficient?

Ans. (5) See the article referred to in the answer to your second query.

* * *

A. R. B., Youngsville, Pa., says:

On the 7th inst. at 9.30 P.M. while I was copying Sayville I heard a low buzzing sound which increased to such an extent that I was unable to read signals. When I tried to change the adjustment of instruments I found it impossible to touch any part of the same; I finally disconnected the lead-in and by holding the lead-in wire ½ inch from the ground wire was able to get a thick blue spark for at least three minutes; the current was practically noiseless and did not change in intensity.

This was repeated at intervals of thirty or forty minutes until midnight, but the current was not nearly so strong after 9.30 P.M. There was a brisk north wind with some snow; the temperature was 20 degrees above zero and static could only be heard occasionally. There is no street car or high voltage lines within nine miles of my station. I have never had an experience of this kind; in fact, I have never read of anyone who had and will appreciate any information you can give me in this matter.

Ans. This phenomenon was first observed at a wireless station in the Middle West in 1904 and under identical conditions of weather temperature, etc. It was noted at that time that this current had no effect on the receiving detector, but if the aerial connection to the earth was broken a severe shock would be received by anyone touching the aerial wire. The antennae would discharge sparks 6 inches in length to earth. Of course this is due to atmospheric or "static" electricity, but just why it should be especially prevalent during snow storms has never been fully explained. This phenomenon has recently been noted by others and has been referred to in the Queries Answered Department in a previous issue of THE WIRELESS AGE.

B. M., Farmington, Ill., inquires:

Ques. (1) Which is the best, a long low aerial or a short high one?

Ans. (1) It all depends upon conditions and the wave lengths it is desired to receive. For amateur work you will find it better to erect an aerial just as high as possible under given conditions.

Ques. (2) Is the enclosed hook-up a desirable one?

Ans. (2) No. It would be practically inoperative. Your sketch shows no fixed condenser in the detector circuit. Previous issues of THE WIRELESS AGE have shown a number of receiving hook-ups which might be employed.

Your third query is not understood and it would be useless to print it.

Ques. (4) Give a list of five of the most sensitive detectors in order.

Ans. (4) Audion amplifier, audion, tikker, galena, Perikon or carborundum.

Ques. (5) Is a licensed station a government station?

Ans. (5) Not necessarily. Commercial and amateur stations are also licensed.

* * *

J. M., Waterbury, Conn., writes:

In your January issue you have an article on How to Conduct a Radio Club, which deals entirely with the audion as a detector and as an amplifier of signals. In describing the audion as a detector, and giving instructions for its installation, on page 276 beginning in the lower left-hand column you write as follows: "Particular care should be taken that at point E the negative end of the storage battery is connected to the positive end of the high voltage battery, for if the batteries are connected in opposition at this point the intensity of signals is considerably reduced."

I find that by connecting up in the manner described my audion refused absolutely, but on the other hand if I connect the positive side of the storage battery to the negative side of the H. V. battery my audion works very well indeed. The rest of the hook-up I find O.K. Am I in error when I consider the carbon of a battery as positive and zinc as negative, or where is the trouble?

Ans. Are you quite sure that you have followed the diagram closely as shown on page 275 of the January issue? It does not make any difference which terminal of the storage battery is connected to one particular leg of the filament provided the remainder of the apparatus is connected up accordingly. Carefully noting the diagram on page 275, you will observe that the lead, which is connected from the secondary of the loose coupler to the filament of the audion, has an arrow on it showing that it may be connected to either side of the filament. This is very important, for if the storage battery leads are reversed this lead will have to be changed also.

Carbon is the positive pole of the battery and zinc the negative. At that point in your circuit where the terminal of the high voltage battery connects to the filament you should see that that terminal is of the opposite polarity to the terminal connected to the lighting battery. We are of the opinion that you have not taken into account one connection of the secondary of the loose coupler as being variable, and moreover, that it may be shifted from the D to the A side or vice versa.

Replying to your second query, in reference to the switch and high voltage battery, there is nothing wrong with our sketch and we do not understand what you mean by a high or low potential, in the way in which you refer to it. The switch we show on page 275 of the January issue is properly connected and allows a variation of voltage over a wide range. The results you refer to in respect to distance covered with this set should be quite satisfactory and are just about what may be expected under the conditions.

* * *

R. R. F., Detroit, Mich.:

With the receiving tunner you describe having a small variable condenser in shunt with the secondary windings, you should be able to receive wave lengths up to and including 2,500 meters.

* * *

J. H., Philadelphia, says:

In one of your recent issues of THE WIRELESS AGE there was an article relating to the audion in which the audion was used as a detector and amplifier. I should be very thankful to you if you would let me know where I could buy one without the batteries and rheostats. The Radiotelephone Company sells them, but the entire outfit must be bought; the valve cannot be bought separately.

Ans. Your statement is quite correct and it is now necessary to purchase a complete outfit. This query was covered in the March issue of THE WIRELESS AGE. At the time the original manuscript on the Audion Amplifier was written it was possible to purchase these bulbs independently of all auxiliary apparatus.

* * *

N. S., Ithaca, N. Y.:

Ques. (1) On what wave length does the Tuckertown, N. J., station send and should a person located here be able to hear the signals if that person can already hear Cape Cod?

Ans.—We have not been advised that the Tuckertown station had been engaged in any transmission work; it has simply been employed for experimental receiving tests. Should it *be* sending you would not be able to hear the signals as they employ the Goldschmitt system for producing undamped oscillations, and you would require a special detector such as the Poulsen Tikker to receive these oscillations.

Ques. (2) Are two audions used as amplifiers twice as sensitive as a single audion?

Ans. (2) Not twice as sensitive but approximately 40 times as sensitive.

Ques. (3) Which is preferable, a long ground lead and short aerial lead or vice versa, providing the sum of the two leads is always constant? Would there be any noticeable difference when receiving signals?

Ans. (3) A short ground lead is preferable. The effect on the signals is a matter of degree.

Ques. (4) How does one determine the capacity in microfarads of an aerial?

Ans. (4) The method for making this computation will appear in an early issue of the series, How to Conduct a Radio Club.

Ques. (5) Who is RAS? I have not had access to an International Call list as yet.

Ans. (5) RAS is a Russian Land Station located at Vladivostok, Russia. Do you mean to infer that you are copying signals from this station?

* * *

E. B. M., Torrington, Conn., writes:

I have had some trouble with my sending set consisting of a ½ K. W. transformer coil, Gernsback electrolytic interrupter, spark gap and a home made condenser consisting of 7 plates of window glass 7 by 9 inches, and six sheets of tin foil, size 4 by 5 inches. I get a fine thick spark about $\frac{5}{16}$ of an inch thick and very steady. I find that amateurs one mile away can hardly hear me, When I take off the condenser and substitute a small Leyden jar I get a spark ¾ of an inch long, very thin and unsteady, or rough. The amateurs say my signals come in great, but the spark is too rough to read. I use 110-volt 60-cycle current. I notice that if I come near one of the primary terminals of the coil with some metal object I draw a $\frac{1}{32}$ inch spark.

What is my trouble?

Ans. (1) After careful thought it appears that while undoubtedly you get the best spark with a $\frac{5}{16}$ inch gap, with the condenser capacity employed at this adjustment your circuits are out of resonance and consequently you are not heard at a distance. When, however, you substitute a small condenser even though you get a bad spark you place your transmitting circuits in resonance; that is, you place the condenser circuit and the antennae circuit in resonance, and are heard at a greater distance. If we were on the ground and could get full data as to the conditions of the wave length under which you were working we could remedy the difficulty. When you are using the $\frac{5}{16}$ inch gap, wind up a loading coil and connect it in series with the antennae and see if your signals do not carry further.

The spark which you draw from the primary terminals of your coil is high voltage energy set up by electrostatic induction from the transmitting apparatus. This effect may be observed at almost any wireless station, particularly those employing high voltages in the transmitting apparatus.

Ques. (2) Can I use my coil as an open core transformer without the interrupter?

Ans. (2) We are not familiar with the transformer in question, but no doubt you will be able to get results when connected to an alternating current source of supply.

* * *

J. F. D., Brooklyn, N. J.:

We understand that the Telefunken Station, at Sayville, L. I., sends signals to Nauen, Germany, at night time only. The Marconi Company handles commercial messages across the Atlantic daily between Glace Bay, Nova Scotia, and Clifden, Ireland. This service is carried on without interruption. The high power stations of the Marconi Wireless Telegraph Company of America will be open for commercial business as soon as they are completed.

* * *

T. J., Jr., Woodside, N. Y.:

The books you desire may be purchased from D. Van Nostrand & Company, New York City.

* * *

I. K., Frederick, Md.:

Previous issues of THE WIRELESS AGE have contained many hook-ups of "loose-couplers" and loading coils. You should have no difficulty in connecting up the apparatus you have on hand.

* * *

L. C. B., Hackettstown, N. J.:

Complete information as to the Poulsen Arc is given in the February issue of THE WIRELESS AGE in The Engineering Measurements of Radio Telegraphy, by Alfred N. Goldsmith. A full answer to your query would require too much space in this department, for you practically request us to cover the entire undamped oscillation transmitting apparatus field. In the Proceedings of The Institute of Radio Engineers you will find an interesting article on arc transmitters by Dr. Lee De Forest.

* * *

C. H. P., Waukeegan, Ill.:

Your query relative to the autotransformer, to be used in connection with the audion amplifier, is fully answered in the March issue of this department. The loud-speaking telephone is an ordinary telephone receiver with an amplifying horn which amplifies the signals to such an extent that it can be set on the table at some distance from the ears. If you desire further information in regard to its construction communicate with the Western Electric Company, Chicago, Ill., or New York City.

* * *

G. T. L., Providence, R. I., writes:

Ques. (1) Is it possible for me to get signals from Arlington at 12 o'clock or 10 o'clock with the following set?

Three slide tuner 3 inches in diameter, No. 22 bare copper wire 11 inches long, a small variable condenser .0005 mfd., a fixed condenser 200 ohm phones, and a perikon detector; this set to be used on an aerial 50 feet high, "T" type, 50 feet long?

Ans. (1) There is sufficient inductance value in your tuning coils to hear signals from Arlington, but the aerial you describe is rather small for the daylight reception of signals. However, by careful adjustment you should be able to receive signals of considerable intensity at night time.

Ques. (2) Is the "T" aerial the best type I can use?

Ans. (2) In many cases the inverted "L" type aerial will give a longer wave length adjustment for a given amount of wire than the "T" aerial.

Ques. (3) Could I with the set described receive signals from Arlington at a station at Newport, R. I.? The latter station has an antenna of the "T" type 60 feet in length and 80 feet in height.

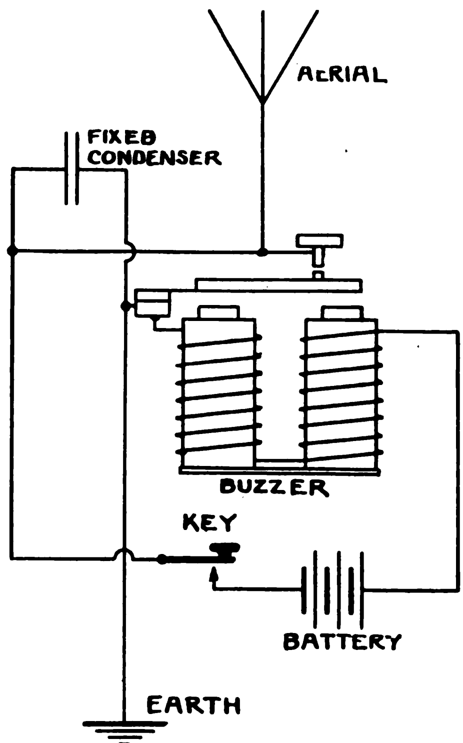
Ans. (3) We are a little bit in doubt as to the reception of daylight signals at this point, but at night time you should hear these signals very loud indeed.

Ques. (4) Can I use a buzzer of the type employed in the Navy (without a helix) connected to an aerial as a transmitting set and comply with the law?

Ans. (4) We do not believe that there will be any urgent objections on account of the limited transmitting range of a set of this type. We do not believe that the authorities would require an oscillation transformer. You should seek advice from the Government wireless inspector in your district.

Ques. (5) Will you kindly give me the connection for the buzzer and fixed condenser used as a sending set?

Ans. (5) We herewith publish a drawing, showing the proper connections. Also note the drawing appearing in the From and For Those Who Help Themselves Department of the March issue of THE WIRELESS AGE.



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W. O. H., Cleveland, Tenn., says:

I have just observed the audion amplifier in the February issue of THE WIRELESS AGE and it certainly looked good to me. I refer to the article on page 394. What is a microphone transmitter and where can I buy one; also, what is the price?

Ans. (1) The ordinary telephone transmitter is a microphone transmitter and this, we believe, is what our correspondent used. One of the original microphone transmitters consisted of two carbon buttons in very light contact. One button was fastened solidly to a piece of wood and the other button was connected to a piece of spring copper in such a manner that the pressure could be easily adjusted. The microphone was then connected in series with the telephone and a cell of battery. Any sounds which occur in the immediate vicinity of the microphone would cause a variation in pressure between the two carbon buttons which would in turn vary the intensity of the current flowing through the head telephones, thereby producing audible sounds.

* * *

C. E. K., Plainfield, N. J.:

You have not stated the thickness of the glass to be used as the dielectric in the transmitting condenser; therefore we cannot answer your query accurately. We suggest that you note the article in the November issue of THE WIRELESS AGE, entitled a 200 Meter Amateur Set. Full instructions are given in this article for the construction of a condenser to suit the average one quarter kilowatt amateur transformer. If your plates of glass, which you state are 10 by 12 inches, are of the same thickness as those described in the article mentioned, you can easily figure out the square inches of foil on plates of your size to correspond with the square inches of foil as given in the article in the November issue. The oscillation transformer shown in your sketch is quite satisfactory and should "sharpen" up the transmitting waves.

With an antenna 90 feet long and 40 feet high connected to this set you should be able to cover 25 or 30 miles; the distance depends entirely upon the local conditions.

Your request as to where you can purchase bamboo poles has been noted and we are unable to put you in touch with anyone having them for sale.

Replying to your fifth query, it is not well to crowd the quarter K. W. transformer. We do not advise you to use more than 2½ amperes.

* * *

H. D., Cleveland, Ohio, sends us a communication which in addition to being a query contains a full description of an amateur home made station and therefore may be of more than ordinary interest to our amateur readers.

Ques. (1) Will you kindly give me a rough estimate of the distance I should be able to cover with the following equipment? My transmitting set consists of a ¾ K. W. home made, close core transformer, voltage 10,000, glass plate condenser, having 5 plates, each 16 by 15 inches, covered with heavy grade foil, 11½ by 14 inches on each side of each plate; "pancake" type of oscillation transformer, primary winding, consisting of 1½ turns of No. 20 gauge brass ribbon; secondary consisting of 6 turns of the same ribbon; rotary spark gap mounted on a synchronous induction motor rotating at a speed of 1,800 R. P. M.; rotary gap has 16 teeth of the saw-tooth type; the disc is of aluminum. This rotary spark discharger gives me 28,800 sparks per minute or 480 per second.

My aerial consists of 4 No. 14 soft drawn copper wires, spaced 33 inches apart. The height of the flat top is 45 feet; the length 81 feet; the length of the lead is 30 feet; the length of the ground lead, 35 feet; the ground lead is connected to the water, gas and drain pipes in the basement.

The aerial is insulated by 4 2-wire porcelain cleats at both ends of each wire. The lead-in is run through 3 fibre tubes, one inside the other, and the whole arrangement is boiled in wax.

Ans. (1) Roughly, with the equipment you have described you should be able to cover a distance of about 40 miles in daylight. Your night range will vary.

Ques. (2) Does the Marconi Company still sell the Fleming oscillation valve and what would be the average life of one of these valves when used about 4 hours each night at proper voltage?

Ans. (2) These valves may be purchased from the Engineering Department of The Marconi Wireless Telegraph Company of America, 233 Broadway, New York. The length of life of these bulbs varies. The average length of life is 300 hours, although many bulbs have lasted 600 hours.

Ques. (3) What is the theory of the action of the new "Radioson" detector? Is it electrolytic?

Ans. (3) We have never heard of this type of detector and do not know who manufactures it.

* * *

J. D. C., Belvidere, Ill., asks:

Ques. (1) What are the call letters of the new Marconi station in Florida?

Ans. (1) Call letters have not yet been assigned.

Ques. (2) What time does San Francisco send press and at what wave length?

Ans. (2) It sends at irregular intervals; wave length varies; it is generally 4,500 meters.

Ques. (3) What are the call letters of the wireless stations of the Lackawanna Railroad at Binghamton and Scranton, Pa.; also the wave length used by them to communicate with trains.

Ans. (3) The call letters of Binghamton are WTB; Scranton, WTP; train WHT (temporary). Wave length variable.

Ques. (4) Give the call and wave length of Tufts College, at Medford, Mass.

Ans. (4) To our knowledge the call is not officially listed.

Ques. (5) To what stations have the following calls been assigned: WNU, WHD, WHY, WRG, WQM.

Ans. (5) These call letters have not yet been assigned.

* * *

G. P. B., Halifax, N. C., asks:

Ques.—Will you kindly tell me the advantages of a 2-wire aerial over a 1-wire antenna of the same length, say 350 feet, and if two wires are used, what is the correct distance that they should be placed apart?

Ans.—The advantage lies principally in the increased conductivity afforded by the two wires. The additional wire also gives a slight increase in capacity, and therefore a longer natural wave length. Separate the wires 10 feet.

* * *

F. L. C., Elgin, Ill.:

Your query has been answered in the Queries Answered department of the March issue.